



# Orthorexia nervosa and its association with narcissism in fitness center users

Dinko Martinovic<sup>1</sup> · Daria Tokic<sup>2</sup> · Lovre Martinovic<sup>1</sup> · Mihaela Rakusic<sup>3</sup> · Marko Kumric<sup>1</sup> · Doris Rusic<sup>4</sup> · Marino Vilovic<sup>1</sup> · Josip Vrdoljak<sup>1</sup> · Tina Ticinovic Kurir<sup>1</sup> · Josko Bozic<sup>1</sup>

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## Abstract

**Purpose** Orthorexia nervosa (ON) is an eating behavior where patients obsessively try to reach health through “purity” of food. Narcissism is a personality trait characterized with the self-belief of grandiosity, importance and need of appreciation. Both of these conditions are connected through self-image in way of reaching perfection through health and body image, whereas one of the ways for reaching it is exercising. This cross-sectional study aimed to investigate ON and its possible association with narcissism in fitness center users.

**Methods** The study included 1017 fitness center users and three questionnaires were used for the assessment: general information, ORTO-R and Narcissistic personality inventory-13 (NPI-13).

**Results** There was a significant negative correlation ( $r = -0.467$ ,  $p < 0.001$ ) between the ORTO-R score and the NPI-13 score. Comparison of the ORTO-R score between different durations of using a fitness center showed statistically significant differences ( $H = 134.72$ ,  $p < 0.001$ ). The subjects who are using the fitness center for less than 1 year have the highest ORTO-R score, while those who are using it 1–3 years have the lowest ORTO-R score. Moreover, multiple linear regression showed that ORTO-R score retained significant association with NPI-13 ( $\beta \pm SE$ ,  $-0.416 \pm 0.026$ ,  $p < 0.001$ ) and the duration of using a fitness center ( $0.576 \pm 0.068$ ,  $p < 0.001$ ) after model adjustment for age and BMI.

**Conclusion** These results are implying that fitness center users could possibly be vulnerable of developing ON and that there is a strong association between ON and narcissism in this population. However, future larger-scale longitudinal studies are needed to address these findings.

**Level of evidence** Level V, cross-sectional survey-based study.

**Keywords** Orthorexia nervosa · Narcissism · Fitness · ORTO-R · NPI-13

## Introduction

Orthorexia nervosa (ON) was first defined as an eating condition in 1997 by Steven Bratman, trying to describe people with unhealthy and obsessive relationship with food whose

radical diet habits, in order to maintain health, often lead to malnutrition and problems in other aspects of life, such as relationships and incapability for daily functions [1]. Although an eating condition, ON has some significant differences from disorders such as bulimia and anorexia nervosa. Patients with anorexia nervosa and bulimia focus on food restriction and forced vomiting to lose weight, while patients with ON obsess about “purity” of food to achieve the desirable level of health [2–4]. ON has only become a major health issue in the last decade as there has been a significant rise of studies conducted on this subject, investigating possible rise of ON prevalence [5]. This could be explained by media influence, as “perfect” body image has been seriously manipulated through unrealistic posts and photographs on social medias [6, 7]. Moreover, as the awareness for quality diet is on the rise, people of all ages are

✉ Josko Bozic  
josko.bozic@mefst.hr

<sup>1</sup> Department of Pathophysiology, University of Split School of Medicine, Soltanska 2, 21000 Split, Croatia

<sup>2</sup> Department of Anesthesiology and Intensive Care, University Hospital of Split, Split, Croatia

<sup>3</sup> Department of Psychiatry, University Hospital of Split, Split, Croatia

<sup>4</sup> Department of Pharmacy, University of Split School of Medicine, Split, Croatia

reaching for food that they deem safe for their health and even use dietary supplements to improve their well-being [8, 9].

Narcissism is a complex personality quality characterized by a belief of a personal superiority and a sense of entitlement to a special treatment [10]. Narcissism can have both positive and negative effects on the functioning of the individual, as well as have consequences on his environment [11]. Positive illusions about someone's self, competitiveness and the desire to be successful are all approved as a part of the "healthy" narcissism. However, even though desires for recognition and respect are normal qualities of a personality, when they become extreme, they can turn into characteristics of the pathological narcissism [12, 13]. Two basic aspects of narcissism can be distinguished: grandiosity and vulnerability. While the hallmark of grandiosity is the exaggerated desire for recognition and admiration, the vulnerable narcissism is characterized with excessive fragility and difficulty to control emotions and behavior [14].

