Evaluating the relationship between orthorexia nervosa, eating disorder symptomatology, and related psychological constructs in an undergraduate mixed-gender sample

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Evaluating the Relationship between Orthorexia Nervosa, Eating Disorder Symptomatology, and Related Psychological Constructs in an Undergraduate Mixed-Gender Sample

by

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Abstract

The pursuit of a healthy lifestyle has become a central focus of Western societies over the past few decades. As rates of chronic conditions, such as obesity and type II diabetes, continue to rise, so too has the desire to maintain one’s optimal state of health. For some, the pursuit of a healthy diet becomes an obsession that interferes with one’s physical and psychological wellbeing. Orthorexia Nervosa (ON) is a proposed eating disorder characterized by a pathological fixation on healthy eating. Unlike other established eating disorders (EDs), ON is focused on the quality of one’s diet, rather than the quantity of food consumed. Although researchers have attempted to define and measure ON, no standardized diagnostic tools exist, and current measurement tools lack sufficient psychometric properties. There is also debate as to whether ON constitutes its own unique diagnosis, or if ON is merely a variation of another EDs, such as anorexia nervosa. As such, the current study aimed to examine the relationship between ON and ED symptomatology using a newly created measure of ON, the Orthorexia Nervosa Inventory (ONI). This study also examined the relationship of ONI to other ED-related constructs, such as compulsive exercise, maladaptive perfectionism, and intolerance of uncertainty. Participants were undergraduate students from a large, Northeastern university who completed a series of online, self-reported questionnaires. Study measures included the ONI, the Eating Attitudes Test (EAT-26), the Compulsive Exercise Test (CET), the Frost Multidimensional Perfectionism Scale – Concern Over Mistakes subscale (FMPS-COM), and the Intolerance of Uncertainty short scale (IUS-12). Relationships between all variables were assessed using Pearson correlations, and multiple linear regression was conducted to determine how much unique variance in EAT-26 scores was explained by the ONI. All variables were positively related to ON, and the ONI demonstrated unique predictive ability towards the EAT-
26 (b=.061, p<.001), even after controlling for other ED-related constructs ($F(6,245)=32.43$, $p<.001$, $R^2=.429$). This study lends support to the categorization of ON as a unique ED and highlights the clinical need to remain vigilant to patient symptoms that resemble ON symptomatology. Furthermore, more research using the ONI as a measurement tool is important to determine the reliability and validity of the measure.
Introduction

A healthy diet has been regarded as a key factor in determining future health and well-being (World Health Organization [WHO], 2021). Global health agencies have stressed the importance of a healthy, nutritious diet in reducing non-communicable diseases such as diabetes, heart disease, stroke, and certain cancers (WHO, 2021; Centers for Disease Control and Prevention, 2021). Worldwide, obesity rates have tripled since the 1970’s (WHO, 2021), with Western-style diets being cited as a major risk factor (Swinburn et al., 2011). Western dietary patterns tend to be higher in saturated fats and refined carbohydrates and are linked to deleterious physical and psychological health outcomes (Jacka et al., 2014; Jacka et al., 2015; Swinburn et al., 2011). Poor dietary patterns have been identified as risk factors for psychological consequences such as depression and cognitive decline (Jacka et al., 2014; Sarris et al., 2014). On the contrary, diets comprised of nutrient-dense foods (i.e., fruits, vegetables, whole grains) have consistently demonstrated an inverse relationship with depressive symptoms or disorders (Lai et al., 2014; Psaltopoulou et al., 2013). Considering the extensive literature linking dietary patterns to health, it comes as no surprise that many individuals are rethinking their dietary choices and attempting to consume healthier diets.

For some, the quest to consume a healthy diet carries unintended consequences. The term “Orthorexia Nervosa,” coined by Bratman (1997), refers to an unhealthy obsession with healthy eating. Although Orthorexia Nervosa (ON) is not currently a diagnosis in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013) or International Classification of Diseases (ICD-11; WHO, 2019), this phenomenon has received considerable empirical attention over the past decade (Dunn & Bratman, 2016). Several measurement tools have been developed to assess ON (Opitz et al., 2020), and proposed sets of
diagnostic criteria have even been developed (Dunn & Bratman, 2016; Moroze et al., 2015). Studies examining ON have demonstrated links between ON and disordered eating patterns (Brytek-Matera et al., 2020a; McComb & Mills, 2019), perfectionism (Barnes & Caltabiano, 2017; Brytek-Matera et al., 2020b; McComb & Mills, 2019; Oberle et al., 2017), obsessive-compulsive tendencies (Yilmaz et al., 2020; McComb & Mills, 2019), body dissatisfaction (Brytek-Matera et al., 2020b; McComb & Mills, 2019), negative affect (Barthels et al., 2019), and anxiety and depressive symptoms (Strahler, 2020); such factors also have strong links to eating disorders (Fairburn et al., 2003). Despite notable similarities between ON and eating disorders (ED), there are also key differences that highlight ON as its own potential disorder. For example, a characteristic feature of ON has been an emphasis on the quality of food, rather than the quantity of food. Whereas the restriction of calories is a diagnostic feature of Anorexia Nervosa (AN; APA, 2013), individuals with ON instead display a fixation on consuming foods perceived as “healthy” or “pure” in the pursuit of optimal health (Bratman, 1997; Bratman & Knight, 2000). Although often well-intended, dietary behaviors associated with ON can inadvertently result in an overly restrictive diet and lead to health complications and malnutrition (Dunn & Bratman, 2016).

