



THE PREVALENCE OF ORTHOREXIA NERVOSA AMONG GYM PARTICIPANTS FROM CROATIA: AN OBSERVATIONAL STUDY

Edita Ružman¹, Orjena Žaja^{2,3}, Jadranka Karuza⁴ and Ines Banjari¹

¹Department of Food and Nutrition Research, Osijek Faculty of Food Technology,
Josip Juraj Strossmayer University of Osijek, Osijek, Croatia;

²Department of Eating Disorders in Children and Adolescents, School of Dental Medicine,
University of Zagreb, Sestre milosrdnice University Hospital Center, Zagreb, Croatia;

³University of Split, School of Medicine, Split, Croatia;

⁴Private Family Physician Office affiliated to University of Rijeka,
School of Medicine, Rijeka, Croatia

SUMMARY – Orthorexia nervosa (ON) is pathological obsession and preoccupation with 'healthy' and 'clean' eating, which is more pronounced in specific population groups such as fitness enthusiasts. The aim of this observational study was to determine the prevalence and characteristics of ON symptoms among gym attendees in Croatia based on ORTHO-15 questionnaire. A number of individual characteristics were considered too, from eating habits, anthropometry, personality traits, psychophysical state, to the presence of irritable bowel syndrome symptoms. Out of 126 participants who completed the questionnaire, 99 were analyzed (female 68.7% and male 31.3%, median age 24 years). Based on the traditional criterion (ORTHO-15 score <40), the prevalence of ON was 77.8% and 33.3% according to the modified criterion (ORTHO-15 <35). Women were two times more likely to have high ON tendency in comparison to men (39.7% *vs.* 19.4%, $p=0.037$). Participants with high ON tendency avoided a wide variety of foods, especially sugar, processed food and gluten, and did not skip meals. There were no significant differences in orthorexic tendencies according to nutritional status, personality traits, psychophysical state, or irritable bowel symptoms. For gym attendees in Croatia, being a woman and dietary restrictions were identified as independent risk factors for ON.

Key words: *Orthorexia nervosa; Eating disorders; Gym attendees; Dietary restriction; Nutritional status; Psychological condition; Irritable bowel syndrome*

Introduction

Orthorexia nervosa (ON) is a relatively new social phenomenon characterized by excessive preoccupation with 'healthy' and 'clean' food. Patients with ON manifest this obsession by a strict restrictive diet,

preparing specific foods and ritualized eating patterns. They are obsessed with food quality, not its quantity, spending most of the time researching, weighing food and planning meals in advance^{1,2}. Physical activity, as an integral component of a healthy lifestyle, was found to represent another focus of many ON patients^{1,3,4}.

Orthorexia nervosa is still not part of the Diagnostic and Statistical Manual (DSM-V) due to a lack of robust empirical data crucial for its proper

Correspondence to: *Prof. Ines Banjari, PhD*, Franje Kuhača 18, HR-31000 Osijek, Croatia
E-mail: ibanjari@ptfos.hr

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diagnosis⁵⁻⁷. The lack of diagnostic criteria is reflected in unreliable prevalence assessments. For this reason, the prevalence ranges from 6.9%⁸ to 57.6%⁸ in the general population, whereas in specific populations (opera singers) it reaches 81%¹⁰ and even 86% (ashtanga yoga practitioners)¹¹. Furthermore, it is still unclear whether ON is more prevalent among women or men^{8,9,12,13}, and similar contradictions exist regarding the prevalence of ON based on the body mass index (BMI)^{8,10,14}.

It is believed that ON is triggered by a desire to improve health or treat a specific disease such as asthma, irritable bowel syndrome (IBS) or allergies, but it can result in nutritional deficiencies, low quality of life, and medical complications¹⁻⁵. Altered and abnormal eating behaviors (e.g., limiting the amount of food, meal skipping), frequently practiced by patients with IBS, whether the restriction was introduced as part of therapy (e.g., low FODMAP diet prescribed by a physician/dietitian) or it was self-imposed, represent a good predictor for developing an eating disorder¹⁵. People with thyroid diseases (hypothyroidism, hyperthyroidism, Hashimoto's thyroiditis and Graves' disease) are also prone to restrictive eating patterns and consequently might be at a higher risk of eating disorders¹⁶ including ON.

