DISSERTATION

# THE ORTHOREXIA NERVOSA SCALE: UPDATED AND TESTED IN A TARGETED COMMUNITY SAMPLE

Submitted by

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ABSTRACT

THE ORTHOREXIA NERVOSA SCALE: UPDATED AND TESTED IN A TARGETED COMMUNITY SAMPLE

In 2000, physician Steven Bratman coined the term Orthorexia Nervosa (ON) based on his observations that some individuals were so obsessed with healthy eating that it reached a pathological level (Bratman & Knight, 2000). He conceptualized ON as a way to describe an obsession about proper nutrition and a "fixation" on healthy eating (Bratman & Knight, 2000). Currently, very little is known about ON, as evidenced by lack of a formal operational definition or standard diagnostic criteria. Although there are three existing scales that measure ON (Bratman & Knight, 2000; Donini, Marsili, Gaziani, Imbriale, & Cannella, 2005; Gleaves, Graham, & Ambwani, 2013), none of them appear to completely capture all of the facets of ON. This dissertation details the attempt to develop a psychometrically valid and reliable scale, the Orthorexia Nervosa Scale (ONS), that more accurately and fully captures the construct of ON, followed up by examining ON and its relationship to other related constructs – obsessive compulsive disorder, anxiety, and disordered eating symptoms.

Initial analyses (exploratory factor analysis and confirmatory factor analysis) of a 103 item pool indicated a 10-factor solution with an adequate model fit once model modifications were made (Kramer, 2016). As part of the current study, items were examined and adjustments were made (e.g. removing and revising items). An EFA and CFA were conducted (n=537 and n=465, respectively), and revealed a 6-factor structure. Additionally, the CFA revealed a good model fit, $X^2$ (650) = 1531.115, $p < 0.01$, CFI = 0.903, SRMR = 0.07. The six dimensions

assessed by the six factors were: 1) Social Concerns, 2) Knowledge/Superiority, 3) Fulfillment/Control, 4) Pureness/Natural Quality of Food, 5) Detox, and 6) Online Forums/Blogs.

Data were then collected using a targeted community sample (i.e. targeting healthy eating groups on Facebook) to examine relationships between the ONS, obsessive compulsive disorder, anxiety, and disordered eating symptoms. Two alternative models were tested using path analysis. Analysis revealed good model fit for both models. This highlights the complex factor structure of ON, and indicates the difficulty in replicating the scale.

The current study provides a strong foundation for determining a definitive factor structure for ON. While more research is needed to clarify the factor structure, the overall results suggest that the six factors captured by the ONS in the current study will be a useful tool for future research and scale development related to ON.

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# INTRODUCTION

In 2000, physician Steven Bratman coined the term Orthorexia Nervosa (ON) based upon his observations that some individuals were so preoccupied with healthy eating that their concern reached a pathological level (Bratman & Knight, 2000). He conceptualized ON to describe this obsession with proper nutrition and a "fixation" on healthy eating (Bratman & Knight, 2000). Past research describes clear individual and social causes of the disorder and clear individual consequences, the implications of which warrant further investigation, assessment tools, and a detailed discussion about ON's inclusion in the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-5). This study will review the causes and the effects to support ON's validity, discuss criteria, and propose the current study.

## *Characteristics of Orthorexia Nervosa*

Within Bratman and Knight's (2000) model, a person may be diagnosed with ON based on the presence of the following: 1) spending more than 3 hours per day thinking about and preparing healthy food, 2) feeling superior to those with differing eating habits, 3) following a particular self-imposed dietary regimen rigidly and engaging in compensatory restriction to make up for any dietary indiscretions, 4) attaching self-esteem to adherence to the self-imposed diet, 5) making consumption of a healthy diet the central focus of life, at the expense of other personal values, relationships, previously enjoyed activities, and sometimes physical health, and 6) making nutritional value of a meal more important than the pleasure of eating it. While ON has been criticized because the concept originated through Bratman's personal experience, there is evidence that ON exists. Researchers using previously developed ON measures have reported very high prevalence rates (Aksoydan & Camci, 2009; Bagci Bosi, Camur & Guler, 2007;

Donini, Marsili, Gaziani, Imbriale & Cannella, 2004; Segura-Garcia et al., 2012), though these high prevalence rates should be viewed with caution (see *Prevalence* section for further discussion).

Among ON sufferers, the desire to maximize physical health and well-being leads to a fixation on food quality that, in turn, drives the attitudes, thoughts, and behaviors characteristic of ON (Koven & Abry, 2015). This health-focused preoccupation likely causes sufferers to develop highly specified, detailed food rules, which can become very restrictive over time (Bartrina, 2007). For example, a person suffering from ON may spend a considerable amount of time determining whether processing has exposed their food to pesticides, herbicides, or unnatural ingredients. Individuals with ON are also concerned about whether food labels provide enough information to judge the quality of the food (Aksoydan & Camci, 2009; Donini et al., 2004). Additionally, research has indicated that individuals with ON may also fear unhealthy food; Brytek-Matera (2012) noted that this distrust can stem from a variety of sources, including genetic predispositions, personality characteristics, unrealistic demands, social pressures, or misinformation. Research suggests that these concerns lead to behavior change, such as a reduction in number of foods a person is willing to eat (Bratman & Knight, 2000).

While a desire to maximize physical health and well-being appears to be the primary explanation for the development of ON (Bratman & Knight, 2000; Koven & Abry, 2015), other possible motivations have been suggested. Some research has indicated that ON is a coping strategy for a more severe eating disorder (Kinzl, Hauer, Traweger & Kiefer, 2006). While the suggestion that ON is a coping strategy is an interesting one, more research is needed to examine the link between ON and eating disorders before connections about coping can be made. Bratman & Knight (2000) have also theorized that ON eating behavior may also be explained by

a compulsion for complete control, a searching for spirituality through food, or use of food behaviors to create an identity. While interviews with current psychologists, therapists, graduate students, and nutritionists that have a specific interest in ON agreed with the aforementioned motivations, there is a paucity of research examining these concerns (Kramer, 2016). For example, it was noted that working with the ON population presents unique challenges. For instance, the majority of individuals viewed their presenting problems as integral to their identity, and many felt they were more of an "expert" on the proper way to eat than the licensed professionals.

One of the characteristics noted in individuals who fit ON criteria is disordered thinking associated with their desire to adhere to these highly specific food rules. They may punish themselves with increasingly stringent dietary restrictions if they violate a personal food rule, such as consuming foods they have labeled bad or wrong (Bratman & Knight, 2000). For example, an individual who experiences pressure to eat an impure food at a social gathering may experience feelings of guilt and shame. As a way to combat those feelings, they increase the number of dietary restrictions they place on themselves. Koven & Abry (2015) noted that symptoms present themselves outside of meal time in the form of extra time spent researching and cataloging food, weighing and measuring food, and planning upcoming meals. Koven & Abry (2015) also highlighted that intrusive, food-related thoughts tend to occur outside of meal times, such that individuals with ON tend to be consumed by food-related thoughts throughout the day.

Individuals with ON also present with restrictive eating, and describe an overwhelming, obsessive desire to have their bodies feel pure and natural. These desires to feel pure leads individuals with ON to commit to eating healthily. This pattern of healthy eating can become so

restrictive that it begins to interfere with the person's quality of life (Bratman & Knight, 2000; Chaki, Pal, & Bandyopadhyay, 2013; Getz, 2009; Mathieu, 2005). Koven & Abry (2015) stated that individuals with ON experience feelings of frustration and disgust when something interferes with their food rituals. Feelings of guilt and self-loathing are also reported when individuals with ON fail to adhere to their restrictive and inflexible food rules (Koven & Abry, 2015; Mathieu, 2005). Despite abundant speculation and observations with respect to the above behaviors and their psychological consequences, there is a lack of empirical attention to this area.

Additionally, there may be social consequences associated with ON. Individuals with ON may avoid social events due to their concern about maintaining healthy eating in unfamiliar surroundings, raising clinical concerns about social isolation (Chaki, et al., 2013). Literature suggests that individuals with ON often initially focus on their diet to improve their health or treat a disease, though the diet later becomes integral to their self-identity (Catalina Zamora et al., 2005). Their narrow perception of healthy eating may then affect their views about others and cause them to feel morally superior to anyone who does not have the same self-discipline; however, no empirical studies exist that examine any potential social consequences of ON.

Dependence on such a strict diet may have health consequences. Individuals with ON may eliminate many essential nutrients from their diets, which may lead to several nutritional and mineral deficiencies (Bagci Bosi et al., 2007; Bratman & Knight, 2000). As mentioned, an individual with ON might choose to withhold food rather than eating foods that he or she considers to be impure, unhealthy, or harmful to his or her health (Bagci Bosi et al., 2007; Bratman & Knight, 2000; Nymah, 2002). Although longitudinal empirical studies are missing from the literature, Koven and Abry (2015) discussed that the extreme dietary choices made by individuals with ON can lead to the same medical complications that are associated with severe

anorexia nervosa (AN; i.e., osteopenia, anemia, pancytopenia, hyponatremia, metabolic acidosis, bradycardia, testosterone deficiency).

Despite the lack of empirical evidence indicating that ON causes significant clinical distress, the potential physical, psychological, social and quality of life consequences for individuals with ON have are potentially quite harmful, and call for careful investigation to deepen our understanding of this phenomenon.

*Societal Context*

Evidence suggests that, in general, individuals have become more aware of how their diet impacts their overall health and have attempted to adjust their food choices accordingly (Bagci Bosi et al., 2007; Nicolosi, 2006). For several reasons, society has increasingly discussed the importance of healthy eating through news outlets, the media, and the medical field. This trend may be due in part to the obesity epidemic occurring today (Flegal, Carroll, Kit, & Ogden, 2012). Additionally, individuals increasingly report food allergies and intolerances and thus alter food choices for health reasons (Rona et al., 2007). Beliefs about food and eating are varied and pervasive (Casazza et al., 2015; Knight, 2012), though scientific support for some of these beliefs has not been well established. For example, there are varying perspectives regarding how gluten-free foods affect the health of non-celiac individuals (Stuadacher & Gibson, 2015). Social media plays a role, as well. Over the last 50 years, there has been an increase in the prevalence of food images in the virtual world (Kickbusch & Payne, 2003; Spence, Okajima, Cheok, Petit, & Michel, 201). In fact, Spence et al. (2016) state that our sense of vision more effectively predicts what foods are likely to be viewed as safe (i.e. edible) and nutritious to consume than our other senses, suggesting a sensory adaptation that may make individuals vulnerable to visual marketing.

Research has also focused on the impact of the changing landscape of food production, with more food being produced in ways that are processed, engineered, and modified. These changes lead individuals to rely more heavily on labels and packaging to evaluate their food. With both an increase in discussion in society about healthy eating and an increase in processed and engineered food, Nicolosi (2006) noted that this has contributed to individuals and societies displaying ON tendencies.

Nicolosi (2006) theorized about a socially constructed view of health. He relayed that in the 1980s, a term called healthism emerged to describe the developing health consciousness that was occurring (Haman, Barker-Ruchti, Patricksson, & Lindgren, 2015). Healthism was defined as the preoccupation with personal health as the primary focus for the achievement of well-being (Crawford, 1980). Healthism is ubiquitous, appearing across media, advertising, and health promotion efforts (Lee & Macdonald, 2010). Healthism focuses on body shape and size (Haman et al., 2015). This implies that health can achieved through individual discipline and moral conduct. These authors highlighted healthism as formative in shaping many behaviors and practices surrounding health and eating. Such practices could have positive effects (e.g. improving one's bad habits) or negative ones (e.g. promoting unhealthy thinking about the body). Regarding ON specifically, negative practices, such as constrained eating behaviors, could emerge in order to conform to health ideals. Thus, while ON has been viewed primarily on an individual level, today's social understanding of health has shaped individual behavior, as well.

Research has also indicated a "proliferation…[of] wellness program" that target preventative behavior, including weight management and healthy eating strategies, in workplaces across the United States (Richardson, 2017). This recent increase has led to a large focus on the

healthy employee, and it is possible that this increased focus on health in the workplace has caused an increase in ON symptoms. While organization's intent is to improve the health of their workers, they may also be contributing to the development of ON symptoms in some employees.

While the emerging focus on healthy eating is a broad social trend, ON presents as an extreme manifestation (Bratman & Knight, 2000; Chaki et al., 2013). In review, there are many facets of ON -- maximizing physical health, coping/compulsive behaviors, disordered thinking, rigidity, desire to feel pure, self-identity, moral superiority, social avoidance, nutritional loss, social pressures – that contribute to its causes and outcomes, the severity of which has caused some researchers to state that ON should be included in the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-5) due to its distinct features (Brytek-Matera, 2012; Catalina Zamora, Bonaecha, Sanchez, & Rial, 2005; Chaki et al., 2013; Donini et al., 2005).

Though some researchers have raised questions about the validity of ON as a unique disorder, others believe that ON is indeed different from recognized eating disorders. My research has led me to agree with researchers who suggest that ON has a place in the DSM-5. To further those aims, I will now begin to set forth a proposed set of diagnostic criteria that will help test and validate a measure for ON.

