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Are increased symptoms of orthorexia nervosa linked to self-perceived body image and nutritional adequacy of Turkish adults?

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ABSTRACT

This cross-sectional study, conducted on 4003 participants aged between 18 and 45, aims to contribute to orthorexia nervosa (ON) research by examining the relationship between ON, body image and nutritional adequacy. The Orthorexia Nervosa-11 scale (ORTO-11) and body perception scale were applied to individuals, and food consumption records were taken with a 24-hour dietary recall method. The study found that more individuals with orthorexia nervosa (ON) considered themselves overweight compared to non-ON individuals. Evaluating diet quality, the mean adequacy ratio was significantly higher in ON individuals. Nutrient adequacy ratios for total fiber, magnesium, zinc, thiamine, folic acid, and vitamin C were higher, while those for carbohydrate and iron were lower in ON individuals. Additionally, increasing the number of snacks, protein, and total fiber adequacy decreased the ORTO-11 score. Distorted body image perception may be a risk factor for ON, but healthy eating fixation does not lead to nutrient inadequacy unless it involves progressive food restriction.

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KEYWORDS

Orthorexia nervosa; ORTO-11; nutritional adequacy; mean adequacy ratio; body image perception

Introduction

In recent years, there has been a noticeable increase in awareness in Western societies about the positive effects of healthy eating on physical and mental health, leading to a growing prevalence of “clean eating” ideals (Horovitz and Argyrides 2023). “clean eating” is the preference for whole and minimally processed foods while limiting the consumption of artificial, refined, or processed foods (Dickinson et al. 2018). However, the obsession with these behavioral patterns can lead to negative consequences in health and quality of life (Decrease in emotional well-being and interpersonal relationships, etc.) (Horovitz and Argyrides 2023). An eating behavior pattern characterized by obsessions with food health, quality, and purity was first emphasized in the literature by Steven Bratman in 1997 and was named “Orthorexia Nervosa (ON)” (Pauzé et al. 2021). Criteria for diagnosing ON: (i) adherence to a restrictive diet consisting of inflexible rules regarding the consumption of only healthy foods; (ii) intense emotional distress and anxiety following a perceived dietary

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violation; and (iii) impairments in daily functioning resulting from extreme dietary restrictions (Dunn and Bratman 2016).

Nowadays, the prevalence of ON has become more common in Western societies. Niedzielski and Kaźmierczak-Wojtaś (2021) reported that the prevalence rates of ON symptoms in the general population ranged from 6.9% to 75.2%. In the study conducted by Yilmaz and Dundar (2022) in Samsun/Turkey, it was found that 19% of the participants had a tendency to ON. The exact cause of the commonly observed condition in society has not been fully understood; however, it is believed to stem from multiple factors such as perfectionism, excessive preoccupation with body weight and shape, and body image distortion (Horovitz and Argyrides 2023). When first defined, ON was thought to be a disorder solely associated with the consumption of healthy foods; however, it is currently accepted that it may also encompass body image distortion (López-Gil et al. 2023). Media promotion of unrealistic body standards, the pervasive influence of social media, and societal pressures to conform to certain body ideals contribute to an increase in disordered eating behaviors across different age groups and genders (Aparicio-Martinez et al. 2019).

Body image is a multidimensional psychological concept covering attitudes and perceptions of one's body, including physical appearance, and encompassing attitudes and perceptions toward one's body. Body image disorder refers to the inconsistency between the person's self-perceived appearance and the actual appearance (Pauzé et al. 2021). Excessive importance placed on body image is considered to be a hidden factor for obsession with healthy eating (Messer et al. 2022). Many studies conducted in different countries have shown that negative body image perception is associated with ON symptoms (Almeida et al. 2018). However, it is essential to note that these relationships are only sometimes recurring (McComb and Mills 2019; He et al. 2021). These conflicting findings also indicate the complexity of the relationship between negative body image and ON, requiring further research (Messer et al. 2022).

Initially aiming to maximize overall health, ON eventually turns into a situation where eating becomes the axis of a person's life, causing long-term harm to one's life (Ruiz and Quiles 2021). ON often leads to a strict diet that results in the elimination of certain types of food from the diet, such as meat and its products, dairy and its products, grains, ready-made products, non-seasonal foods, non-organic foods, and foods rich in fat, salt, or sugar (Kaźmierczak-Wojtaś and Drozd 2022). However, ON symptoms have also been associated with healthy lifestyle choices, like consuming more vegetables and exercising (Şentürk et al. 2022). Acceptable foods and food groups may vary from person to person, but the typical characteristics of the group are the progressive character of the dietary restrictions imposed (Kaźmierczak-Wojtaś and Drozd 2022). As a result, failure to provide nutritional diversity may result in inadequate intake of essential nutrients such as proteins, fats, and some vitamins and minerals. Therefore, healthcare professionals must be aware of the potential nutritional consequences of ON and provide appropriate support and intervention to address both the physical and psychological aspects of the disorder (Horovitz and Argyrides 2023). However, limited studies have focused on understanding which food groups are eliminated from the diet. Therefore, the consequences of dietary restrictions in ON regarding nutrient adequacy need to be clarified (Mitrofanova et al. 2021). Generally, ON studies have focused on the psychological aspects of eating behaviors and reported on the eating behaviors of various groups following specific diets. Only a limited number of studies have evaluated the nutritional content of orthorexic diets (Grammatikopoulou et al. 2018; Mitrofanova et al. 2021). Therefore, the current study, which also examines nutritional adequacy, can shed light on the eating habits of the ON population. The study aims to examining the relationship between ON, body image, and nutritional adequacy.

Materials and methods

Study design and population

The cross-sectional study was conducted on a total of 4003 individuals (1997 men and 2006 women) aged between 18–45 years. Participants were included in the study in Ankara (the capital of Turkey) between 24 January 2023, and 4 February 2024. 542 people refused to participate in the study, and 231 people were excluded from the study due to incomplete data. Individuals diagnosed with neurological diseases were excluded from the study due to difficulties in healthy communication and concerns about not answering the questions correctly. Additionally, those who were on a diet in the last 6 months, pregnant and lactating women were not included in the study.

