



B.Sc.
Department of psychology

Orthorexia Nervosa:
Prevalence and psychometric properties of screening tools

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Foreword

Submitted in partial fulfillment of the requirements of the BSc Psychology degree, Reykjavik University, this thesis is presented in the style of an article for submission to a peer-reviewed journal.

This thesis was completed in the Fall of 2020 and may therefore have been significantly impacted by the COVID-19 pandemic. The thesis and its findings should be viewed in light of that.

Abstract

Orthorexia Nervosa (ON) is a proposed disorder that centers around a fixation on and preoccupation with healthy eating leading to impairments in social function or health. The most common screening tool, ORTO-15, has questionable psychometric properties. Two new measures, DOS and EHQ, have been found to have better reliability and construct validity. These measures were translated into Icelandic and their psychometric properties, along with those of ORTO-11, assessed in a sample of Icelandic university students ($N = 215$). Results of two separate independent sample t-tests showed that ORTO-11 found a significant difference between genders and that EHQ found a significant difference between meat-eaters and non-meat eaters while the other measures found no difference. The results of reliability analysis showed that ORTO-11 had lower internal consistency than DOS and EHQ, factor analysis also revealed a worse factor structure and a Pearson's correlation test showed lower correlation to DOS and EHQ than was found between those two measures. DOS assessed the prevalence of ON to be 5.8% in our sample. It is important for future research that a consensus is reached about a diagnostic criteria for ON and that further studies are performed on the psychometric properties of the currently used screening tools to see whether they might be tapping into other constructs than ON.

Útdráttur

Orthorexia Nervosa (ON) er enn óstaðfest röskun sem byggist á áráttukenndum hugsunum og hegðun í tengslum við hollt mataræði sem leiðir til skaða í félagslegu lífi eða á líkamlegri heilsu. Mest notaða mælitækið, ORTO-15, er talið hafa óviðunandi próffræðilega eiginleika. Tvö ný mælitæki, DOS og EHQ, hafa hins vegar sýnt meiri áreiðanleika og hugsmíðaréttmæti. Þau hafa verið þýdd yfir á íslensku og próffræðilegir eiginleikar þeirra bornir saman við eiginleika ORTO-11. Notast var við úrtak íslenskra háskólanema ($N = 215$). Rannsóknir hafa ekki verið á einu máli um hvaða áhrif kyn sem og það að meina sér um vissa fæðuflokka hafa á ON. Niðurstöður þessarar rannsóknar sýndu að ORTO-11 fann kynjamun á ON og EHQ fann mun milli kjötæta og þeirra sem borða ekki kjöt á meðan hin mælitækin fundu ekki marktækan mun á milli sömu hópa. ORTO-11 mældist með lægri innri áreiðanleika en DOS og EHQ sem og verri þáttabyggingu. Fylgni ORTO-11 var einnig lægri við bæði mælitæki en fylgnin þeirra á milli. Samkvæmt DOS var tíðni ON 5,8% í úrtakinu. Það er mikilvægt að sett verði fram greiningarviðmið fyrir ON og að komandi rannsóknir skoði betur hvort mælitæki ON meti mögulega aðra hugsmíð en ON.

Orthorexia Nervosa (ON) is a proposed disorder that has not yet been acknowledged by either the Diagnostic and Statistical Manual of Mental Disorders (DSM) or International Classification of Diseases (ICD) (Oberle et al., 2020). Therefore, consensus has not been reached with regards to a diagnostic criteria (Barthels et al., 2019). Dunn and Bratmann (2016) have, however, proposed a criteria. Criterion A states that the main symptoms of ON are a fixation with the perceived benefits of subjective healthy eating associated with great distress related to unhealthy eating. This entails a preoccupation with rigid dietary rules, anxiety and fear of the perceived negative consequences of breaking them along with the escalation of the rigidity of these rules over time. Criterion B stipulates that this preoccupation leads to clinical impairments in social function (such as in the workplace or social life), medical problems due to the rigid diet, such as malnutrition or lastly that the healthy eating becomes so attached to one's identity that it causes impairments in thoughts about self-worth or satisfaction.

Currently there are various screening tools used to assess the symptoms of ON (Meule et al., 2020). ORTO-15 has been one of the more widely used tools (Brytek-Matera et al., 2018) but questions have been raised about its psychometric properties (Roncero et al., 2017). A study by Barnett et al. (2016) found that the questionnaire had unsatisfactory internal consistency ($\alpha = .47$). Meule et al. (2020) also found that ORTO-15 only showed a moderate correlation with DOS, EHQ and BOT, which all had strong correlations with each other. Heiss et al. (2019) proposed that ORTO-15 may be assessing another construct than that belonging to ON. However, Roncero et al. (2017) found that the shortened ORTO-11 questionnaire had adequate psychometric properties ($\alpha = .74$). ORTO-11 has three subscales; emotional aspects, clinical symptoms, and lastly cognitive rational (Parra-Fernandez et al., 2018) and has been translated into Icelandic (Ólafsdóttir, 2019).

New screening tools have recently been developed to assess the symptoms of ON, including the Eating Habits Questionnaire (EHQ) a 21-item questionnaire based on three

subscales (Gleaves et al., 2013) and the Dusseldorf Orthorexia Scale (DOS) a 10-item unidimensional scale (Brytek-Matera, 2019; Brytek-Matera, 2020). Meule et al. (2020) found that the sum scores of the two measures were highly correlated and both measures had high internal consistencies. Likewise, Chard et al. (2019) found that the DOS had a high retest reliability and high internal consistency, both indicating good reliability. They also found the DOS and EHQ to correlate well with each other, indicating construct validity. Neither the EHQ nor DOS have been translated into Icelandic.