The aim of this study was to determine the prevalence and characteristics of ON symptoms among gym attendees in Croatia. A number of individual characteristics were considered too, from eating habits, anthropometry, personality traits, psychophysical state, to IBS symptom presence.

Subjects and Methods

Subject recruitment

The study was approved by the Ethics Committee for Research on Human Subjects, Osijek Faculty of Food Technology, Osijek, Croatia (Class 003-08/20-01/01; Registry No. 2158-82-01-20-29). This observational study was carried out on a sample of 126 gym attendees between May and July 2020. The inclusion criterion was the level of physical activity which was tested with Baecke's questionnaire. After excluding 27 participants due to low physical activity level (sport index ≤ 2.8 (± 0.1) for men and ≤ 2.4 (± 0.1) for women), answers of 99 participants (68.7% of female and 31.3% of male subjects, median age 24 years) were analyzed. The first 50 participants were recruited through direct contact in four fitness centers

in Osijek-Baranja and Međimurje County. Informed consent was provided by all participants, after the informed consent procedure. These participants received a unique participation code for filling out the online questionnaire they accessed by a link. Due to restrictions imposed to stop the spread of coronavirus (SARS-CoV-2), the remaining participants were recruited online by sharing the questionnaire link *via* social networks.

Research tools

The questionnaire was created using Google Forms and consisted of seven parts. The general part included questions about basic data such as year of birth, gender, body height and weight, place of residence, level of education, employment, life status (in relationship/marriage, single), health condition, and medication/supplement use. Additionally, questions about general dietary habits (e.g., number of meals *per* day, frequency of meal skipping, how they characterize their diet, whether they stick to „cheatmeal“/„cheatday“/„intermittent fasting“ or avoid certain type of food), smoking and alcohol consumption were included.

The remaining parts consisted of the following validated questionnaires: Eating Habits Questionnaire (EHQ), ORTHO-15 Questionnaire, Baecke Physical Activity Questionnaire, Big Five Inventory (BFI), Depression, Anxiety and Stress Scale (DASS-21), and Gastrointestinal Symptom Rating Scale-Irritable Bowel Syndrome (GSRS-IBS).

ORTHO-15 Questionnaire

The ORTO-15 is a self-reported questionnaire used to diagnose ON. It consists of 15 questions about a person's attitudes towards healthy eating. The original cut-off score is 40, which means that everything below this score is considered as ON¹⁷. However, to avoid exaggeration of the prevalence, the recommended cut-off is score is 35^{18,19}. We used Croatian version of ORTHO-15²⁰.

Eating Habits Questionnaire (EHQ)

Given that internal consistency of ORTHO-15 in studies differs considerably, it is recommended to combine it with EHQ which displayed strong internal consistency to get more reliable diagnosis of ON. It consists of 35 yes/no questions which assesses problems associated with healthy eating, feeling positively about healthy eating, and knowledge of healthy eating²¹.

Baecke Physical Activity Questionnaire

The level of physical activity was measured with the Croatian version²² of Baecke Physical Activity Questionnaire²³. This instrument consists of 16 questions classified into three domains: work, sports, and non-sports leisure activity over the previous 12 months. Higher scores indicate higher level of activity in a specific area²².

Big Five Inventory (BFI)

The BFI²⁴ is a self-reported 44-item questionnaire that measures the big five personality traits: extraversion, agreeableness, openness, conscientiousness and neuroticism. Total score for each scale was obtained by summing the items related to specific personality trait. The Croatian version of the questionnaire was used²⁵.

Depression, Anxiety and Stress Scale (DASS-21)

The psychophysical state of participants was assessed by DASS-21. This instrument measures symptoms of depression, anxiety and stress with seven items for each subscale where higher score on each subscale indicates greater level of each state²⁶.

Gastrointestinal Symptom Rating Scale-Irritable Bowel Syndrome (GSRS-IBS)

The GSRS-IBS was used to measure the presence and severity of IBS symptoms. The questionnaire includes 13 items which are rated on a seven-point Likert scale. The points are summed up, and higher scores indicate more pronounced symptoms²⁷.