In the study, individuals' descriptive information, such as age, gender, marital status, education level, profession, health status, and nutritional habits, were questioned by the face-to-face interview method. Additionally, the Orthorexia Nervosa-11 scale (ORTO-11) and body perception scale were applied to individuals, and food consumption records were taken with a 24-hour dietary recall method.

The study has been approved by the Amasya University Rectorate Non-Interventional Clinical Research Ethics Committee at the meeting held on 19 January 2023, with decision number 02. Volunteers who agreed to participate were given detailed information about the study, and consent was obtained. The study was performed in line with the principles of the Declaration of Helsinki.

Anthropometric measurements and evaluation

The body weight (kg) and height (cm) measurements, obtained based on participant declarations, have been recorded. The researchers measured and recorded the waist and hip circumference using the appropriate technique (Lohman 1988).

Body mass index

Body mass index (BMI) was calculated using the body weight/height² (kg/m²). The resulting BMI values were classified according to the World Health Organization (WHO) standards (WHO 2003)

Body image perception

The Body Image Scale (Figure 1) was utilized to assess individuals' body perceptions. Body image perception in Supplementary Method.

Food consumption

The participants' eating habits were questioned with the help of a survey form, and the researchers took their food consumption records using a 24-hour dietary recall method. The book “Yemek ve Besin Fotoğraf Kataloğu: Ölçü ve Miktarlar” was used to show participants order to determine the portion sizes of foods (Rakıcioğlu et al. 2012). The foods included in the meals were questioned, and the books “Standart Yemek Tarifeleri, Geleneksel Türk Mutfağından Seçmeler” and “Türk Mutfağından Örnekler” were used to determine the types and amounts of nutrients included in the meals (Baysal et al. 2000; Karadağ 2014; Merdol 2014). The energy and macro and micronutrient values of foods consumed daily were calculated using the Nutrition Information System (BeBis) program 9.0 full version.

NAR (Nutrient adequacy ratio): NAR was calculated with the following equation (Hjertholm et al. 2019):

$$\text{NAR}:(\text{Nutrient intake amount} * 100)/\text{DRI}$$

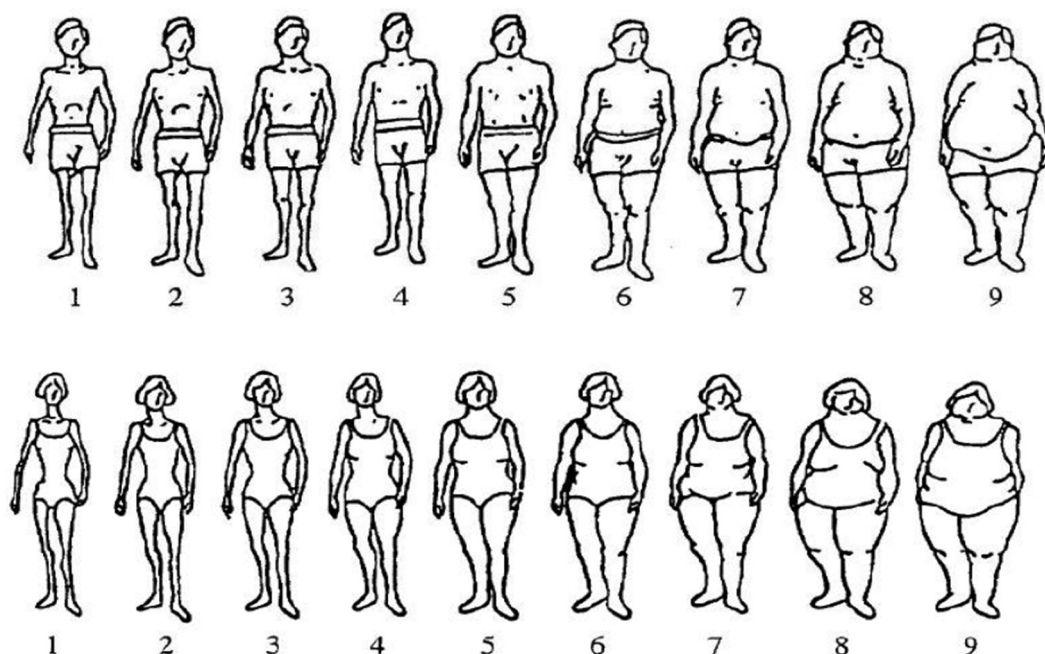


Figure 1. Images of perceived body shape from the rating scale adapted from the article by Stunkard et al. (1983)

MAR (Mean adequacy ratio): MAR was calculated with the following equation (Krebs-Smith and Diane Clark 1989):

MAR: Total NAR value of the selected nutrients/Number of nutrients

Details about Nutrient adequacy ratio (NAR), Mean adequacy ratio (MAR) calculations are given in the Supplementary method.

ORTO-11 scale

Each item in the ORTO-11 scale is answered using a 4-point Likert scale. According to the ORTO-11 score, ≤ 27 points are classified as the group with an obsession with healthy eating (ON), and > 27 points are classified as the group with no obsession with healthy eating (non-ON) (Ergin 2015). Details about ORTO-11 calculations are given in the Supplementary method.

Statistical analysis

The data obtained from the study were analyzed using appropriate statistical methods using the IBM Statistical Package for the Social Sciences 22.0 (SPSS, version 22.0) statistical package program. While evaluating the research data, mean and standard deviation (SD) were used for quantitative variables, and number (n) and percentage (%) were used for qualitative variables in descriptive statistical analyses. When comparing two independent groups, the “Independent Sample t-test” was used if the variables were normally distributed, and the “Mann Whitney U test” was used if they were not. In qualitative data analysis, the “chi-square test” was used to evaluate whether the difference between the observed and expected frequencies was significant. “Spearman correlation coefficient” was used to examine the relationship between two quantitative variables that do not have a normal distribution. A multiple linear regression model was used to identify independent

predictors of ON. Each nutrient's NAR value and MAR value were calculated according to gender, and the difference between ON and non-ON individuals was shown with a radar chart. All statistical calculations were evaluated at a significance level of $p < 0.05$ with a 95% confidence interval.

Results

The study was conducted with 4003 adult participants with an average age of 27.50 ± 7.80 years. According to the ORTO-11 scores, 54.9% of the participants were in the ON group, and 45.1% were in the non-ON group (Table 1).