Moderate exercise is connected with the reduction several serious conditions and illnesses, such as obesity, diabetes, cardiovascular diseases, depression, anxiety, neurodegenerative diseases and drug addiction [15–18]. Yet, reasons for exercise can go beyond just a simple idea of a health. Recently, some studies have found a link between extensive exercise and the narcissistic personality through motives such as body image, rivalry and pathologically needed admiration [19]. One of the well-established components of narcissism is the tendency to addictive behaviors, which can among others present through exercise addiction. It was established by previous studies that fitness center users are prone to developing exercise addiction and some studies conducted on fitness center users found that they have a high narcissism [20–23]. A study conducted by Bruno et al. found positive correlation between extensive exercise and narcissism, with both being connected to a lower self-esteem [20]. Although vulnerable narcissism and self-esteem are not directly co-dependent, both of them can be predictors of specific behaviors, including eating disorders [24, 25]. Another interesting element in fitness users is their aspiration for achieving a "perfect" physical appearance. In order to improve and achieve this goal exercising without following a proper dietary pattern is not enough. Therefore, it is possible to hypothesize that fitness center users with a higher narcissism behavior could obsess over food and eating. Bandi et al. confirmed a positive correlation between narcissism and ON, with vulnerable narcissism having a major impact on developing ON symptoms due to its association with the lower self-esteem and negative ideas about someone's self [26]. Through regular exercise eating habits are often changed in order to improve results and general health, which sometimes can become a preoccupation that can lead into developing eating disorders [19, 27]. All of the

abovementioned suggests that regular fitness center users have a higher narcissism and that they could be vulnerable to developing ON.

Hence, the aim of this study was to investigate ON and narcissism in fitness center users and to evaluate their possible correlation. Moreover, we sought to evaluate the association of anthropometric parameters and exercise durations with ON and narcissism. Additionally, our goal was to evaluate the possibility that narcissism could be a predictor of ON tendencies. With extensive research of the available literature, this is the first study that investigates the intercorrelation of these disorders in fitness center users.

## Methods

### Study design and ethical considerations

This cross-sectional survey-based study was conducted at several fitness centers in Split, Croatia during the time period from June 2021 to August 2021. From February 15th onwards, the lock-down due to COVID-19 pandemic was lifted for fitness centers in Croatia.

The study was approved by the Ethics committee of University of Split School of Medicine (No: 003-08/20-03/0005) and it was conducted in accordance with the latest Helsinki declaration. All participants gave a consent by completing and submitting the questionnaire.

### Participants

The survey was performed on fitness center users. Participation in the study was voluntary and was conducted using Google Forms® online application which guaranteed the anonymity of the participants. The link for the survey was distributed using QR codes, fitness groups and via e-mail. The inclusion criteria were: 18–65 years of age;  $\geq 3$  months and  $\geq 1$ /week of training at the fitness center. The only exclusion criterion was the involvement in professional sports. The study included 1017 fitness center users.

### Questionnaires

Three assessment scales were used in this study. The first assessment scale provided general information about the participants such as the age, gender, involvement in professional sport, anthropometric traits, as well as frequency of fitness center usage and duration of the training. It was a structured, self-administrated questionnaire which was developed for the purpose of this study and it consisted of 12 questions.

The second assessment scale was the Narcissistic Personality Inventory (NPI), a questionnaire used for the

assessment of subclinical narcissism in the general population [28, 29]. It was used in the form of NPI-13, a reliable validated short form which consists of thirteen self-reported questions and evaluates three dimensions of narcissism: leadership/authority (LA), grandiose exhibitionism (GE) and entitlement/exploitativeness (EE) [30]. The questions are in a binary forced choice format (0—low narcissism; 1—high narcissism). These 13 items are split in three dimensions; subscale of LA is measured with results of four items (3, 6, 9 and 12), GE includes five items (2, 5, 8, 11 and 13) and EE is measured by four items (1, 4, 7 and 10). Except providing results of those three subdimensions, NPI-13 also imparts the results of total score for narcissism. The internal consistency of the NPI-13 in the total study sample was correct as Cronbach's alpha was 0.81.

The third assessment scale used in the study was the ORTO-R, a reliable validated self-report questionnaire used for assessing pathological obsession for healthy food. It is a revised version of an older ORTO-15 which showed an unstable factorial structure. According to the most recent studies, ORTO-R is more reliable than ORTO-15 for assessing and comparing orthorexic tendencies between different populations [31, 32]. ORTO-R consists of 6 questions which are scored on a four-point Likert scale on a range from “always” to “never” [33]. The total score ranges 4–24 points and a lower score is indicative of a higher pathology. The internal consistency of the ORTO-R in the total study sample was correct as Cronbach's alpha was 0.83.