Anthropometric measurements

Anthropometric measurements were conducted in the first 50 participants, whereas the remaining ones self-reported their height and weight (because of the restrictions introduced due to the SARS-CoV-2 pandemic). Their body weight (kg), fat mass (%), muscle mass (%), and visceral fat index were measured using a bioimpedance scale (OMRON BF 500). Height was measured barefoot with the head positioned in the Frankfurt plane. Waist and hip circumference was measured by using a nonelastic measuring tape. BMI was calculated by dividing body mass (kg) with square height (m), and was used to categorize participants according to their nutritional status as underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obese (≥30.0 kg/m²).

The waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR) were also calculated and used for health risk assessment²⁸. Cut-off values for health risk based on the WHR for women are low ≤80, moderate 0.81–0.85 and high ≥86, whereas in men they are defined as low 0.95, moderate 0.96–0.99 and high ≥1.00²⁸. The WHtR is considered to be a more direct measure of abdominal obesity and cardiovascular risk than WHR, and it has universal cut-off values for both sexes, regardless of race or age. Health risk based on the WHtR is defined as low <0.5, increased 0.5–0.6 and high ≥0.6²⁹.

Statistical analysis

Analysis was performed using the Statistica software (version 13.5, StatSoft Inc., USA) with the level of significance of 0.05. Graphic data processing was performed by the MS Office Excel (version 2016, Microsoft Corp., USA). Kolmogorov-Smirnov test was used to test the normality of data distribution. Data were subsequently expressed as arithmetic mean and standard deviation (SD), or as median and interquartile range (IQR). Data categories were expressed in the form of absolute and relative frequencies. Spearman's rank-order correlation test was used to assess the significance of the relation between numerical data, while Mann-Whitney U test was used to compare variables between two groups. Participants were categorized into two groups based upon scores on the ORTHO-15, i.e., group with low ON tendency and group with high ON tendency. Lastly, the effect of participant characteristics on ON tendency (observed as the number of points on the ORTHO-15) was tested with univariate logistic regression, and the variables shown to be significant were afterwards examined by multivariate logistic regression.

Results

Prevalence of orthorexia nervosa

The prevalence of ON was 77.8% according to the traditional criterion (cut-off 40 points), and 33.3% according to the modified criterion (cut-off 35 points). On further analyses, the modified criterion was used. According to gender, women were two times more likely to have high ON tendency as compared to men (39.7% *vs.* 19.4%, *p*=0.037) (Fig. 1).

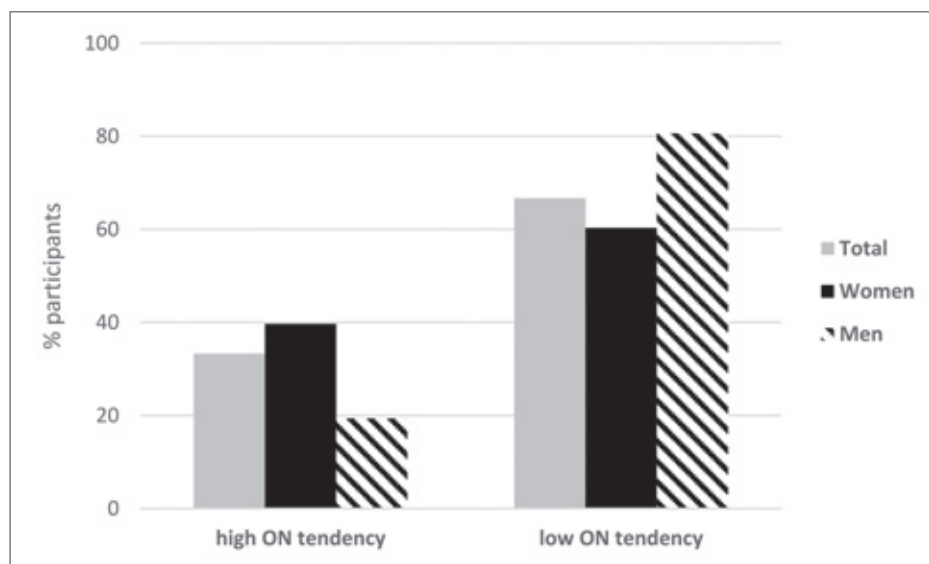


Fig. 1. The prevalence of orthorexia nervosa based on the ORTHO-15 Questionnaire, total and for each gender.