*Proposed Diagnostic Criteria for ON*

Currently, there are two articles that propose diagnostic criteria for ON. The first captured the way in which ON is currently understood (i.e. Bratman & Knight's (2000) definition), with diagnostic criteria describing many of the components of ON (Moroze, Dunn, Holland, Yager, & Weintraub, 2014; see Table 1). The manuscript, however, did not address psychological variables that likely comprise ON, such as superiority, downward social comparison, disordered eating identity and meaning, loss of control, eating to cope, and

searching for spirituality through food. Additionally, as noted by Dunn and Bratman (2016), Moroze and colleagues (2014) criteria do not consider the role of body weight in ON. Consequently, practitioners assessing and treating ON, as well as researchers who study and conceptualize ON, are missing these important facets of the construct. It is important to understand the potential contribution of these variables to the overall picture in order to aid our conceptualization of ON, and also to guide development of measures to assess ON.

Table 1

*Orthorexia nervosa diagnostic criteria proposed by Moroze et al. (2014)*

Criterion A: Obsessional preoccupation with eating "healthy foods," focusing on concerns regarding the quality and composition of meals. (Two or more of the following.)

- Consuming a nutritionally unbalanced diet owing to preoccupying beliefs about food "purity."
- Preoccupation and worries about eating impure or unhealthy foods and of the effect of food quality and composition on physical or emotional health or both.
- Rigid avoidance of foods believed by the patient to be "unhealthy," which may include foods containing any fat, preservatives, food additives, animal products, or other ingredients considered by the subject to be unhealthy.
- For individuals who are not food professionals, excessive amount of time (eg., 3 or more hours per day) spent reading about, acquiring, and preparing specific types of foods based on their perceived quality and composition/
- Guilty feelings and worries after transgressions in which "unhealthy" or "impure" foods are consumed.
- Intolerance to other's food beliefs.
- Spending excessive amounts of money relative to one's income on foods because of their perceived quality and composition.

Criterion B: The obsessional preoccupation becomes impairing by either of the following:

- Impairment of physical health owing to nutritional imbalances (eg., developing malnutrition because of an unbalanced diet).
- Severe distress or impairment in social, academic, or vocational functioning owing to obsessional thoughts and behaviors focusing on patient's beliefs about "healthy" eating.

Criterion C: The disturbance is not merely an exacerbation of the symptoms of another disorder such as obsessive-compulsive disorder or of schizophrenia or another psychotic disorder.

Criterion D: The behavior is not better accounted for by the exclusive observation of organized orthodox religious food observance or when concerns with specialized food requirements are in relation to professionally diagnosed food allergies or medical conditions requiring a special diet.

The second manuscript, by Dunn and Bratman (2016), noted that Moroze et al.'s (2014) criteria (above) were incomplete, so they developed new diagnostic criteria that they believed to be more inclusive. They proposed two criteria, the first of which (Criterion A) was designed to capture the characteristics of ON (e.g., focus on healthy eating, dietary rules, etc.). The second (Criterion B) was designed to capture any consequences associated with ON, such as malnutrition and weight loss (see Table 2).

Table 2

*Orthorexia nervosa diagnostic criteria proposed by Dunn & Bratman (2016)*

**Criterion A.** Obsessive focus on "healthy" eating, as defined by a dietary theory or set of beliefs whose specific details may vary; marked by exaggerated emotional distress in relationship to food choices perceived as unhealthy; weight loss may ensue, but this is conceptualized as an aspect of ideal health rather than as the primary goal. As evidenced by the following:

1. Compulsive behavior and/or mental preoccupation regarding affirmative and restrictive dietary practices* believed by the individual to promote optimum health.**
2. Violation of self-imposed dietary rules causes exaggerated fear of disease, sense of personal impurity and/or negative physical sensations, accompanied by anxiety and shame.
3. Dietary restrictions escalate over time, and may come to include elimination of entire food groups and involve progressively more frequent and/or severe "cleanses" (partial fasts) regarded as purifying or detoxifying. This escalation commonly leads to weight loss, but the desire to lose weight is absent, hidden or subordinated to ideation about healthy food.

*Dietary practices may include use of concentrated "food supplements."

**Exercise performance and/or fit body image may be regarded as an aspect or indicator of health.

**Criterion B.** The compulsive behavior and mental preoccupation becomes clinically impairing by any of the following:

1. Malnutrition, severe weight loss or other medical complications from restricted diet

2. Intrapersonal distress or impairment of social, academic or vocational functioning secondary to beliefs or behaviors about healthy diet.
3. Positive body image, self-worth, identity and/or satisfaction excessively dependent on compliance with self-defined "healthy" eating behavior

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Dunn and Bratman's (2016) proposed diagnostic criteria were more thorough than Moroze and colleagues (2014), capturing both weight loss and additional characteristics. While they also omitted some of the psychological factors missing in Moroze et al.'s (2014) criteria, they stated that these additional traits that were not essential to making a diagnosis, but that may help confirm it. These included:

> "obsessive focus on food choice, planning, purchase, preparation, and consumption; food regarded primarily as source of health rather than pleasure; distress or disgust when in proximity to prohibited foods; exaggerated faith that inclusion or elimination of particular kinds of food can prevent or cure disease or affect daily well-being; periodic shifts in dietary beliefs while other processes persist unchanged; moral judgment of others based on dietary choices; body image distortion around sense of physical "impurity" rather than weight; persistent belief that dietary practices are health-promoting despite evidence of malnutrition" (Dunn & Bratman, 2016).

These diagnostic criteria, however, were not developed empirically (Dunn & Bratman, 2016); the literature indicates that an important first step in being able to measure something is developing and defining its criteria (DeVellis, 2016). Thus, this project will build upon these criteria and aim to refine them through scale development. Dunn and Bratman's (2016) criteria and traits, along with additional psychological factors that appear to be a part of ON (e.g., disordered eating identity and meaning, loss of control, and eating to cope) will be considered.

*Prevalence*

Previous studies reporting prevalence of ON have not relied upon rigorous methods (see *Measuring Orthorexia Nervosa*), and thus prevalence rates should be viewed skeptically. The consensus using existing measures is that prevalence rates are high, ranging from 12.8 to 90% (Alvarenga et al., 2012; Kinzl, Hauer, Traweger, & Keifer, 2006). To compare, the lifetime

prevalence rate of AN in the United States is 0.9% (Hudson, Hiripi, Pope, & Kessler, 2007). It seems unlikely that prevalence rates for ON would be more than twelve times the prevalence rate for AN, highlighting the need for more research in this area. It is possible that current measures used to sample prevalence do not assess whether unusual eating behavior has reached clinical significance or caused medical problems, which might account for prevalence rates that are much higher than other diagnosable eating disorders.

Some research indicates that women, adolescents, athletic individuals, medical students, medical physicians, dietitians, and performance artists may be at particular risk for ON (Aksoydan & Camci, 2009; Varga, Dukay-Szabo, Tury, & van Furth, 2014; Arusoğlu, Kabakci, Köksal, & Merdol, 2008; Catalina Zamora et al., 2005; Fidan, Ertekin, Işikay, & Kirpinar, 2010; Mathieu, 2005). Poor measurement makes these speculations tentative, however. Having accurate information about prevalence is important because it helps identify causes and prevent additional cases. Developing a scale that will accurately capture the construct, and thus accurately measure the prevalence, is an important step in this process.

*Overlap of ON with Other Diagnostic Categories*

Unlike other eating disorders such as AN and bulimia nervosa (BN), ON has not yet been included in the DSM-5. While a separate diagnostic category does not yet exist, ON has certain overlapping qualities with eating disorders, as well as symptoms of anxiety and obsessive-compulsive disorder (OCD). Existing research has highlighted a comorbidity between AN and OCD (Altman & Shankman, 2009), and due to ON's overlapping qualities with eating disorders and anxiety symptoms, it raises a question about ON's relationship to AN and OCD. Some researchers, however, have argued that ON is "nothing but a psychopathological characteristic"

that can be seen on a spectrum from the normal to the pathological (Kummer, Diaz, & Teixeira, 2008).

Individuals displaying ON and AN share several common traits, such as being detailed, perfectionistic, careful, and having a strong need for self-care and protection (Fidan et al., 2010). Individuals with ON and AN are described as focused on achievement, and view their diet through a lens of self-discipline and self-control (Koven & Abry, 2015). Varga and colleagues (2014) found that individuals with ON and AN were highly similar regarding their eating attitudes and behaviors. Additionally, both sets of individuals may face the potential for significant weight loss (Donini et al., 2004).

As discussed in Kramer (2016), Gleaves and colleagues (2013) mentioned that individuals with AN and ON are:

> "overly preoccupied with food, may practice food related rituals, feel a sense of superiority over others based on their eating practices, have rigid or restrictive eating habits, increase restriction following consumption of forbidden foods, link their self-esteem to food-related behaviors, and make their eating-related issues the primary focus of their lives" (p. 2).

The authors also discussed how both AN and ON are ego-syntonic, which means that a person's thoughts and behavior associated with either AN or ON are consistent with the rest of the personality (Gleaves et al., 2013; Colman, 2015). Ego-syntonic disorders make it more unlikely that individuals will seek help for their eating problems because those thoughts and behaviors are in accord with the needs of the ego (Bratman & Knight, 2000). Overall, these similarities between AN and ON suggest some overlap between the two disorders.

While there are several apparent similarities between ON and AN, there also seem to be clear differences. Quantity and quality distinguish AN and ON: whereas weight loss motivates individuals with anorexia, food purity motivates ON sufferers (Chaki et al., 2013; Fidan et al.,

2010). In other words, for individuals with ON, a drive for thinness is not the main motivation. Thus, the major difference between ON and AN seems to be whether a person is driven by the goal of a perfect diet or by the desire for weight loss.

Another difference between AN and ON is that individuals with anorexia tend to hide their behaviors, whereas individuals with ON are more likely to display their habits (Bratman & Knight, 2000). While the presence of cognitive distortions exists with both AN and ON, Gleaves and colleagues (2013) noted that the focus of these distortions are different - those with ON experience distortions related to the ingredients and contaminants in food while those with AN experience distortions about their body image. For example, an individual with ON may have the distorted belief that any vegetable not grown in his or her own garden has too many contaminants to eat, while an individual with AN may have the distorted belief that their thighs are too big even though they are severely underweight.

Despite much discussion, similarities and differences between those with AN and ON are not yet empirically supported in the literature. Regardless, the number of differences between ON and AN led to the hypothesis that there is not a significant positive relationship between the two; in other words, higher ON symptoms would not be related to a significant increase in AN symptoms.

It may be that characteristics of ON overlap with other disorders, as well. Those with ON often present with certain obsessive-compulsive and anxious tendencies (Donini et al., 2004; Mathieu, 2005). The following characteristics - intrusive thoughts about food, inflated concern over the impurity of food, compulsion to personally prepare food for all meals, careful weighing and measuring food, strong need to eat and/or arrange food in a ritualistic way, and feeling guilty when eating an impure food – parallel common symptoms of OCD (Bratman & Knight, 2000;

Koven & Abry, 2015). Additionally, Koven & Abry (2015) noted that following such a strict diet leads individuals with ON to have a restricted amount of time for other activities in a way that is similar to individuals with OCD. Finally, the fear and perfectionism present in ON are common components of OCD (Mathieu, 2005).

Yet, a difference between ON and OCD involves the content of the obsessions; as noted by Koven and Abry (2015), the content of the obsession in OCD is ego-dystonic, whereas the content of the obsession in ON is perceived as ego-syntonic. Additionally, Gleaves and colleagues (2013) discussed that in order to meet diagnostic criteria for OCD, the obsessive thoughts must cause distress and the subsequent compulsive behaviors are designed to lessen the distress (DSM-5, 2013). The literature, however, has suggested that individuals with ON feel spiritually satisfied with eating the correct way, which indicates that ON may be something other than OCD (Bratman & Knight, 2000; Gleaves et al., 2013). Although, just as with the research on ON and disordered eating, similarities and differences between those with ON and OCD/anxiety have not yet been confirmed in the literature.

There does, however, seem to be an overlap between ON and OCD and anxiety, and it is hypothesized that, if ON is measured properly, there will be a significant positive relationship between ON and OCD/anxiety.

In summary, there is speculation that ON may be related to anxiety, OCD, and other disordered eating behaviors such as AN. Because of the lack of a psychometrically sound scale to measure ON, the literature is lacking with regard to accurate detail about these relationships. However, it is hypothesized that there will be positive relations between ON and OCD and anxiety and no relations between ON and other eating disorders.

*Treatment*

Although there are no studies examining treatment effectiveness for ON (Koven & Abry, 2015), authors have alluded to recommendations for intervention with these individuals. As is the case with other eating disorders, Koven and Abry (2015) recommend a multidisciplinary treatment team utilizing psychotherapists, physicians, and nutritionists, offered in an outpatient setting. In cases of severe malnutrition, clinicians recommend inpatient treatment (Bartina, 2007; Mathieu, 2005). Psychiatrists have suggested serotonin reuptake inhibitors, alongside therapy, as potentially useful medications for ON (Brytek-Matera, 2012; Simpson, Wetterneck, & Cahill, 2013), as well as antipsychotics to treat the obsessive nature of food-related thoughts (Moroze et al., 2014). Albeit, given that individuals with ON are concerned with the natural quality and purity of their food, researchers have noted that it is questionable as to whether they would view pharmaceutical intervention as a desirable option (Koven & Abry, 2014).