The prevalence of ON varies greatly between studies. A German study using the DOS questionnaire found the rate to be 6.9% within the general population (Luck-Sikorski et al., 2019). However, studies using samples of university students in the USA have found the rate to be as low as 8% according to DOS (Chard et al., 2019) and as high as 71% using the ORTO-15 questionnaire (Dunn et al., 2017). This gap between findings might be explained by the scales' psychometric differences, since Parra-Fernandez et al. (2019) found a higher prevalence of ON in their sample of university students using ORTO-11 (25.2%) than when using DOS (10.5%).

Previous studies have examined differences in ON symptoms by gender. Brytek-Matera et al. (2015) found no significant difference between genders using the ORTO-15 questionnaire in a sample of university students. Neither did Valera et al. (2014) using the same screening tool within a sample of yoga practitioners. Using ORTO-11, Parra-Fernandez et al. (2018) found that women showed more symptoms than men. With regards to education, one study found that those who had a graduate or post-graduate degree had significantly less symptoms of ON than those with lower levels of education (using the ORTO-11 questionnaire) but no difference was found between those with a secondary school education and those with an undergraduate degree (Arusoğlu et al., 2008).

Recent studies have also examined whether self-imposed dietary restrictions such as veganism could be an indication of ON, but the results from these studies have differed

(Brytek-Matera, 2019). Çiçekoğlu and Tunçay (2018) found that the rate of ON was not higher among a vegan/vegetarian group than a non-vegan/non-vegetarian group. However, it is noteworthy that vegetarians were not separated from vegans in their analyzes, despite that vegan diet is considerably more restrictive than a vegetarian one. Barthels et al. (2018) found that the rate of orthorexic eating behavior was not significantly different between vegans and vegetarians, although both groups showed more symptoms than meat-eaters. Similarly, a study among the German public found that a vegetarian diet was associated with a higher rate of orthorexic eating behavior (Luck-Sikorski et al., 2019).

ON is a relatively new concept that is still lacking a diagnostic criteria. It is important to gather information about the prevalence of this disorder and to test the psychometric properties of the screening tools being used to assess that prevalence. Therefore, the goal of this study is twofold, first the goal is to assess the prevalence of ON among Icelandic university students and compare mean scores to background variables such as gender, education and dietary restrictions to gather further information about the disorder in an Icelandic sample. The second goal is to translate two new screening tools for Orthorexia Nervosa (EHQ and DOS) into Icelandic and assess their psychometric properties along with the properties of the already translated ORTO-11 questionnaire.

Based on previous studies, eight hypotheses were put forward and tested 1) Women show more symptoms of ON than men. 2) Those who restrict their meat consumptions show more symptoms than those who don't. 3) There is no difference in ON symptoms by education. 4) ORTO-11 estimates a larger prevalence of ON. 5) A factor analysis will yield a three-factor solution for ORTO-11. 6) A factor analysis will yield a three-factor solution for EHQ. 7) A factor analysis will yield a unidimensional solution for DOS. 8) DOS and EHQ are highly correlated.

Method

Participants

A questionnaire was administered via the social media website Facebook and through email which was sent to all registered students at Reykjavik University. A total of 246 individuals participated and 215 met the eligibility criteria for this study (were enrolled in university during the fall semester of 2020). Thereof 64 were male (29.8%), 150 female (69.8%) and 1 (0.5%) did not define their own gender. The age distribution was as follows 27 were 20 years old and younger (12.6%), 70 were 21-25 years old (32.6%), 43 were 26-30 years old (20%), 19 were 31-35 years old (8.8%) and 20 were 36-50 years old (11,7%). Age was not recorded for 36 participants (16.7%). When asked about their highest completed level of education 1.9% ($n = 4$) stated that their highest level of education was elementary school (Icelandic: *grunnskólapróf*), 63.7% ($n = 137$) secondary school (Icelandic: *stúdentspróf*), 5.6% ($n = 12$) had finished vocational schooling, 24.2% ($n = 52$) had a bachelor's degree and lastly 3.7% ($n = 8$) had a master's degree. When asked about previous history of eating disorders 18 (8.4%) confirmed that they had been diagnosed with 1 or more eating disorders, 191 (88.8%) said no and 6 (2.8%) preferred not to answer or did not know. Participants were informed about the nature of the questionnaire and that they could withdraw their participation at any point and choose not to answer individual questions. Participants did not receive any compensation for their participation in the study.

Measures

The questionnaire contained 49 items. The first item asked participants to confirm that they accepted to participate. The second item asked whether they were currently enrolled in university studies. This was followed by four background questions which then led to the ORTO-11, the Dusseldorf orthorexia scale (DOS), Eating habits questionnaire (EHQ) and lastly one item related to dietary preferences.

The survey ended automatically if the participant answered “no” the whether they agreed to partake in the study. Unfortunately, individuals who answered “no” to whether they

were currently university students could continue with the questionnaire, their answers were, however, not used for statistical analysis.