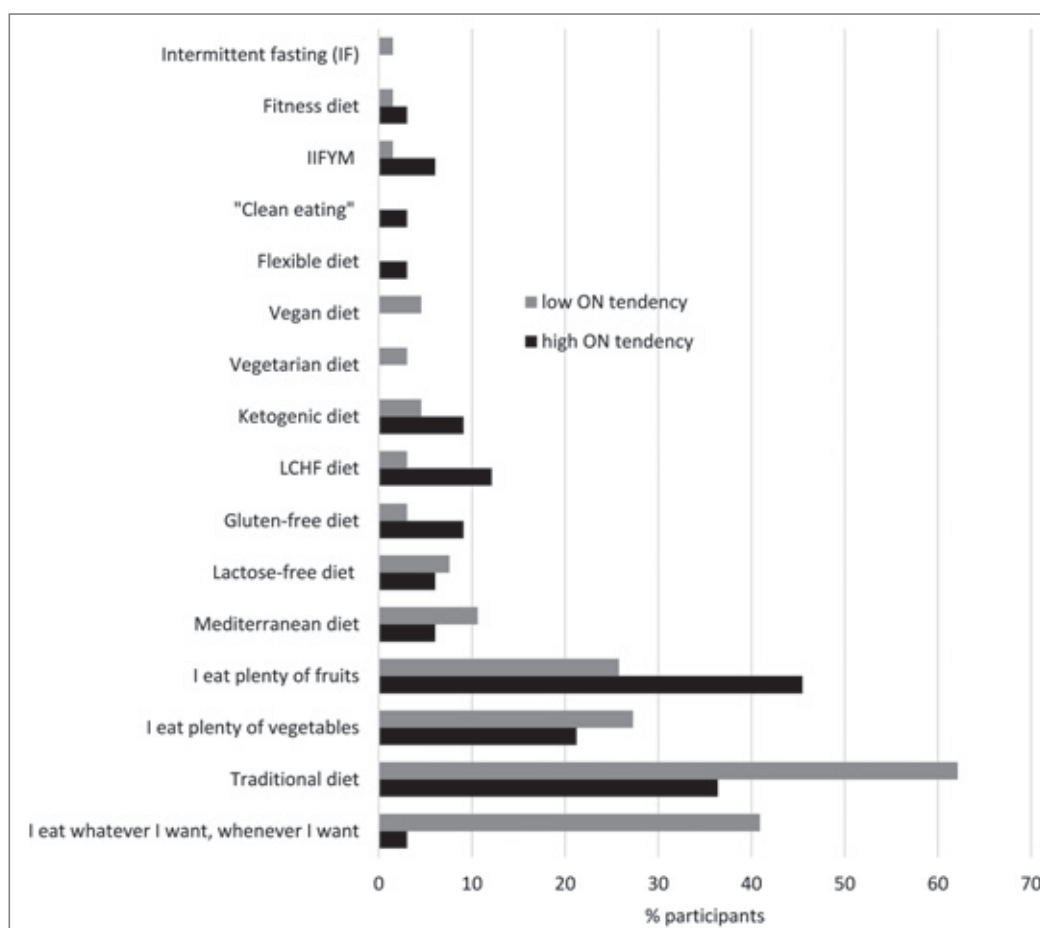


Fig. 2. Characterization of participant diet.