The NPI-13 and ORTO-R questionnaires were evaluated and translated to Croatian language by an expert who has a degree in both English and Croatian languages. A pre-testing was conducted on 32 randomly chosen fitness center users. The average time of completion was 10–15 min. The feedback by the responders showed that all the questions were comprehensible and easy to understand. The internal consistency in this pre-testing was acceptable as Cronbach's alpha coefficient was 0.80 for NPI-13, 0.84 for ORTO-R. The final version of the questionnaire consisted of 31 questions.

## Statistical analysis

The analyses of the data were conducted using computer software MedCalc (MedCalc Software, Ostend, Belgium, version 17.4.1). The normality of data distribution was estimated using Shapiro–Wilk test. All quantitative variables were presented as mean  $\pm$  standard deviation or median and interquartile range, while all qualitative variables were presented as whole number and percentage. Student *t* test and Mann–Whitney *U* test were used for statistical comparison of quantitative variables, while Chi-squared test was used for comparison between qualitative variables. Spearman's rank correlation coefficient was used to test association between

non-parametric variables. Comparison of multiple non-parametric variables was performed using one-way analysis of variance on ranks and afterwards post hoc Dunn's test was performed to examine the differences between each group. Additionally, multiple linear regression analysis was used to determine significant independent predictors for the ORTO-R score. From these analysis, we reported the *p* values with unstandardized  $\beta$ -coefficients, standard error and *t* values. The level of statistical significance was set at *p* value < 0.05.

## Results

### Sample characteristics

There were 570 (56.0%) male and 447 (44.0%) female subjects included in the study. Their mean age was  $29.1 \pm 8.8$  years and the mean BMI was  $24.3 \pm 3.4$  kg/m<sup>2</sup>. Most of the subjects (28.5%) are users of the fitness center for 1–3 years, while majority of them (62.2%) exercise 3–4 days per week (Table 1).

### Association between orthorexia and narcissism

The mean ORTO-R score in the study population was  $13.87 \pm 3.06$ , while the mean NPI-13 score was  $4.93 \pm 3.05$ . There was a significant negative correlation between NPI-13 score and the ORTO-R score ( $r = -0.467$ ,  $p < 0.001$ ). Furthermore, all three NPI-13 subscales showed a significant, but relatively weak negative correlation with the ORTO-R score (Table 2).

### Mean comparison analyses

The study population was divided using the median-split method. Group with the tendencies to ON behavior had the ORTO-R < 14 while the group with the lower tendencies to ON behavior had the ORTO-R  $\geq$  14. After the division, there were 437 (31.3%) participants with higher tendencies to ON behavior and 680 (68.7%) participants with lower tendencies to ON. The group with the higher ON tendencies had a significantly younger age compared to the lower ON tendencies group ( $28.5 \pm 7.4$  vs  $30.9 \pm 10.1$  years,  $p < 0.001$ ) (Table 3). Moreover, there was a significant difference in the duration of using the fitness center as most subjects from the group with the higher ON tendencies (41.0%) are users for 1–3 years while most subjects from the group with lower ON tendencies (36.0%) are users for < 1 year (Table 3).

Furthermore, the group with higher ON tendencies had a significantly higher total NPI-13 score ( $6.0$  ( $4.0$ – $9.0$ ) vs  $3.0$  ( $2.0$ – $5.0$ ),  $p < 0.001$ ) and significantly higher scores in all three subscales compared to the group with lower ON tendencies (Table 4).

**Table 1** Sample characteristics of the study population

Parameter	<i>N</i> (1017)
Male gender ( <i>N</i> , %)	570 (56.0%)
Age (years)	29.1 ± 8.8
Height (m)	1.79 ± 0.09
Weight (kg)	78.65 ± 15.62
BMI (kg/m <sup>2</sup> )	24.30 ± 3.41
Education level	
Elementary school	5 (0.5%)
High school	263 (25.9%)
Bachelor's degree	749 (20.9%)
Master's degree	536 (52.7%)
How long are you a fitness center user?	
< 1 year	272 (26.8%)
1–3 years	290 (28.5%)
4–7 years	202 (19.9%)
> 7 years	252 (26.8%)
How many days a week do you averagely exercise?	
1–2 days	199 (19.6%)
3–4 days	632 (62.2%)
5–7 days	186 (18.3%)
How long does your average exercises last?	
< 45 min	138 (13.6%)
45–90 min	800 (78.7%)
> 90 min	79 (7.8%)
How would you describe your exercise?	
Mostly dynamic “cardio” exercises	134 (13.2%)
Mostly static “weight lifting”	325 (32.0%)
A balance between static and dynamic exercises	558 (54.9%)

