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Assessing orthorexic behaviors in a clinical sample: validity and reliability study of the Turkish version of the Düsseldorf orthorexia scale

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Abstract

Background Orthorexia nervosa (ON) is defined as a pathological fixation on eating healthy and pure food. In this study, it was aimed to evaluate the psychometric properties of the Turkish version of the Düsseldorf orthorexia scale (DOS) in a clinical sample.

Methods A total of 385 individuals, 117 with generalized anxiety disorder (GAD), 108 with major depressive disorder (MDD), 56 with obsessive–compulsive disorder (OCD) and 104 healthy controls, participated in the study. Hamilton Depression Rating Scale (HAM-D), Hamilton Anxiety Rating Scale (HAM-A), Yale–Brown Obsessive–Compulsive Scale (Y-BOCS), Eating Attitude Test (EAT-40), Orthorexia Nervosa Inventory (ONI) and Düsseldorf Orthorexia Scale (DOS) were applied to all participants.

Results The DOS demonstrated high internal consistency (Cronbach's alpha = 0.87) and good construct validity. Confirmatory factor analysis supported a one-factor structure, explaining a significant portion of variance among responses. In the analyses performed to test the convergent validity of DOS, a positive correlation was found with ONI and EAT scores ($p < 0.001$ for each). There was no significant correlation between DOS and HAM-D and HAM-A scores ($p > 0.05$ for each). The severity of orthorexic symptoms measured by DOS was similar between each patient group and healthy control group. DOS was applied to 70 more participants two weeks apart and the test–retest reliability was determined as 0.99.

Conclusions This study shows that the Turkish version of DOS is valid and reliable in clinical samples and healthy individuals, is largely consistent with ONI, and that this scale can be used in studies investigating ON.

Plain English Summary

Orthorexia nervosa (ON) is a phenomenon in which there is intense effort to eat foods that are believed to be healthy and pure. It has been stated that there is a decrease in the professional, social and academic functionality of orthorexic individuals due to their efforts on healthy eating, and their physical health may be affected over time. Therefore, there is a need for an appropriate screening scale for rapid screening of orthorexic symptoms. The Düsseldorf orthorexia scale (DOS) is a self-report scale consisting of 10 questions created to assess ON. Our study is the first study to evaluate this scale in a Turkish clinical sample. The main aim of our study was to test the psychometric properties

All authors have seen and approved the final version of the manuscript and believe that the manuscript represents honest work.

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of DOS in patients diagnosed with major depressive disorder, generalized anxiety disorder and obsessive–compulsive disorder. The results showed that DOS had satisfactory psychometric properties in the Turkish clinical sample and could be a short, useful, and valid scale to screen for ON in these individuals.

Keywords Orthorexia nervosa, Düsseldorf orthorexia scale, Validation, Clinical sample

Background

The term "Orthorexia Nervosa" (ON) has been defined as a pathological fixation on healthy and pure eating [1]. Bratman defines this concept as a disorder in which individuals pursue diets meticulously in order to feel more meticulous and clean [2]. It is not yet listed as a separate mental disorder in the latest editions of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5-TR) and the International Classification of Diseases (ICD-11) [3, 4]. However, four sets of criteria have been proposed to evaluate ON [5, 6]. These criteria are as follows: (a) obsessive behaviors involving strongly avoiding foods believed to be unhealthy and strictly adhering to a restrictive diet, along with preoccupation with healthy eating; (b) feelings of extreme emotional distress accompanied by guilt, shame, and/or anxiety when violating restrictive dietary rules; (c) physical disorders that can lead to significant weight loss and/or physical health complications due to nutritional deficiencies; and (d) psychosocial impairments related to social, occupational, and/or academic functioning.

In studies, it is assumed that ON shares common features and possibly overlaps with certain mental disorders, especially obsessive–compulsive disorder (OCD) and eating disorders (ED) [7]. Many studies have shown that as disturbances in eating attitudes increase, orthorexic symptoms also increase, suggesting a significant overlap between ON and EDs [8–10]. Regarding the relationship between ON and OCD, obsessive–compulsive tendencies are considered one of the most valid and reliable symptoms of ON [11]. However, despite some specific obsessions-compulsions being identified in studies with OCD-diagnosed patient groups, no relationship has been found between the severity of OCD and ON, suggesting very little overlap between the two [9, 10, 12]. Studies on the relationships between ON and major depressive disorder (MDD) and anxiety disorders are limited. In a study involving patients with generalized anxiety disorder (GAD) and panic disorder, the severity of orthorexic symptoms was found to be similar between patient groups [9]. Another study comparing patients diagnosed with anxiety disorder and depressive disorder with a healthy control group found similar levels of orthorexic symptom severity among the groups, but did not provide information on anxiety and depression levels [12]. In a study conducted with healthy volunteers, a positive association was found between depression and anxiety levels and ON, with orthorexic symptoms playing a mediating role [13]. A longitudinal study found that high orthorexic symptoms predicted an increase in depressive symptoms [14]. Another study found no relationship between depressive symptoms and ON [15]. Overall, studies on the relationship between ON and MDD and GAD are limited and inconsistent.

In studies related to ON, research results vary significantly due to the use of different measurement tools and threshold values, as well as the lack of precise and reliable diagnostic criteria [5, 16]. In the majority of studies, ON has been evaluated using the ORTO-15 scale [17]. However, the validity and reliability of this tool are often questioned due to factors such as its unstable factorial structure and its unsuitability for assessing the prevalence of orthorexic behaviors [18, 19]. Subsequently, new scales such as the Eating Habits Questionnaire (EHQ), Düsseldorf Orthorexia Scale (DOS), Teruel Orthorexia Scale (TOS), and Orthorexia Nervosa Inventory (ONI) have been developed to assess ON, and consistent results regarding their reliability and validity have been obtained [20–23]. Among these scales, DOS is a self-report likert-type scale with four rates, consisting of 10 items developed by Friederike Barthels [21]. For several reasons, we wanted to test whether the Turkish version of this scale is valid and reliable. Firstly, the scale is very short, making it an efficient screening tool in terms of time. Secondly, the items are short, simple, and understandable, making it suitable for individuals with low educational levels. Thirdly, it has been validated in many languages, enabling comparisons across different countries and cultures.