Existing treatments for eating disorders are only partially successful for ON, likely because many of the symptoms present in ON do not exist in other disorders (Koven & Abry, 2015); though it has been suggested that treatments should expand to fit the needs of individuals with ON (Brytek-Matera, 2012). Research has suggested that individuals with ON may respond better to treatment than those with AN or BN due to their heightened focus on their health (Brytek-Matera, 2012).

*Current Measurement of ON*

Over the past 18 years, the research on ON has been sparse and lacking in methodological rigor. To date, there are three measures to assess orthorexia concerns, two of which have empirical support. The first of these is the Bratman Orthorexia Test (BOT). The BOT was first mentioned in Bratman and Knight's (2000) book *Health Food Junkies* as a way

for readers to administer a self-test to ascertain where they fell on the ON continuum. The BOT includes 10 yes/no items, where 2 to 3 'yes' answers indicate the individual is showing some signs of orthorexic behavior and 4 or more 'yes' answers indicate the individual suffers from the condition (Bratman & Knight, 2000). Because the original items were never validated, the BOT is not frequently used (Bratman & Knight, 2000).

Kinzl, Hauer, Traweger, and Keifer (2006) administered the BOT to 286 female dietitians in Germany and found that 12.8% of the sample had orthorexia, while 34.9% had some orthorexic behavior. In 2016, Bundros and colleagues (2016) compared the BOT to validated tools for assessing disordered eating, body dysmorphic, and obsessive-compulsive tendencies among 448 college students in the United States. Of those college students, 54.3% were classified as "health fanatics," which is equivalent to having orthorexic eating attitudes. Two additional published studies utilized the BOT. In 2008, Eriksson and colleagues translated the BOT to Swedish and administered the BOT to members of a Sweden fitness center. They examined social physique anxiety and sociocultural attitudes toward appearance and found that subdomains of these constructs (i.e. internalization and awareness) explain some of the variation in BOT results. They did not, however, report prevalence rates. Korinth, Schiess, and Westenhoefer (2009) translated the questions into German to compare nutrition student majors' tendency toward ON compared to an "other majors" control group in Germany. They found no difference in disordered eating patterns and, again, no prevalence rates were reported (Korinth, Schiess, & Westenhoefer, 2009). In the studies that reported prevalence, the rates were quite high, suggesting possible problems with the measure, such that the BOT is capturing too broad a spectrum of healthy eating behaviors. More specifically, it appears that the BOT is not sensitive enough to capture only those with ON (i.e. it is likely that proportion of people identified as

meeting criteria for ON is too large), and thus needs to be more specific to order to correctly identify the individuals who do not meet criteria for ON. The BOT has been used as recently as 2016, though the original items were never validated (Dunn & Bratman, 2000).

The second of these three measures is the ORTO-15, which is based on the BOT. Donini et al. (2005) expanded Bratman and Knight's (2000) original scale to include 15 items designed to assess symptoms of ON. Responses to each item were based on a 4-point Likert scale. Anchors for the scale were "always," "often," "sometimes," and "never." Lower scores indicated the presence of ON and higher scores indicated normal eating habits. Adding up the scores for each item created a total score, with total scores below 40 points meeting criteria for ON. Little validation data exists for this measure, yet it is the most frequently used measure in the small number of existing studies examining ON.

Missbach and colleagues (2015) examined the psychometric properties of the ORTO-15, and found a Cronbach's alpha of .67. This alpha level is representative of the rest of the literature on ON that has used the ORTO-15. There are different reports about the acceptable value of alpha, ranging from .70 - .95 (Nunnally & Bernstein, 1994). Bagci Bosi et al. (2007) translated the ORTO-15 into Turkish using a single step design. When administered to 318 resident physicians, around half scored in the ON range (Bagci Bosi et al., 2007). In 2008, Arusoğlu and colleagues aimed to reveal the psychometric properties of the Turkish version of the ORTO-15 and used confirmatory factor analysis to determine that only 11 of the 15 items from the ORTO-15 were needed to identify ON. Fidan and colleagues (2010) used the ORTO-11 developed by Arusoğlu et al. (2008) and found that, from their sample of 878 Turkish medical residents, more than 40% met criteria for ON. Asil and Surucuoglu (2015) used the ORTO-15 with a Turkish

sample of dieticians and they reported prevalence rates of higher than 40% using a cut off score of 40 (Asil & Surucuoglu, 2015).

In 2011, Ramacciotti and colleagues examined the prevalence of ON in the general Italian population using the original ORTO-15 developed by Donini et al. (2005). They administered the ORTO-15 to 177 adult participants and found a 57.6% prevalence rate using the 40-point cut-off score. From this, the researchers determined that a lower cut-off (35) was more sensible, with a prevalence rate of 21%. Segura-Garcia et al. (2012) also used the original ORTO-15 in a sample of 577 Italian athletes. They found that 28% of women and 30% of men fell in the ON range using a cut-off score of 35 (Segura-Garcia et al., 2012). Segura-Garcia et al. (2015) examined the frequency of ON among women with eating disorders (AN and BN) using the ORTO-15. They found that ON symptoms are highly prevalent with both AN and BN (28%), and increased after treatment (58%).

Alvarenga and colleagues (2012) translated the ORTO-15 into Portuguese and sampled a group of 392 Brazilian dietitians. Their findings were two-fold: there was no evidence of validity and reliability of the ORTO-15 with the initial psychometric evaluation performed, and using the cut-off value of 40, 81.9% of the Brazilian dietitians met criteria for ON. De Souza and Rodrigues (2014) conducted a second study using the ORTO-15 in Portuguese. They examined 150 female nutrition students and found that approximately 90% met the cut-off for ON.

Varga and colleagues (2014) examined the psychometric properties of the Hungarian adaptation of the ORTO-15 (ORTO-11-Hu). Their confirmatory factor analysis rejected the original 3-factor structure determined by Donini and colleagues (2005), as well as a single factor structure with the original 15 items. Varga and colleagues (2014) omitted 4 items, and confirmed a single-factor structure for an 11-item version of the scale due to better fit indices. Additionally,

using the original cut-off point of 40 on the 15-item version, 74.2% of the sample "had a tendency for ON" (Varga et al., 2014).

Valera, Ruiz, Valdespino, and Visioli (2014) sampled 136 members of a Spanish Ashtanga yoga community using the ORTO-15 (the language the scale was administered in is unclear). Approximately 90% of the participants scored in the clinical range for ON when a cut-off score of 40 was used (43% when a cut off score of 35 was used). Jerez, Lagos, Valdes-Badilla, Pacheco, and Perez (2015) tested the ORTO-15 with a high school sample in Chili; 205 students completed the ORTO-15 and prevalence rates of 30.7% were found.

There have been four studies using a Polish version of the ORTO-15. Brytek-Matera, Krupa, Poggiogalle and Donini (2014) translated the ORTO-15 from English to Polish and administered the items to 400 university students. They conducted both exploratory and confirmatory factor analysis and found only nine items that were valid for use in a Polish population. As a follow-up, Brytek-Matera, Donini, Krupa, Poggiogalle, and Hay (2015) administered the Polish version of the ORTO-15 to another university sample. 82.7% of the participants presented a "strong preoccupation with a healthy food intake" based on the new cut-off (24) for the Polish version of the ORTO-15. Gubiec, Stetkiewicz-Lewandowicz, Rasmus, and Sobow (2015) translated the English version of the ORTO-15 to Polish. They sampled 155 nutrition students and found that 33% of participants met criteria for ON, and 39% of participants were at high risk for developing ON. Stochel and colleagues (2015) translated the Italian version of the ORTO-15 into Polish. They administered this version to a sample of 399 Polish high school students twice in order to examine reliability, and found that in both studies, more than half of the sample scored in the ON range using a cut off score of 40.

As mentioned earlier, Missbach and colleagues (2015) reported mediocre validity of the ORTO-15. The researchers examined the psychometric properties of a translated German version of the ORTO-15. The German version of the ORTO-15 was completed by 1029 German participants. Missbach and colleagues (2015) found that a nine item, single-factor structure was the best fitting model (ORTO-9-GE); even then, the final model showed only moderate internal consistency after omitting 40% of the original questions. In terms of prevalence, 69.1% of the participants showed ON tendencies.

The overall prevalence rates measured by the ORTO-15 and its subsequent versions are remarkably high, which raises the concern that this measure may simply be assessing healthy eating patterns, and not actually ON. As indicated by Nicolosi (2002), Crawford (1980) and Haman et al. (2015), this increased focus on health and healthy eating is a societal shift, and thus many individuals are concerned with their health. Therefore, the ORTO-15 may in fact be measuring the ubiquitous presence of healthy eating, and not the extreme version that we conceptualize as ON. Second, a 4-point Likert-type scale was used, which did not leave the participants a choice to choose a neutral answer; this was problematic in that it may have forced participants to select a response that did not apply to them, skewing the results in various ways. Third, this scale does not seem to capture the construct of ON. The ORTO-15 items do not appear to be representative of criteria proposed by researchers and clinicians to be central to ON. For example, one of the questions asks about the calories in food. Paying attention to the calories in food does not seem to be related to ON; it seems more likely that the pureness and natural quality of the food, and whether it fits within an individual's strict guidelines, is more pertinent. Lastly, because the ORTO-15 was developed outside of the United States and most of these studies were conducted in countries outside of the United States, there are cross-cultural

methodological issues to consider. Bias and equivalence issues may be present for the ORTO-15 in the United States, such that nuisance factors could jeopardize the validity of the instrument when applied to the United States population and the level of comparability may be compromised (He & van de Vijver, 2012).

The third of these three measures, the Eating Habits Questionnaire (EHQ), was the first ON measure developed in the English language. Gleaves and colleagues (2013) developed the EHQ to assess the symptoms of ON. The EHQ was found to have 3-factors: a knowledge factor, a problems factor, and a feelings factor. It was also found to have good internal consistency, good test-retest reliability, and evidence for both convergent and discriminant validity (Gleaves et al., 2013).

Like the ORTO-15, the EHQ uses a 4-point Likert scale, which does not allow the participants to choose a neutral answer. There are advantages and disadvantages to using a 4-point Likert scale (see Method section for a discussion of this). Nonetheless, this response format may force participants to choose an answer than does not apply to them. Additionally, some components of ON appear to be missing from the measure, so it is possible that the EHQ may not fully capture the construct of ON. For example, the scale does not address an important piece of ON involving the identity and meaning placed on food. Additionally, while self-esteem is mentioned in some of the questions, it may be preferable to ask about it directly.

Oberle, Samaghabadi, and Hughes (2016) conducted a principal components analysis (PCA) on the EHQ to assess the factor structure and confirmed that it assesses three internally-consistent ON components. However, PCA is not a factor analysis technique. PCA is atheoretical and is not designed to identify latent constructs (Raykov & Marcoulides, 2011). This is important to note, since factor analysis is the preferred analytical method when a scale is developed using

an underlying theory and that is presupposed to include items assessing this theory. While the results are promising in that a PCA revealed the same factor structure, additional confirmatory factory analysis should be conducted.

These existing scales should be recognized for how much they have contributed to our understanding of ON thus far, as well as acknowledged for having guided and shaped the current project. But, it appears as though existent measures (BOT, ORTO-15, EHQ) of ON are not explaining the full range of the construct. Additionally, because the ORTO-15 was based on Bratman and Knight's (2000) criteria, cultural concerns exist due to the translation of United States criteria for use in other countries. Much of the current ON literature was published by European researchers, and prevalence in their samples was determined by using the ORTO-15 or one of its versions. Rather than continuing to use these measures, it seems important to develop a different assessment tool that is valid and reliable.

To advance the study of ON, I originally proposed the development of a new measure - the Orthorexia Nervosa Scale (ONS) - that adequately measures the construct. The study reported herein accomplished two things: 1) the construction of a scale using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) that has good psychometric properties and 2) completed psychometric evaluation of the new scale within a targeted community sample to investigate the relationship between ON and symptoms of anxiety, OCD, and other disordered eating behaviors.

*The Orthorexia Nervosa Scale (ONS): Initial Scale Construction*

The development of the original ONS items was a multiple step process outlined in detail in previous work (Kramer, 2016). A thorough review of relevant research was conducted, including reviews of the three existing ON scales (Bratman & Knight, 2000; Donini et al., 2005;

Gleaves et al., 2013). The initial item pool was constructed using face validity along with adapting items from the ORTO-15 (2004), the EHQ (2016), and Bratman & Knight's (2000) questionnaire. This process resulted in the construction of 160 items. Of the 160 items originally written, 103 were retained to form the initial version of the ONS. In consultation with subject matter experts, the 57 items deleted prior to data collection were removed because they were repetitive, double-barreled, or contained colloquial language.