Background questions

Background questions were used to assess gender, age, highest level of education completed and whether participants had a history of eating disorders. To record gender, participants were given the option of male, female, other or that they did not identify with a gender. Age was recorded using age ranges, ranging from 20 years or younger, 21-25 years old, 26-30 years old, 31-35 years old, 36-40 years old, 41-45 years old, 46-50 years old and then 51 years or older. To record the highest level of education completed, participants were given the option of elementary school, secondary school, vocational school, bachelor's degree, master's degree or a Ph.D. Lastly, participants were asked whether they had ever been diagnosed with one or more eating disorders, options given were "yes", "no" and "do not know/prefer not to answer".

ORTO-11

The questionnaire consists of 11 items that are measured using a 4-point scale, ranging from always (1) to never (4), summing up to possible scores ranging from 11 to 44 with lower scores indicating increased symptoms of ON (Moller et al., 2019). The questionnaire is a shortened version of the commonly used ORTO-15 (Parra-Fernandez et al., 2018). As ORTO-15 does, ORTO-11 should reflect three factors: emotional aspects, clinical symptoms and lastly cognitive rational (Parra-Fernandez et al., 2018). A study on the psychometric properties of the ORTO-11 questionnaire found that the temporal stability ($r = .92; p < .001$) and internal consistency ($\alpha = .74$) were adequate for the use in assessing the symptoms of ON (Roncero et al., 2017). Previous studies have used a score < 25 as a cutoff point to determine the presence of ON (Parra-Fernandez et al., 2018). The version of the ORTO-11 used in this study was translated by Ólafsdóttir (2019) (see Appendix A). In this study, the scale's Cronbach's alpha was .659.

Dusseldorf Orthorexia Scale (DOS)

DOS is a unidimensional (Brytek-Matera, 2020) 10 item self-report questionnaire with items on a 4-point scale ranging from *this does not apply to me* (1) to *this applies to me* (4). Higher scores indicate increased symptoms of ON (Meule et al., 2020). Chard et al. (2019) found DOS to have good reliability (Cronbach's $\alpha = .882$) and good construct validity as the sum scores of the scale correlated well with the sum scores of two other ON measurements. A cutoff score of ≥ 30 is used to indicate prevalence of ON (Chard et al., 2019). In this study, the scale's Cronbach's alpha was .881. This questionnaire was translated into Icelandic for the purpose of this study using the parallel translation technique (see Appendix B)

Eating Habits Questionnaire (EHQ)

EHQ has 21 items with response options ranging from *false, not at all true* (1) to *very true* (4). As with DOS, higher scores indicate more symptoms of ON (Gleaves et al., 2013). The EHQ has been found to have high internal reliability ($\alpha = 0.9$) (Meule et al., 2020). The questionnaire consists of three subscales; 1) feeling positive about healthy eating, 2) knowledge of healthy eating and 3) problems related to healthy eating (Gleaves et al., 2013). No cutoff point for presence of ON was found in the current literature for EHQ. This questionnaire was translated into Icelandic for the purpose of this study using the parallel translation technique (see Appendix C).

Dietary preference (Food restrictions)

Dietary preference was assessed by asking "In general, which of the following food groups do you not eat? Please select all that apply to your diet.". This was a variation of a question asked in a study by Rosenfeld and Burrow (2018). Participants were then presented with seven options, 1) *I do not generally eat red meat.* 2) *I do not generally eat chicken.* 3) *I do not generally eat fish.* 4) *I do not generally eat dairy products.* 5) *I do not generally eat eggs.* 6) *Generally, I consume all of these foods* and 7) *I do not know or wish to not answer.*

This information was then used to categorize participants into meat-eaters and non-meat eaters.

Procedure

Before conducting the study, permission from the National bioethics committee of Iceland was received. On November 13th, 2020 the online questionnaire, scripted via surveymonkey.com was posted on to a Facebook group for students of psychology at Reykjavik University and members were asked to participate. The questionnaire was also sent out via email to all students of the same school on 18th of November 2020. Data collection ended on the 22nd of November 2020.

Both the Facebook post and the email explained the purpose of the study and that researchers were seeking participants who were enrolled in a university level program during that current semester. The questionnaire consisted of 49 items, with each item being presented one at a time. Once the questionnaire was finished it could not be restarted on the same device.

Design and Data analysis

The data was analyzed using the SPSS version 26 (IBM SPSS Statistics for Mac, version 26.0). A reliability analysis was done on all three screening tools to test their internal consistencies. Next a total score of each measure, equaling the sum of all items on the concerning scale was calculated for each participant. Independent sample t-tests were performed to examine difference in mean scores on all three screening tools by gender, education and food restrictions. All assumptions were met for performing the independent sample t-test. A factor analysis was performed for all three screening tools and reliability analysis for each factor found. All assumptions for the factor analyses were met. Lastly, correlations between screening tools were assessed using the Pearson's correlation coefficient.

To test the hypotheses that there is no difference in ON symptoms by education, two groups were created. The first group included those who listed elementary, secondary or vocational school as their highest completed level of education. To test the hypothesis that those who restrict their meat consumptions show more symptoms of ON than those who don't, two groups were created. The first group (non-meat-eaters) excluded only those who reported to eat both red meat and chicken. The second group (meat eaters) contained those participants who ate red meat and chicken regardless of what other food restrictions they had.