The German version of DOS was developed in 2015 [21]. Subsequently, it was rapidly adapted into English [24], Polish [25], Italian [26], Chinese [27], French [28], Spanish [29], and Arabic [17]. These studies have demonstrated the validity and reliability of the scale. However, most of these studies were conducted among students, with one study among adolescents and one in the general population. To our knowledge, there has been no validation study of this scale conducted in a clinical sample. The aim of this study is to adapt the Turkish version of DOS and test its psychometric properties in a sample consisting of patients diagnosed with MDD, GAD, OCD, and healthy volunteers.

Methods

Permission and translation

The first author obtained permission from Friederike Barthels, corresponding author of DOS, via email to do a validation study of the scale before starting the study. DOS was translated into Turkish by two psychiatrists fluent in both languages. The Turkish version was then back-translated into German and compared to the original scale by linguists who had no prior access to the original scale. Both researchers and linguists approved the Turkish version of the study prior to the research.

Sample and procedure

The study consisted of 130 patients diagnosed with major depressive disorder, 130 patients diagnosed with generalized anxiety disorder, 65 patients diagnosed with obsessive–compulsive disorder according to DSM-5-TR who applied to Mersin City Training and Research Hospital Psychiatry outpatient clinic for treatment between 01.11.2023–01.02.2024, and 120 volunteers who lived in the same environment with the patients, declared that they had not been diagnosed with psychiatric illness before, and were similar to the patient group in terms of sociodemographic variables. Inclusion criteria were being between 18 and 65 years old, being fluent in Turkish, having at least an elementary school education, and not having cognitive impairment or psychotic symptoms. We included 120 healthy individuals without any psychiatric diagnosis who were similar to the patient group in terms of age, gender, and education level to the control group. The control group consisted of hospital staff members' relatives who expressed willingness to participate in the scientific research. No financial incentives were provided to the participants.

Psychiatric interviews were conducted with all participants according to the DSM-5-TR diagnostic criteria, and diagnoses of MDD, GAD, and OCD were confirmed. To prevent the confusing effect of comorbid mental illnesses, 15 cases with comorbid GAD diagnosis and 3 cases with comorbid OCD diagnosis among MDD cases were excluded from the study. Four cases were excluded from the study because they did not complete the scales. Among GAD-diagnosed cases, 4 cases with comorbid MDD diagnosis, 5 cases with comorbid panic disorder diagnosis, and 4 cases who did not complete the scales were excluded from the study. Among OCD-diagnosed cases, 5 cases with comorbid MDD diagnosis and 4 cases who did not complete the scales were excluded from the study. From the control group, 5 participants who did not complete the scales, 4 participants diagnosed with somatic symptom disorder, 4 participants diagnosed with alcohol use disorder, and 3 participants diagnosed with bipolar disorder were excluded. We continued the study with 117 patients diagnosed with GAD, 108 patients diagnosed with MDD, 56 patients diagnosed with OCD, and 104 healthy volunteers. Taking into account the potentially confounding effects of different types of medications, we excluded patients using medications other than selective serotonin reuptake inhibitors (SSRIs) or serotonin-norepinephrine reuptake inhibitors (SNRIs) monotherapy. All patients had been receiving SSRI-SNRI monotherapy for at least 3 months. To assess test–retest reliability, we administered DOS to 70 participants who completed the first test and were reachable at two-week interval. The study was approved by the Toros University Scientific Research and Publication Ethics Committee with decision number 115 dated 27.10.2023. Necessary permissions were obtained from Mersin City Training and Research Hospital to recruit patients. All participants completed the informed consent form. The study was conducted in accordance with the Helsinki Declaration.

Sample size

In validity and reliability studies, it is recommended to have at least 5 to 10 times the number of items in the scale as participants [30]. Power analysis for the study was conducted using G Power 3.1 software. It was calculated that a total of 280 participants across 4 groups would be required for an effect size of 0.25, a margin of error of 0.05, and a power of 0.95, and with a total of 385 participants, it was believed that this study had sufficient power [31].

Measures

Sociodemographic and clinical data form

In this form, sociodemographic data such as age, sex at birth, marital status, educational status and place of residence are questioned.

Hamilton depression rating scale (HAM-D)

It is a clinician-administered likert-type scale consisting of 17 questions, measuring the severity of depressive symptoms [32]. Higher scores indicate increased depressive symptoms. In the Turkish validity and reliability study, the Cronbach's alpha value was found to be 0.75 [33]. In our study, Cronbach's alpha coefficient was calculated to be 0.82.

Hamilton anxiety rating scale (HAM-A)

It is a clinician-administered likert-type scale consisting of 14 items used to measure the severity of anxiety [34]. The scale has 5 items questioning psychic symptoms and 9 items questioning somatic symptoms. The total score of these two subscales yields the scale score. In the Turkish validity and reliability study, the correlation coefficients of the items were found to be 0.72 individually, and 0.94

as total [35]. In our study, Cronbach's alpha coefficient was calculated to be 0.90.

The Yale–Brown obsessive–compulsive scale (Y-BOCS) and symptom checklist

It is a clinician-rated scale developed to measure the type and severity of obsessive–compulsive symptoms [36]. The YBOCS consists of a total of 19 items, with scores evaluated for the first 10 items (excluding items 1b and 6b). Items 1–5 assess the severity of obsessions, while items 6–10 assess the severity of compulsions. As scores increase, the severity of the disorder also increases. In the Turkish validity and reliability study, the Cronbach's alpha value was calculated to be 0.81 [37]. In our study, Cronbach's alpha coefficient was calculated to be 0.90.

The eating attitude test (EAT-40)

It was developed to screen for eating disorders, primarily anorexia nervosa (AN) [38]. It is a self-report scale consisting of 40 questions rated on a 6-point Likert-type scale. The total score of the scale is obtained by summing the scores obtained from each item. Participants scoring thirty or higher are considered to be in the high-risk group for eating disorders, primarily AN [38]. In the Turkish validity and reliability study of the scale, the Cronbach's alpha value was found to be 0.70 [39]. In our study, Cronbach's alpha coefficient was calculated to be 0.80.