Following an EFA and CFA of the items, a 10-factor, 47 item scale was determined (Kramer, 2016; see Appendix A for the 10 factors and associated items - *removed for publication purposes*). The CFA model indicated an acceptable fitting model once model modifications were made. The model modification indices indicated that there were certain items that were significantly correlated with each other beyond their shared variance on the factor. That is, the significance of the correlated error terms indicated that there was something about two particular items within a factor that were more related than all of the items in the factor. The model modifications included correlating 9 pairs of error residuals to decrease $\chi^2$ that improved overall model fit (Kramer, 2016). When looking closely at those items that were highly correlated with one another, they appeared analogous. For example, two of the items were "I strictly avoid food that has been treated with artificial substances" and "I strictly avoid food that has been treated with pesticides and herbicides." Thus, a goal of the current project (Study 1) was, in part, to look at the item pairs that were highly correlated and adjust the ONS as necessary, along with removing any additional problematic items, to achieve a better fitting model.

After the ONS was factor analyzed and good model fit was achieved, the second goal of this project was to examine the relationship between ON and established measures of anxiety, OCD, and disordered eating (Study 2). As I highlighted earlier, there is very little known about

ON's relationship to other disorders because of the lack of psychometrically sound measures. However, several studies have suggested a relationship between ON and other eating disorders, as well as to anxiety and OCD. The current project explored those relationships by examining hypothesized causal connections between ON and OCD, anxiety, and eating disorders to determine directionality of these relationships. Because there has not been an empirically sound measure of ON prior to this study, the previous research that highlights links between ON and OCD, anxiety, and eating disorders should be interpreted with caution. Based on the current literature, the following hypotheses were proposed:

1) Research points to more of an overlap and between ON and OCD/anxiety than it does differences. Thus, it was hypothesized that symptoms of ON would be positively associated with measures of anxiety and OCD. Numerous researchers have drawn comparisons between symptoms of ON, anxiety and OCD, highlighting the possibility of a link between them (Bratman & Knight, 2000; Donini et al., 2005; Mathieu, 2005).
2) Research presents mixed findings regarding the relationship between existing eating disorders and ON, and thus it was hypothesized that higher ON symptomology would not be significantly positively associated with higher scores on measures of other eating disorders. While research has suggested an overlap regarding certain characteristics of ON and AN (e.g., need for control, perfectionistic, careful), there has been no research to support this link (Fidan et al., 2010; Mathieu, 2005). Additionally, more differences between ON and other eating disorders have been noted (e.g., focus on the quality of food ingested rather than the quantity of food, differences regarding the desire to be thin (Bratman & Knight, 2000).

# METHOD

*Study 1*

***Participants***

This sample consisted of college students (total $n$ = 1002) from Colorado State University (data collected fall 2016). I recruited these samples using Colorado State University Research Subject Pool via Qualtrics during the Fall 2016 Semester. Qualtrics allows researchers to do online data collection and analysis. All surveys were completed online and survey respondents were provided with research credit that is required in introductory psychology classes. See Table 3 below for demographic information.

Table 3

*Demographic Data for Study 1*

| Variable | Sample ($n$ = 1002) |
|---|---|
| Age (M, SD) | 19 (1.7) |
| Race (%) | |
| American Indian/Native Alaskan | 0.9 |
| Asian, Asian-American | 4.0 |
| Black/African-American | 2.2 |
| Native Hawaiian/Pacific Islander | 0.9 |
| White | 83.7 |
| Bi-racial/Multiracial | 5.1 |
| Do Not Wish to Respond | 3.0 |
| Ethnicity (%) | |
| Hispanic | 15.6 |

| | |
|---|---|
| Not Hispanic | 81.1 |
| Do Not Wish to Respond | 2.5 |
| Sex (%) | |
| Male | 31.9 |
| Female | 67.6 |
| Do Not Wish To Respond | 0.5 |
| | |
| BMI (M, SD) | 22.9 (4.0) |

The data collected was factor analyzed. In terms of an ideal sample size, Hoelter (1983) recommends a sample size of at least 200. Other researchers have recommended about 5-10 participants per item (Floyd & Widaman, 1995). The data collected was split into two groups; the first group served as data for the EFA ($n$ = 537) and the second as a cross-validation sample for the CFA ($n$ = 465).

***Measures***

Participants filled out a demographic questionnaire. The questionnaire included questions about age, gender, race/ethnicity, weight, and height.

***Procedure***

**Scale Development.** To extend my thesis study, and produce a scale with better model fit, I adjusted the original 10-factor, 47-item original ONS (Kramer, 2016) that was developed using the recommendations of DeVellis (2012). Then, I ran a CFA with the second sample once the concerns that arose from the 10-factor scale were addressed. Before collecting data in the fall of 2016, I modified and added items to the scale to establish a better model fit.

For example, two of the factors had low alpha and omega values, which could be due to a low number of questions or heterogeneous constructs. Thus, I revised and discarded certain items

after careful examination of each item (Tavakol & Dennick, 2011). Additionally, before collecting data with a new development sample, I carefully examined the items that had large correlations based on the model modification indices. There were three pairs of items that appeared to be asking the same question in a different way, so I removed one of those items from each pair. This will likely improve the model fit. After making item adjustments, the number of items totaled 46 – these items were used for the EFA and CFA (see Appendix B for item list – *removed for publication purposes*).

The measurement format for the ONS remains the same: ONS items were rated on a 1-5 Likert-type scale where 1=Strongly Disagree, 2=Disagree, 3=Neither Agree or Disagree, 4=Agree, 5=Strongly Agree. A Likert-type response scale was chosen because it allows respondents to indicate their levels of agreement or endorsement of times. Other ON scales have measured ON with Likert scales that use response anchors of "False, Not At All True" to "Very True" (Gleaves et al., 2013) or "Never" to "Always" (Donini et al., 2007). This type of response scale reflects how often an individual engages in ON behaviors. Specifically, choosing to use a 5-point Likert-type response scale was selected because it does not force participants to choose an answer when it may in fact be neutral. It may be argued, however, that a 5-point or 7-point Likert scale allows participants to continually select the neutral response. While there are advantages and disadvantages to this, some researchers agree that 5-point or 7-point Likert scales are preferable (Nunnally & Bernstein, 1994).

DeVellis (2012) recommends considering the inclusion of other constructs that can be used to obtain validity evidence. For the purposes and scope of this project, however, validation measures will not be included.

**Evaluation of Items**. First, I conducted an EFA with the data from the first sample. This revealed the structure of the scale. Then, I analyzed the items to pinpoint which ones characterize ON best and could be tested with the second sample. With the second sample of data, I conducted a CFA to determine a final set of items to include in the ONS. I used Mplus version 7 software for statistical analyses (Muthén & Muthén, 1998-2018).

***Exploratory Factor Analysis***. Conducting an EFA is the most appropriate method when little is known about a construct, as is the case with ON (Floyd & Widaman, 1995). I conducted an EFA to see if the data revealed a factor structure that is consistent with my expectations for the scale.

Factor analysis has four primary goals (DeVellis, 2012). Factor analysis provides information that can help a researcher decide how many underlying concepts (also called constructs, dimensions, or factors) are captured in a set of items. The second primary goal of factor analysis is to "condense information" (DeVellis, 2012, p. 117) by creating a scale that measures the construct of interest well, but with a smaller subset of items. This allows for the reduction of the large number of generated items to a smaller, more manageable, and representative set. The third goal is to determine the meaning of the factors, based both on theoretical justification and the ways in which items covary with each other. Lastly, factor analysis can pinpoint items that are performing well or poorly in the scale dimensions.

For the EFA, I used the maximum likelihood (ML) method for extraction. The maximum likelihood extraction method estimates population values for factor loadings by calculating loadings that maximize the probability of sampling the observed correlation matrix from a population (Tabachnick & Fidell, 2007). Within constraints imposed by the correlations among variables, population estimates for factor loadings are calculated that have the greatest

probability of yielding a sample with the observed correlation matrix. ML is the best choice when data are normally distributed because it allows for the computation of a wide range of indexes of the goodness of fit of the model and allows statistical significance testing of factor loadings and correlations among factors (Fabrigar, Leandre, Wegener, MacCallum & Strahan, 1999).

To determine how many meaningful factors to extract from the EFA, only factors that accounted for additional variance were included in the scale (Ford, MacCallum & Tait, 1986). In the original study (Kramer, 2016), multiple methods were used to determined how many factors to extract (i.e., eigenvalues, scree plot, parallel analysis). For this project, I examined the previously decided factor structure and eigenvalues, interpretability of the factors, and theoretical justification (DeVellis, 2012; Ford et al., 1986). Most scales do not include each item as its own factor, but rather, show how items load onto a fewer number of factors. Thus, if any factor has a value greater than one, it is explaining more variance than a single item and can be considered more useful in creating a scale. Kaiser (1960) and Guttman (1954) are often credited with establishing the "eigenvalues greater than one rule," which states that any eigenvalue less than one should be dropped because it does not explain as much variance as the average item.

Factor analysis can use either orthogonal or oblique rotation. Orthogonal rotation assumes that the factors are uncorrelated. Oblique rotation allows the factors to correlate, modeling a slightly more complex, but possibly more realistic relationship between the dimensions (DeVellis, 2012). This EFA used an oblique rotation, since the different dimensions of ON are related to one another. Once the number of factors and the type of rotation were determined, I looked at the item factor loadings to decide which items best define the factors. High item loadings are desirable, but loadings should be at least .30 and items should not load

across all factors highly (Ford et al., 1986). Low factor loadings can indicate a potential item that may need to be revised or dropped all together.

Internal consistency was calculated for this scale, as it indicates whether all items are related to one another and measure the same construct (Cronbach, 1951; DeVellis, 2012; Raykov & Marcoulides, 2011). Omega (McDonald, 1999) is a statistic that indicates unidimensionality, and follows similar rules of thumb as the alpha coefficient, with values of .80 - .90 suggesting reliability of scores (Raykov & Marcoulides, 2011). Additionally, omega is robust with respect to sample size inflation (Raycov & Marcoulides, 2011). For this study, omega was calculated.

To summarize the overall approach for retaining items in the scale, I first removed items that operated poorly. Then, as the scale was refined, some items were dropped based on one indicator or another (e.g. factor loadings, cross loadings), but in general, I used converging evidence and not just a single indicator to retain items for the ONS. This revised scale was then tested with the second data sample.

***Confirmatory Factor Analysis*.** Based on the EFA results, a CFA was conducted on the revised scale with the second data sample. A goal of the current study was to confirm the structure that the EFA elucidated; the information gained through a CFA determines if items and factors relate in ways that are predicted by existing theory.

For the CFA, I also used the maximum likelihood (ML) method for extraction to establish the number of underlying factors. As mentioned earlier, the ML method is a preferred method for extraction because it allows for tests of goodness of fit and permits significance testing of factor loadings and correlations among factors (Fabrigar, Wegener, MacCallum, & Straham, 1999). I then specified a factor model with six factors that constrained certain items to load on their respective (expected) factors, and examined fit statistics to see if the model

represented the data well. Like the EFA, high factor loadings are most desirable, but loadings of at least .30 indicated that an item fits well with a particular factor (Ford et al., 1986). Goodness of fit was evaluated using the chi square ($\chi^2$) statistic, comparative fit index (CFI), root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). A nonsignificant $\chi^2$ indicates that the hypothesized model does not significantly deviate from the observed model ($p > .05$). $\chi^2$ tests, however, are sensitive to sample size (Ullman & Bentler, 2009), and because the current study uses a relatively large sample, it was informative to use fit indices that correct for sample size, such as the CFI. The CFI value ranges from 0 to 1, and indicates the improvement in fit of the hypothesized model compared to a model of complete independence among the measured variables, after controlling for sample size. Values between 0.90 and 0.95 indicate adequate model fit and values of 0.95 and above indicate excellent fit; an excellent fit indicates that at least 95% of the covariation in the data will be reproduced by the hypothesized model (Hu & Bentler, 1999). The RMSEA is an absolute measure of fit based on the non-centrality parameter; values of 0.01, 0.05, and 0.08 are used to indicate excellent, good, and mediocre fit (MacCallum, Browne, & Sugawara, 1996). The SRMR is the square root of the difference between the residuals of the sample covariance matrix and the hypothesized covariance model. SRMR values range from 0-1, with acceptable models falling between 0.05 and 0.08, and well-fitting models falling below 0.05 (Hu & Bentler, 1999).

As with the first sample, internal consistency (omega) was calculated for each factor using MPlus version 7 (Muthén & Muthén, 1998-2018), which will capture how homogenous the items are, demonstrating that they measure a single dimension of ON (McDonald, 1999; Raykov & Marcoulides, 2011).

***Optimizing Scale Length.*** It is important to create the optimal scale length because longer scales tend to be unrealistic to administer (DeVellis, 2012). Even though there is no single best way to determine the final items in a scale, the process is guided by the steps of the item evaluation. It is important to consider multiple pieces of information, relying on both the data and theory, to justify decisions. Multiple pieces of information were considered to optimize the length of the ONS. For example, if an item did not load on its hypothesized factor, then it was removed from the scale (DeVellis, 2012). Items with low variance were also considered for removal, since they do not discriminate low- versus high-frequency ON characteristics (DeVellis, 2012).

*Study 2*

***Participants***

For the second phase of the study, 162 participants were recruited from Facebook. The population targeted were individuals who are members of healthy eating and healthy lifestyle groups, and who follow any type of healthy food and/or eating pages. Facebook allows researchers to target a specific audience using "keywords." Participants over the age of 18 who follow and visit "healthy eating" pages were targeted for recruitment. To control for order-effects, the order of the questionnaires were randomly varied for each participant.