Results

Descriptive statistics

The sample used for statistical analysis consisted of 215 participants. As can be seen in Table 1, all 215 participants answered ORTO-11 ($M = 27.32$, $SD = 4.43$), DOS was answered by 189 participants ($M = 18.61$, $SD = 6.01$), and 182 completed the EHQ ($M = 35.71$, $SD = 8.41$). Lower scores on ORTO-11 signify increased symptoms of ON while higher scores signify increased symptoms on DOS and EHQ. The internal consistencies of both DOS and EHQ was acceptable (Field, 2013) at $\alpha = .881$ for DOS and $\alpha = .871$ for EHQ respectively. The Cronbach's alpha for ORTO-11 was lower, $\alpha = .659$.

Table 1

Descriptive statistics for ORTO-11, DOS and EHQ

Measure	Number of						
	items	<i>N</i>	<i>M</i>	<i>SD</i>	Min	Max	α
ORTO-11	11	215	27.32	4.43	17	36	.659
DOS	10	189	18.61	6.01	10	35	.881
EHQ	21	182	35.71	8.41	21	63	.871

Table 2 presents the means scores on all three screening tools by gender. Women ($M = 26.88, SD = 4.60, n = 150$) showed more symptoms of ON than men ($M = 28.42, SD = 4.20, n = 64$) on ORTO-11 ($t(212) = 2.36, p = .019$). No gender difference was found on EHQ ($t(179) = -1.34, p = .181$) or DOS ($t(186) = -1.28, p = .202$).

Table 2

Means scores on ORTO-11, EHQ and DOS by gender

Measure	Gender	<i>N</i>	<i>M</i>	<i>SD</i>
ORTO-11	Male	64	28.42	4.20
	Female	150	26.88	4.60
EHQ	Male	55	34.40	8.36
	Female	126	36.22	8.42
DOS	Male	56	17.75	5.76
	Female	132	18.97	6.12

An independent samples t-test revealed that non-meat-eaters ($M = 40.04, SD = 10.55, n = 28$) had a higher mean score than meat-eaters ($M = 34.94, SD = 7.62, n = 132$) on EHQ ($t(33.23) = -2.43, p = .021$). However, differences on ORTO-11 ($t(158) = .68, p = .499$) and DOS ($t(33.28) = -.914, p = .367$) were non-significant. Table 3 shows mean scores of ORTO-11, EHQ and DOS by food restrictions.

Table 3

Mean scores of ORTO-11, EHQ, and DOS by food restrictions

Measure	Food preference	<i>N</i>	<i>M</i>	<i>SD</i>
ORTO-11	Meat-eaters	132	27.16	4.45
	Non-meat-eaters	28	26.54	4.28
EHQ	Meat-eaters	132	34.94	7.62
	Non-meat-eaters	28	40.04	10.55
DOS	Meat-eaters	132	18.68	5.67
	Non-meat-eaters	28	20.11	7.82

Independent sample t-test, did not show a significant difference by education for ORTO-11 ($t(134.79) = -1.37, p = .172$), EHQ ($t(179) = .07, p = .947$) or DOS ($t(186) = -.49, p = .623$). Table 4 presents the mean scores on ORTO-11, EHQ and DOS by education.

Table 4

Mean scores on ORTO-11, EHQ and DOS by education

Measure	Level of education	<i>N</i>	<i>M</i>	<i>SD</i>
ORTO-11	Secondary or lower	153	27.05	4.66
	University degree	60	27.88	3.71
EHQ	Secondary or lower	127	35.80	8.60
	University degree	54	35.70	8.00
DOS	Secondary or lower	134	18.52	6.08
	University degree	54	19.00	5.84

Prevalence of ON

The prevalence of ON was assessed as 26.5% ($n = 50$) according to ORTO-11 but as 5.8% ($n = 11$) according to DOS. This can be seen in Table 5.

Table 5

Prevalence of ON according to ORTO-11 and DOS

			ORTO-11		Total
			Yes	No	
DOS	No	<i>N</i>	41	137	178
	Yes	<i>N</i>	9	2	11
Total		<i>N</i>	50	139	189

ORTO-11

A principal axis factoring using varimax rotation was performed, extracting factors with eigenvalues over 1. KMO test of sampling adequacy shows that the sampling size was satisfactory (Field, 2013) for factor analysis (KMO = .764: $\chi^2(55) = 494.30, p < .001$). Four items had low communalities as can be seen in Table 6.

Table 6

Communalities for ORTO-11

	Initial	Extraction
1. <i>In the last 3 months, did the thought of food worry you?</i>	.550	.734
2. <i>Are your eating choices conditioned by your worry about your health status?</i>	.376	.458
3. <i>Is the taste of food more important than the quality when you evaluate food?</i>	.169	.533
4. <i>Are you willing to spend more money to have healthier food?</i>	.097	.153*
5. <i>Does the thought about food worry you for more than three hours a day?</i>	.474	.565
6. <i>Do you allow yourself any eating transgressions?</i>	.097	.129*
7. <i>Do you think your mood affects your eating behavior?</i>	.279	.334
8. <i>Do you think that eating healthy food changes your life-style (frequency of eating out, friends,..)?</i>	.212	.223*
9. <i>Do you think that consuming healthy food may improve your appearance?</i>	.239	.423
10. <i>Do you feel guilty when transgressing?</i>	.485	.551
11. <i>Do you think that on the market there is also unhealthy food?</i>	.156	.138*

* items with communalities under .3

Table 7 shows the three-factor solution based on eigenvalues over 1. The first factor has five items with adequate factor loadings and a Cronbach’s alpha over .8, meaning that internal consistency between the items is good (Field, 2013). The other two factors are not as strong, with each including only one item with a factor loading over .6 and both including

two items loading under .4 and a Cronbach’s alpha below .5 which would warrant concerns (Field, 2013). The first factor contains items related to emotional aspects of ON. The second factor contains items related to the cognitive rational and the third factor relates to discipline associated with healthy eating. Item 4 was reversed for the calculation of the Cronbach’s alpha as it loaded negatively onto the factor. This three-factor solution explains 38.55% of the variance.