The orthorexia nervosa inventory (ONI)

It is a four-point Likert-type self-report scale developed to assess emotional, behavioral, physical and psychosocial impairments related to pathological focus on healthy eating [40]. The three-factor scale consists of 24 items, assessing emotions with 5 items, behaviors and preoccupation with healthy eating with 9 items, and physical and psychosocial disturbances with 10 items. The lowest score that can be obtained from the scale is 24, and the highest score is 96. The cutoff score is determined as 72 [40]. As scores increase, orthorexic symptoms also increase. In the validity and reliability study of the Turkish version, Cronbach's alpha coefficient was calculated to be 0.91 [41]. In our study, Cronbach's alpha coefficient was calculated to be 0.92.

The Düsseldorf orthorexia scale (DOS)

It is a four-point self-report Likert-type scale created to assess orthorexic symptoms, consisting of 10 items [21]. Scores range from 10 to 40. Items are marked between "definitely applies to me" (4 points) and "definitely does not apply to me" (1 point). As scores increase, orthorexic symptoms also increase. In studies, it has been reported that scores between 25 and 29 indicate a high risk of ON, while scores of 30 or above indicate the presence of ON [21, 42]. The Cronbach's alpha value of the scale is 0.84, and the test–retest reliability ranges from 0.67 to 0.79 [21].

Statistical analysis

Descriptive statistics were presented in tabular form, indicating mean ± standard deviation or median, minimum and maximum for continuous variables depending on the distribution to summarize the data obtained from the study. Categorical variables were summarized as numbers and percentages. The normality of numerical variables was assessed using the Shapiro–Wilk, Kolmogorov–Smirnov, and Anderson–Darling tests.

To determine differences in categorical variables between diagnostic groups, the Pearson Chi-Square test was used for cases with 5 or more observations. For group comparisons of numerical variables, the One-Way ANOVA test was applied if the data showed normal distribution, and the Kruskal–Wallis H test was used if they did not. For multiple comparisons, the Games-Howell or Tukey test was used for parametric tests, and the Dwass-Steel-Critchlow-Fligner test was used for non-parametric tests.

To determine the structural properties of the DOS, Exploratory Factor Analysis (EFA) was conducted. In EFA, the principal axis factoring method was used to extract factors. Internal consistency analysis was performed to evaluate the reliability of the DOS. In this analysis, Cronbach's alpha coefficient and each Cronbach's alpha value obtained when each item was extracted were examined. Test–retest reliability of the scale was calculated using the intraclass correlation coefficient.

After conducting EFA to validate the structure defined for the DOS, Confirmatory Factor Analysis (CFA) was performed to validate this structure. Since the Mardia test indicated that multivariate normal distribution was not met, robust maximum likelihood estimation based on the covariance matrix was used in CFA. Comparative Fit Index (CFI), Normed Fit Index (NFI), Goodness of Fit Index (GFI), and Root Mean Square Error of Approximation (RMSEA) were considered to evaluate the goodness of fit of the model.

To assess the validity of the DOS, its relationships with the ONI, EAT, HAM-D, and HAM-A scales were examined using correlation analysis. Statistical analyses were conducted using Jamovi (Version 2.3.28), JASP (Version 0.18.3), and LISREL (version 8.50) softwares. A significance level of 0.05 (p-value) was used for all analyses.

Results

When examining the sociodemographic data of the groups, no significant differences were found between the groups in terms of age, gender, years of education, marital status, and place of residence ($p > 0.05$ for each).

There were no significant differences between diagnostic groups in DOS and ONI scores ($p > 0.05$ for each). Significant differences were found in EAT, YBOCS, HAM-D, and HAM-A scores ($p < 0.05$ for each).

When examining HAM-D and HAM-A scores, it was found that both the GAD and MDD groups had significantly higher scores compared to the healthy control group in both HAM-A and HAM-D scores. In the HAM-D scale, significant differences were also found between the GAD and MDD groups, as well as between the OCD and MDD groups ($p < 0.001$). In the HAM-A scale, the scores of the GAD group were higher compared to all other groups. Especially in the psychic subscale, the GAD group scored significantly higher than the depression and healthy control groups ($p < 0.001$). In paired comparisons, a significant difference was determined between MDD and OCD groups in EAT, and MDD group scored significantly higher than OCD group ($p = 0.044$). Table 1 compares the groups in terms of scale scores.

Item statistics and internal consistency of DOS is presented in Table 2. The corrected item-total score correlation values in this table vary between 0.42 and 0.70. The fact that item-total score correlation values are higher than 0.30 indicates that the items have discriminating power and the scale is valid. The Cronbach's alpha values for the total scores of the scale was calculated as 0.87. Since this value is higher than 0.70, the scale is considered reliable. As the Cronbach alpha values obtained when each item was deleted were not higher than the total Cronbach alpha value of the scale, it was concluded that all items contributed to the reliability of the scale.

The Kaiser–Meyer–Olkin (KMO) measure was 0.884 and Bartlett's test result was 1507.131 (sd = 45, $p < 0.001$); these results showed that the sample size was suitable for factor analysis. The results of the exploratory factor analysis are presented in Table 3 with eigenvalues and explained variance ratios. When the initial eigenvalues were analyzed, although the eigenvalues

Table 2 Item analysis of the Düsseldorf Orthorexia Scale

	Mean ± Sd	Corrected item-total correlation	Cronbach's alpha if item deleted	Cronbach's alpha
DOS1	2.71 ± 0.95	0.55	0.87	0.87
DOS2	2.53 ± 0.99	0.57	0.86	
DOS3	2.36 ± 1.03	0.67	0.86	
DOS4	1.90 ± 0.96	0.62	0.86	
DOS5	2.51 ± 1.06	0.68	0.86	
DOS6	2.62 ± 1.06	0.61	0.86	
DOS7	1.55 ± 0.88	0.42	0.87	
DOS8	1.94 ± 0.96	0.70	0.85	
DOS9	2.18 ± 0.96	0.57	0.86	
DOS10	2.50 ± 1.11	0.56	0.87	