IIFYM = If It Fits Your Macros; LCHF = low-carbohydrate high-fat

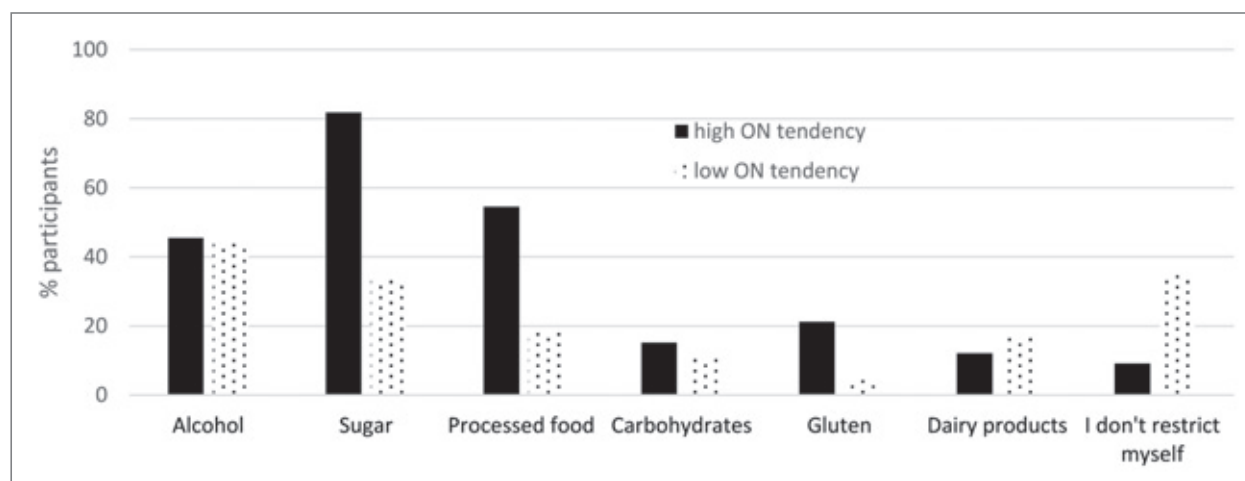


Fig. 3. Share of participants with a particular food restriction based on their orthorexia nervosa tendency.

Table 1. Characteristics of study participants based on their ON tendency

Characteristic [§]	Low ON tendency (n=97)	High ON tendency (n=66)	p
Body mass index (kg/m ²)	23.7±3.0	23.3±3.2	0.518
ORTHO-15 (points)	38.8±3.2	31.8±2.7	<0.001*
Work index	2.53±0.75	2.41±0.83	0.526
Leisure index	3.25 (2.75-3.75)	3.75 (3.00-4.25)	0.492
Sport index	2.40 (1.96-2.71)	2.21 (1.71-2.71)	0.032*
Depression	2 (1-6)	3 (0-10)	0.361
Anxiety	4 (1-6)	3 (2-9)	0.375
Stress	6 (3-10)	7 (3-11)	0.585
Neuroticism	21.5 (19.0-25.0)	22.0 (19.0-26.0)	0.545
Openness	34.8±6.5	35.9±6.3	0.402
Conscientiousness	34.3±5.6	36.1±4.4	0.116
Extraversion	28.1±4.5	29.8±5.1	0.106
Agreeableness	32.4±4.9	33.2±5.4	0.499
IBS score	19 (14-26)	17 (13-29)	0.700
EHQ _{score}	11.8±4.9	18.2±4.2	<0.001*

ON = orthorexia nervosa; IBS = irritable bowel syndrome; EHQ = Eating Habits Questionnaire; [§]expressed as mean ± standard deviation or median (interquartile range); *statistical significance at p<0.05

Table 2. Variables correlated with orthorexia nervosa (multivariate logistic regression)

Variable	Category	OR	95% CI	p
EHQ _{score}	<i>Per point</i>	1.326	1.169-1.506	<0.001*
Gender	1=male 2=female	4.319	1.210-15.415	0.024*
Alcohol consumption	0=no 1=occasionally 2=yes	0.764	0.423-1.380	0.373
Constant		0.001		0.001

*significant at $p < 0.05$; EHQ = Eating Habits Questionnaire; OR = odds ratio; CI = confidence interval

Associations between orthorexia nervosa and eating habits

Strong negative correlation was found between ORTHO-15 score and EHQ score ($r = -0.611$). This confirms that individuals with high ON tendency (lower ORTHO-15 score) had more restrictions in their diet (higher EHQ score) (18.2 ± 4.2 vs. 11.8 ± 4.7 , $p < 0.001$) (Table 1). This is further emphasized when subjective characterization of diet and food restrictions were observed.

Participants were asked to describe/characterize their diet (Fig. 2). Nearly half of the participants (45.5%) with high ON tendency reported that they ate lots of vegetables, in comparison to 25.8% of the participants with low ON tendency. On the other hand, those in the low ON tendency group consumed more fruits than those with high ON tendency (27.3% vs. 21.2%). It seems that orthorexic individuals are more prone to follow restrictive eating patterns because they characterized their diet as gluten-free, low-carbohydrate high-fat (LCHF), or ketogenic diet more often than those with low ON tendency. Some participants with high ON tendency described their diet as flexible (3.0%), fitness diet (3.0%) or clean eating (3.0%). Furthermore, five participants who characterized their diet as vegetarianism (4.5%) or veganism (3.1%) did not show orthorexic behaviors. Interestingly, in comparison to low ON tendency participants, those with high ON tendency never skipped meals (60.6% vs. 20.0%; $p < 0.001$), and did not consume alcohol ($p = 0.010$).