Considering the similarities to and differences from other established EDs, does ON warrant its own ED diagnosis? Additionally, how does ON relate to both ED pathology and other predictive constructs? The current study aimed to explore the relationship between ON and ED pathology using a novel assessment tool, the Orthorexia Nervosa Inventory (ONI; Oberle et al., 2021). Another aim of the current study was to determine if ON added any unique variance in predicting ED pathology after controlling for other known correlates. For the first study aim, it was hypothesized that maladaptive healthy eating would display stronger correlations with eating
disorder pathology and related constructs (e.g., perfectionism, obsessive-compulsive symptoms, compulsive exercise, and body dissatisfaction) than would adaptive healthy eating. For the second study aim, it was hypothesized that ON would contribute a unique portion of variance in explaining eating disorder pathology, even after controlling for other correlated constructs.

**Literature Review**

**Defining Orthorexia Nervosa**

Orthorexia Nervosa (ON) has been defined in the literature as a pathological obsession with healthy eating (Andreas et al., 2018; Barrada & Roncero, 2018; Barthels et al., 2015a; Dunn & Bratman, 2016; Park et al., 2011). Although eating a healthy diet is not inherently problematic, the extreme fixation seen among individuals with ON (Gleaves et al., 2013) may lead to serious health complications, including excessive weight loss and malnutrition (Moroze et al., 2015; Saddichha et al., 2012; Zamora et al., 2005). ON is characterized by a psychological preoccupation with “healthy” or “clean” foods (Cena et al., 2019), and this fixation is accompanied by compulsive behaviors aimed at achieving an optimal state of health (Bratman, 2017). Accordingly, individuals may self-impose dietary restrictions which may escalate to the elimination of entire food groups, therefore increasing the likelihood of health complications (Bratman, 2017). Although dietary restrictions and weight loss are often consequences of ON, an important, unique feature regarding ON is the emphasis on the quality of food, rather than the quantity of food (Dunn & Bratman, 2016). The motivations underlying ON are often related to health and well-being, rather than body image or weight-loss (Cena et al., 2019; Dunn & Bratman, 2016). Instead of imposing restrictions and rituals for the sake of changing one’s appearance, individuals with ON are driven by the pursuit of optimal health.
Although there is a general understanding of ON among clinicians and researchers (Vandereycken, 2011), its precise definition has remained inconsistent. Since ON is not currently a diagnosis in the DSM-5 (APA, 2013), there has not been a uniform set of diagnostic criteria for researchers and clinicians to work from. Research on established EDs, such as AN, Bulimia Nervosa (BN), Binge Eating Disorder (BED), or Other Specified Feeding or Eating Disorder (OSFED), has benefitted from the inclusion of a formal diagnostic criteria, as such criteria act as guides for creating assessment measures, developing population norms, and developing and evaluating treatment protocols. Although the term “orthorexia” was coined near the turn of the twenty-first century (Bratman, 1997; Bratman & Knight, 2000), empirical popularity has lagged behind.

Despite the lack of a uniform definition of ON, several sets of diagnostic criteria have been proposed (Cena et al., 2019). Four such sets have been published in the literature (Barthels et al., 2015a; Dunn & Bratman, 2016; Moroze et al., 2015; Setnick, 2013). There are similarities across each set of diagnostic criteria, including core diagnostic features such as: 1) a pathological obsession, preoccupation, or fixation with healthy eating, 2) emotional distress resulting from deviations from one’s perceived healthy diet, and 3) physical, psychological, social, and or occupational impairments due to an imbalanced diet and/or strictly imposed dietary rules (Cena et al., 2019). Additionally, a preoccupation with one’s weight or shape is not a proposed feature in any of the diagnostic criteria sets, setting ON apart from other EDs such as AN or BN. Rather, ON is specifically conceptualized as a disorder focused on one’s health and well-being (Bratman, 1997; 2017). In fact, three of the four sets of proposed criteria specify that the underlying motivation for the disorder should not be driven by weight or shape but should instead be driven by a desire to achieve optimal health (Barthels et al., 2015a; Dunn & Bratman, 2016; Setnick,
Although the consequences may appear similar to those seen in AN, such as weight loss and malnutrition, the underlying motives are different (Cena et al., 2019). Descriptions of each proposed diagnostic criteria are listed in Table 1.

**Measurement of ON**

The dilemma of how to best diagnose ON is further exemplified by the myriad of different assessment tools employed in studies examining ON (Cena et al., 2019; Oberle et al., 2021; Opitz et al., 2020). There is no consensus on how to best assess ON, and this absence of a uniform assessment tool has been criticized in several reviews (Costa et al., 2017; Koven & Abry, 2015; Missbach et al., 2015; Missbach et al., 2017; Opitz et al., 2020; Valente et al., 2019). Specifically, the inconsistency among measurement tools has led to concern regarding prevalence estimates in the population (Oberle et al., 2017) as well as issues regarding validity and reliability (Koven & Abry, 2015).