Sd standard deviation

Table 1 Relationship of scale scores between diagnostic groups

	Diagnostic groups				*p*
	GAD (n = 117)	MDD (n = 108)	OCD (n = 56)	HC (n = 104)	
DOS	23.9 ± 6.9	22.4 ± 6.9	21.9 ± 6.3	22.5 ± 7.0	0.197**
ONI–total	41.0 [24.0–72.0]	41.0 [24.0–73.0]	38.0 [24.0–60.0]	35.5 [24.0–70.0]	0.397*
Behaviour	18.0 [9.0–31.0]	17.0 [9.0–33.0]	16.5 [9.0–25.0]	17.0 [9.0–36.0]	0.336*
İmpairment	13.0 [10.0–32.0]	15.0 [10.0–27.0]	12.5 [10.0–25.0]	13.0 [10.0–29.0]	0.177*
Emotion	9.0 [5.0–20.0]	9.0 [5.0–19.0]	8.0 [5.0–13.0]	8.0 [5.0–16.0]	0.229*
EAT-40	19.0 [0.0–62.0]	18.0 [5.0–60.0]	16.0 [0.0–40.0]	17.0 [0.0–61.0]	**0.024***
YBOCS–total	0.0 [0.0–10.0]	0.0 [0.0–10.0]	20.0 [6.0–31.0]	0.0 [0.0–0.0]	**< 0.001***
YBOCS obsession	0.0 [0.0–5.0]	0.0 [0.0–5.0]	11.0 [5.0–16.0]	0.0 [0.0–0.0]	**< 0.001***
YBOCS Compulsion	0.0 [0.0–5.0]	0.0 [0.0–5.0]	9.5 [0.0–15.0]	0.0 [0.0–0.0]	**< 0.001***
HAM-D	6.0 [0.0–32.0]	10.0 [1.0–23.0]	4.0 [0.0–15.0]	2.0 [0.0–22.0]	**< 0.001***
HAM-A–total	11.0 [2.0–46.0]	8.0 [1.0–29.0]	5.0 [1.0–17.0]	2.0 [0.0–6.0]	**< 0.001***
HAM-A psychic	6.0 [0.0–18.0]	5.0 [1.0–14.0]	3.0 [1.0–8.0]	1.0 [0.0–4.0]	**< 0.001***
HAM-A somatic	6.0 [0.0–28.0]	3.0 [0.0–16.0]	2.0 [0.0–11.0]	1.0 [0.0–6.0]	**< 0.001***

There are values that are used to represent values presented as mean ± standard deviation (mean ± sd) and values that express median [Minimum–Maximum] ranges. *: Kruskal Wallis-H test, **: One-Way ANOVA test, *DOS* Düsseldorf orthorexia scale, *ONI* orthorexia nervosa inventory, *EAT* eating attitude test, *YBOCS* Yale–Brown Obsessive–Compulsive Scale, *HAM-D* Hamilton depression rating scale, *HAM-A* Hamilton anxiety rating scale, *GAD* generalized anxiety disorder, *MDD* major depressive disorder, *HC* healthy control, black font indicates statistical significance.

Table 3 Eigenvalues and percentages of variance explained for the exploratory factor analysis results of the Düsseldorf Orthorexia Scale

Factor	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.725	47.247	47.247	4.223	42.232	42.232
2	1.030	10.302	57.549	0.539	5.388	47.620
3	0.955	9.546	67.095			
4	0.617	6.172	73.267			
5	0.607	6.070	79.337			
6	0.552	5.522	84.858			
7	0.436	4.357	89.215			
8	0.403	4.027	93.242			
9	0.383	3.827	97.069			
10	0.293	2.931	100.000			

Table 4 Factor load values of the Düsseldorf Orthorexia Scale ıtems

	Factor
DOS1	0.60
DOS2	0.63
DOS3	0.74
DOS4	0.65
DOS5	0.73
DOS6	0.66
DOS7	0.45
DOS8	0.74
DOS9	0.60
DOS10	0.64

DOS Düsseldor orthorexia scale

of two factors were above 1, only one factor was found to have an eigenvalue above 1 as a result of the assessment of the extracted factors. This implied that DOS was one-dimensional. The single factor structure of the scale explained 42.23% of the variance.

Factor loadings are presented in detail in Table 4. The factor loadings of the items analyzed ranged between 0.45 and 0.74. Factor loadings higher than 0.30 indicate that the items effectively measure the relevant structure in their factors.

CFA was performed to determine whether the Turkish version of the DOS shows a single-factor structure. In CFA, fit index values, factor loadings and error variances were examined to assess the fit of the model to the data. The fit index values, factor loadings and error variances obtained as a result of the analysis are presented in Table 5. Additionally, the measurement model obtained as a result of the analysis is shown in Fig. 1.

According to Table 5, the χ^2/sd value was between 3 and 5, indicating a moderate fit of the model to the data. CFI, NFI and GFI values were calculated 0.98, 0.97 and 0.94, respectively. These values indicated a very good fit of the model to the data as they were higher than 0.90. Based on the RMSEA index, this value was found to be 0.077 and it was less than 0.080, indicating that the model was a good fit to the data. A general assessment of the fit indices concluded that the one-factor model fit the data well. Since the factor loadings of all items of the scale were higher than 0.30, it was concluded that all items served their purpose appropriately.

In our study, the correlation analysis between ONI, EAT, HAM-D, HAM-A scores to determine the convergent validity of the DOS is shown in Table 6. DOS was moderately and highly significantly and positively

Table 5 Confirmatory factor analysis of the Düsseldorf Orthorexia Scale

								Factor load values		Error variances	
	χ^2	χ^2/sd	*p*	CFI	NFI	GFI	RMSEA	Max	Min	Max	Min
Scale	104.33	3.26	0.000	0.98	0.97	0.94	0.077	0.75	0.54	0.70	0.43
Proposed		χ^2/sd ≤ 3		≥ 90	≥ 90	≥ 90	≤ 0.080	≥ 0.30		≤ 0.90	

CFI Comparative fit ındex, *NFI* Normed fit ındex, *GFI* Goodness of fit ındex, *RMSEA* Root mean square error of approximation, *max* maximum, *min* minimum.