In comparison to low ON tendency participants, those with high ON tendency more often restricted

their sugar (81.8% vs. 33.3%; $p < 0.001$), processed food (54.6% vs. 18.2%; $p < 0.001$), and gluten (21.2% vs. 4.6%; $p = 0.015$) intake (Fig. 3).

Being a woman (odds ratio (OR) 4.319, 95% confidence interval (CI) 1.210-15.415; $p = 0.024$) and more dietary restrictions (OR 1.326, 95% CI 1.169-1.506; $p < 0.001$) are independent risk factors for ON (Table 2).

Associations between orthorexia nervosa and the remaining variables

The remaining characteristics of the study participants based on their ON tendency are shown in Table 1. No significant correlation was found for BMI or any other anthropometric measurement. The level of physical activity differed significantly only in sport index, which was significantly lower in high ON tendency participants ($p = 0.032$), who, on the other hand, had higher leisure index.

Our results did not show any difference in the symptoms of depression, anxiety or stress between low and high ON tendency, although correlation coefficients showed an inverse relationship between ORTHO-15 score and levels of psychological condition (all below statistical significance, not shown). Personality traits among high ON tendency participants did not differ significantly from low ON tendency participants, but higher openness, conscientiousness, extraversion, and neuroticism could be seen. There was no difference in IBS symptoms either. The prevalence of high IBS score was 21.0% in the high ON tendency group and 13.0% in the low ON tendency group.

Discussion

Public is becoming ever more aware of all the benefits a healthy lifestyle poses. People who engage in one healthy behavior tend to cluster other healthy behaviors (for example, combine exercise with a healthy diet)³⁰. Healthy behaviors can be triggered by a health condition (e.g., food allergy, gastrointestinal disease) or body image. Yet, pathological preoccupation with a healthy lifestyle may lead to unwarranted dietary restrictions, disordered eating behaviors, and even to an eating disorder^{1,5,17}. ON is pathological obsession and preoccupation with healthy foods and a restrictive and avoidant eating behavior¹⁷. This is the first study to report on ON prevalence and its characteristics in Croatia, in a specific population group such as gym attendees.

We found the prevalence of ON to vary greatly between cut-offs for the same research tool. Lower cut-off for ORTHO-15 questionnaire was recommended to avoid exaggeration of ON prevalence^{18,19}. However, most studies agree that ON tendency is more pronounced in specific population groups¹⁷, among whom are gym attendees^{12,31}. A study conducted in Portugal used ORTHO-15 questionnaire with 35 points as the cut-off found that ON was present in 51.8% of gym attendees³².

Our results showed that women were two times more likely to have high ON tendency in comparison to men, and being a woman was found to independently increase the risk of ON. Gender-specific differences in many areas of nutrition are extensively documented, obviously due to psychological and socio-cultural factors. Women have an ambivalent attitude towards nutrition, they are more preoccupied with body weight, and show higher body dissatisfaction, therefore are more prone to disordered eating behaviors³³. Expectedly, women are more susceptible to eating disorders³⁴. However, when it comes to ON, the evidence is not as clear. Some studies have shown a higher prevalence in women^{9,12}, others in men⁸, whereas some found no gender difference¹³.

Adherence to stringent eating rules can result in social isolation or nutritional deficiencies⁵. Strict diets such as low-carbohydrate high-fat (LCHF) diet, paleo diet, raw or gluten-free diet used to improve wellbeing, lose weight, or treat and manage a disease, increase the risk of eating disorders³⁵. We found that restrictive eating patterns represented independent risk factor

for ON. This was expected given that ON is often described as 'clean eating', which implies avoidance of food that is considered 'unhealthy' or 'impure'³⁶. Specifically, we found that participants with high ON tendency avoided a wide variety of foods, especially sugar, processed food, and gluten. It is important to note that none of the participants reported being diagnosed with celiac disease (CD) or non-celiac gluten sensitivity (NCGS), so there are no warranted reasons for their gluten avoidance³⁷. One study found that 23% of people with a gastrointestinal disorder diagnosis undergo restrictive eating patterns, as compared to 10% in the general population¹⁵. Gastrointestinal symptoms often manifest with weight loss and can trigger distorted and restrictive eating behaviors as a symptom relieving technique^{38,39}.