Commonly used assessment tools include several self-report questionnaires such as the Bratman Orthorexia Test (BOT; Bratman, 1997), the ORTO-15 (Donini et al., 2005), the Eating Habits Questionnaire (EHQ; Gleaves et al., 2013), and the Dusseldorf Orthorexia Scale (DOS; Barthels et al., 2015a). Several newer scales have also been developed to address shortcomings in the existing scales, including the Teruel Orthorexia Scale (TOS; Barrada & Roncero, 2018) and the Orthorexia Nervosa Inventory (ONI; Oberle et al., 2021), although such scales have not been employed to the extent that the former scales have been. For example, Cena et al. (2019) conducted a systematic review of ON literature to clarify the definition of ON and the assessment tools that have been utilized. Their findings highlight the lack of uniformity among ON studies, including both the measurement tools employed and the conceptualization of ON itself (Cena et al., 2019). Out of studies that contained a specific measurement tool, the authors
found that nearly 70 percent of studies utilized the ORTO-15, about 13 percent utilized the BOT, and the remainder was split between the EHQ and DOS (Cena et al., 2019). Similarly, a more recent systematic review also found the ORTO-15 to be the most common assessment tool, followed by the EHQ (Opitz et al., 2020).

Although the predominant assessment tool across ON studies, the ORTO-15 is predated by the original self-assessment tool for ON, the Bratman Orthorexia Test (BOT). Steven Bratman, author of the book “Health Food Junkies” (Bratman & Knight, 2000), developed the BOT after observing what he coined as “orthorexia nervosa”, or an eating disorder characterized by a pathological obsession with eating healthfully to the point of physical and/or psychological dysfunction (Bratman & Knight, 2000). The BOT is a 10-question, self-report questionnaire with dichotomous “yes/no” response choices. The total number of “yes” responses determines the extent to which one may be experiencing ON. Questions on the BOT include “Is the nutritional value of your food more important than the pleasure of eating it?” and “Have you given up foods you used to enjoy in order to eat the ‘right’ foods?” Compared with other measures of ON, the BOT is rarely chosen due to psychometric concerns. The BOT remains unvalidated and has received criticism for demonstrating poor internal consistency when compared with other assessment measures, with Cronbach’s alpha ranging from .60-.67 among studies (Bundros et al., 2016; Grammatikopoulou et al., 2018). Therefore, other assessment tools have been developed in response to concerns surrounding the BOT.

The second major assessment tool for examining ON, the ORTO-15 (Donini et al., 2015), is the most widely used assessment tool to date (Cena et al., 2018; Opitz et al., 2020). The ORTO-15 consists of 15 items rated on a 4-point Likert scale with options ranging from “Always” to “Never.” The measure was based off Bratman’s original 10-item questionnaire, with
six modified items remaining in the ORTO-15 (Donini et al., 2005). The ORTO-15 has been adapted to several languages from the original Italian version, including Turkish (Arusoğlu et al., 2008), Portugese (Alvarenga et al., 2012), Polish (Brytek-Matera et al., 2014), Hungarian (Varga et al., 2014), German (Missbach et al., 2015), and Spanish (Roncero et al., 2017). The original measure was intended to examine both the “emotional” and “rational” aspects of subjects’ attitudes toward healthy eating. Therefore, questions fall into one of the three categories: cognitive-rational (e.g., *Are you willing to spend more money to have healthier food?*), clinical (e.g., *In the last 3 months, did the thought of food worry you?*), or emotional (e.g., *Do you feel guilty when transgressing?*). Despite these categories, no factor analysis was provided by Donini et al. (2005) to confirm this three-factor structure. The questionnaire is scored by summing each response for a total score, and a threshold score of 40 was determined to be sufficient for a diagnosis of ON to be given (Donini et al., 2005).

Despite its widespread use, the ORTO-15 has received criticism regarding its psychometric properties (Missbach et al., 2015; Oberle et al., 2017; Oberle et al., 2021; Opitz et al., 2020; Roncero et al., 2017). Using the recommended cutoff score of 40 on the ORTO-15, prevalence rates among studies have ranged anywhere from 4% to 86% (see Oberle et al., 2017 for list of studies), with an average prevalence rate of 55% being reported (Oberle et al., 2017), an abnormally high estimate. The internal consistency of the ORTO-15 has also varied considerably across studies, with Cronbach’s alpha coefficients ranging from unacceptable estimates of .14 to acceptable estimates nearing .83 (Roncero et al., 2017; Oberle et al., 2017). Validity concerns have been raised regarding the overall structure of the ORTO-15, with several studies failing to find the original 15-item structure an acceptable model fit (Missbach et al., 2015; Roncero et al., 2017). Although there have been adaptations to improve model fit,
including the ORTO-11 (Roncero et al., 2017) and ORTO-9-GE (Missbach et al., 2015), such measures have only shown moderate reliability and internal consistency (Missbach et al., 2015). The ORTO-15 also fails to include items assessing the negative physical and/or psychological consequences of ON (Oberle et al., 2017), which is thought to be an important component of the disorder (Cena et al., 2018). Overall, the reliability and validity concerns associated with the ORTO-15 have made it increasingly difficult to interpret and evaluate literature on ON.