Table 4

*Demographic Data for Study 2*

| Variable | Sample |
|---|---|
| Age (M, SD) | 25.7 (10.3) |
| Race (%) | |
| American Indian/Native Alaskan | 0.6 |
| Asian, Asian-American | 4.9 |

| | |
|---|---|
| Black/African-American | 1.9 |
| Native Hawaiian/Pacific Islander | 0.0 |
| White | 87.0 |
| Bi-racial/Multiracial | 4.9 |
| Do Not Wish to Respond | 0.6 |
| Ethnicity (%) | |
| Hispanic or Latino | 4.3 |
| Not Hispanic or Latino | 94.4 |
| Do Not Wish to Respond | 1.2 |
| Sex (%) | |
| Male | 7.4 |
| Female | 91.4 |
| Transgender | 1.2 |
| Athlete (%) | |
| Yes | 33.3 |
| No | 66.7 |
| Medical Condition (%) | |
| Arthritis | 2.5 |
| Asthma | 9.9 |
| Chronic GI Disorder | 0.6 |
| Obesity | 2.5 |
| Other | 11.1 |
| None | 73.5 |
| BMI (M, SD) | 23.0 (5.0) |
| Weekly Work Hours (M, SD) | 30.5 (17.2) |

***Measures***

Participants filled out a demographic questionnaire similar to the one used when collecting data from Study 1. Additional questions about athlete status, occupation, and medical history were asked, along with asking the participants to log the amount and type of food eaten in the last 24 hours.

ON was assessed using the ONS. The ONS is a 38 item measure that was developed for this study and was used to measure ON symptoms.

Other eating disorder symptomology was assessed with the Eating Attitudes Test (EAT-26; Garner, Olmstead, Bohr & Garfinkel, 1982). The EAT-26 was designed to screen for symptoms of an eating disorder. The EAT-26 is not intended to diagnose. It is designed to determine whether additional testing is required to make a diagnosis of an eating disorder. There are three subscales in the EAT-26: Dieting, Bulimia and Food Preoccupation, and Oral Control. Participants answer questions based on a 6-point Likert scale in which Always = 3, Usually = 2, Often = 1, Sometimes = 0, Rarely = 0, and Never = 0. There is only question that is reverse scored. The total points indicate the total score; a total cut-off score of more than 20 is commonly used to indicate the presence of significant symptomology of disordered eating (Garner et al., 1982). The EAT-26 is one of the most widely used standardized measures of symptoms of disordered eating. The original validation study of the EAT-26 indicated that the measure is a reliable and valid measure of eating disorder symptomatology (Garner et al., 1982). Internal consistency for AN and female comparison groups were .90 and .83, respectively (Garner et al., 1982). Additionally, this measure is available to the public and for use in research upon request.

OCD was assessed with the Florida Obsessive-Compulsive Inventory (FOCI; Storch et al., 2007). The FOCI is a self-report questionnaire that evaluates the severity of symptoms associated with OCD. The measure includes 20 dichotomous yes or no questions that serve as a symptom checklist, in addition to five questions on a 5-point Likert scale which indicates severity. Total score is calculated by tallying up the number of symptoms endorsed. Tested in a non-clinical sample of college students, the symptom checklist and severity scale indicated good internal consistency (.89; Storch et al., 2007). Concurrent and divergent validity of the FOCI has also been supported through correlations with the Beck Depression Inventory II, Hamilton Depression Rating Scale, and the Yale-Brown Obsessive Compulsive scale (Goodman et al., 1989; Storch et al., 2007). The FOCI is brief, and thus time-effective; previous research has indicated that the FOCI takes approximately 5 min to complete (Storch et al., 2007). For purposes of this project, only the symptom checklist will be included in the study, as I am primarily concerned with presence, and not severity, of OCD symptoms.

Anxiety was assessed with the State-Trait Anxiety Inventory, Form Y (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI is a commonly used measure of state and trait anxiety (Speilberger et al., 1983). Form Y has 20 items for assessing trait anxiety and 20 items for assessing state anxiety. State anxiety items include: “I am tense, I am worried, I feel calm, I feel secure.” Trait anxiety items include: “I worry too much over something that really doesn’t matter, I am a steady person.” All items are rated on a 4-point Likert scale in which 1 = Not At All and 4 = Very Much So. The state scale requires participants to rate the intensity of their feelings in that moment and the trait scale asks participants to rate how they have felt over the past 3 months. Higher scores indicate greater anxiety. Each scale is scored separately and the scores can range from 20 – 80, with a higher score indicating greater

anxiety. Internal consistency for the scale has ranged from .86 to .95; test-retest reliability has ranged from .65 to .75 over a 2-month interval, with samples collected from high-school students, college students and working adults (Speilberger et al., 1983). There is considerable evidence attesting to the construct and concurrent validity of the scale (Spielberger, 1989).

***Procedure***

Because the final participant count after cleaning the community sample data was 162, the data was examined in two proposed path models (as opposed to structural equation models). Thus, I examined the relationship between the ONS factors and anxiety, OCD, and disordered eating behaviors using path analysis. Path analysis uses multiple regression to estimate the parameters of a structural model; this will help determine the structure among the variables that produces a pattern of collinearity. Path analysis will allow for the evaluation of the contribution of the hypothesized paths to the overall fit of each structural model. Path analysis, however, cannot help decide among alternative structural models or provide tests of causality.

After running preliminary path analyses (*Figures 1* and *2*) on the two proposed structural models and trimming non-significant paths, two path analyses were conducted.

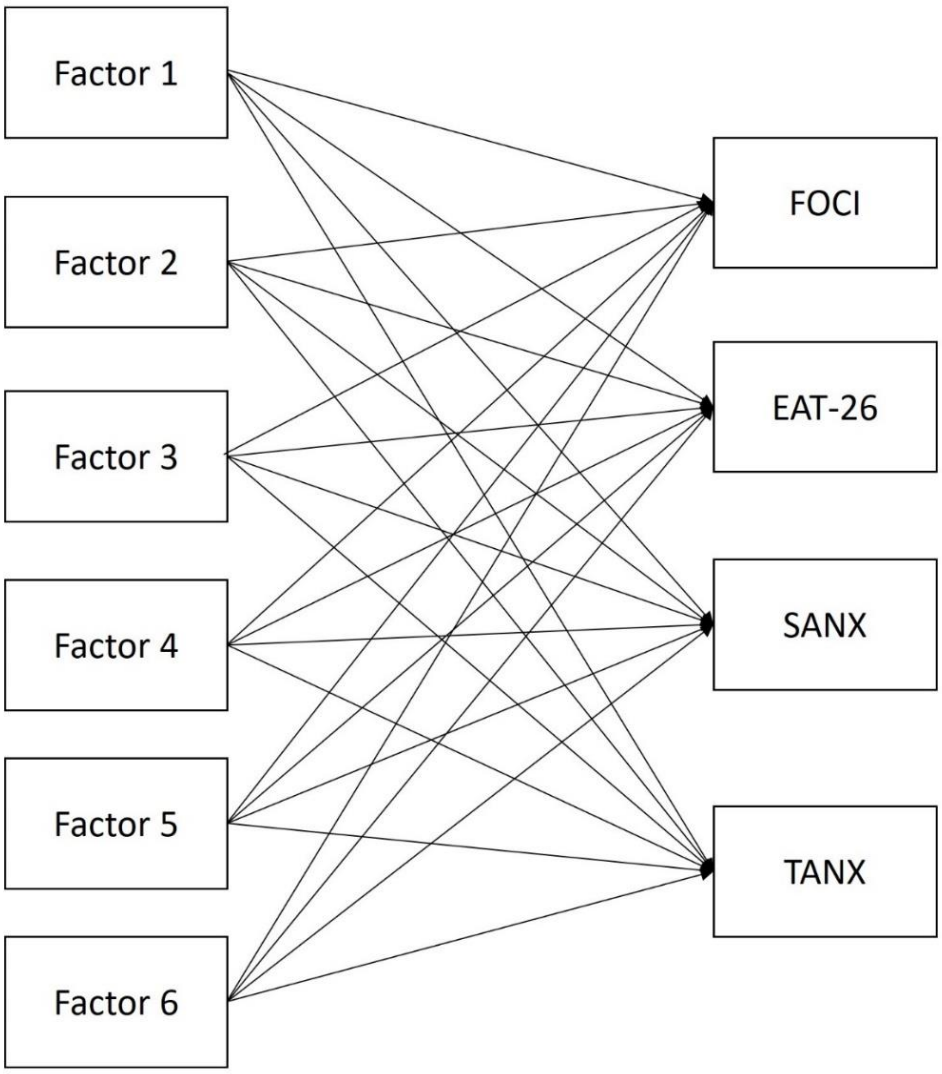


*Figure 1*. Model 1

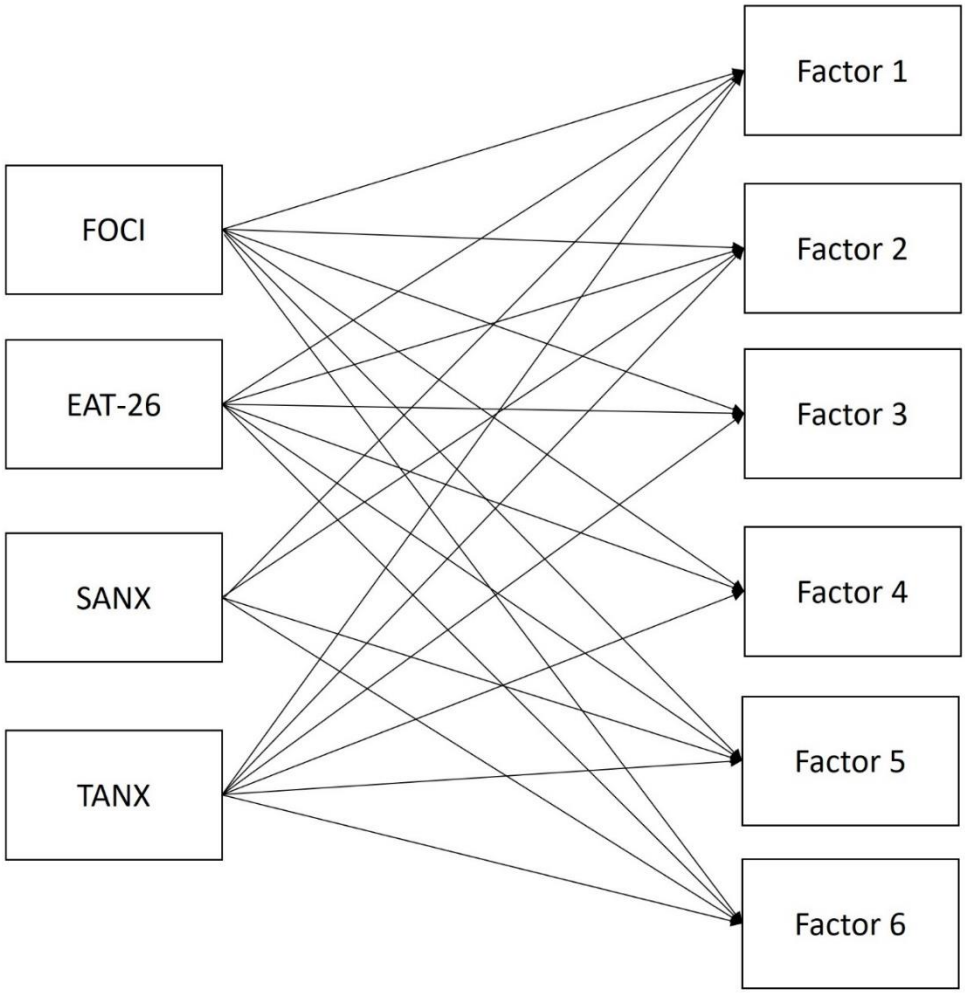


*Figure 2.* Model 2

The first trimmed path model tested the relationship between certain ONS factors and OCD, disordered eating symptoms, state anxiety, and trait anxiety. All variables were scored on a continuous scale. A second path analysis was conducted to test the second trimmed model; that disordered eating and OCD symptoms are predictors of certain ONS factors.

Standardized regression coefficients (i.e., β) are an index of effect size, with values of .1, .3, and .5 being considered small, medium, and large, respectively. Maximum Likelihood Estimation was used to derive parameter estimates and indices of model fit using Mplus version

7 (Muthén & Muthén, 1998–2012). To evaluate overall model fit, I used model fit criteria suggested by Hu and Bentler (1999) including the comparative fit index (CFI) > .95, root mean square error of approximation (RMSEA) < .06, and standardized root mean square residual (SRMR) < .08. In addition, I evaluated the Chi-Square test of model fit, where a non-significant test indicates perfect fit of the model to the data. When evaluating regression coefficients, I examined both standardized and unstandardized regression coefficients, standard errors, p-values, and confidence intervals.