Data are presented as mean ± standard deviation or whole numbers (percentage)

*BMI* body mass index

Furthermore, the same differences were found in comparison of the ORTO-R score between different durations of using a fitness center ( $H = 134.72$ ,  $p < 0.001$ ). The subjects

who were using the fitness center for less than 1 year had the highest ORTO-R score, while those who were using it 1–3 years had the lowest ORTO-R score. Significant difference was found between certain groups (Table 5).

### Multiple linear regression

Multiple linear regression analysis showed that NPI-13 score ( $\beta \pm SE$ ,  $-0.416 \pm 0.026$ ,  $p < 0.001$ ) and the duration of using a fitness center ( $0.576 \pm 0.068$ ,  $p < 0.001$ ) significantly predicted the ORTO-R score after model adjustment for age and BMI, with ORTO-R score as a dependent variable (Table 6). The model showed that the NPI-13 score has a negative prediction while the duration of using a fitness center has a positive prediction of the ORTO-R score. The overall regression model was statistically significant ( $p < 0.001$ ) with coefficient of determination ( $R^2$ ) of 0.356 ( $R^2$  adjusted = 0.353).

### Discussion

The findings of this study determined a significant negative correlation between the NPI-13 score and the ORTO-R score. However, since lower ORTO-R scores are indicative of a higher pathology, this outcome indicates that there is a positive correlation between the tendency to ON behavior and the tendency to narcissistic behavior in the study sample. Furthermore, it evaluated ON in fitness center users in Croatia and showed that ON could also be associated with the duration of using a fitness center. To the best of our knowledge, this is the first study which investigated ON and its association with narcissism in the fitness center user's population.

Our study showed that 31.3% of our fitness center users sample had a higher tendency to ON behavior (ORTO-R < 14). It was proposed by the outcomes of several previous studies that engagement in exercise could be associated

**Table 2** Correlation matrix between the quantitative variables ( $N = 1017$ )

Parameter	1	2	3	4	5	6	7	8
1. ORTO-R	1.000							
2. NPI-13	-0.467*	1.000						
3. Leadership/authority	-0.225*	0.391*	1.000					
4. Grandiose exhibitionism	-0.328*	0.380*	0.294*	1.000				
5. Entitlement/exploitativeness	-0.134*	0.295*	0.283*	0.127*	1.000			
6. Age	0.018	0.025	-0.004	0.039	0.017	1.000		
7. BMI	0.009	-0.036	-0.018	0.022	0.008	0.118*	1.000	
8. Duration of using a fitness center	0.354*	-0.329*	-0.201*	-0.306*	-0.041	-0.038	0.046	1.000

*NPI-13* Narcissistic Personality Inventory 13, *BMI* body mass index

\* $p < 0.001$

**Table 3** Comparison of the sample characteristics between the group with higher ON tendencies and the group with lower ON tendencies

Parameter	Higher ON tendencies ( <i>N</i> =437)	Lower ON tendencies ( <i>N</i> =580)	Test value	<i>p</i>
Male gender ( <i>N</i> , %)	242 (55.4%)	331 (57.1%)	0.225	0.635*
Age (years)	28.5 ± 7.4	30.9 ± 10.1	4.191	< 0.001 <sup>†</sup>
Height (m)	1.79 ± 0.09	1.80 ± 0.09	− 0.293	0.769 <sup>†</sup>
Weight (kg)	79.5 ± 15.1	80.5 ± 15.8	− 1.025	0.305 <sup>†</sup>
BMI (kg/m <sup>2</sup> )	24.4 ± 3.3	24.6 ± 3.6	− 1.243	0.214 <sup>†</sup>
Education level				
Elementary school	2 (0.5%)	3 (0.5%)	0.050	0.997*
High school	112 (25.6%)	151 (26.0%)		
Bachelor's degree	96 (22.0%)	128 (22.1%)		
Master's degree	227 (51.9%)	298 (51.4%)		
For how long are you using the fitness center?				
< 1 year	64 (14.6%)	209 (36.0%)	84.114	< 0.001*
1–3 years	179 (41.0%)	111 (19.1%)		
4–7 years	108 (24.7%)	116 (20.0%)		
> 7 years	86 (19.7%)	144 (24.8%)		
How many days a week do you averagely exercise?				
1–2 days	62 (14.2%)	98 (16.9%)	2.383	0.303*
3–4 days	280 (64.1%)	374 (64.5%)		
5–7 days	95 (21.7%)	108 (18.6%)		
How long does your average exercises last?				
< 45 min	86 (14.8%)	52 (11.9%)	1.831	0.400*
45–90 min	450 (77.6%)	350 (80.1%)		
> 90 min	44 (7.6%)	35 (8.0%)		
How would you describe your exercise?				
Mostly dynamic “cardio” exercise	61 (14.0%)	73 (12.6%)	0.832	0.659*
Mostly static “weight lifting” exercise	143 (32.7%)	182 (31.4%)		
A balance between static and dynamic exercises	233 (53.3%)	325 (56.0%)		