Other assessment tools have been created to evaluate ON, including the Eating Habits Questionnaire (EHQ; Gleaves et al., 2013) and the Dusseldorf Orthorexia Scale (DOS; Barthels et al., 2015a). The EHQ contains 21 items on a 4-point Likert scale and is comprised of three subscales: problems associated with healthy eating, knowledge of healthy eating, and feeling positively about healthy eating. Higher values are indicative of greater ON severity. The EHQ has demonstrated good internal consistency, with Cronbach’s alpha values ranging from .86-.94 on total scores, and subscale values ranging from .70 (“Feelings”) to .92 (“Problems”) (Opitz et al., 2020). Test-retest reliability values have been adequate, ranging from .72-.81 (Gleaves et al., 2013). Several studies have also verified the factorial structure of the EHQ (Gleaves et al., 2013). In addition to the EHQ, the DOS was also developed to evaluate symptoms of ON (Barthels et al., 2015a). The DOS contains 10 items rated on a 4-point Likert scale, with higher scores indicative of greater ON severity. Although the factorial structure of the DOS is questionable (Opitz et al., 2020), good internal consistency has been demonstrated through Cronbach’s alpha values ranging from .79-.84 (Barthels et al., 2015a; Chard et al., 2018; He et al., 2019; Parra-Fernandez et al., 2019). Adequate test-retest reliability has also been reported across studies (Opitz et al., 2020).
Although the EHQ and the DOS appear psychometrically stronger than the ORTO-15, there are still aspects of ON that may not be reflected by either measure, namely the physical and psychological consequences resulting from a preoccupation with healthy eating (Oberle et al., 2021). Additionally, none of the previously mentioned measures attempts to piece apart normal healthy eating from pathological healthy eating (Barrada & Roncero, 2018). The latter concern was addressed by Barrada & Roncero (2018) by the creation of the Teruel Orthorexia Scale (TOS), a 17-item measure comprised of two subscales – healthy orthorexia and orthorexia nervosa. The former reflects a normal, adaptive pattern of healthy eating, while the latter is indicative of an unhealthy, pathological obsession with healthy eating that causes distress and/or dysfunction (Barrada & Roncero, 2018). The TOS has exhibited good internal consistency, with Cronbach’s alpha values exceeding .8 for both subscales (Barrada & Roncero, 2018; Mhanna et al., 2019). There is mixed support for the two-factor structure of the TOS, with some studies finding an acceptable fit (Barrada & Roncero, 2018; Mhanna et al., 2019) and some failing to find a strong fit (Chace, 2020; Roberto da Silva et al., 2021). In addition to the TOS, the ONI is another novel measurement tool that includes 24 items across three factors relating to ON: behaviors, impairments, and emotions. Each item is rated on a 4-point Likert scale, and higher total scores indicate greater levels of ON symptomatology. Thus far, the ONI has demonstrated good internal consistency with Cronbach’s alpha ranging from .91-.94, and subscale values ranging from .81-.90 (Kaya et al., 2021; Oberle et al., 2021). Good test-retest reliability has been reported (Oberle et al., 2021) and studies thus far have lent support to the factorial structure (Kaya et al., 2021). Although relatively new, it has been suggested that both the TOS and the ONI be examined in future studies on ON, since older measures (i.e., ORTO-15) appear
problematic (Bartel et al., 2020; Opitz et al., 2020). There remains no consensus on a “gold
standard” measure for ON to date.

**Orthorexia Nervosa and Eating Disorders**

The muddled assortment of assessment tools for ON highlights a core topic of debate - is
ON a distinct disorder, and if so, should it be classified as an eating disorder in the DSM? It is
uncertain if ON is its own distinct disorder, a symptom of another disorder, or even a social
phenomenon (Costa et al., 2017; McComb & Mills, 2019). At its core, ON has been
conceptualized as a disorder characterized by extreme dietary restriction resulting in physical and
psychological impairments (Costa et al., 2017; Cena et al., 2019). The distinguishing feature of
ON is not necessarily the observable behaviors or consequences, but rather the specific
motivations and beliefs involved in the dietary choices (Costa et al., 2017; Dunn & Bratman,
2016). For example, individuals with ON choose foods based on the perceived “healthy” or
“pure” qualities of the food rather than for the caloric content (Cena et al., 2019). The emphasis
is placed on the *quality* of the food instead of the *quantity* of the food (Cena et al., 2019).

Studies have consistently demonstrated an association between disordered eating and ON
(Brytek-Matera et al., 2020a; Brytek-Matera et al., 2020b; Cena et al., 2019; Costa et al., 2017;
McComb & Mills, 2019; Obeid et al., 2021; Oberle et al., 2021; Strahler et al., 2018). Dietary
restriction is common in individuals with ON tendencies (Dunn & Bratman, 2016), in addition to
being a frequent behavior seen in individuals with both AN and BN (Elran-Barak et al., 2015).
Ritualized behaviors surrounding food, commonly observed in cases of AN, are also noted
among individuals with ON (Dunn & Bratman, 2016). The fixation on a healthy diet often leads
to rigid cognitions and behaviors regarding where food is purchased, how food is prepared, and
the types of food deemed “worthy” of consumption (Cena et al., 2019). As is the case with other EDs, these inflexible patterns eventually result in physical, psychological, and social consequences, impacting one’s quality of life (Cena et al., 2019; Costa et al., 2017; Dunn & Bratman, 2016; Oberle et al., 2017). The dysfunction and distress caused by ED behaviors and cognitions are core components in ED pathology and are necessary components for receiving an ED diagnosis in the DSM-5 (APA, 2013). Proposed diagnostic criteria for ON also assert that ON behaviors lead to significant impairments across physical and psychosocial domains (Barthels et al., 2015a; Dunn & Bratman, 2016; Moroze et al., 2014; Setnick, 2013). Such impairments include physical consequences such as malnutrition or excessive weight-loss, and psychosocial impairments such as excessive guilt, anxiety, and social isolation.