The participants' eating habits, anthropometric measurements, and body perceptions according to the ORTO-11 scale are given in Table 2. While the daily snack frequencies did not differ, the number of main meals in ON individuals was higher than in non-ON individuals ($p < 0.05$). Additionally, the use of any weight loss product/mixture was significantly higher in orthorexic participants ($p < 0.05$). While the body weight and waist/hip ratios of participants with ON were found to be significantly lower than those with non-ON ($p < 0.05$), no difference was detected in terms of BMI and waist circumference measurements ($p > 0.05$). Additionally, the participants' body perception in the study differed significantly from each other ($p < 0.05$). This difference resulted from the fact that among participants with ON, more people considered themselves normal and overweight compared to non-ON ($p < 0.05$) (Table 2).

The mean adequacy ratio [MAR (%)] in individuals with ON was found to be significantly higher than non-ON ($p < 0.05$). Still, no difference was detected in MAR classification ($p > 0.05$). While the NAR was generally higher in participants with ON, only carbohydrate and iron intakes were significantly higher in non-ON ($p < 0.05$). The adequacy rates for total fiber, magnesium, zinc, vitamin A, thiamine, riboflavin, folate, and vitamin C were found to be significantly higher in ON participants ($p < 0.05$) (Table 3).

Table 1. General characteristics of the participants.

General features	Total participants (n = 4003)
Age (mean$\pm$SD)	27.50 $\pm$ 7.80
Gender, n (%)	
Female	2006 (50.1)
Male	1997 (49.9)
Educational status, n (%)	
Primary school	240 (6.0)
High school	683 (17.1)
University	2926 (73.1)
Postgraduate	154 (3.8)
Education time, mean$\pm$SD	14.41 $\pm$ 2.71
Working status, n (%)	
Working	1680 (42.0)
Not working	2323 (58.0)
Occupation, n (%)	
Housewife	304 (7.6)
Officer	749 (18.7)
Worker	490 (12.2)
Self-employment	208 (5.2)
Retired	5 (0.1)
Student	1928 (48.2)
Other	319 (8.0)
Marital status, n (%)	
Married	2693 (67.3)
Single	1310 (32.7)
ORTO-11 score (mean$\pm$SD)	26.92 $\pm$ 4.64
ON (n, %)	2198 (54.9)
Non-ON (n, %)	1805 (45.1)

Chi-square test, independent sample t test.

Table 2. Nutritional habits, anthropometric measurements, and body perception of the participants according to orthorexic tendency status.

Parameters	ON (n = 2198)	Non-ON (n = 1805)	p
The belief in being adequately and balanced nourished (n, %)			
Yes	1138 (51.8)	802 (44.4)	0.000*
No	1060 (48.2)	1003 (55.6)	
The number of main meals (mean±SD)	2.37 ± 0.53	2.33 ± 0.54	0.047*
The number of snacks (mean±SD)	1.66 ± 0.95	1.66 ± 0.93	0.877
Skipped main meal (n, %)			
Breakfast	592 (42.1)	630 (51.6)	0.000*
Lunch	704 (50.0)	472 (38.7)	0.000*
Dinner	111 (7.9)	119 (9.7)	0.068
The usage of weight loss products/mixtures (n, %)			
Yes	215 (9.8)	106 (5.9)	0.000*
No	1983 (90.2)	1699 (94.1)	
Anthropometric measurements (mean±SD)			
Body weight (kg)	68.98 ± 13.50	69.90 ± 13.25	0.030*
Waist circumference (cm)	80.59 ± 11.76	80.98 ± 11.46	0.296
Waist/hip ratio	0.83 ± 0.90	0.84 ± 0.08	0.002*
BMI (kg/m ²)	23.89 ± 3.85	23.75 ± 3.59	0.217
BMI Classification (n, %)			
Underweight	109 (4.9)	92 (5.1)	0.096
Normal	1329 (60.5)	1105 (61.2)	
Overweight	595 (27.1)	508 (28.2)	
Obese	165 (7.5)	100 (5.5)	
Self-perceived Body Image (n, %)			
Underweight	412 (18.7) ^a	341 (18.9) ^a	0.010*
Normal	1475 (67.1) ^a	1272 (70.5) ^b	
Overweight	292 (13.3) ^a	180 (10.0) ^b	
Obese	19 (0.9) ^a	12 (0.6) ^a	

Since more than one answer was given, the number n was used in the % calculation. BMI:Body mass index. Chi-square test, independent sample t test. The “a” and “b” superscripts show the results of pairwise comparisons between groups; values with unlike letters were significantly different among groups. The bold values indicate statistically significant values ($p < 0.05$).

Figure 2 shows NAR and MAR values of non-ON and ON individuals according to gender. Protein, phosphorus, vitamin A, riboflavin, vitamin B6, vitamin B12, and vitamin C intakes were higher in men with ON ($p < 0.05$). In women with ON, carbohydrate, total fiber, magnesium, vitamin E, folic acid, and vitamin C intakes were found to be higher ($p < 0.05$) (Figure 2; Supplementary Table 1).

Regression models were created to identify potential factors affecting individuals' orthorexic tendency status (Table 4). In the first stage, gender, age, and education time were added to the models, then body weight and BMI and the number of main and snack meals were added. Finally, model 5 was created by adding MAR and NAR values of some macronutrients. According to Model 5, a one-unit increase in age, education time, number of snacks, protein, and total fiber adequacy reduced the ORTO-11 score by 0.047, 0.085, 0.175, 0.005, and 0.014 points, respectively ($p < 0.05$). In addition, a one-unit increase in carbohydrate sufficiency increased the ORTO-11 score by 0.010 points ($p < 0.05$) (Table 4).

Discussion

Although ON is not classified as a disease, it has become a subject that attracts the attention of researchers with its rapidly increasing frequency. Many studies have determined the incidence of ON in adults; however, the results vary within a wide range, from 6.9% to 75.2% (Niedzielski and Kaźmierczak-Wojtaś 2021; Pökön et al. 2021). In the study, 54.9% of the participants were found to have an orthorexic tendency (Table 1). Differences in nutritional habits between countries and regions and sociodemographic characteristics of the sample group may have caused the prevalence of ON to vary within a wide range.

Table 3. Nutrient adequacy status of the participants according to orthorexic tendency status.