Irritable bowel syndrome is common among people with eating disorders^{40,41}. Perkins *et al.*⁴² found that 87% of participants developed an eating disorder before the onset of IBS with an average of 10 years between these conditions. Our results do not support the higher prevalence of IBS in participants with high ON tendency. While study participants did not say they restricted their alcohol consumption, participants with high ON tendency were more likely to completely avoid alcohol. Alcohol consumption is not typically regarded as a health-promoting behavior³⁰. Median age of our study population was 24 years, so these findings were somewhat unexpected but support the underlying pathology of an eating disorder. We also found that participants with high ON tendency did not skip meals. Regularity of meals is another characteristic of a healthy, balanced diet, and is one of dietary behaviors characteristic of ON⁴⁰. Other studies also found that individuals with ON were less likely to skip meals⁴³.

As previously mentioned, gym attendees are one of the groups particularly at risk of ON. One study found the presence of obsessive behaviors during physical activity, such as guilt for skipping training and counting calories during training, which suggest unhealthy relationship with physical activity³. Patients with eating disorders favor intensive physical activity in order to regulate negative emotions and to improve their mood⁴⁴, change body shape or lose weight, compensate overeating⁴⁵ or increase muscle mass⁴⁶. However, we found that leisure activity was higher than sport activity among participants with high ON tendency.

There was no difference in orthorexic tendency according to nutritional status, although some research found correlation between orthorexic tendencies and lower³¹ or higher BMI⁴⁷. No difference was found in orthorexic tendency according to the presence of depression, anxiety and stress level either. Low level of depression and anxiety were previously reported in a study which assessed sexual function in healthy females from eastern Croatia⁴⁸. Our results are opposite to some recent research which has shown that orthorexic behaviors are associated with a greater level of depression, anxiety, chronic stress and difficulty relaxing⁴⁹.

It is well known that social media increase the risk of depression and disordered eating. During the past 10 years, Instagram seems to be the leader among social media when it comes to nutrition consueing by 'pseudnutritionists'. Consequently, Turner and Lefevre⁵⁰ have discovered that higher Instagram use is associated with a greater risk of ON.

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Sažetak

UČESTALOST ORTOREKSIJE NERVOZE MEĐU POLAZNCIMA TERETANA U HRVATSKOJ:
OPAŽAJNA STUDIJA*E. Ružman, O. Žaja, J. Karuza i I. Banjari*

Ortoreksija nervoza (ON) je patološka opsesija i preokupacija „zdravom“ i „čistom“ prehranom, izraženija u specifičnim populacijskim skupinama kao što su polaznici teretana. Cilj ovoga opažajnog istraživanja bio je ispitati učestalost i značajke ON među polaznicima teretana u Hrvatskoj primjenom upitnika ORTHO-15. Ispitan je utjecaj niza značajka, od prehrambenih navika, antropometrije, crta ličnosti, psihofizičkog stanja i prisutnosti simptoma sindroma iritabilnog crijeva. Od ukupno 126 polaznika teretana koji su ispunili upitnik analizirani su odgovori njih 99 (68,7% žene, 31,3% muškarci, medijan dobi 24 godine). Prema tradicionalnom kriteriju (ORTHO-15 zbroj <40) učestalost ON iznosila je 77,8% i 33,3% prema modificiranom kriteriju (ORTHO-15 zbroj <35). Žene su imale dva puta veću sklonost ka ON u usporedbi s muškarcima (39,7% prema 19,4%, $p=0,037$). Ispitanici s visokom sklonošću ka ON su izbjegavali široki spektar hrane, pogotovo šećer, procesiranu hranu i gluten te nisu preskakali obroke. Nisu utvrđene statistički značajne razlike u stanju uhranjenosti, crtama ličnosti, psihofizičkom stanju niti simptomima iritabilnog crijeva s obzirom na sklonost ka ON. Kao neovisni čimbenici rizika za visoku sklonost ka ON među polaznicima teretana u Hrvatskoj pokazali su se ženski spol i značajnija ograničenja u prehrani.

Ključne riječi: *Ortoreksija nervoza; Poremećaj u prehrani; Polaznici teretana; Ograničenja u prehrani; Stanje uhranjenosti; Psihofizičko stanje; Sindrom iritabilnog crijeva*