Data are presented as mean ± SD and whole number (%)

*BMI* body mass index, *ON* orthorexia nervosa

\*Chi-square test

<sup>†</sup> *t* test for independent samples

**Table 4** Comparison of NPI-13 results between the group with the higher ON tendencies and the group with lower ON tendencies

Parameter	Higher ON tendencies ( <i>N</i> =437)	Lower ON tendencies ( <i>N</i> =580)	Test value	<i>p</i> *
NPI-13 total score	6.0 (4.0–9.0)	3.0 (2.0–5.0)	11.794	< 0.001
Leadership/authority	3.0 (1.0–4.0)	1.0 (1.0–3.0)	6.074	< 0.001
Grandiose exhibitionism	2.0 (1.0–3.0)	1.0 (0.0–2.0)	8.845	< 0.001
Entitlement/exploitativeness	1.0 (0.0–2.0)	1.0 (0.0–1.0)	3.852	< 0.001

Data is presented as median (IQR)

*NPI-13* Narcissistic personality inventory-13, *ON* orthorexia nervosa

\*Mann–Whitney *U* test

with an increased risk for ON [34–36]. A recent Portuguese study conducted on a fitness center users sample showed ON prevalence of 51.8% [37]. Moreover, correspondingly with the outcome of our study, their study also showed that

subjects with higher tendencies to ON behavior were significantly younger compared to the subjects with lower tendencies to ON behavior. Likewise, several other studies also found that people of younger age have a higher tendency to



**Table 5** Comparison of ORTO-R score between different durations of using a fitness center

Duration of using a fitness center	Median (interquartile range)	<i>H</i> <sup>*</sup>	<i>p</i>
< 1 year ( <i>N</i> =272) <sup>a</sup>	15.0 (14.0–17.0)	134.72	<0.001
1–3 years ( <i>N</i> =290) <sup>b</sup>	12.0 (10.0–15.0)		
4–7 years ( <i>N</i> =202) <sup>c</sup>	14.0 (12.0–16.0)		
> 7 years ( <i>N</i> =252) <sup>d</sup>	14.0 (12.0–16.0)		

\*Tested with one-way analysis of variance on ranks with post hoc Dunn's test to examine differences between each group

a vs b= $p < 0.05$ ; a vs c= $p < 0.05$ ; a vs d= $p < 0.05$ ; b vs c= $p < 0.05$ ; b vs d= $p < 0.05$

**Table 6** Multiple linear regression model of independent predictors for the ORTO-R score

Parameter	$\beta$ <sup>*</sup>	SE <sup>a</sup>	<i>t</i>	<i>p</i>
Age	0.014	0.008	1.626	0.104
BMI	−0.019	0.024	−0.774	0.438
NPI-13	−0.416	0.026	−15.679	<0.001
Duration of using a fitness center	0.576	0.068	8.449	<0.001