Parameters	ON (<i>n</i> = 2198)	Non-ON (<i>n</i> = 1805)	<i>p</i>
NAR (mean±SD)			
Protein	126.54 ± 50.94	123.38 ± 47.06	0.106
Carbohydrate	146.07 ± 59.47	150.29 ± 56.78	0.002*
Total fiber	64.37 ± 34.71	57.47 ± 28.58	0.000*
Calcium	58.87 ± 28.60	56.78 ± 26.98	0.050
Iron	88.39 ± 62.38	96.12 ± 62.12	0.000*
Magnesium	68.08 ± 31.34	64.10 ± 28.40	0.000*
Phosphorus	147.01 ± 57.57	143.90 ± 53.68	0.151
Zinc	94.48 ± 43.15	90.25 ± 38.40	0.001*
Vitamin A	132.30 ± 236.07	112.05 ± 189.75	0.000*
Vitamin E	131.73 ± 89.90	131.54 ± 85.02	0.469
Thiamine	71.38 ± 31.37	68.94 ± 29.98	0.018*
Riboflavin	95.95 ± 44.64	90.52 ± 38.69	0.000*
Niacin	158.94 ± 84.25	157.00 ± 79.40	0.598
Vitamin B ₆	98.44 ± 47.47	96.54 ± 42.80	0.723
Vitamin B ₁₂	177.98 ± 257.60	165.28 ± 176.48	0.189
Folic acid	69.06 ± 35.34	65.64 ± 32.42	0.004*
Vitamin C	109.25 ± 110.90	92.92 ± 80.82	0.000*
MAR			
MAR (%) (mean±SD)	77.65 ± 14.27	76.40 ± 14.41	0.006*
Insufficient (≤50) (<i>n</i> , %)	97 (4.4)	98 (5.4)	0.110
Needs improvement (51–80) (<i>n</i> , %)	1010 (46.0)	862 (47.8)	
Good (>80) (<i>n</i> , %)	1091 (49.6)	845 (46.8)	

NAR: Nutrient adequacy ratio; MAR: Mean adequacy ratio.

Independent sample t test, Mann-Whitney U test.

The bold values indicate statistically significant values (**p* < 0.05).

Findings regarding the role of age as a risk factor for ON are mixed. Various studies have reported that ON is more common among young adults than older adults. In a sample of Turkish students, ON was found to be more common among students under 21 years than among students over 21 years (Fidan et al. 2010). Another study showed an increased trend towards ON in participants younger than 29 years of age (Dell'osso et al. 2016). Some studies did not observe a statistically significant difference between age and obsession with healthy eating (Herranz Valera et al. 2014; Turner and Lefevre 2017). Since research in the literature has predominantly focused on individuals aged between 20–30 years, the study is essential for considering adults over 30 years. According to the study, a one-unit increase in age decreased the ORTO-11 score by 0.047 points (Table 4). As the ORTO-11 score decreases, the orthorexic tendency increases. It seems possible to say that the incidence of ON is higher in older ages. However, the relationship should be further investigated with new studies due to conflicting study results.

Since anxiety about healthy eating is high in ON, individuals with orthorexic tendencies are expected to be more sensitive about consuming regular meals (Yılmaz and Dundar 2022). When the meal consumption of individuals was examined in the study, it was determined that individuals with ON tendency had more main meals (Table 2). Additionally, increasing the number of snacks by one unit decreased the ORTO-11 score by 0.175 points (Table 4). Accordingly, it can be said that the number of meals consumed is generally higher in orthorexic individuals. Similarly, a study found that individuals with orthorexic tendencies ate four or more meals a day and had a 3–4 hour interval between meals (Plichta and Jezewska-Zychowicz 2020). Meal skipping, one of the critical factors in healthy eating habits, refers to the omission of one or more traditional main meals (breakfast, lunch, or dinner) during the day. Notably, skipping breakfast is associated with lower diet quality and reduced total energy, vitamin, and mineral intake (Kabakuş Aykut and Bilici 2022). Although it would be expected for individuals with orthorexic tendencies to skip meals less frequently, studies on the topic are limited; the specific meal skipped, and the reasons for meal skipping have yet to be discovered. Plichta and colleagues (2020) reported that university students with ON tendencies skipped breakfast and dinner less frequently (Plichta and Jezewska-Zychowicz