Table 7

Factor loadings from a three-factor solution for ORTO-11

Items	1	2	3
1. <i>In the last 3 months, did the thought of food worry you?</i>	.852	-.065	-.066
5. <i>Does the thought about food worry you for more than three hours a day?</i>	.737	.037	-.144
10. <i>Do you feel guilty when transgressing?</i>	.695	.260	.009
2. <i>Are your eating choices conditioned by your worry about your health status?</i>	.563	.330	-.178
7. <i>Do you think your mood affects your eating behavior?</i>	.482	.256	.190
9. <i>Do you think that consuming healthy food may improve your appearance?</i>	.204	.617	-.034
11. <i>Do you think that on the market there is also unhealthy food?</i>	-.008	.370	-.035
8. <i>Do you think that eating healthy food changes your life-style (frequency of eating out)?</i>	.302	.362	-.018
3. <i>Is the taste of food more important than the quality when you evaluate food</i>	.041	-.093	.723
4. <i>Are you willing to spend more money to have healthier food?</i>	.023	.001	-.390
6. <i>Do you allow yourself any eating transgressions?</i>	-.064	-.016	.353
Cronbach’s alpha	.807	.424	.455

To estimate relations between factors a Pearson’s r correlation test was performed.

Factors 1 and 2 were moderately correlated ($r(213) = .38, p < .001$). Factors 2 and 3 were not

significantly correlated ($r(213) = -.07, p = .279$) neither were factors one and three ($r(213) = -.05, p < .504$). This can be seen in Table 8.

Table 8

Pearson correlation for factors on ORTO-11

	Emotional (Factor 1)	Cognitive (Factor 2)
Cognitive (Factor 2)	.38**	
Discipline (Factor 3)	-.05	-.07

**Correlation is significant at $p < .001$ (2-tailed).

Dusseldorf Orthorexia Scale (DOS)

As DOS is a unidimensional scale, one factor was extracted using principal axis factoring method with a varimax rotation. The KMO test of sampling adequacy shows that the sampling size was satisfactory (Field, 2013) for factor analysis (KMO = .867; $\chi^2(45) = 858.376, p < .001$). This one factor solution explains 43.9% of the variance and has a Cronbach’s alpha of .881 which indicates good internal reliability (Field, 2013). Table 9 shows the factor loadings for each item of the scale.

Table 9

Factor loadings for a unidimensional solution on DOS

Items	1
8. <i>My thoughts constantly revolve around healthy nutrition and I organize my day around it</i>	.817
9. <i>I find it difficult to go against my personal dietary rules</i>	.694
3. <i>I can only enjoy eating foods considered healthy</i>	.692
7. <i>I have the feeling of being excluded by my friends and colleagues due to my strict nutrition rules</i>	.679
10. <i>I feel upset after eating unhealthy foods</i>	.674

Table 9 (continued)

Factor loadings for a unidimensional solution on DOS

Item	1
6. <i>If I eat something I consider unhealthy, I feel really bad</i>	.656
5. <i>I like that I pay more attention to healthy nutrition than other people</i>	.651
2. <i>I have certain nutrition rules that I adhere to</i>	.621
1. <i>Eating healthy food is more important to me than indulgence/enjoying the food</i>	.575
4. <i>I try to avoid getting invited over to friends for dinner if I know that they do not pay attention to healthy nutrition</i>	.525
Cronbach's alpha	.881

Eating Habits Questionnaire (EHQ)

A factor analysis was performed using the principal axis factoring method and varimax rotation. KMO test of sampling adequacy shows that the sampling size was satisfactory (Field, 2013) for factor analysis (KMO = .846: $\chi^2(210) = 1490.75, p < .001$). First a principal axis factor analysis was performed using the varimax method, as the EHQ should have three subscales three factors were extracted but when doing so ten out of the 21 items had communalities below .3. Therefore, another factor analysis was performed extracting factors with eigenvalues over 1 (See Table 10). Using that method, four factors were extracted, with only three of the items having communalities under .3.

Table 10

Factor loadings for a four-factor solution on EHQ

Item	1	2	3	4
6. <i>I am distracted by thoughts of eating habits</i>	.743	.126	.080	.242
18. <i>I spend more than 3 hours a day thinking about healthy food</i>	.684	.277	.092	.201

Table 10 (continued)