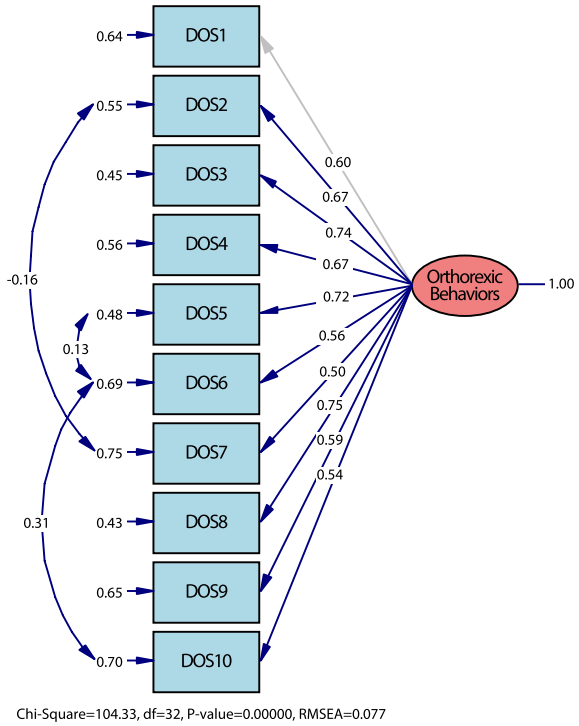

Fig. 1 Confirmatory factor analysis of the Düsseldorf Orthorexia Scale

Table 6 Convergent validity analysis of the Düsseldorf Orthorexia Scale

Scales	DOS	
	r	*p*
ONI emotion	0.629	**< 0.001**
ONI behaviour	0.726	**< 0.001**
ONI İmpairment	0.471	**< 0.001**
ONI-total	0.710	**< 0.001**
EAT-40 total	0.394	**< 0.001**
HAM-D	− 0.073	0.223
HAM-A psychic	− 0.084	0.161
HAM-A somatic	0.054	0.367
HAM-A total	− 0.001	0.986

DOS Düsseldorf orthorexia scale, *ONI* orthorexia nervosa inventory, *EAT* eating attitude test, *HAM-D* Hamilton depression rating scale, *HAM-A* Hamilton anxiety rating scale, black font indicates statistical significance.

correlated with all subscales and total scores of ONI and EAT scores ($p < 0.001$ for each). No statistically significant relationship was found between HAM-D and HAM-A scores and DOS scores ($p > 0.05$).

In Table 7, the relationship of DOS with obsessive–compulsive, depressive and anxious symptoms was analyzed separately according to the diagnostic groups in order to evaluate whether ON was associated with the symptom clusters of the related disorders in patients diagnosed with GAD, MDD and OCD. Significant positive correlations were found between DOS scores and ONI total and EAT scores in all groups ($p \leq 0.001$ for each).

A moderate negative correlation ($r = -0.294$, $p = 0.028$) was observed between increasing DOS scores and HAM-A psychic scores in patients diagnosed with OCD. However, the correlation with the YBOCS score was not significant ($p > 0.05$).

Within the scope of the study, DOS was administered to 70 people, including 15 patients diagnosed with OCD, 13 patients diagnosed with MDD, 20 patients diagnosed with GAD, and 22 healthy volunteers, who could be reached two weeks after completing the first questionnaire, and intraclass correlation coefficient was calculated between the two measurements. According to the results presented in Table 8, the test–retest reliability for DOS scores was found to be 0.99.

Discussion

Studies on ON are increasing continuously in our country as well as in the world. In this regard, it is suggested that DOS can be used as a short and reliable screening tool in future studies. The most important result of this study is that the Turkish version of the DOS was shown to be valid and reliable. Our findings indicate that the psychometric properties of the scale are compatible with Turkish culture and it is an effective tool for measuring ON symptoms. The internal consistency coefficient (Cronbach's alpha) of DOS was calculated as 0.87, indicating that the scale has high reliability. It was found to be 0.84 in the original German version of the scale [21], and similar ratios were found in the Polish, French and Italian adaptation versions [25, 26, 28]. Literature findings give contradictory results about the factor structure of the scale. The single-factor structure of the scale was partially confirmed in the original German version [21]. Some studies suggest that all items represent orthorexic behaviors and consequently a single-factor model best describes the structure [26, 28]. On the other hand, in some studies, while a 4- or 5-factor structure fits the model better, it has been reported that a single-factor structure should be preferred in practice [17, 24]. Nevertheless, there are studies suggesting the preservation of a 2, 3 or even 5-factor structure [25, 27, 43]. In two different studies, a three-factor model was identified. But in these studies, the items attributed to the factors were different from each other; this shows that the results are not based on theory, but rather on data [25, 27]. Moreover, in these studies, even the factor names measuring ON were different. Dividing the 10-item DOS into factors would complicate the scale and cause the clinical features of ON

Table 7 Correlation analysis between Düsseldorf Orthorexia Scale and other scales according to diagnostic groups

	DOS					
	GAD		MDD		OCD	
Scales	r	*p*	r	*p*	r	*p*
ONI emotion	0.600	**< 0.001**	0.646	**< 0.001**	0.622	**< 0.001**
ONI behaviour	0.703	**< 0.001**	0.766	**< 0.001**	0.642	**< 0.001**
ONI İmpairment	0.422	**< 0.001**	0.562	**< 0.001**	0.396	**0.003**
ONI total	0.679	**< 0.001**	0.764	**< 0.001**	0.609	**< 0.001**
EAT-40 total	0.422	**< 0.001**	0.331	**< 0.001**	0.425	**0.001**
HAM-D	0.052	0.578	−0.163	0.091	−0.103	0.448
HAM-A psychic	−0.016	0.865	−0.182	0.059	−0.294	**0.028**
HAM-A somatic	0.096	0.305	−0.016	0.869	0.014	0.916
HAM-A total	0.065	0.483	−0.088	0.367	−0.14	0.303
YBOCS obsession	–	–	–	–	−0.043	0.754
YBOCS compulsion	–	–	–	–	0.001	0.998
YBOCS total	–	–	–	–	−0.043	0.752

DOS Düsseldorf orthorexia scale, *ONI* orthorexia nervosa inventory, *EAT* eating attitude test, *YBOCS* Yale–Brown Obsessive–Compulsive Scale, *HAM-D* Hamilton depression rating scale, *HAM-A* Hamilton anxiety rating scale, *GAD* generalized anxiety disorder, *MDD* major depressive disorder, black font indicates statistical significance.