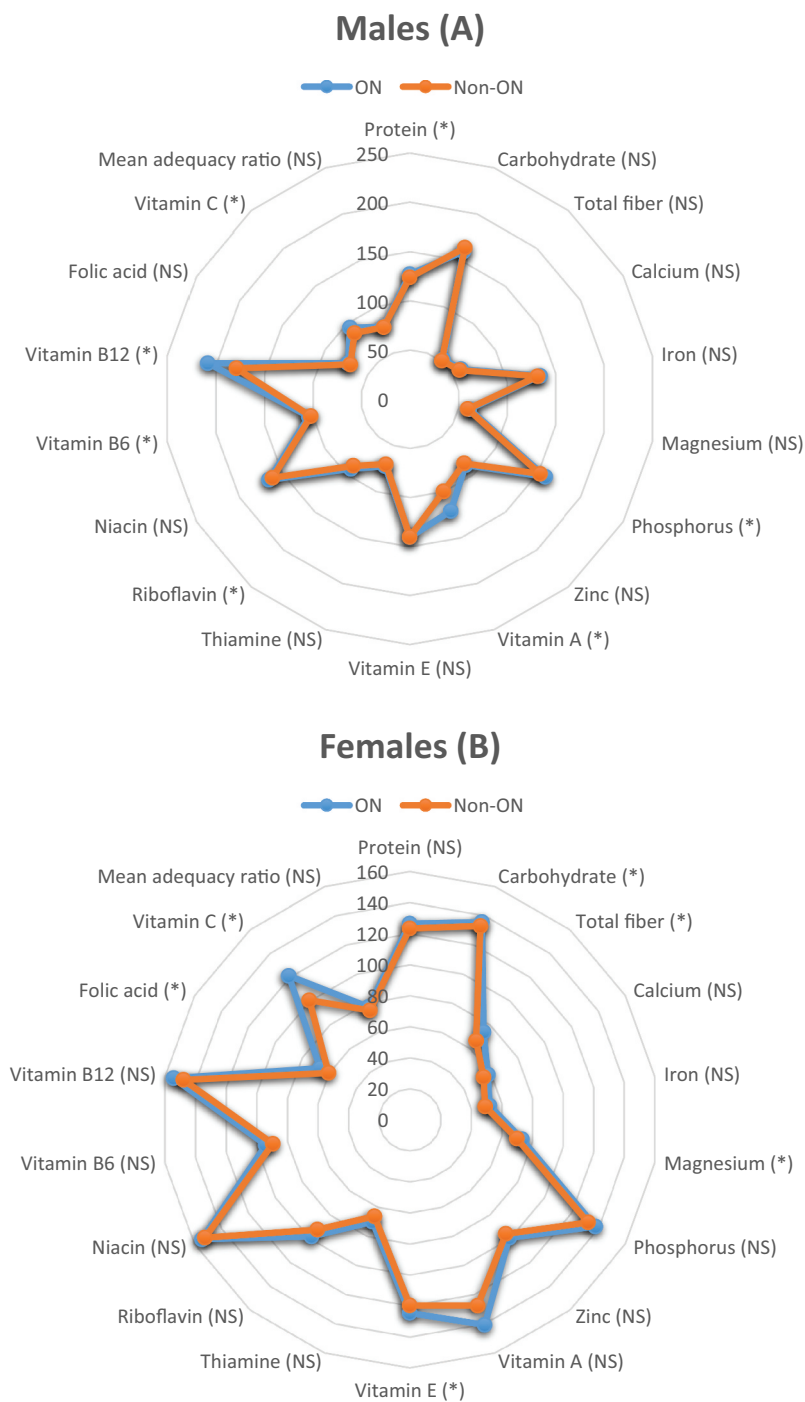


Figure 2. Radar chart of nutrient adequacy and mean adequacy ratio regarding gender (A) males, (B) females, and orthorexia nervosa tendency. NS: not significant; * $p < 0.05$

Table 4. Relationship between ORTO-11 and sociodemographic characteristics, eating habits, anthropometric measurements, and nutrient adequacy using linear regression models.

Parameters	Model 1			Model 2			Model 3			Model 4			Model 5		
	β	se	p	β	se	p	β	se	p	β	se	p	β	se	p
Age	-0.060	0.010	0.000	-0.052	0.011	0.000	-0.053	0.011	0.000	-0.052	0.011	0.000	-0.047	0.011	0.000
Gender	1.568	0.144	0.000	1.699	0.203	0.000	1.657	0.203	0.000	1.671	0.203	0.000	1.135	0.223	0.000
Education time	-0.088	0.028	0.002	-0.094	0.028	0.001	-0.100	0.028	0.000	-0.097	0.028	0.001	-0.085	0.028	0.002
Body weight				-0.004	0.014	0.760	-0.003	0.013	0.833	-0.002	0.013	0.875	-0.005	0.013	0.706
BMI				-0.036	0.043	0.399	-0.039	0.042	0.364	-0.037	0.042	0.377	-0.027	0.042	0.522
Main meal							-0.285	0.136	0.037	-0.221	0.138	0.109	-0.212	0.137	0.123
Snack							-0.193	0.077	0.012	-0.149	0.078	0.057	-0.175	0.078	0.025
MAR										-0.016	0.005	0.002	-0.005	0.008	0.534
NAR															
Protein													-0.005	0.002	0.014
Carbohydrate													0.010	0.002	0.000
Total fiber													-0.014	0.003	0.000
Adjusted R ²	0.036			0.037			0.039			0.042			0.050		

BMI: Body mass index; NAR: Nutrient adequacy ratio; MAR: Mean adequacy ratio
Model 1: $Y = 27.448 - 0.60X_1 + 1.568X_2 - 0.88X_3$
Model 2: $Y = 28.285 - 0.052X_1 + 1.699X_2 - 0.094X_3 - 0.004X_4 - 0.036X_5$
Model 3: $Y = 29.415 - 0.053X_1 + 1.657X_2 - 0.100X_3 - 0.003X_4 - 0.039X_5 - 0.285X_6 - 0.193X_7$
Model 4: $Y = 30.260 - 0.052X_1 + 1.671X_2 - 0.097X_3 - 0.002X_4 - 0.037X_5 - 0.221X_6 - 0.149X_7 - 0.016X_8$
Model 5: $Y = 29.934 - 0.047X_1 + 1.135X_2 - 0.085X_3 - 0.005X_4 - 0.027X_5 - 0.212X_6 - 0.175X_7 - 0.005X_8 - 0.005X_9 + 0.010X_{10} - 0.014X_{11}$
(X_1 = Age, X_2 = Gender, X_3 = Education time, X_4 = Body weight, X_5 = BMI, X_6 = Main meal, X_7 = Snack, X_8 = Protein, X_9 = Carbohydrate and X_{10} = Total fiber).

2020). In our study, however, although individuals with orthorexic tendencies had lower rates of skipping breakfast and dinner than non-orthorexic individuals, approximately half of the participants skipped lunch, which was higher than healthy individuals (Table 2). This suggests that although individuals obsessed with healthy eating do not generally skip breakfast and dinner due to concerns about healthy eating, they may skip lunch, mainly due to lack of financial means. This is not surprising, considering that approximately half of the sample group of the study (48.2%) were university students (Table 1). Additionally, in a study where reasons for skipping meals were investigated among individuals at risk of eating disorders, the desire to avoid weight gain emerged as a prominent factor (Kabakuş Aykut and Bilici 2022). This suggests that individuals with orthorexic tendencies may skip lunch intentionally to restrict food intake. The result showing a higher prevalence of using weight loss products/mixtures among ON participants compared to non-ON individuals supports this idea (Table 2). In future studies, a detailed investigation of the reasons for meal skipping among orthorexic individuals will help shed light on the issue.