Factor loadings for a four-factor solution on EHQ

Item	1	2	3	4
8. <i>My healthy eating is a significant source of stress in my relationship</i>	.611	.219	.111	.052
13. <i>In the past year, friends or family members have told me that I'm overly concerned with eating habits</i>	.530	.357	.031	.000
10. <i>My diet affects the type of employment I would take</i>	.479	.284	.234	-.142
15. <i>Eating the way I do gives me a sense of satisfaction</i>	-.414	.174	.363	.064
7. <i>I only eat what my diet allows</i>	.081	.733	.257	.045
4. <i>I follow a diet with many rules</i>	.321	.592	.152	.239
20. <i>I follow a health-food diet rigidly</i>	.058	.503	.326	.455
17. <i>I go out less since I began eating healthily</i>	.402	.482	.122	.076
16. <i>Few foods are healthy for me</i>	.174	.450	-.049	.150
14. <i>I have difficulty finding restaurants that serve the food I eat</i>	.397	.439	.188	-.020
2. <i>I turn down social offers that involve eating unhealthy food</i>	.185	.436	.150	.162
5. <i>My eating habits are superior to others</i>	.109	.154	.930	.122
11. <i>My diet is better than other people's diet</i>	.160	.229	.787	.187
1. <i>I am more informed than others about healthy eating</i>	.081	.064	.494	.176
19. <i>I feel great when I eat healthy</i>	-.187	-.010	.103	.548
9. <i>I have made efforts to eat more healthily over time</i>	.317	.147	.268	.500
12. <i>I feel in control when I eat healthy</i>	.246	.226	.071	.497
21. <i>I prepare food in the most healthy way</i>	.111	.430	.185	.455
3. <i>The way my food is prepared is important in my diet</i>	.158	.340	.261	.347
Cronbach's alpha	.720	.796	.798	.695

All four factors extracted had three or more items per factor and factor loading over .4, with the exception of the last item on the fourth factor which had a loading of .347. Cronbach's alpha for all factors is adequate (Field, 2013). Items on the first factor describe problems related to healthy eating, except for item 15 which loads negatively onto the factor. Items on the second factor describe restrictions caused by healthy eating. The third factor contains items that relate to feelings of superiority about healthy eating, item 15 has a factor loading of

.363 onto this factor similar to its highest factor loading on the first factor. The fourth and last factor describes positive feelings about healthy eating.

To see the relationship between the four factors, Pearson’s *r* correlation tests were performed. A significant positive correlation was found between all four factors. As is presented in Table 11, the greatest correlation being between factors 2 and 4 ($r(180) = .56, p < .001$) and lowest between 1 and 3 ($r(180) = .16, p < .027$).

Table 11

Pearson correlation between factors on EHQ

	Problems (Factor 1)	Restrictions (Factor 2)	Superiority (Factor 3)
Restrictions (Factor 2)	.48**		
Superiority (Factor 3)	.16*	.46**	
Positive feelings (Factor 4)	.30**	.56**	.45**

*Correlation is significant at $p < .05$ (2-tailed)

** Correlation is significant at $p < .001$ (2-tailed).

Correlation between Screening tools

To assess construct validity, correlation between the three screening tools was assessed using the Pearson’s correlation coefficient. As lower scores on ORTO-11 indicate increased symptoms of ON, while lower scores on DOS and EHQ indicate less symptoms of ON, one would expect ORTO-11 to correlate negatively with DOS and EHQ. Table 12 shows that ORTO-11 was negatively correlated to EHQ ($r(180) = -.49, p < .001$) and DOS ($r(187) = -.60, p < .001$). Meaning that individuals with more ON symptoms on one scale had in general more symptoms on the other scales as well. EHQ and DOS were more strongly correlated than the two scales were with ORTO-11 ($r(180) = .81, p < .001$)

Table 12

Pearson correlation between ORTO-11, DOS and EHQ

	ORTO-11	EHQ
EHQ	-.49**	
DOS	-.60**	.81**

** Correlation is significant at $p < .001$.

Discussion

Eight hypotheses were put forwarded and tested. First that women show more symptoms of ON than men. In this study, women showed more symptoms than men only on ORTO-11. This supports the findings of Parra-Fernandez et al. (2018) who found that women showed more symptoms of ON than men using ORTO-11. Hence, hypothesis 1 was partly supported. Second that those who restrict their meat consumptions show more symptoms than those who don't. In this study only EHQ found a significant difference in ON symptoms for non-meat eaters and those who eat meat. These findings partially support the results of Luck-Sikorski et al. (2019), but they found that vegetarian diet was associated with a higher rate of orthorexic eating behavior. Hypothesis 2 was therefore, partially supported. Third that there is no difference in ON symptoms by education. This hypothesis was supported, as no significant difference was found between those who had not completed a university degree and those who had. These results support the findings of Arusoğlu et al. (2008), who found no difference between those whose highest level of education was secondary school and those whose highest level of completed education was a bachelor's degree

The fourth hypothesis was that ORTO-11 would estimate a higher prevalence of ON than DOS. Using the ORTO-11 questionnaire, 26.5% of participants reached the cutoff point for ON while the rate was 5.8% according to DOS. This supports the findings of Parra-Fernandez et al. (2019) who found a higher prevalence rate in a sample of university students with ORTO-11 than by using DOS. Hypothesis 4 was therefore supported.

The fifth hypothesis was that a factor analysis would yield a three-factor solution for ORTO-11. A three factors solution was extracted from ORTO-11. The three factors were described as emotional, cognitive, and discipline, which was inconsistent with the reported subscales of ORTO-11 (emotional, clinical symptoms and cognitive rational) (Parra-Fernandez et al., 2018). The cognitive and discipline factors found in this analysis both had weak internal consistency and the discipline factor did not significantly correlate with either the emotional or the cognitive factor. There were four problem items that had low communalities and low factor loadings. These items were; item 4, *Are you willing to spend more money to have healthier food?*, item 11, *Do you think that on the market there is also unhealthy food?* item 8, *Do you think that eating healthy food changes your life-style (frequency of eating out)?* and item 6, *Do you allow yourself any eating transgressions?* These items could be tapping into some different construct than ON causing troubles for the internal consistency and validity of the measure. Hypothesis 5 was, however, supported.