Table 8 Test–retest analysis of the Düsseldorf Orthorexia Scale

	Re-test	*p*	95% confidence interval	
			Lower bound	Upper bound
DOS	0.99	**< 0.001**	0.985	0.994

DOS Düsseldorf orthorexia scale

Bold font indicates statistical significance

to be overlooked [24]. From the available data, it can be concluded that all items of the DOS measure orthorexic eating behavior, do not differ from each other, and its single-factor use is suitable and practical. Consequently, the DOS, which is recommended to be used with a single factor, showed compliance with this model in the Turkish version. However, both methodological and demographic differences should be considered when making any hypotheses about these differences in the structure of the scale.

In our study, DOS scores were highly correlated with the ONI total score, which directly measures ON, and the scores of emotion, behavior and impairment subscales. Convergent analyses of the scale using scales such as TOS [17], EHQ [25, 28], ORTO-15 [26] showed good convergent validity. This implies that the convergent validity of the Turkish version of the DOS is good, similar to the other versions of the scale. DOS total scores were also positively correlated with EAT scores measuring eating disorders. In addition, the correlation with ONI scores was higher than the correlation with EAT. This suggests that ON has different aspects from eating disorder psychopathology as measured by the EAT [25]. There have been many studies so far on the relationship between ON and eating disorders. It has been reported that orthorexic symptoms may be a coping strategy in individuals diagnosed with AN [44], and some studies have suggested that ON may be the initial symptom of serious disorders such as AN [45]. Segura et al. noted that orthorexic symptoms are related to both clinical recovery and transition to milder forms of disorders such as AN and ON [46]. As a result, studies have shown that there is a substantial correlation between ON and ED. However, it is not yet known whether ON will take its place among eating disorders and become an independent disorder or whether it will be categorized within the clinical evolution of other disorders.

In validation studies of the DOS conducted in different cultures, different results were obtained regarding the relationship between depressive-anxious symptom severity and orthorexic symptom severity [26, 28]. In our sample, which consisted of healthy population and participants diagnosed with various psychopathologies such as GAD, MDD and OCD, no correlation was found between orthorexic symptom severity and depressive-anxious symptom severity. According to the present findings, it cannot be assumed that general psychopathology increases as the levels of orthorexic eating behavior measured by the DOS increase. When our study results and the existing literature are examined, it is not possible to conclude a clear relationship between orthorexic eating behavior and psychopathology level. Another hypothesis is that the lack of differentiation between healthy

orthorexia and pathological orthorexia in our study may have made it difficult for us to understand the relationship between ON and anxiety-depressive disorder symptomatology. However, the number of studies between ON and general psychopathology is limited and longitudinal studies are particularly needed to understand these correlations.

Similar to OCD, ON is characterized by obsessions (e.g. excessive thinking about food preparation), compulsions (e.g. food preparation rituals), decreased quality of life and impaired social functions [10, 47]. Previous studies suggest that orthorexic individuals may have obsessive–compulsive symptoms [7, 10]. In a study conducted by Barthels et al. with patients diagnosed with ED and OCD, orthorexic symptoms were found to be high in the ED group and similar to the general population in the OCD group [48]. In adaptation studies of the DOS, there are inconsistent results regarding the relationship between orthorexic symptoms and the severity of obsessive–compulsive symptoms [26, 28]. In our study, no correlation was found between orthorexic symptom severity and obsessive–compulsive symptom severity. At the same time, we found a negative correlation between orthorexic symptom severity and psychic symptoms of anxiety. Considering the available data and literature, it is understood that ON and OCD indicate different psychopathologies, although they have some common aspects.

The results of the test–retest reliability revealed that the scale has a good reliability. Test–retest reliability has also been shown to be of good level in the original German and Chinese versions of the scale [21, 27]. In our study, we found a higher retest correlation compared to other studies. However, while this period was set as 1 month in other studies, it was 2 weeks in our study. Since the duration was shorter, the retest correlations of our study may have been higher than other studies. As a result of the findings, we suggest that the scale can be used in future longitudinal studies in Turkish culture.

The strengths of our study include its application in different clinical groups, the possibility of comparison with patient groups by adding a healthy control group to the study, and the examination of the relationship between ON and anxiety, depression and obsessive–compulsive symptoms in addition to the validation study. On the other hand, our first limitation is that the discriminative feature of the scale could not be tested because the patient group with ED was not included in the study. Second, as the DOS, EAT and ONI are self-reported, they can lead to reporting bias and can be considered as a weakness in terms of reliability. Third, test–retest measurements were made 2 weeks apart, which is relatively a short period. Fourth, although the healthy control group included in the study stated that they had no psychiatric application and no mental complaints, this was not enough to accept the participant as a healthy control. It is recommended to study with sample groups from different regions in order to generalize the study.

Conclusions

This study aimed to adapt the Turkish version of the Düsseldorf Orthorexia Scale in a clinical sample of patients with GAD, MDD and OCD. This 10-item scale was found to be a valid and reliable scale for assessing orthorexic behaviors and attitudes. The brevity and good psychometric properties of this scale suggest that it may be a useful tool for detecting orthorexic symptoms in clinical samples. Future studies should evaluate the discriminative properties and potential use of the scale in patients diagnosed with eating disorders.