Next, I coded the 24-hour food log data that each participant recorded during the demographic section of the study. I used the USDA's MyPlate Recommendations, which are the most recently developed food guidelines for individuals in the United States (USDA, 2018). The recommendations for daily serving size varies by gender and age; for the purposes of this study, the 19-30 year old female recommendations were used as the cutoff score since the large majority of the sample is comprised of adult females in this age range. The MyPlate categories (and daily serving suggestions) include vegetables (3 cups), fruits (2 cups), grains (6 ounces), protein foods (5.5 ounces), dairy (3 cups), and oils (6 tablespoons). It should be noted that the above amounts are appropriate for individuals who get less than 30 minutes per day of moderate physical activity, beyond normal daily activities. Because amount of daily exercise was not measured in this study, exercise was not accounted for. I assigned a score of "1" to each participant who met the suggested daily intake for each category, and a score of "0" to each participant who did not meet the suggested daily intake for each category. I then ran thirty-six one-way ANOVA's to determine whether there were any statistically significant differences between whether or not the participants were meeting the USDA suggested daily food guidelines in each category and their scores on each of the 6 ONS factors. I used a p-value cutoff of $p < .01$

to account for the multiple comparisons; using a stricter p-value will help control for Type I errors. Ten participants were removed from this part of the analysis because they did not provide enough information to code their food intake.

# RESULTS

*Study 1 Results*

The descriptive analyses and EFA were conducted on the data collected on the 46 items of the ONS using the SPSS statistical software package version 22.0 and MPlus version 7 software, respectively (SPSS, 2012; Muthén & Muthén, 1998-2018). Descriptive analyses indicated that, for all items, all response options were selected and variables were roughly normally distributed (means and standard deviations presented in Table 5 – item wording removed for continued scale development purposes). Principal axis factoring with oblique, promax rotation was conducted and identified a 6-factor structure. Items were trimmed if their factor loadings were below .3 or if they had a cross-loading greater than .3 on any other factor. Based on the analysis, it was determined that 40 items would be retained for the final version of the ONS. Results of the EFA indicated an excellent fitting model, $\chi^2$ (555) = 890.099, $p < 0.001$, CFI = 0.97, RMSEA = 0.03, SRMR = 0.02. Factor loadings for the retained items are presented in Table 7.

Table 5

*Means and Standard Deviations for EFA and CFA*

| Item | EFA<br>*M* (*SD)* | CFA<br>*M* (*SD*) |
|---|---|---|
| 1. | 1.9 (.96) | 1.8 (.86) |
| 2. | 1.7 (.86) | 1.7 (.79) |
| 3. | 1.8 (.84) | 1.9 (.92) |
| 4. | 2.1 (1.1) | 2.1(1.0) |

| | | |
|---|---|---|
| 5. | 1.9 (.95) | 1.8 (.94) |
| 6. | 2.1 (1.0) | 2.0 (.90) |
| 7. | 1.8 (.91) | 1.7 (.82) |
| 8. . | 2.0 (.96) | 1.9 (.91) |
| 9. | 2.2 (1.1) | 2.3 (1.1) |
| 10. | 2.6 (1.2) | 2.4 (1.1) |
| 11. | 3.0 (1.0) | 2.8 (1.1) |
| 12. | 2.3 (.98) | 2.3 (1.0) |
| 13. | 2.8 (1.1) | 2.8 (1.2) |
| 14. | 2.9 (1.1) | 2.6 (1.1) |
| 15. . | 2.7 (1.0) | 2.5 (.99) |
| 16. | 2.8 (1.0) | 2.7 (1.1) |
| 17. | 2.6 (1.1) | 2.5 (1.1) |
| 18. | 2.8 (1.2) | 2.8 (1.1) |
| 19. | 2.7 (1.1) | 2.6 (1.0) |
| 20. | 3.7 (1.0) | 3.5 (1.0) |
| 21. | 3.5 (1.0) | 3.4 (1.1) |
| 22. | 3.4 (1.2) | 3.2 (1.2) |
| 23. | 3.4 (1.1) | 3.3 (1.1) |
| 24. | 2.6 (1.2) | 2.6 (1.1) |
| 25. | 3.2 (1.1) | 3.1 (1.1) |
| 26. | 3.6 (1.1) | 3.5 (1.1) |
| 27. | 2.7 (1.1) | 2.6 (1.1) |
| 28. | 2.7 (1.2) | 2.5 (1.1) |
| 29. | 4.0 (.88) | 4.0 (.85) |
| 30. | 2.4 (.93) | 2.3 (1.0) |
| 31. | 2.6 (1.0) | 2.5 (1.0) |

| | | |
|---|---|---|
| 32. | 2.6 (1.1) | 2.5 (1.1) |
| 33. . | 2.3 (.97) | 2.2 (.96) |
| 34. | 2.7 (1.2) | 2.6 (1.1) |
| 35. | 2.2 (1.3) | 2.1 (1.2) |
| 36. | 2.9 (1.2) | 2.9 (1.1) |
| 37. | 2.9 (1.1) | 2.9 (1.1) |
| 38. | 1.7 (.87) | 1.7 (.81) |
| 39. | 2.7 (1.4) | 2.6 (1.3) |
| 40. | 1.8 (.89) | 1.7 (.78) |
| 41. | 3.1 (1.1) | 3.0 (1.1) |
| 42. | 2.1 (1.0) | 2.2 (1.1) |
| 43. | 2.4 (1.1) | 2.3 (1.1) |
| 44. | 2.8 (1.2) | 2.5 (1.2) |
| 45. | 2.9 (1.3) | 2.7 (1.3) |
| 46. | 2.7 (1.1) | 2.6 (1.1) |

The first factor contains nine items that appear to measure social concerns (see Table 6 for reliabilities). This subscale, Social Concerns, demonstrated good internal consistency, ($\Omega$ = .84). The second factor contains seven items that appear to measure knowledge about food and feelings of superiority. This subscale, Knowledge/Superiority, demonstrated good internal consistency, ($\Omega$ = .80). The third factor contains 11 items that appear to measure feelings of fulfillment and control. This subscale, Fulfilment/Control, demonstrated good internal consistency, ($\Omega$ = .79). The fourth factor contains 5 items that appear to measure the importance of pureness and natural quality of food. This subscale, Pureness/Natural Quality, demonstrated good internal consistency ($\Omega$ = .78). The fifth factor contains three items that appear to measure the importance of detoxification in one's diet. This subscale, Detox, had inadequate internal

consistency (Ω = .69). The sixth factor contains three items that appear to measure the use of online forums and blogs as a social outlet. This subscale, Online Forums/Blogs, demonstrated inadequate internal consistency (Ω = .68).

Table 6

*EFA correlation table and reliabilities for orthorexia nervosa factors*

| **Factor** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| **1** | .84 | | | | | |
| **2** | .36 | .80 | | | | |
| **3** | .37 | .60 | .79 | | | |
| **4** | .56 | .58 | .57 | .78 | | |
| **5** | .33 | .17 | .44 | .38 | .69 | |
| **6** | .52 | .24 | .32 | .42 | .20 | .68 |

Note. All correlations significant at 5% level. For reliabilities, omega is reported.

Using MPlus version 7 software, I conducted a CFA with maximum likelihood estimation (Muthén & Muthén, 1998-2018). Descriptive analyses indicated that, for all items, all response options were selected and variables were roughly normally distributed (means and standard deviations presented in Table 5). Two additional items were dropped because they shared more variance between themselves and another item than they did with another factor, bringing the scale down to a 6 factor, 38 item scale. Table 7 presents the factor loadings for the hypothesized latent factors in the CFA model; all measured variables loaded significantly ($p < 0.001$) onto their hypothesized latent variables (item wording removed for continued scale development purposes). Results of the CFA indicated a good fitting model, $\chi^2$ (650) = 1531.115, $p < 0.001$, CFI = 0.903, RMSEA = 0.03, SRMR = 0.07.

Table 7

*EFA and CFA Factor Loadings*

| Variable | EFA | CFA* |
|---|---|---|
| *Social Concerns* | | |
| Item 1 | 0.63 | 0.63 |
| Item 2. | 0.66 | 0.61 |
| Item 3. | 0.53 | 0.57 |
| Item 4 | 0.37 | 0.65 |
| Item 5 | 0.51 | 0.58 |
| Item 6 | 0.44 | 0.65 |
| Item 7 | 0.87 | 0.60 |
| Item 8. | 0.41 | 0.63 |
| Item 9. | 0.49 | -- |
| Item 10 | 0.44 | 0.50 |
| *Knowledge/Superiority* | | |
| Item 11 | 0.79 | 0.88 |
| Item 12 | 0.59 | 0.74 |
| Item 13 | 0.59 | 0.81 |

| | | |
|---|---|---|
| Item 14. | 0.81 | 0.94 |
| Item 15 | 0.65 | 0.73 |
| Item 16 | 0.83 | 0.87 |
| Item 17 | 0.50 | -- |
| Item 18 | 0.46 | 0.85 |
| *Control/fulfillment* | | |
| Item 19. | 0.31 | 0.62 |
| Item 20 | 0.76 | 0.67 |
| Item 21 | 0.78 | 0.83 |
| Item 22 | 0.69 | 0.84 |
| Item 23 | 0.59 | 0.72 |
| Item 24 | 0.38 | 0.77 |
| Item 25 | 0.49 | 0.79 |
| Item 26 | 0.72 | 0.71 |
| Item 27 | 0.48 | 0.81 |
| Item 28 | 0.45 | 0.80 |
| Item 29 | 0.72 | 0.47 |
| *Pureness/Natural Quality* | | |

| | | |
|---|---|---|
| Item 30 | 0.58 | 0.55 |
| Item 31. | 0.56 | 0.82 |
| Item 32. | 0.65 | 0.88 |
| Item 33 | 0.65 | 0.74 |
| Item 34 | 0.46 | 0.73 |
| *Detox/Restriction* | | |
| Item 35 | 0.53 | 0.70 |
| Item 36 | 0.78 | 0.92 |
| Item 37. | 0.78 | 0.84 |
| *Online forums/blogs* | | |
| Item 38 | 0.60 | 0.62 |
| Item 39. | 0.52 | 0.73 |
| Item 40. | 0.50 | 0.58 |

* All CFA factor loadings significant $p < 0.001$.

***CFA Reliability.*** Internal consistency (omega) was calculated for each scale factor (see Table 8) using MPlus version 7 (Muthén & Muthén, 1998-2018). Five of the six dimensions of the ONS showed adequate reliability of scores, 1) Social Concerns: Ω = 87; 2) Knowledge/Superiority: Ω = .91 3) Fulfillment/Control Ω = .91, 4) Pureness/Natural Quality: Ω

= .84, 5) Detox: Ω = .77, and 6) Online Forums/blogs: Ω = .66. Factor 6 has an inadequate reliability score.

Table 8

*CFA correlation table and reliabilities for orthorexia nervosa factors*

| **Factor** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| **1** | .87 | | | | | |
| **2** | .57 | .91 | | | | |
| **3** | .60 | .71 | .91 | | | |
| **4** | .70 | .75 | .72 | .84 | | |
| **5** | .50 | .31 | .57 | .55 | .77 | |
| **6** | .81 | .42 | .52 | .56 | .47 | .66 |

Note. All correlations significant at 5% level. For reliabilities, omega is reported.

*Study 2 Results*

Correlations and descriptive statistics are provided in Tables 9 and 10, respectively, for all measures used in Study 2. Data was originally collected from 360 participants. Six participants were removed from data collection because they declined to continue the survey after the informed consent. Another 192 participants were removed because they did not complete 67% or more of the survey. After removing those participants, 162 participants remained and were used for data analysis. Thus, the SEM models as proposed could not be executed, and path analysis was run in order to account for the lower number of participants.

Table 9

*Path analysis correlation table for FOCI, EAT-26, SANX, TANX, and ONS Factors*

| | FOCI | EAT26 | SANX | TANX | Factor1 | Factor2 | Factor3 | Factor4 | Factor5 | Factor 6 |
|---|---|---|---|---|---|---|---|---|---|---|
| FOCI | 1.00 | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| EAT26 | .36 | 1.00 | | | | | | | | |
| SANX | .40 | .37 | 1.00 | | | | | | | |
| TANX | .42 | .43 | .87 | 1.00 | | | | | | |
| Factor1 | .33 | .54 | .22 | .25 | 1.00 | | | | | |
| Factor2 | -.05 | .09 | -.03 | .00 | .42 | 1.00 | | | | |
| Factor3 | .22 | .48 | .13 | .20 | .60 | .48 | 1.00 | | | |
| Factor4 | .10 | .10 | .11 | .08 | .38 | .55 | .52 | 1.00 | | |
| Factor5 | .23 | .17 | .08 | .04 | .25 | .05 | .32 | .29 | 1.00 | |
| Factor6 | .20 | .47 | .18 | .17 | .53 | .27 | .57 | .34 | .37 | 1.00 |

Table 10

*Means and standard deviations for the ONS, EAT-26, STAI, and FOCI total scale scores*

| Scale | Total Scale Score |
|---|---|
| ONS Factor 1 (M, SD) | 2.62 (.81) |
| ONS Factor 2 (M, SD) | 3.48 (.75) |
| ONS Factor 3 (M, SD) | 3.73 (.57) |
| ONS Factor 4 (M, SD) | 3.14 (.82) |
| ONS Factor 5 (M, SD) | 2.12 (.96) |
| ONS Factor 6 (M, SD) | 2.92 (.88) |
| EAT-26 (M, SD) | 14.03 (12.88) |
| STAI (state) (M, SD) | 38.72 (13.9) |
| STAI (trait) (M, SD) | 45.1 (12.1) |
| FOCI (M, SD) | 3.0 (3.3) |

***Path Analysis Results***

***Model 1***. After trimming non-significant paths, the first hypothesized model contained six predictor variables (ONS factors) and four outcome variables (FOCI, EAT-26, STAI state and trait scales) (see *Figure 3*).