The sixth hypothesis was that a unidimensional model would be found for DOS. The analysis supported a good unidimensional model with good internal consistency. Hypothesis 6 was supported.

The seventh hypothesis was that a three-factor solution would be found for EHQ. A four-factor solution was extracted, this solution was a good fit; with high factor loadings, acceptable Cronbach's alpha for each factor and significant correlations between all factors. Of the four factors extracted, two matched with the original three factor solution (problems related to healthy eating and positive feelings about healthy eating). Knowledge of healthy eating was not extracted, instead two factors termed restrictions caused by healthy eating and feelings of superiority via healthy eating were extracted. These results were not in line with the three subscales of EHQ reported by Gleaves et al. (2013). Hypothesis seven was not supported.

The eight-hypothesis stated that DOS and EHQ would be highly correlated. The results support this hypothesis and are consistent with the findings of Meule et al. (2020) and Chard et al. (2019). It is interesting to note that even though ORTO-11 correlated with both DOS and EHQ, the correlation coefficient was weaker. These results indicate that ORTO-11 might not be assessing exactly the same construct as DOS and EHQ, causing doubts about the construct validity of the scale.

The strengths of this study were that this was the first time DOS and EHQ have been translated into Icelandic and therefore the first time that their psychometric properties have been examined in an Icelandic sample. This is also one of the first studies done on ON screening tools in an Icelandic sample. Additionally, to the best of the authors knowledge, there are not very many studies in the literature that compare three or more ON screening tools. The sample size was also a strength for this study, along with the fact that almost 85% of the participants answered all three questionnaires.

This present study had certain limitations, the aim was to study Orthorexia in a sample of university students, the survey was administered online, therefore, researchers cannot confirm that all participants were university students. Four participants reported that elementary school was their highest level of education. These four individuals were not removed from data analysis as researchers had no way of knowing whether they had entered university via another path than the traditional one. This might have been avoided by only sending the survey to current university students. The results can also not be generalized over to the general population as participants came from a pool of university students. Another weakness was that not many vegans or vegetarians answered the questionnaire. To test our hypothesis that those who restrict their meat consumptions would show more symptoms than those who don't, researchers had to compare those who reported to not eat red meat nor fish to those who ate both red meat and fish regardless of other food restrictions that were reported. Hence, we were unable to discriminate between vegans, vegetarians and meat-

eaters. A more equal gender distribution would also have been preferred. It might help in future research on this topic to specifically advertise for vegans or vegetarians.

The results of this study indicate DOS to be a better screening tool for ON than ORTO-11, due to its higher internal consistency and better factor structure. Both EHQ and DOS also correlate more highly with each other than both instruments do with ORTO-11. Due to this, we can assume DOS to be a better measure of the prevalence of ON. Hence, we can estimate that the prevalence among Icelandic university students is more likely to be around 5.8% than the 26.5% reported by ORTO-11.

It is important for future studies on the topic of ON that a consensus be reached with regards to a diagnostic criteria for the disorder. As it is in essence problematic to use screening tools to detect the presence of a disorder that does not have a clear diagnostic criterion. It is, furthermore, important that future research assess and compare the psychometric properties of the ON screening tools currently used. As the results of this study indicate that the screening tools might be assessing different constructs, or possibly different elements of ON. This further assessment would be especially important for ORTO-11 and EHQ. Future studies should also aim to find an acceptable cutoff point for prevalence estimation on EHQ as that measure correlates well with DOS. Future research might also examine ON in extreme health focused groups such as in CrossFit or Fitness modeling as that behavior might oscillate with symptoms of ON.

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Appendix A

ORTO-11

Icelandic version

1. Ollu hugsanir um mat þér áhyggjum á síðustu þremur mánuðum? (e. *In the last 3 months, did the thought of food worry you?*)
 Alltaf Oft Stundum Aldrei
2. Hafa áhyggjur af heilsufari þínu áhrif á fæðuval þitt? (e. *Are your eating choices conditioned by your worry about your health status?*)
 Alltaf Oft Stundum Aldrei
3. Skiptir bragð matarins þig meira máli en gæði hans þegar þú ákveður hvaða mat þú ætlar að fá þér? (e. *Is the taste of food more important than the quality when you evaluate food?*)
 Alltaf Oft Stundum Aldrei
4. Ertu tilbúin/n til að borga meira fyrir hollari mat? (e. *Are you willing to spend more money to have healthier food?*)
 Alltaf Oft Stundum Aldrei
5. Eyðir þú meira en þremur klukkustundum á dag í áhyggjur af mat? (e. *Does the thought about food worry you for more than three hours a day?*)
 Alltaf Oft Stundum Aldrei
6. Leyfir þú þér að “svindla” í mataræði? (e. *Do you allow yourself any eating transgressions?*)
 Alltaf Oft Stundum Aldrei
7. Finnst þér líðan þín hafa áhrif á það hvernig og hvað þú borðar? (e. *Do you think your mood affects your eating behavior?*)
 Alltaf Oft Stundum Aldrei
8. Telur þú að hollt mataræði hafa áhrif á lífsstíl þinn? (hafi t.d. áhrif á það hversu oft þú ferð út að borða, hittir vini, takir þátt í félagslífi) (e. *Do you think that eating healthy food changes your life-style (frequency of eating out, friends,...)?*)
 Alltaf Oft Stundum Aldrei
9. Telur þú að neysla á hollri fæðu geti bætt útlit þitt? (e. *Do you think that consuming healthy food may improve your appearance?*)
 Alltaf Oft Stundum Aldrei
10. Færð þú samviskubit ef þú “svindlar” í mataræði þínu? (e. *Do you feel guilty when transgressing?*)