Findings regarding the relationship between anthropometric measurements and body composition and ON are inconsistent in the literature, and there are two different views on this subject. One of these is that orthorexic individuals restrict food choices for a healthy diet, and this may cause body weight loss. The other is that increased body weight and fat may increase orthorexic tendencies (Asil and Sürücüoğlu 2015; McComb and Mills 2019). The study observed that healthy participants' body weight and waist-to-hip ratio were higher than those with ON. However, there was no difference in BMI and waist circumference (Table 2). Additionally, when regression models were established, no relationship was found between body weight and BMI and ORTO-11 scores (Table 4). Similarly, no relationship was found between BMI and ON tendency in studies conducted in different countries (Karakus et al. 2017; Grammatikopoulou et al. 2018; Oberle and Lipschuetz 2018). The relationship between BMI and ON remains unclear (Asil and Sürücüoğlu 2015; Brytek-Matera et al. 2019). However, it is generally thought that being overweight or obese may trigger increased orthorexic tendencies. It is predicted that as the severity of orthorexic tendency increases, anthropometric measurements and body composition may decrease (McComb and Mills 2019). Accordingly, maintaining an average body weight may protect against orthorexic tendencies.

While it is not fully understood whether body image disturbance and body dissatisfaction are diagnostic features of ON, it has been shown that ON symptoms are associated with certain specific body image attitudes (Pauzé et al. 2021). Individuals with ON typically have concerns about body weight, body shape, and appearance (Barnes and Caltabiano 2017). The risk of ON increases significantly in individuals who are excessively concerned about body weight and attach more importance to body appearance (McComb and Mills 2019). A study conducted with 220 adults in Australia revealed that higher perceived body weight was associated with an orthorexic tendency (Barnes and Caltabiano 2017). The study showed that the body perception of individuals with ON differed from those without it. Among individuals with ON, the rate of those who consider themselves overweight was higher than healthy individuals, while the rate of those who define themselves as normal was lower. Additionally, although not statistically significant, the rates of describing themselves as obese were also higher (Table 2). This indicates that ON is associated with higher perceived body weight. However, since anthropometric measurements were self-reported in the study, it is difficult to determine whether ON is associated with actual differences in body appearance or body image disturbances. Some studies have shown that individuals with orthorexic tendencies often evaluate body appearance negatively and experience body dissatisfaction (Barnes and Caltabiano 2017; Almeida et al. 2018). There are also opinions in the literature that individuals with orthorexic tendencies do not experience body dissatisfaction. This is explained by the fact that the primary goal of individuals is to eat healthily rather than lose body weight. Plichta et al. (2019) reported no significant difference between participants' body dissatisfaction classifications according to orthorexic tendencies. Due to the contradictory results, further studies are necessary to understand better the relationship between body image and body dissatisfaction and ON.

Diet quality can be analyzed according to the consumption frequency/amount of foods, thus helping to eliminate nutritional errors and make correct dietary choices. On the basis, dietary evaluation may help prevent nutrition-related disorders (Każmierczak-Wojtaś and Drozd 2022). In the current study, the MAR value, calculated from the NAR of each of the 17 nutrients, was used to determine diet adequacy, one of the indicators of diet quality. One of the distinctive aspects of the study is the lack of previous research evaluating the relationship between ON and nutritional adequacy through MAR. In the study, the MAR value was statistically higher in the ON group than in the non-ON group (Table 3). This does not support the hypothesis that food restriction increases in individuals with a tendency to ON. On the contrary, it has been observed that individuals obsessed with healthy eating have higher general nutritional adequacy and better diet quality. This suggests that nutritional preferences arise from personal tastes and the nutritional awareness of individuals with ON.

As the obsession with healthy eating progresses, the intake of energy and some nutrients may be limited. This can result in inadequate intake of certain nutrients (Horovitz and Argyrides 2023). One study reported that the healthy eating index was statistically higher in the ON group compared to the other group (Każmierczak-Wojtaś and Drozd 2022). Another study determined that ORTO-11 scores were lower in individuals who consumed fruits and vegetables (Varga et al. 2014). It has been found that the Mediterranean diet, which includes more olive oil, vegetables, nuts, fish, and white meat instead of red meat, is more common among individuals with orthorexic tendencies (McComb and Mills 2019). In the study, NAR was calculated from the nutrient intake amounts obtained from individuals' food consumption records, and as a result of the study, it was observed that NAR values were generally higher in participants with ON (Table 3). In addition, it was determined that a one-unit increase in protein and total fiber adequacy decreased the ORTO-11 score by 0.005 and 0.014 points, respectively, while a one-unit increase in carbohydrate sufficiency increased the ORTO-11 score by 0.010 points (Table 4). Individuals with ON generally tend to reduce carbohydrate intake and increase protein and fiber intake. In addition, almost all vitamin and mineral sufficiencies in individuals with ON are higher than in non-orthorexic individuals, suggesting that the obsession with healthy eating has not yet turned into progressive food restriction. On the contrary, Mitrofanova et al. (2021) found that individuals with ON had low intakes of energy, total fat, polyunsaturated fatty acids, fiber, iron, calcium, folic acid, and vitamins A and C. Accordingly, it shows that individuals with orthorexic tendencies do not have a single dietary pattern, that food restriction may vary depending on the severity of ON, and that the adopted restriction patterns cannot be defined as healthy under all circumstances. Although the results obtained from our study provide another perspective on the relationship between ON and nutritional adequacy, it is clear that further studies evaluating the nutritional content of orthorexic diets are necessary.

The study has some limitations that, despite its originality compared to other studies, necessitate further investigation with more advanced research. One of the most important limitations is inherent in cross-sectional study design and the use of survey data. Determining a causal relationship between variables in such studies is challenging, hence inevitable inconsistencies in results, as seen in the literature. Additionally, ensuring participants provide accurate responses regarding food consumption history through food intake records can be challenging.

Conclusion

The results obtained from the study suggest that distorted body image perception may be a risk factor for the development of ON, and orthorexic tendencies could affect dietary habits and adequacy. However, it should not be overlooked that if a fixation on healthy eating turns into progressive food restriction, this seemingly positive effect on nutritional adequacy could turn into a negative one. In future studies, examining the relationships between the severity of orthorexic tendencies and body image perception, as well as nutritional status, in more detail will contribute to

determining the etiology of ON and identifying potential positive/negative outcomes. Additionally, examining food preferences and levels of eating awareness would help in understanding the causes and potential outcomes of ON.