Similarities between ON and EDs extend to psychological correlates, including perfectionism (Brytek-Matera et al., 2020a; Brytek-Matera et al., 2020b; McComb & Mills, 2019; Oberle et al., 2017), obsessive-compulsive traits (Brytek-Matera et al., 2020b; Strahler et al., 2018; Yilmaz et al., 2020; Zickgraf et al., 2019), body image disturbance (McComb & Mills, 2019), anxiety (Strahler, 2020), negative affect (Barthels et al., 2019), and exercise behaviors (Oberle et al., 2021; Surala et al., 2020). Consistent with the development of both AN and BN, factors such as drive for thinness (Barthels et al., 2017) and thin-ideal internalization (Eriksson et al., 2008) both were shown to predict ON symptomatology, contrary to the idea that ON is not theorized to be motivated by a preoccupation with weight or shape (Costa et al., 2017). Perfectionism is another factor that has been strongly linked to ED pathology (Bardone-Cone et al., 2007) and appears to also demonstrate a strong relationship to ON symptomatology (Brytek-Matera, 2020a; Brytek-Matera, 2020b; Oberle et al., 2017). Perfectionism is a trait that involves the adherence to an exceedingly high set of standards towards oneself and one’s behaviors – in
relation to EDs, this often translates to excessive control over one’s diet, resisting temptations, and strictly adhering to imposed dietary rules (Barthels et al., 2015b; Oberle et al., 2017). With ON, a fixation on consuming a “pure” or “healthy” diet is the primary focus and any diversion from such diet results in excessive feelings of guilt or shame (Cena et al., 2019). Therefore, perfectionism may drive individuals with ON to exert even more control over their behaviors to achieve their “perfect” diet.

Interestingly, the most robust predictor of ON appears to be a history of ED pathology (Costa et al., 2017; McComb & Mills, 2019; Oberle et al., 2021; Strahler et al., 2018). Several studies examining risk factors for ON have concluded that ED history predicted ON symptomatology above other known correlates, including perfectionism (McComb & Mills, 2019), maladaptive exercise (Oberle et al., 2021; Surala et al., 2020), negative affect (Barthels et al., 2019), and depression and anxiety (Strahler, 2020). It is important to note that these findings have resulted from cross sectional data and causality cannot be implied. It remains unclear whether ON is a condition that acts as a precursor to other EDs or if ON results from having a previous ED. A study by Segura-Garcia and colleagues (2015) examined ON symptomatology in a group of recovered ED patients and found high rates of ON apparent in this population. Additionally, ON is a phenomenon that many clinicians acknowledge, indicating that ON tendencies are common among individuals with existing EDs (Vandereycken, 2011). Is it the case that a seemingly harmless desire to improve one’s health leads to a full-blown ED? Or is it the case that EDs increase the likelihood that an individual will find a new dietary fixation?

Among ED diagnoses, ON appears to overlap considerably with AN. Like AN, ON is characterized by a pattern of dietary restriction (Dunn & Bratman, 2016). Although low body weight is not a proposed diagnostic criterion for ON, the consequences associated with ON
overlap with those observed in cases of AN. Physical complications such as malnutrition and psychosocial consequences such as excessive guilt and social impairments are similar among both disorders (Cena et al., 2019). Similar patterns of ritualized behaviors surrounding food are also apparent in both AN and ON – the planning and preparing of food occupies a significant amount of time, thus contributing to social impairments (McComb & Mills, 2019). Key differences appear to be the motivation underlying the dietary restriction – individuals with AN tend to be concerned about overall energy intake, whereas individuals with ON tend to fixate on consuming an optimally healthy diet. Therefore, although each disorder results in dietary restriction and subsequent physical consequences, the differing motivations warrant different clinical implications.

**Current Study**

The purpose of the present study was to clarify the relationship between ON and ED pathology. Accordingly, it was hypothesized that: 1) ON would be positively related to ED pathology in addition to other ED-related constructs, such as maladaptive perfectionism, compulsive exercise, and intolerance of uncertainty, and 2) ON will account for a unique portion of variance in EAT-26 scores after controlling for maladaptive perfectionism, compulsive exercise, and intolerance of uncertainty. In other words, it was predicted that ON would be related to ED pathology but offer its own predictive capabilities beyond those of other known predictive factors.

**Methods**

**Participants and Procedures**
Participants in this study were 258 undergraduate students (55% female) from a large, Northeastern university with a mean age of 19.1 years (SD=1.5). Participants were recruited online through the university’s undergraduate psychology research pool and were given course credit in exchange for study participation.

Informed consent was received from each participant prior to beginning the study. Participants then completed a series of online questionnaire through Qualtrics, a secure online survey platform. Information regarding demographics, eating pathology, and related psychological constructs were assessed. All study procedures were approved by the university’s human subjects committee.

Measures

**Orthorexia Nervosa Inventory** (ONI; Oberle et al., 2021). The ONI is a 24-item self-report measure which assesses ON symptomatology, or a pathological fixation on healthy eating. Participants rated each item on a 4-point Likert scale, with options ranging from 1 (“not true at all”) to 4 (“very true”). The ONI consists of three subscales in addition to an overall score: impairments (e.g., “My healthy eating is a significant source of stress in my relationships”), behaviors (e.g., “I strictly avoid all foods I feel are unhealthy”), and emotions (e.g., “I feel much guilt or self-loathing when I stray from my healthy diet”). A total score was calculated for the current sample by summing all items. Higher scores on the ONI indicate greater levels of ON symptomatology. The ONI demonstrated excellent internal consistency in the current sample (Cronbach’s α = .93).