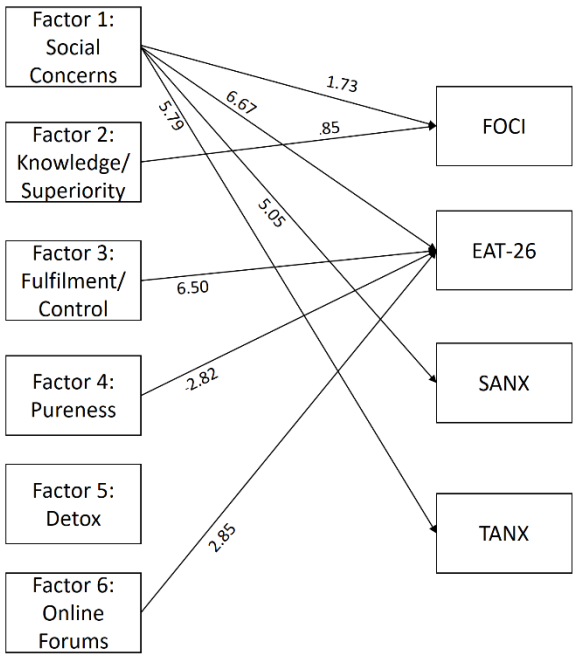


*Figure 3*. Model 3

*Note*. All lines and corresponding estimates are all significant $p < .05$.

***Overall Model 1 Fit.*** The path analysis resulted in excellent model fit. The $\chi^2$ test of model fit was not significant ($\chi^2(13) = 19.67$, $p = .10$). Overall fit indices were all in the excellent range (RMSEA = .05 [.00, .11], p = .37; CFI = .98; SRMR = .03).

***Direct Effects.*** The majority of direct effects specified in the model were significant (see *Figure 3*).

*FOCI.* Scores on the social concerns factor significantly predicted scores on the FOCI (b = 1.73, SE = .34, p <.001), such that a one unit increase in scores on the social concerns factor

was associated with a 1.73 unit increase on the FOCI. This is a medium sized effect (β = .42). Scores on the knowledge and superiority factor significantly predicted scores on the FOCI (b = -0.85, SE = 0.35, p =.014), such that a one unit increase in scores on the knowledge and superiority factor was associated with a 0.85 unit decrease on the FOCI. This is a small effect size (β = -.19).

*EAT-26.* Scores on the social concerns factor significantly predicted scores on the EAT-26 (b = 6.67, SE = 1.26, p <.001), such that a one unit increase in scores on the social concerns factor was associated with a 6.67 unit increase on the EAT-26. This is a medium sized effect (β = .42). Scores on the control factor significantly predicted scores on the EAT-26 (b = 6.50, SE = 1.96, p =.001), such that a one unit increase in scores on the control factor was associated with a 6.50 unit increase on the EAT-26. This is a medium sized effect (β = .29). Scores on the pureness factor significantly predicted scores on the EAT-26 (b = -2.82, SE = 1.19, p =.017), such that a one unit increase in scores on the pureness factor was associated with a 2.82 unit decrease on the EAT-26. This is a small effect size (β = -.18). Scores on the online/social forums factor significantly predicted scores on the EAT-26 (b = 2.85, SE = 1.10, p =.010), such that a one unit increase in scores on the online/social forum factor was associated with a 2.85 unit increase on the EAT-26. This is a small effect size (β = .19).

*State Anxiety (STAI).* Scores on the social concerns factor significantly predicted scores on the state anxiety subscale of the STAI (b = 5.05, SE = 1.74, p = .004), such that a one unit increase in scores on the social concerns factor was associated with a 5.05 unit increase on the state anxiety subscale of the STAI. This is a small effect size (β = .23).

*Trait Anxiety (STAI).* Scores on the social concerns factor significantly predicted scores on the trait anxiety subscale of the STAI (b = 5.79, SE = 1.81, p = .001), such that a one unit

scores on the social concerns factor was associated with a 5.79 unit increase on the trait anxiety subscale of the STAI. This is a small effect size (β = .25).

***Model 2.*** After trimming non-significant paths, the second hypothesized model contained two predictor variables (FOCI, EAT-26) and four outcome variables (certain ONS factors) (see *Figure 4*).

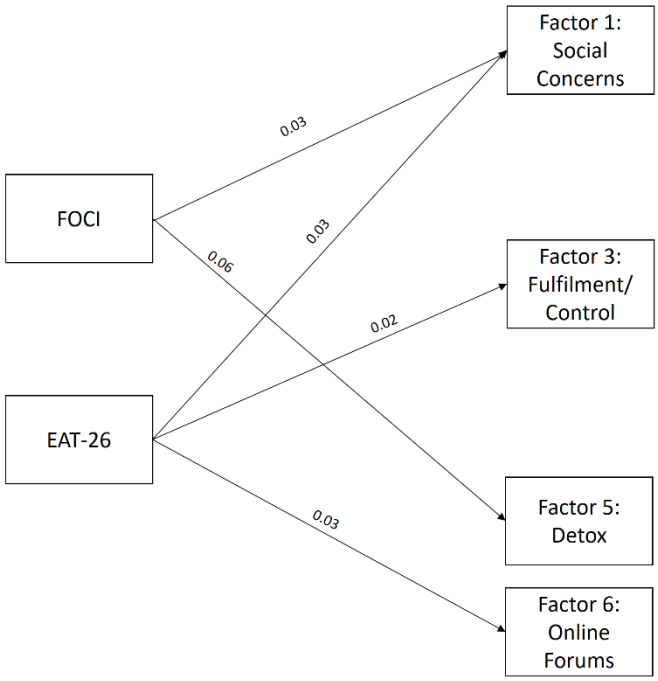


*Figure 4*. Model 4

*Note*. All lines and corresponding estimates are all significant $p < .05$.

***Overall Model 2 Fit.*** The path analysis resulted in excellent model fit. The $\chi^2$ test of model fit was not significant ($\chi^2(2) = 2.73$, $p = .26$). Overall fit indices were all in the excellent range (RMSEA = .05 [.00, .17], p = .39; CFI = .99; SRMR = .04).

***Direct Effects.*** A number of direct effects specified in the model were significant (see *Figure 4*).

*Factor 1: Social Concerns.* Scores on the FOCI significantly predicted scores on social concerns factor of the ONS (b = 0.03, SE = .02, p <.05), such that a one unit increase in scores on the FOCI was associated with a 0.03 unit increase on the social concerns factor. This is a small effect size (β = .12). Scores on the EAT-26 significantly predicted scores on the social concerns factor (b = 0.03, SE = 0.00, p = .00), such that a one unit increase in scores on the EAT-26 was associated with a 0.03 unit increase on the social concerns factor. This is a large effect size (β = .50).

*Factor 3: Fulfilment/Control.* Scores on the EAT-26 significantly predicted scores on the fulfilment/control factor (b = 0.02, SE = 0.03, p =.00), such that a one unit increase in scores on the EAT-26 was associated with a 0.02 unit increase on the fulfilment/control factor. This is a medium sized effect (β = .47).

*Factor 5: Detox.* Scores on the FOCI significantly predicted scores on the detox factor (b = 0.06, SE = 0.02, p =.01), such that a one unit increase in scores on the FOCI was associated with a 0.06 unit increase on the detox factor. This is a small effect size (β = .21).

*Factor 6: Online Forums/Blogs*. Scores on the EAT-26 significantly predicted scores on the online forums/blogs factor (b = 0.03, SE = 0.01, p =.00), such that a one unit increase in scores on the EAT-26 was associated with a 0.03 unit increase on the online forums/blogs factor. This is a medium sized effect (β = .45).

***Comparing Model 1 and Model 2.*** Since both path models resulted in excellent model fit, a chi-squared difference test was conducted to determine if there were statistically significant differences between the models. Based on chi-squared distribution, the models were not statistically significantly different from each other (p = .20).

***Food Diary Results***

Thirty-six one-way analyses of variance (ANOVA) were calculated to examine participants diet and its relationship to scores on each of the 6 ONS factors. Significant relationships ($p < .01$) will be discussed below; no significant relationships were found between protein intake or oil intake and factor scores.

A one-way between subjects ANOVA was conducted to compare the average score on Factor 5 for individuals who either met the recommended daily guideline for dairy intake or not. There was a significant effect of the average score on Factor 5 at the $p < .01$ level for diary intake [$F(1,150) = 12.47$, $p = .001$]; those who met the recommended dairy guidelines scored significantly lower ($M = 1.80$, $SD = .80$) than those who did not meet the recommended dairy intake ($M = 2.32$, $SD = .98$). These results suggest that participants who eat significantly less dairy report a higher endorsement of detoxing behaviors (i.e. higher scores on Factor 5).

A one-way between subjects ANOVA was conducted to compare the average score on Factor 2 for individuals who either met the recommended daily guideline for vegetable intake or not. There was a significant effect of the average score on Factor 2 at the $p < .01$ level for vegetable intake [$F(1, 151) = 7.79$, $p = .00$]; those who met the recommended vegetable guidelines scored significantly higher ($M = 3.69$, $SD = .78$) than those who did not meet the recommended vegetable intake ($M = 3.23$, $SD = .79$). These results suggest that participants who eat significantly more vegetables report a higher knowledge base and feelings of superiority about their healthy eating (i.e. higher scores on Factor 2).

A one-way between subjects ANOVA was conducted to compare the average score on Factor 2 for individuals who either met the recommended daily guideline for fruit intake or not. There was a significant effect of the average score on Factor 2 at the $p < .01$ level for fruit intake

[F (1, 151) = 8.15, p = .005]; those who met the recommended fruit guidelines scored significantly higher (M = 3.66, SD = .64) than those who did not meet the recommended fruit intake (M = 3.33, SD = .81). These results suggest that participants who eat significantly more fruit report a higher knowledge base and feelings of superiority about their healthy eating (i.e. higher scores on Factor 2).

# DISCUSSION

A measure of ON was tested on an undergraduate student sample and determined to have good psychometric properties. There were six significant subscales present that, upon examination, led to the labeling of six factors. The descriptions of the constructs they were hypothesized to measure are as follows: 1) Social Concerns, 2) Knowledge/Superiority, 3) Fulfilment/Control, 4) Pureness/Natural Quality of Food, 5) Detox, and 6) Online Forums/Blogs. Based on the conceptualization of ON outlined herein, the scale taps dimensions of the construct previous scales do not, such as purity, detoxification, identity, and an online presence for a social outlet. All six of these factors were captured in the original 10-factor scale, providing content validity evidence for the six factor scale (Kramer, 2016).

The first subscale, Social Concerns, contained nine items that are related to social and interpersonal concerns. Many of the items were related to social avoidance, such as turning down social offers that might involve eating certain foods and avoiding certain types of employment because of diet. This subscale also included items that reflect relationship stress. Existing proposed diagnostic criteria support this factor; both Moroze and colleagues (2014) and Dunn and Bratman's (2016) diagnostic criteria include an impairment in social functioning component, highlighting the importance of the inclusion of this dimension (see Tables 1 and 2).

The second subscale, Knowledge/Superiority, contained seven items that are related to knowledge, superiority, and identity. The items in this subscale refer to feelings of superiority or knowledge about one's diet in comparison to other people's diets. Bratman & Knight (2000) discussed how a person with ON will spend hours researching healthy food, which is a large component of this subscale. The second component of the subscale, superiority, has been

discussed in the literature as being a component of ON; it is also included in the EHQ (Gleaves et al., 2013). Lastly, the third component of the subscale includes an item that assesses the importance of eating healthily to one's identity. Identity is a hypothesized important component of ON, yet it has not been included in diagnostic criteria or existing scales thus far. When interviews were conducted with psychologists and nutritionists about their conceptualization of ON (Kramer, 2016), they all highlighted the importance that individuals place on their identity as a healthy eater. Additionally, identity as a central component of ON has been emphasized in clinical case studies (Catalina Zamora et al., 2005). Thus, because only one item assessing identity loaded significantly onto this factor, the importance of identity should continue to be discussed and explored as a component of ON.

The third subscale, Fulfillment/Control, contained 11 items that are related to fulfillment and control. Items that indicated feeling distressed when not eating healthily, feeling as though eating healthily is something one must do, and experiencing feelings of control when eating healthily are included in this subscale. Koven and Abry (2015) discussed the frustration that an individual with ON feels when their food routines are disrupted. They also noted feelings of disgust when something gets in the way of his or her healthy eating (Koven & Abry, 2015). Additionally, this subscale directly asks about self-esteem, which was highlighted earlier as something important to ask about directly. According to the literature, this subscale seems to fit well within our understanding of ON.

The fourth subscale, Pureness/Natural Quality, contained five items that are related to the pureness and natural quality of food. Items that assessed avoiding food that has been treated with artificial substances, worrying about food preparation techniques, and preparing food in the purest way are included in this subscale. This subscale is a large component of ON, and previous

research supports its inclusion (Bratman & Knight, 2000; Moroze et al., 2014; Catalina Zamora et al., 2005); Bratman & Knight (2000) developed the construct of ON based on the idea that people can become obsessed with the nutritional value, and therefore the pureness of the foods they eat.