The strengths of the study are as follows. The study, conducted with 4003 participants, increases the generalizability of the results and provides data with high statistical power. Using specific measurement tools such as ORTO-11 and body perception scale increases the reliability of the results. It contributes to understanding the effects of ON on nutritional quality and the role of body perception in the development of ON. While it details the impact of ON on specific nutrients, it also reveals the relationship of ON with certain nutritional behaviors by examining the effect of eating habits such as the number of snacks and protein and fiber intake on the ORTO-11 score.

The study may guide future research and interventions by identifying potential risk factors for the development of ON (e.g. distortion in body image perception). It also helps better understand the risks of ON by showing that focusing on healthy eating does not lead to nutrient deficiencies unless it turns into extreme food restriction.

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References

- Almeida C, Vieira Borba V, Santos L. 2018. Orthorexia nervosa in a sample of Portuguese fitness participants. *Eat Weight Disord.* 23(4):443–451. doi: [10.1007/s40519-018-0517-y](https://doi.org/10.1007/s40519-018-0517-y).
- Aparicio-Martinez P, Perea-Moreno AJ, Martinez-Jimenez MP, Redel-Macías MD, Pagliari C, Vaquero-Abellan M. 2019. Social media, thin-ideal, body dissatisfaction and disordered eating attitudes: an exploratory analysis. *Nt J Environ Res Public Health.* 16(21):4177. doi: [10.3390/ijerph16214177](https://doi.org/10.3390/ijerph16214177).
- Asil E, Sürücüoğlu MS. 2015. Orthorexia nervosa in Turkish dietitians. *Ecol Food Nutr.* 54(4):303–313. doi: [10.1080/03670244.2014.987920](https://doi.org/10.1080/03670244.2014.987920).
- Barnes MA, Calabiano ML. 2017. The interrelationship between orthorexia nervosa, perfectionism, body image and attachment style. *Eat Weight Disord.* 22(1):177–184. doi: [10.1007/s40519-016-0280-x](https://doi.org/10.1007/s40519-016-0280-x).

- Baysal A, Kutluay MT, Çiğirim N, Sacır H, Başoğlu S. 2000. Türk mutfağından örnekler. Ankara: Hatiboğlu Yayınevi.
- Brytek-Matera A, Czepczor-Bernat K, Jurzak H, Kornacka M, Kołodziejczyk N. 2019. Strict health-oriented eating patterns (orthorexic eating behaviours) and their connection with a vegetarian and vegan diet. *Eat Weight Disord.* 24(3):441–452. doi: [10.1007/s40519-018-0563-5](https://doi.org/10.1007/s40519-018-0563-5).
- Dell'osso AM, Carpita B, Massimetti G, Pini S, Rivetti L, Gorrasi F, Tognetti R, Ricca V, Carmassi C. 2016. Orthorexia nervosa in a sample of Italian university population. *Riv Psichiatr.* 51(5):190–196. doi: [10.1708/2476.25888](https://doi.org/10.1708/2476.25888).
- Dickinson KM, Watson MS, Richard I. 2018. Are clean eating blogs a source of healthy recipes? A comparative study of the nutrient composition of foods with and without clean eating claims. *Nutrients.* 10(10):1440. doi: [10.3390/nu10101440](https://doi.org/10.3390/nu10101440).
- Dunn TM, Bratman S. 2016. On orthorexia nervosa: a review of the literature and proposed diagnostic criteria. *Eat Behav.* 21:11–17. doi: [10.1016/j.eatbeh.2015.12.006](https://doi.org/10.1016/j.eatbeh.2015.12.006).
- Ergin G. 2015. Orthorexia nervosa prevalence study in health-care and non-health care individuals [master's thesis]. Ankara: Baskent University.
- Fidan T, Ertekin V, Işıkay S, Kırpınar I. 2010. Prevalence of orthorexia among medical students in Erzurum, Turkey. *Compr Psychiatry.* 51(1):49–54. doi: [10.1016/j.comppsy.2009.03.001](https://doi.org/10.1016/j.comppsy.2009.03.001).
- Grammatikopoulou MG, Gkiouras K, Markaki A, Theodoridis X, Tsakiri V, Mavridis P, Dardavessis T, Chourdakis M. 2018. Food addiction, orthorexia, and food-related stress among dietetics students. *Eat Weight Disord.* 23(4):459–467. doi: [10.1007/s40519-018-0514-1](https://doi.org/10.1007/s40519-018-0514-1).
- He J, Zhao Y, Zhang H, Lin Z. 2021. Orthorexia nervosa is associated with positive body image and life satisfaction in Chinese elderly: evidence for a positive psychology perspective. *Int J Eat Disord.* 54(2):212–221. doi: [10.1002/eat.23400](https://doi.org/10.1002/eat.23400).
- Herranz Valera J, Acuña Ruiz P, Romero Valdespino B, Visioli F. 2014. Prevalence of orthorexia nervosa among ashtanga yoga practitioners: a pilot study. *Eat Weight Disord.* 19(4):469–472. doi: [10.1007/s40519-014-0131-6](https://doi.org/10.1007/s40519-014-0131-6).
- Hjertholm KG, Holmboe-Ottesen G, Iversen PO, Mdala I, Munthali A, Maleta K, Shi Z, Ferguson E, Kamudoni P. 2019. Seasonality in associations between dietary diversity scores and nutrient adequacy ratios among pregnant women in rural Malawi—a cross-sectional study. *Food Nutr Res.* 63(00). doi: [10.29219/fnr.v63.2712](https://doi.org/10.29219/fnr.v63.2712).
- Horovitz O, Argyrides M. 2023. Orthorexia and orthorexia nervosa: a comprehensive examination of prevalence, risk factors, diagnosis, and treatment. *Nutrients.* 15(17):3851. doi: [10.3390/nu15173851](https://doi.org/10.3390/nu15173851).
- Kabakuş Aykut M, Bilici S. 2022. The relationship between the risk of eating disorder and meal patterns in university students. *Eat Weight Disord.* 27(2):579–587. doi: [10.1007/s40519-021-01179-4](https://doi.org/10.1007/s40519-021-01179-4).
- Karadağ MG. 2014. Geleneksel Türk mutfağından seçmeler: Besin öğeleri açısından değerlendirilmesi. Ankara: Detay Yayıncılık.
- Karakus B, Hidiroğlu S, Keskin N, Karavus M. 2017. Orthorexia nervosa tendency among students of the department of nutrition and dietetics at a university in Istanbul. *N Clin Istanbul.* 4(2):117. doi: [10.14744/nci.2017.20082](https://doi.org/10.14744/nci.2017.20082).
- Kaźmierczak-Wojtaś N, Drozd M. 2022. Diet quality and level of nutrition knowledge among young people with orthorexic tendencies. *Nutrients.* 14(20):4333. doi: [10.3390/nu14204333](https://doi.org/10.3390/nu14204333).
- Krebs-Smith SM, Diane Clark L. 1989. Validation of a nutrient adequacy score for use with women and children. *J Am Diet Assoc.* 89(6):775–781. doi: [10.1016/S0002-8223\(21\)02247-1](https://doi.org/10.1016/S0002-8223(21)02247-1).
- Lohman TG. 1988 Anthropometric standardization reference manual. *Ergon.* 31(10):1493–1494.
- López-Gil JF, Tárraga-López PJ, Hershey MS, López-Bueno R, Gutiérrez-Espinoza H, Soler-Marín A, Fernández-Montero A, Victoria-Montesinos D. 2023. Overall proportion of orthorexia nervosa symptoms: a systematic review and meta-analysis including 30 476 individuals from 18 countries. *J Glob Health.* 13. doi: [10.7189/jogh.13.04087](https://doi.org/10.7189/jogh.13.04087).
- McComb SE, Mills JS. 2019. Orthorexia nervosa: a review of psychosocial risk factors. *Appetite.* 140:50–75. doi: [10.1016/j.appet.2019.05.005](https://doi.org/10.1016/j.appet.2019.05.005).
- Merdol T. 2014. Toplu beslenme servisi yapılan kurumlar için standart yemek tarifeleri. Ankara: Hatiboğlu Yayınları.
- Messer M, Liu C, McClure Z, Mond J, Tiffin C, Linardon J. 2022. Negative body image components as risk factors for orthorexia nervosa: prospective findings. *Appetite.* 178:106280. doi: [10.1016/j.appet.2022.106280](https://doi.org/10.1016/j.appet.2022.106280).
- Mitrofanova E, Mulrooney H, Petroczi A. 2021. Assessing psychological and nutritional impact of suspected orthorexia nervosa: a cross-sectional pilot study. *J Hum Nutr Diet.* 34(1):42–53. doi: [10.1111/jhn.12797](https://doi.org/10.1111/jhn.12797).
- Niedzielski A, Kaźmierczak-Wojtaś N. 2021. Prevalence of orthorexia nervosa and its diagnostic tools—A literature review. *Int J Eat Disord.* 18(10):5488. doi: [10.3390/ijerph18105488](https://doi.org/10.3390/ijerph18105488).
- Oberle CD, Lipschuetz SL. 2018. Orthorexia symptoms correlate with perceived muscularity and body fat, not BMI. *Eat Weight Disord.* 23(3):363–368. doi: [10.1007/s40519-018-0508-z](https://doi.org/10.1007/s40519-018-0508-z).
- Paüzé A, Plouffe-Demers M-P, Fiset D, Saint-Amour D, Cyr C, Blais C. 2021. The relationship between orthorexia nervosa symptomatology and body image attitudes and distortion. *Sci Rep.* 11(1):13311. doi: [10.1038/s41598-021-92569-2](https://doi.org/10.1038/s41598-021-92569-2).
- Plichta M, Jezewska-Zychowicz M, Gębski J. 2019. Orthorexic tendency in Polish students: exploring association with dietary patterns, body satisfaction and weight. *Nutrients.* 11(1):100. doi: [10.3390/nu11010100](https://doi.org/10.3390/nu11010100).
- Plichta M, Jezewska-Zychowicz P. 2020. Orthorexic tendency and eating disorders symptoms in Polish students: examining differences in eating behaviors. *Nutrients.* 12(1):218. doi: [10.3390/nu12010218](https://doi.org/10.3390/nu12010218).