**Eating Attitudes Test-26** (EAT-26; Garner et al., 1982). The EAT-26 is a 26-item self-report measure used to assess eating disorder risk. Items are rated on a 6-point Likert scale with
options ranging from 0 ("never") to 6 ("always"), and a total score is obtained by recoding and summing all items. The EAT-26 assesses several domains related to disordered eating, including 13 items addressing dieting (e.g., “Am preoccupied with a desire to be thinner”), 6 items addressing bulimia and food preoccupation (e.g., “Have the impulse to vomit after meals” and “Find myself preoccupied with food”), and 7 items addressing oral control (e.g., “Avoid eating when I am hungry”). The EAT-26 demonstrated good internal consistency in the current sample (Cronbach’s α = .89).

**Compulsive Exercise Test** (CET; Taranis et al., 2011). The CET is a 24-item self-report measure assessing pathological exercise. Items are rated on a 5-point Likert scale with options ranging from 1 (“never true”) to 5 (“always true”). The CET is comprised of five subscales, including avoidance and rule driven behavior (e.g., “I feel like I’ve let myself down if I miss an exercise session”), weight control exercise (e.g., “I exercise to burn calories and lose weight”), mood improvement (e.g., “I feel happier and/or more positive after I exercise”), lack of exercise enjoyment (e.g., “I find exercise a chore”), and exercise rigidity (e.g., “My weekly pattern of exercise is repetitive”). A global score was obtained for the current study by summing all items, with items 8 and 12 reverse-coded. The CET demonstrated good internal consistency in the current sample (Cronbach’s α = .89).

**Intolerance of Uncertainty – Short Scale** (IUS-12; Carleton et al., 2007). The IUS-12 is a 12-item self-report questionnaire that assesses the degree to which individuals find uncertain situations to be unacceptable. Items are rated on a 5-point Likert scale with options ranging from 1 (“not at all characteristic of me”) to 5 (“entirely characteristic of me”), and a total score is calculated by summing all items. The IUS-12 consists of items relating to prospective IU (e.g., “unforeseen events upset me greatly”) and items relating to inhibitory IU (e.g., “The smallest
doubt can stop me from acting”). Total scores were used in the current study. Internal consistency was excellent in the current sample (Cronbach’s α = .93).

**Frost Multidimensional Perfectionism Scale** (FMPS; Frost et al., 1990). The FMPS is a well-validated self-report measure assessing multiple domains of perfectionism. The current study utilized the Concern over Mistakes subscale (FMPS-COM) due to its strong link to eating disorder pathology (Davies et al., 2009). The FMPS-COM consists of 13 items rated on a 5-point Likert scale with options ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). Sample items include, “I should be upset if I make a mistake” and “Even when I do something very carefully, I often feel that it is not quite right”. Total FMPS-COM scores were calculated by summing all 13 items. Internal consistency for the FMPS-COM was excellent in the current sample (Cronbach’s α = .93).

**Demographic information.** Participants provided information regarding their age, weight, height, gender, sexual orientation, racial and ethnic identity, household income, and eating disorder history. Participants were given the option to withhold any demographic information which they were uncomfortable sharing (e.g., “I choose not to respond).

**Statistical Analysis**

Data were analyzed using IBM SPSS Statistics (Version 26) predictive analytic software. Correlations were computed for the ONI, EAT-26, CET, IUS-12, and FMPS-COM scores. Multiple linear regression was used to determine the amount of variance in EAT-26 scores which could be explained by scores on the ONI, CET, IUS-12, and FMPS-COM. A stepwise approach was used to determine if ON symptomatology was predictive of ED pathology, the outcome variable, after controlling for other known correlates of disordered eating (e.g., compulsive exercise, intolerance of uncertainty, perfectionism). Additionally, both gender and BMI
(computed from self-reported weight and height) were entered into the model as covariates. Step one included gender and BMI, step two included the addition of the CET global score, the IUS-12, and the FMPS-COM, and the third step included the addition of the ONI.

**Results**

A total of 323 undergraduate students consented to take part in the online study. Attention checks were integrated into the survey to ensure valid responses, and a total of 63 participants were excluded from analyses for failing to respond accurately. Two additional participants were also removed for invalid responses.

The final sample consisted of 258 undergraduate students. Responses to all items included in analyses were $\geq 99\%$. Missing data analyses were performed using Little’s (1988) Missing Completely at Random (MCAR) test, which was not significant ($\chi^2=568.96$, DF=586, $p=.69$). A non-significant MCAR test indicates that data are missing at random. Therefore, listwise deletion was employed during data analytic procedures. All variables were assessed for normality and heteroscedasticity assumptions prior to running analyses. EAT-26 scores exhibited positive skew and underwent a square-root transformation to fit normality assumptions.