Abbreviations

AN	Anorexia nervosa
CFA	Confirmatory factor analysis
CFI	Comparative fit index
DOS	Düsseldorf orthorexia scale
DSM-5-TR	Diagnostic and statistical manual of mental disorders fifth edition text revision
EAT-40	Eating attitude test
ED	Eating disorders
EFA	Exploratory factor analysis
EHQ	Eating habits questionnaire
GAD	Generelized anxiety disorder
GFI	Goodness of fit index
HAM-A	Hamilton anxiety rating scale
HAM-D	Hamilton depression rating scale
HC	Healthy control
ICD-11	International classification of diseases for mortality and morbidity statistics eleventh revision
KMO	Kaiser–Meyer–Olkin test
MDD	Major depressive disorder
NFI	Normed fit index
OCD	Obsessive–compulsive disorder
ONI	Orthorexia nervosa inventory
ON	Orthorexia nervosa
RMSEA	Root mean square error of approximation
SNRIs	Serotonin-norepinephrine reuptake inhibitors
SSRIs	Selective serotonin reuptake inhibitors
TOS	Teruel orthorexia scale
Y-BOCS	Yale–Brown obsessive–compulsive scale

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Author contributions

All authors contributed to the study conception and design. HY and MED wrote the manuscript and involved in data analysis and interpretation. HY, LT, SÖY and CY involved in the study design. CY and LT prepared the tables. HY, MED and LT prepared the writing-review and editing. HY, MED and SÖY created the methodology. All authors read and approved the final manuscript.

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Data Availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study was performed in line with the principles of the Declaration of Helsinki. The study was approved by the Toros University Scientific Research and Publication Ethics Committee with decision number 115 dated 27.10.2023. Necessary permissions were obtained from Mersin City Training and Research Hospital to recruit patients.

Consent for publication
Not applicable.

Consent to participate
Informed consent was obtained from all individual participants included in the study.

Competing ınterests
The authors declare that they have no competing interests.

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References

1. Bratman S. Health food Junkie. Yoga J. 1997;8:42–50.
2. Bratman S, Knight D. Health food junkies: orthorexia nervosa: overcoming the obsession with healthful eating. 1st ed. New York: Broadway Books; 2001.
3. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th edn, text revision. American Psychiatric Association, Washington; 2022.
4. World Health Organization (WHO). ICD-11, International classification of diseases for mortality and morbidity statistics. World Health Organization, Geneva; 2022.
5. Dunn TM, Bratman S. On orthorexia nervosa: a review of the literature and proposed diagnostic criteria. Eat Behav. 2016;21:11–7.
6. Moroze RM, Dunn TM, Holland C, Yager J, Weintraub P. Microthinking about micronutrients: a case of transition from obsessions about healthy eating to near-fatal "orthorexia nervosa" and proposed diagnostic criteria. Psychosomatics. 2014;56(4):397–403.
7. Koven NS, Abry A. The clinical basis of orthorexia nervosa: emerging perspectives. Neuropsychiatr Dis Treat. 2015;11:385–94.
8. Arusoğlu G, Kabakçi E, Köksal G, Merdol TK. Orthorexia nervosa and adaptation of ORTO-11 into Turkish. Turk Psikiyatri Derg. 2008;19(3):283–91.
9. Poyraz CA, Tüfekçioğlu EY, Özdemir A, Baş A, Kani AS, Erginoz E, Duran A. Relationship between orthorexia and obsessive-compulsive symptoms in patients with generalised anxiety disorder, panic disorder and obsessive compulsive disorder. Yeni Symp. 2016;53(4):22–6.
10. Yılmaz H, Karakuş G, Tamam L, Demirkol ME, Namlı Z, Yeşiloğlu C. Association of orthorexic tendencies with obsessive-compulsive symptoms, eating attitudes and exercise. Neuropsychiatr Dis Treat. 2020;3035–44.
11. Tamam L, Yılmaz H. Linking orthorexia and obsessive-compulsive symptoms. In: Patel V, Preedy V, editors. Eating disorders. Springer; 2022. p. 1–28.
12. Vaccari G, Cutino A, Luisi F, Giambalvo N, Navab Daneshmand S, Pinelli M, et al. Is orthorexia nervosa a feature of obsessive–compulsive disorder? A multicentric, controlled study. Eat Weight Disord. 2021;26(8):2531–44.
13. Awad E, Salameh P, Sacre H, Malaeb D, Hallit S, Obeid S. Association between impulsivity and orthorexia nervosa/healthy orthorexia: any mediating effect of depression, anxiety, and stress? BMC Psychiatry. 2021;21:1–14.
14. Messer M, Liu C, Linardon J. Orthorexia nervosa symptoms prospectively predict symptoms of eating disorders and depression. Eat Behav. 2023;49:101734.
15. Łucka I, Domarecki P, Janikowska-Hołoweńko D, Plenikowska-Ślusarz T, Domarecka M. The prevalence and risk factors of orthorexia nervosa among school-age youth of Pomeranian and Warmian-Masurian voivodeships. Psychiatr Pol. 2019;53(2):383–98.
16. Donini LM, Marsili D, Graziani MP, Imbriale M, Cannella C. Orthorexia nervosa: validation of a diagnosis questionnaire. Eat Weight Disord. 2005;10(2):e28–32.
17. Rogoza R, Hallit S, Soufia M, Barthels F, Obeid S. Validation of the Arabic version of the Dusseldorf Orthorexia Scale (DOS) among Lebanese adolescents. J Eat Disord. 2021;9:1–9.
18. Roncero M, Barrada JR, Perpina C. Measuring orthorexia nervosa: psychometric limitations of the ORTO-15. Span J Psychol. 2017;20:E41.
19. Rogoza R. Investigating the structure of ORTO-15: a meta-analytical simulation study. Eat Weight Disord. 2019;24(2):363–5.
20. Gleaves DH, Graham EC, Ambwani S. Measuring, "orthorexia": development of the eating habits questionnaire. Int J Educ Psychol Assess. 2013;12(2):1–18.
21. Barthels F, Meyer F, Pietrowsky R. Duesseldorf orthorexia scale–construction and evaluation of a questionnaire measuring orthorexic eating behavior. Z Klin Psychol Psychother. 2015;44:97–105.
22. Barrada JR, Roncero M. Bidimensional structure of the orthorexia: development and initial validation of a new instrument. Ann Psychol. 2018;34(2):283–91.
23. Oberle CD, De Nadai AS, Madrid AL. Orthorexia Nervosa Inventory (ONI): development and validation of a new measure of orthorexic symptomatology. Eat Weight Disord. 2021;26:609–22.
24. Chard CA, Hilzendegen C, Barthels F, Stroebele-Benschop N. Psychometric evaluation of the English version of the Düsseldorf Orthorexie Scale (DOS) and the prevalence of orthorexia nervosa among a US student sample. Eat Weight Disord. 2019;24:275–81.
25. Brytek-Matera A. The polish version of the Düsseldorf Orthorexia Scale (PL-DOS) and its comparison with the English version of the DOS (E-DOS). Eat Weight Disord. 2021;26:1223–32.
26. Cerolini S, Vacca M, Zagaria A, Donini LM, Barbaranelli C, Lombardo C. Italian adaptation of the Düsseldorf Orthorexia Scale (I-DOS): psychometric properties and prevalence of orthorexia nervosa among an Italian sample. Eat Weight Disord. 2022;27:1405–13.
27. He J, Ma H, Barthels F, Fan X. Psychometric properties of the Chinese version of the Düsseldorf Orthorexia Scale: prevalence and demographic correlates of orthorexia nervosa among Chinese university students. Eat Weight Disord. 2019;24:453–63.
28. Lasson C, Barthels F, Raynal P. Psychometric evaluation of the French version of the Düsseldorfer Orthorexia Skala (DOS) and prevalence of orthorexia nervosa among university students. Eat Weight Disord. 2021;26:2589–96.
29. Parra-Fernández ML, Onieva-Zafra MD, Fernández-Muñoz JJ, Fernández-Martínez E. Adaptation and validation of the Spanish version of the DOS questionnaire for the detection of orthorexic nervosa behavior. PLoS ONE. 2019;14(5):e0216583.
30. Polit DF, Hungler BP. Self-reports. In: Nurs Res Princ Methods. 6th ed.: Lippincott Williams Wilkins. Philadelphia; 1991. p. 331–62.
31. Kang H. Sample size determination and power analysis using the G* Power software. J Educ Eval Health Prof. 2021;18:17.
32. Hamılton M. A rating scale for depression. J Neurol Neurosurg Psychiatry. 1960;23:56–62.
33. Akdemir A, Örsel DS, Dağ İ, Türkçapar MH, İşcan N, Özbay H. Hamilton Depresyon Derecelendirme Ölçeği (HDDÖ)'nin geçerliliği-güvenilirliği ve klinikte kullanımı. 3P Derg. 1996;4(4):251–9.
34. Hamılton M. The assessment of anxıety states by ratıng. Br J Med Psychol. 1959;32(1):50–5.
35. Yazıcı MK, Demir B, Tanrıverdi N, Karaağaoğlu E, Yolaç P. Hamilton Anksiyete Değerlendirme Ölçeği, Değerlendiriciler Arası Güvenirlik ve Geçerlik Çalışması. Türk Psikiyatr Derg. 1998;9(2):114–7.
36. Goodman WK, Price LH, Rasmussen SA, Mazure C, Fleischmann RL, Hill CL, et al. The Yale–Brown obsessive compulsive scale: i. development, use, and reliability. Arch Gen Psychiatry. 1989;46(11):1006–11.
37. Tek C, Uluğ B, Rezaki BG, Tanriverdi N, Mercan S, Demir B, Vargel S. Yale–Brown obsessive compulsive scale and US national institute of mental