- Pökön M, Başpınar MM, Basat O. 2021. Prevalence of orthorexia nervosa tendency in non-obese population: a cross-sectional study. *Anatol J Fam Med*. 4(3):252–256. doi: [10.5505/anatoljfm.2021.24085](https://doi.org/10.5505/anatoljfm.2021.24085).
- Rakıcıoğlu N, Tek N, Ayaz A, Pekca A. 2012. *Yemek ve Besin Fotoğraf Kataloğu. Ölçü ve Miktarlar*. 5th ed. Ankara: Merdiven Yayın.
- Ruiz Á, Quiles Y. 2021. Prevalence of orthorexia nervosa in Spanish university students: relationship with body image and eating disorders. *Anal Psicol*. 37(3):493–499.
- Şentürk E, Güler Şentürk B, Erus S, Geniş B, Coşar B. 2022. Dietary patterns and eating behaviors on the border between healthy and pathological orthorexia. *Eat Weight Disord*. 27(8):3279–3288. doi: [10.1007/s40519-022-01457-9](https://doi.org/10.1007/s40519-022-01457-9).
- Stunkard AJ, Sørensen T, Schulsinger F. 1983. Use of the Danish adoption register for the study of obesity and thinness. *Res Publ Assoc Res Nerv Ment Dis*. 60:115–120.
- Turner PG, Lefevre CE. 2017. Instagram use is linked to increased symptoms of orthorexia nervosa. *Eat Weight Disord*. 22(2):277–284. doi: [10.1007/s40519-017-0364-2](https://doi.org/10.1007/s40519-017-0364-2).
- Varga M, Thege BK, Dukay-Szabó S, Túry F, van Furth EF. 2014. When eating healthy is not healthy: orthorexia nervosa and its measurement with the ORTO-15 in Hungary. *BMC Psychiatry*. 14(1):1–11. doi: [10.1186/1471-244X-14-59](https://doi.org/10.1186/1471-244X-14-59).
- WHO. 2003. Diet, nutrition and the prevention of chronic diseases. World health organ. Technical report series 916.
- Yılmaz MN, Dundar C. 2022. The relationship between orthorexia nervosa, anxiety, and self-esteem: a cross-sectional study in Turkish faculty members. *BMC Psychol*. 10(1):82. doi: [10.1186/s40359-022-00796-7](https://doi.org/10.1186/s40359-022-00796-7).