Demographic information is listed in Table 1. The sample ($M_{age}=19.1$, $SD_{age}=1.5$) was comprised of 141 women, 116 men, and 1 individual who identified as non-binary. Body mass index (BMI) values were calculated from self-reported weight and height measurements. The average BMI calculated for the current sample was 24.5 ($SD=5.0$). The racial/ethnic breakdown of the sample was 54.3% White, 21.7% Black or African American, 11.6% Asian, 19.8% Hispanic/Latinx, 0.4% Native Hawaiian or Pacific Islander, 0.4% American Indian or Alaska Native, and 4.3% biracial or other.
Correlation analyses revealed significant positive associations between variables (Table 2). The ONI displayed positive associations with EAT-26 scores ($r=.57, p<.001$), CET global scores ($r=.50, p<.001$), IUS-12 scores ($r=.32, p<.001$), and FMPS-COM scores ($r=.42, p<.001$). Table 2 provides a full description of Pearson correlations between variables.

Regression analyses were performed to determine if ON symptomatology contributed a unique portion of variance of disordered eating indices above and beyond other known correlates of ED pathology, such as compulsive exercise, intolerance of uncertainty, and perfectionism (Table 3). Despite positive correlations between predictor variables, multicollinearity was not an issue. All tolerance values were greater than .5 and variance inflation factor (VIF) values were less than 2. Tolerance values ≤.10 and VIF values ≥10 have been suggested in the literature as indicative of multicollinearity (Hair et al., 1995; Tabachnick & Fidell, 2001). Furthermore, residuals appeared to be normally distributed and displayed a random pattern of dispersal on a residuals plot.

After controlling for BMI and gender (step 1), approximately 31.4% of the variance in EAT-26 scores could be explained by CET, IUS-12, and FMPS-COM scores (step 2), although the FMPS-COM was not a significant predictor ($F(5,246)=23.98, p<.001, R^2=.314$). The addition of ONI scores to the model (step 3) accounted for an additional 11.5% ($\Delta R^2=.115$) of the variance in EAT-26 scores for a total of 42.9% of variance explained by the model ($F(6,245)=32.43, p<.001, R^2=.429$).

**Discussion**

The purpose of this study was to clarify the relationship between orthorexia nervosa (ON) symptomatology and eating disorder (ED) pathology by using a novel measure of ON, the
Orthorexia Nervosa Inventory (ONI). Correlation analyses were used to determine the nature of the relationship between ON symptomatology and ED-related constructs, and multiple regression was then performed to determine if ON symptomatology provided any unique predictive value towards disordered eating symptoms after controlling for other established correlates of ED pathology. Results indicate that ON symptomatology is moderately positively correlated with disordered eating symptoms and uniquely predicted disordered eating symptoms above other known predictors.

These findings are consistent with other studies examining the construct of ON with measures of ED pathology (Bartel et al., 2020; Brytek-Matera et al., 2020a; Obeid et al., 2021; Strahler et al., 2018; Zickgraf et al., 2019). Previous work has also demonstrated a positive relationship between the ONI and ED pathology (Kaya et al., 2021; Oberle et al., 2021). ON symptomatology has also demonstrated positive associations with other constructs such as maladaptive exercise (Oberle et al., 2021), obsessive-compulsive symptomatology (Yilmaz et al., 2020; Zickgraf et al., 2019), and perfectionism (Oberle et al., 2017). Regarding gender and BMI, we found no significant differences in ONI scores. Although some research has noted a positive relationship between ON symptomatology and BMI (Asil & Surucuogli, 2015; Fidan et al., 2010), the majority of studies examining this relationship failed to find a significant relationship between the two constructs (Donini et al., 2004; Varga et al., 2014; Oberle et al., 2017; Zickgraf et al., 2019). The lack of a relationship between the ONI and both gender and BMI suggest that ON is a distinct phenomenon, separate from other EDs (e.g., AN).

An interesting finding, contrary to hypotheses, was the lack of a significant relationship between the FMPS-COM and EAT-26 scores in the final regression model. The Concern over Mistakes subscale of the FMPS has been consistently linked to ED pathology (Bardone-Cone et
al., 2007) in addition to various other forms of psychopathology (Frost & DiBartolo, 2002). Although the FMPS-COM was positively correlated with EAT-26 scores, the FMPS-COM was not a significant predictor in the regression analyses. Due to the use of a non-clinical, undergraduate sample, it is possible that FMPS-COM scores did not reach the threshold necessary to explain any variance in disordered eating behaviors. Additionally, since the FMPS-COM is positively correlated with both CE and IU in the current study, it is possible that the latter two constructs explained the variance in ED pathology more than the FMPS-COM.

A strength of the current study was the use of the ONI, which was developed only recently by Oberle et al. (2021). This measure offers several advantages over other commonly used measures of ON, such as the ORTO-15. For example, the ORTO-15 has demonstrated poor internal consistency (Oberle et al., 2017) and produced inconsistent prevalence ratings for ON, ranging from lower estimates of 4% to higher estimates of 86% (Oberle et al., 2017). These variable findings highlight the problematic psychometric properties of the ORTO-15 and reason to cease its use in research on ON. Although several measures of ON have been proposed since the conception of the ORTO-15, the ONI is the first measure to specifically assess the physical impairments that accompany ON (Oberle et al., 2021). Considering that several proposed sets of diagnostic criteria assert physical impairments as a core feature of the disorder (Cena et al., 2019), this measure offers a potential advantage over other existing measures. Although there is limited research involving the ONI, the two existing studies suggest good psychometric properties (Kaya et al., 2021; Oberle et al., 2021).