health global obsessive compulsive scale in Turkish: reliability and validity. Acta Psychiatr Scand. 1995;91:410–3.
38. Garner DM, Garfinkel PE. The eating attitudes test: an index of the symptoms of anorexia nervosa. Psychol Med. 1979;9(2):273–9.
39. Savasir I, Erol N. Yeme tutum testi: anoreksia nervosa belirtiler indeksi. Psikol Derg. 1989;7(23):19–25.
40. Oberle CD, De Nadai AS, Madrid AL. Orthorexia Nervosa Inventory (ONI): development and validation of a new measure of orthorexic symptomatology. Eat Weight Disord. 2021;26(2):609–22.
41. Kaya S, Uzdil Z, Çakıroğlu FP. Validation of the Turkish version of the Orthorexia Nervosa Inventory (ONI) in an adult population: its association with psychometric properties. Eat Weight Disord. 2022;27(2):729–35.
42. Depa J, Schweizer J, Bekers SK, Hilzendegen C, Stroebele-Benschop N. Prevalence and predictors of orthorexia nervosa among German students using the 21-item-DOS. Eat Weight Disord. 2017;22(1):193–9.
43. Brytek-Matera A, Sacre H, Staniszewska A, Hallit S. The prevalence of orthorexia nervosa in polish and Lebanese adults and its relationship with sociodemographic variables and BMI ranges: a cross-cultural perspective. Nutrients. 2020;12(12):3865.
44. Barthels F, Meyer F, Huber T, Pietrowsky R. Orthorexic eating behavior as a coping strategy in patients with anorexia nervosa. Eat Weight Disord. 2017;22(2):269–76.
45. Kinzl JF, Hauer K, Traweger C, Kiefer I. Orthorexia nervosa in dieticians. Psychother Psychosom. 2006;75:395–6.
46. Segura-Garcia C, Papaianni MC, Caglioti F, Procopio L, Nistico CG, Bombardiere L, Ammendolia A, Rizza P, De Fazio P, Capranica L. Orthorexia nervosa: a frequent eating disordered behavior in athletes. Eat Weight Disord. 2012;17:226–33.
47. Brytek-Matera A, Fonte ML, Poggiogalle E, Donini LM, Cena H. Orthorexia nervosa: relationship with obsessive-compulsive symptoms, disordered eating patterns and body uneasiness among Italian university students. Eat Weight Disord. 2017;22(4):609–17.
48. Barthels F, Meyer F, Huber T, Pietrowsky R. Analysis of orthorexic eating behavior in patients with eating disorder and obsessive-compulsive disorder [Analyse des orthorektischen ernährungsverhaltens von Patienten mit Essstörungen und mit Zwangsstörungen]. Z Klin Psychol Psychother. 2017;46(1):32–41.

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