The fifth subscale, Detox, contained three items that are related to the importance of detoxification in one's diet as a way to cleanse the body. Items that assessed having done a cleanse in the past year and the belief that the body needs to be detoxified were included in this subscale. As mentioned above, the idea of feeling pure is central in ON and achieving this sense of purity can come through detoxification methods (Bagci Bosi et al., 2007; Bratman & Knight, 2000; Moroze et al., 2014). This is an area of ON that has not been discussed frequently in the literature, and the presence of this factor indicates that more research should be done looking specifically at detoxification and cleansing and its relation to ON.

The sixth subscale, Online Forums/Blogs, contained three items that are related to the use of online blogs and forums as a social outlet. Items that assessed following food blogs and time spent on the Internet reading about food were included in this subscale. As mentioned in Kramer (2016), research on other eating disorders (e.g. AN, BN) have discussed the importance of an online community (Brotsky & Giles, 2007; Wilson, Peebles, Hardy & Litt, 2006). This importance of an online community for eating disorders seems to hold true for individuals with ON.

Altogether, the EFA and CFA led to a scale with six subscales that contained items that conceptually fit with the literature's understanding of ON. These items loaded significantly onto their specified factors at greater than 0.30, with cross loadings of less than 0.30 onto the other subscales. The overall results of the EFA provide strong evidence for the value of the ONS. The

scale had excellent model fit. This is important because it indicates that the ONS is consistent with the proposed understanding of the nature of the construct. Reliability analysis indicated that the subscales were relatively unidimensional, which indicates that each subscale of items is closely related to one another as a group. In addition, the ONS includes the hypothesized components of ON that previous scales do not include, such as identity and detoxification. Once the factor structure was determined with the EFA, the next step was to conduct a CFA to replicate the results with a new sample of participants. The results of the CFA indicated that the hypothesized factor structure that was discovered with the EFA was replicated with the second sample. The model had good fit and all items loaded significantly onto their factors. There were no items with significant cross loadings, and reliability analysis indicated that the subscales continued to be relatively unidimensional.

The next step in the process was to collect data from a targeted community sample (i.e. healthy eaters) to examine relationships between the ONS and anxiety, disordered eating symptoms, and obsessive-compulsive symptoms, and to determine the direction of those relationships. Two structural equation models were proposed. The first model proposed that the ONS factors would predict anxiety, eating disorder, and obsessive compulsive symptoms. The second model proposed the opposite - that anxiety, disordered eating, and obsessive compulsive symptoms would predict ONS symptoms. Because the participant sample size was less than necessary to produce enough power to execute the model, path analysis with total subscales were used as measured indicators. In other words, there were too few participants in the sample for the number of parameters in the fully latent model, so model fit was poor.

Therefore, I examined the proposed models using path analysis. By creating observed variables to address this issue, and thereby removing parameters, the model fit greatly improved.

The first path model suggested that certain subscales of the ONS predicted obsessive-compulsive tendencies, anxiety symptoms, and disordered eating behaviors. Four (of the six) ONS factors predicted disordered eating symptoms, two factors predicted obsessive-compulsive symptoms, one factor predicted state anxiety, and one factor predicted trait anxiety. The social concerns factor (Factor 1) was related to scores on the FOCI, EAT-26, and both subscales of the STAI, suggesting that increased social concerns and endorsement of isolating behaviors was predictive of higher scores on the FOCI, EAT-26, and STAI. The knowledge and superiority factor (Factor 2) was related to scores on the FOCI, suggesting that increased feelings of superiority and knowledge regarding healthy food is predictive of higher obsessive-compulsive symptoms. The control and fulfillment factor (Factor 3) was related to scores on the EAT-26, suggesting that increased feelings of control and fulfillment that result from eating healthily are predictive of higher disordered eating symptoms. The pureness factor (Factor 5) was related to scores on the EAT-26, suggesting that increased value placed on the pureness and natural quality of food is predictive of lower disordered eating symptoms. Lastly, the online blogs and social forums factor (Factor 6) was related to scores on the EAT-26, suggesting that endorsement of online blogs and forums to not only learn about healthy eating, but also as a social outlet is predictive of higher disordered eating symptoms. The detoxification factor (Factor 5) was not significantly predictive of any of the outcome variables.

The second path model suggested that both obsessive-compulsive tendencies and disordered eating symptoms predicted certain subscales of the ONS. Obsessive-compulsive symptoms predicted scores on two factors and disordered eating symptoms predicted scores on three factors. The FOCI was related to scores on the social concerns (Factor 1) and detox (Factor 4) factors, suggesting that an increase in obsessive-compulsive symptoms is predictive of higher

social concerns regarding food, as well as higher endorsement of detoxing behaviors. The EAT-26 was related to scores on the social concerns factor, online forums/blogs factor, and fulfilment/control factor. This suggests that a higher endorsement of disordered eating symptoms predicts higher scores on the social concerns factor, online forums/blogs factor, and fulfilment/control factor. The state and trait anxiety subscales of the STAI did not significantly predict any of the factor scores.

The proposed hypotheses were partially supported. With regard to the first hypothesis, which stated that there would be a positive relationship between symptoms of ON and measures of anxiety and OCD, it was found that certain subscales of the ONS (i.e. Factor 1, Factor 2) were positively related to obsessive-compulsive and/or anxiety symptoms and when examined in the opposite direction, obsessive-compulsive symptoms were positively related to certain subscales of the ONS (i.e. Factor1, Factor 5). There were no relationships, however, between factors 3,4, and 6, and anxiety or obsessive-compulsive symptoms. With regard to the second hypothesis, which stated that ON symptomology would not be significantly positively associated with higher scores on the EAT-26, the opposite was found to be true. Factors 1, 3, and 6 were positively related to eating disorder symptoms, and when examined in the opposite direction, the EAT-26 significantly predicted scores on Factors 1, 3, and 6. Factor 4, however, was found to be significantly negatively related to eating disorder symptoms, partially supporting this hypothesis. Overall, this indicates that while some of the factors appear to be related to anxiety and obsessive compulsive symptoms, there is the most overlap between ON and eating disorder symptomology, suggesting more of a relationship between the two than originally hypothesized. One of the original questions in this study was to help clarify whether ON is a unique disorder or a component of existing one, and the correlations between the ONS factors and the EAT-26, STAI,

and FOCI do not indicate a strong overlap between constructs, suggesting that ON may in fact be unique. Next steps should begin to clarify the diagnostic components of ON in order to determine if the construct should be considered for inclusion in the DSM-5.

*Food Diary Conclusions*

After running 36 one-way ANOVAs to examine the relationship between meeting the daily nutritional guidelines and scores on each of the ONS factors, some interesting relationships emerged. Regarding dairy intake, the results indicated that participants who eat significantly less dairy report a higher endorsement of detoxing behaviors (i.e. higher scores on Factor 5). Conceptually, this makes sense given that dairy foods are not a usual component of a detox or a food eaten by someone who engages in detoxing behaviors.

Regarding vegetable intake, the results indicated that participants who eat significantly more vegetables report a higher knowledge base and feelings of superiority about their healthy eating (i.e. higher scores on Factors 2). Again, conceptually this result fits well within our understanding and conceptualization of ON – those who eat more vegetables (i.e. pure, natural, unprocessed food) feel more knowledgeable and superior regarding their healthy eating.

Regarding fruit intake, the results suggested that participants who eat significantly more fruit report a higher knowledge base and feelings of superiority about their healthy eating (i.e. higher scores on Factor 2). This result also fits well with our conceptual understanding of ON – those who eat more fruit (i.e. pure, natural, unprocessed food) also report a higher knowledge base about healthy eating, as well as feelings of superiority about their eating behaviors.

Eating less dairy products and eating more fruits and vegetables seems to be related to different components of ON, all of which fit within our conceptual understanding of ON. The food log data provides preliminary evidence that the ONS is measuring what it claims to be

measuring (i.e. internal validity), since individuals who score higher on the ONS scale also seem to be eating in ways that fit with our understanding of nutrient intake in those with ON.

*Limitations*

This study is not without its limitations. While effort was put forth to make sure that quality data were collected from the samples, it is possible that some participants may have responded carelessly to the items due to lack of motivation. Survey completion times and variability were used to attempt to rule out any participants that were careless of demotivated, however it is possible that they may still occur. Over half of the sample had to be removed due to invariant responding, lack of effortful responding, and incomplete responding, and because of this, it was not possible to test the proposed models with latent variables. Future research should collect data from at least 500 participants – the current study did not have the time or the financial resources do be able to do so. It is important to note, however, that when a CFA was run in the targeted community sample, while it was underpowered to assess model fit, each item loaded significantly onto their respective factors. Because the ONS has 38 items, the current study would have needed 380 participants at minimum to calculate stable model fit estimates. It is promising for future research to see that the items loaded significantly onto their factors.

The participants in the second study were not from a clinical sample of individuals with ON. Because a clinical sample has not been established, the data was collected with a targeted community sample. Because a targeted community sample was used instead of an identified clinical one, not all participants would likely meet criteria for ON. Additionally, in both studies, participants were predominantly White and female, which limits the ability to generalize findings to different genders and racial/ethnic groups.

Regarding the scale development, two of the factors did not have an adequate omega estimates – Factors 5 and 6 had an estimate falling just below .80. As previously discussed, Omega (McDonald, 1999) is a statistic that indicates unidimensionality, with values of .80 - .90 suggesting reliability of scores (Raykov & Marcoulides, 2011. These low omegas could be due to a low number of questions, as both of these factors had only 3 items each. It will be important to build out these factors to include more items; while this was attempted in this scale development process, the majority of those items were trimmed from the item pool due to low factor loadings and/or significant cross-loadings.

Qualitative information was not gathered for this study; qualitative interviews and/or focus groups would have provided an opportunity to gather rich information about ON. Conducting qualitative interviews with adults who identify as healthy eaters and/or meet criteria for ON and asking them to describe their thoughts, feelings, and behaviors surrounding healthy eating would have helped me to develop items for the ONS that could then be tested. While I reviewed existing data from case studies on ON to help me develop items, I did not conduct my own qualitative research.

The data collected in this study was cross-sectional, and thus conclusions cannot be drawn regarding the directionality of the relationships between ONS factor scores and obsessive-compulsive symptoms, anxiety symptoms, and disordered eating symptoms. Both path models resulted in excellent fit, with significant relationships between certain factor scores and the other measures used in both directions; because longitudinal data was not collected, I am unable to speak to the true directionality of the relationships between the ONS and the EAT-26, STAI, and FOCI. A longitudinal study would have allowed me to observe the development taking place in

the sample, and potentially speak to the directionality of the relationships. Future research should consider a longitudinal research design in order to explore this further.

With regard to the food diary data analysis, it is important to address the potential inaccuracy of the information reported. Participants may have been reluctant to report the consumption of certain foods, for example. Research has discussed the problem of accuracy in dietary surveys, and thus this is important to consider when interpreting the results (Cook, Pryer, & Shetty, 2000). Additionally, research has suggested collecting between 3-14 days of food diary records; as such, analyzing one day of food intake may not have been accurate in terms of estimating nutrient intake (Schlundt, 1988). Further, conducting 36 one-way ANOVAs significantly increases the chances of making a Type I error; although this was corrected for by using a stricter p value cutoff, the relationships between meeting dietary recommendations in each food group and scores on each factor could have been examined in another way, such as by using a multivariate analysis of variance (MANOVA) instead that may better handle multiple comparisons.

*Future Steps and Directions*

The next step in this scale development process involves collecting data from at least 500 participants in order to test the proposed structural equation model and model fit. As mentioned above, the current study did not have the financial resources or the time to collect complete data from this many participants.

Construct validity evidence should continue to be established by comparing the ONS, once it is complete, to other well-established constructs, such as anxiety, OCD, and disordered eating like was attempted in this study. It will be important to understand the similarities and

differences between these constructs because more convergent and discriminant validity evidence is needed, especially since the factor structure appears to be complex.

Additionally, future research should aim to develop cutoff scores for the ONS. As noted earlier, the majority of existing scales in the literature tend to "overdiagnose" ON (i.e. being too sensitive and not specific enough) such that prevalence rates fall somewhere between 12.8 to 90% (Alvarenga et al., 2012; Kinzl, Hauer, Traweger, & Keifer, 2006). With regard to the ONS, the means for most of the items are less than the mean (see Table 5). This implies that the ONS will not overdiagnose since the mean for each item is right around neutral, likely being less sensitive and more specific than previous scales. Future research should look into the sensitivity and specificity of the ONS in order to develop appropriate cutoff scores for ON.

*Conclusions about the Scale*

The development of the ONS provides clarity about the nature of the ON construct, however the ONS scale is not complete. The six factors found in this study were consistent with six of the factors found in the original version of the scale, and while the current study was underpowered to assess model fit in the community sample, the fact that the items loaded significantly onto their respective factors is promising (Kramer, 2016). Thus, more data needs to be collected from a larger targeted community sample in order to calculate the true model fit of the ONS. Overall, the current study provides additional evidence supporting the factor structure, and potential clinical use, of the ONS.

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