Overall, this study contributes to the growing body of literature examining ON and its relationship to EDs. ON is not currently a diagnosis in the DSM-5, and its potential place within the manual remains controversial (Brytek-Matera et al., 2020a). Although more studies are
needed to elucidate the trajectory of ON and the long-term effect of the condition, this study lends support to the idea that ON may fit in as a distinct form of ED and appears to be related to similar constructs. Since, at present, ON is not a recognized ED in current diagnostic manuals, this disorder may go relatively unnoticed in affected individuals and therefore may not be treated until symptoms become severe enough and/or resemble other known EDs, such as AN. Therefore, this study supports the notion of spreading clinical awareness of ON and routinely monitoring affected individuals for any potential negative consequences.

**Limitations**

The current study carries with it several limitations worthy of note. First, this study utilized a sample of undergraduate students from the University’s psychology research pool, therefore limiting the generalizability of the findings. This study also consisted of a non-clinical sample, and future research would benefit from examining the construct of ON in a clinical ED sample. It may also be useful to examine the construct of ON in individuals who meet criteria for AN to determine the amount of overlap among the two disorders. Since this study was cross-sectional, no causal relationships can be implied. Additionally, the self-reported nature of this study may have led to potential bias when reporting on current and/or past behaviors. Future research would benefit from prospective study designs with multiple sources of information (e.g., diagnostic interviews in addition to self-reported clinical data).

**Conclusions**

This study lends support to the recognition of ON as a potential form of disordered eating. ON appears to be related to other ED-related constructs, such as compulsive exercise, intolerance of uncertainty, and perfectionism. Additionally, ON symptomatology was positively associated with disordered eating and was uniquely predictive of ED pathology even after
controlling for other known correlates of ED pathology. Clinically, it may be useful for clinicians to screen for ON symptoms when screening for EDs, since ON may be camouflaged as a harmless interest in eating healthy. It may also be useful to monitor for ON symptoms throughout the course of ED treatment, since research has yet to elucidate the etiology of ON – it remains unknown if ON symptomatology predates or results from ED symptoms. As society evolves, ED presentations may also be evolving, and remaining vigilant for newer patterns of eating pathology, like ON, may be an important step in preventing EDs in those at risk.
References


https://doi.org/10.1080/01612840.2017.1371816


https://doi.org/10.1007/BF03325060

https://doi.org/10.1007/BF03327537

https://doi.org/https://doi.org/10.1016/j.eatbeh.2015.12.006


Table 1

**Demographic information of study sample**

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<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>%</th>
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<td>BMI</td>
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<tr>
<td>Native Hawaiian/Pacific Islander</td>
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<tr>
<td>Mixed or Other</td>
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<td>Hispanic/Latinx</td>
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*Note. M=mean, SD=standard deviation, n=number of participants*
Table 2

Means, standard deviations, and correlations between study variables

<table>
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<tr>
<th>Variable</th>
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<th>4</th>
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<td>.50*</td>
<td>.33*</td>
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<td>2. EAT-26</td>
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<td>10.91</td>
<td>.57*</td>
<td>-</td>
<td>.39*</td>
<td>.42*</td>
<td>.43*</td>
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<td>3. FMPS</td>
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<td>11.30</td>
<td>.42*</td>
<td>.39*</td>
<td>-</td>
<td>.36*</td>
<td>.63*</td>
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<tr>
<td>4. CET</td>
<td>15.50</td>
<td>3.55</td>
<td>.50*</td>
<td>.42*</td>
<td>.36*</td>
<td>-</td>
<td>.27*</td>
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<tr>
<td>5. IUS-12</td>
<td>31.79</td>
<td>10.65</td>
<td>.33*</td>
<td>.43*</td>
<td>.63*</td>
<td>.27*</td>
<td>-</td>
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</table>

*Note. ONI=Orthorexia Nervosa Inventory; EAT-26=Eating Attitudes Test; FMPS=Frost Multidimensional Perfectionism Scale – Concern Over Mistakes subscale; CET=Compulsive Exercise Test total score; IUS-12=Intolerance of Uncertainty Scale – short form; The EAT-26 underwent a square-root transformation prior to correlational analyses. *p<.01
Table 3

*Multiple regression*

<table>
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<th>Predictor</th>
<th>b</th>
<th>SEb</th>
<th>95% CIb</th>
<th>t</th>
<th>p</th>
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<td>[-.005,.062]</td>
<td>1.70</td>
<td>.09</td>
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<tr>
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<td>3.18</td>
<td>&gt;.01*</td>
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<tr>
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<td>.010</td>
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<td>.35</td>
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<tr>
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<td><strong>Model 3</strong></td>
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<td>1.72</td>
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<td>3.70</td>
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<td>2.73</td>
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<td>[.017,.053]</td>
<td>3.77</td>
<td>&gt;.001**</td>
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<tr>
<td>ONI</td>
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<td>[.044,.077]</td>
<td>7.11</td>
<td>&gt;.001**</td>
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</table>

\[ R^2=0.314 \]
\[ F(5,246)=23.98, \ p<.001 \]

\[ R^2=0.429 \]
\[ F(6,245)=32.43, \ p<.001 \]

*Note.* The outcome variable for the multiple regression analysis was the Eating Attitudes Test (EAT-26); ONI=Orthorexia Nervosa Inventory; FMPS-COM=Frost Multidimensional Perfectionism Scale – Concern Over Mistakes subscale; CET=Compulsive Exercise Test total score; IUS-12=Intolerance of Uncertainty Scale – short form; BMI was calculated from self-reported weight and height information.

*\( p<.01 \)

**\( p<.001 \)