Alltaf Oft Stundum Aldrei

11. Telur þú að það sé til óhollur matur? (e. *Do you think that on the market there is also unhealthy food?*)

Alltaf Oft Stundum Aldrei

Appendix B

Dusseldorf Orthorexia Scale

Icelandic version

1. Að borða hollan mat er mikilvægara en að njóta matarins (*Eating healthy food is more important to me than indulgence/enjoying the food*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

2. Ég set sjálfum mér og fylgi vissum næringarreglum (*I have certain nutrition rules that I adhere to*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

3. Ég get einungis notið þess að borða mat ef hann telst hollur (*I can only enjoy eating foods considered healthy*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

4. Ég reyni að forðast að vera boðið í mat til vina ef ég veit að viðkomandi hugsar ekki mikið um næringu. (*I try to avoid getting invited over to friends for dinner if I know that they do not pay attention to healthy nutrition*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

5. Ég kann að meta það við sjálfan mig að ég hugsa meira um holla næringu en aðrir (*I like that I pay more attention to healthy nutrition than other people*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

6. Mér líður mjög illa ef ég borða eitthvað sem mér finnst vera óhollt (*If I eat something I consider unhealthy, I feel really bad*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

7. Ég upplifi mig útundan meðal vina og vinnufélaga vegna strangra næringarregla minna (*I have the feeling of being excluded by my friends and colleagues due to my strict nutrition rules*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

8. Hugsanir mínar snúast ítrekað um holla næringu og skipulegg ég daginn minn í kringum það (*My thoughts constantly revolve around healthy nutrition and I organize my day around it*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

9. Mér finnst erfitt að ganga gegn þeim reglum sem ég hef sett mér um mataræði (*I find it difficult to go against my personal dietary rules*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

10. Mér líður illa eftir að hafa borðað óhollan mat (*I feel upset after eating unhealthy foods*)

Þetta á alveg við um mig (*This applies to me*)

Þetta á að nokkru leyti við um mig (*This does somewhat apply to me*)

Þetta á að litlum hluta við um mig (*This does rather not apply to me*)

Þetta á ekki við um mig (*This does not apply to me*)

Appendix C

Eating Habits Questionnaire

Icelandic version

1. Ég er upplýstari en aðrir um hollt mataræði (*I am more informed than others about healthy eating*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

2. Ég afþakka boð ef það felur í sér að borða óhollan mat (*I turn down social offers that involve eating unhealthy food*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

3. Það skiptir mataræði mitt máli hvernig maturinn er undirbúinn (*The way my food is prepared is important in my diet*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

4. Mataræði mitt er háð mörgum reglum (*I follow a diet with many rules*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

5. Matarvenjur mínar eru betri en annarra (*My eating habits are superior to others*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

6. Hugsanir um matarvenjur trufla mig í mínu daglega lífi (*I am distracted by thoughts of eating habits*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

7. Ég borða einungis það sem að mataræði mitt leyfir (*I only eat what my diet allows*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

8. Hollt mataræði mitt veldur streitu í sambandinu mínu (*My healthy eating is a significant source of stress in my relationship*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

9. Ég hef markvisst reynt að borða hollara með tímanum (*I have made efforts to eat more healthily over time*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

10. Mataræðið mitt hefur áhrif á hvaða atvinnu ég vel mér (*My diet effects the type of employment I would take*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

11. Mataræði mitt er betra en mataræði annarra (*My diet is better than other people's diet*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

12. Mér finnst ég vera við stjórnvölin þegar ég borða hollt (*I feel in control when I eat healthy*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

13. Vinir eða fjölskyldumeðlimir hafa, á síðasta ári, sagt mér að ég hafi of miklar áhyggjur af því að borða hollt (*In the past year, friends or family members have told me that I'm overly concerned with eating habits*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

14. Það reynist mér erfitt að finna veitingastaði sem bjóða upp á mat sem ég borða (*I have difficulty finding restaurants that serve the food I eat*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

15. Mataræði mitt veitir mér ánægju (*Eating the way I do gives me a sense of satisfaction*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

16. Einungis fáar matartegundir eru nógu hollar fyrir mig (*Few foods are healthy for me*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

17. Ég fer sjaldnar út eftir að ég byrjaði að borða hollar (*I go out less since I began eating healthily*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

18. Ég eyði meira en 3 klst á dag í að hugsa um hollan mat (*I spend more than 3 hours a day thinking about healthy food*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

19. Mér líður mjög vel þegar ég borða hollt (*I feel great when I eat healthy*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

20. Ég fylgi hollu mataræði af mikilli festu (*I follow a health-food diet rigidly*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

21. Ég undirbý matinn minn á sem hollastan máta (*I prepare food in the most healthy way*)

Ósatt (*False, not at all true*)

Satt að einhverju leyti (*Slightly true*)

Satt að mestu leyti (*Mainly true*)

Satt (*Very true*)