BMI body mass index, NPI-13 Narcissistic personality inventory-13

\*Unstandardized coefficient  $\beta$

<sup>a</sup>Standard error

ON behavior [38–41]. This could possibly be explained that younger fitness center users are more prone to exhibiting ON behavior due to a distorted body image, lower self-esteem and the use of social media [42–44]. Additionally, it was proposed that younger people engaged in fitness are inclined to a higher risk of exercise addiction and eating disorders [45]. Furthermore, a recent German survey-based study showed a significant positive correlation between ON tendencies and exercise addiction in fitness center users [39]. However, the prevalence of ON in their study was much lower compared to the other aforementioned studies. A possible reason for this major difference in ON prevalence could be in the different questionnaires used for the evaluation. The author of the German study used the Dusseldorfer Orthorexie Skala (DOS) to assess orthorexic behavior, a questionnaire which was also used by several other studies that similarly reported a very low prevalence of ON [46–48]. On the other hand, the previously mentioned studies used ORTO-15 as the assessment tool and it was showed that ORTO-15 overestimates ON prevalence and it is recommended not to use it for calculating prevalence of ON. Nevertheless, the reported vulnerability of developing ON in this population should be further addressed in future studies.

Even though ON as a pathological condition has been defined more than 20 years ago, it has only become a major

issue recently with the rise in awareness of quality nutrition and the infliction of the “perfect” body images through media and the internet [44, 49]. A recent survey-based study on female university students found that disordered eating attitudes were significantly linked to the use of social media, body image and body dissatisfaction [42]. Moreover, another recent study conducted on younger adults of both genders showed that mass media considerably influences the development of body dissatisfaction in adolescents which consequently increases the risk of developing eating disorders [43]. However, ON is still not considered a psychiatric diagnosis like the other well-known eating disorders and unlike them, it still has undetermined symptoms and risk factors [50].

Another important finding of this study is the positive correlation between ON and narcissism. However, it is important to note that this correlation is relatively weak. Moreover, multiple linear regression analyses showed that NPI-13 score was a significant predictor of the ORTO-R score after the model correction regarding age and BMI. Previous studies determined a positive correlation of exercise addiction with both narcissism and low self-esteem in the general population [20, 51]. Both of these studies used NPI as a narcissistic scale as was used in our study. Furthermore, populations investigated are comparable to ours, while both studies were also conducted on fitness center users. Zeigler-Hill et al. investigated the relationship between narcissism and exercise addiction through motives of fitness users and they found complex correlations with different aspects of narcissism and different motives, such as body image and narcissistic admiration [19]. This study was conducted on general population, and two scales were used for measurement of narcissism: Narcissistic Admiration and Rivalry Questionnaire and Narcissistic Vulnerability Scale. These results suggested that exercise-related motives could play an important role in the association between narcissism and exercise addiction. Furthermore, narcissism was found to be linked with appearance concerns [52, 53] and pursuit of status [54, 55]. Both of these features could be accomplished through exercise at the fitness centers as narcissistic personalities could show off their superiority and grandiosity via “perfect” body. Additionally, the results of our study showed that ON has a significant positive correlation with all three of the NPI-13 subscales; LA, GE and EE. Yet, LA and EE showed a relatively weak correlation while the strongest correlation was determined with the GE subdimension which could be in line with the well-established association between fitness and the body image [56]. Since fitness center users are inclined on pursuit of physical appearance and perhaps consequent exhibitions, it is possible that this population is more vulnerable of developing ON. However, it is still not possible to determine from the available

data whether narcissistic individuals are more engaged in fitness or the fitness through social pressure triggers higher level of narcissism in these individuals.

Another result of this study which needs to be highlighted are the differences of the ORTO-R score depending on the years a subject is using the fitness center. It was found that the subjects which have used the fitness center for less than a year have the highest ORTO-R scores. On the contrary, those who have used it for 1–3 years had the lowest ORTO-R scores. These findings imply that, over time, “newcomers” at the fitness center could be vulnerable to developing ON. However, according to our results, it seems that subjects who are using the fitness center for more than 3 years have a drop in tendencies to ON behavior. Still, it should be noted that those who are using the fitness center for 1–3 years are mostly younger subjects who are, as aforementioned, according to several studies more vulnerable to developing ON [38–41]. Nonetheless, it could be hypothesized that gradually, after a few years, fitness center users are showing a decline in ON tendencies. One of the possible reasons why our results showed these differences could be explained by the learning curve. First, newcomers try to identify what are their main goals in fitness; weight loss, muscle gain, or simply stronger physique and general health. In time, as they get deeply in the possibilities and results they are achieving, they start to focus over details such as food patterns, self-image, frequency and duration of the training. Later with time, most of them are past adolescent and young adult years, which brings other life challenges on daily bases, where they have less time to focus on excessive food regime and training. Still, longer fitness center users develop habit with time, which is why their ON tendencies are still higher than in newcomers, but lower than 1–3 year fitness center users. Nevertheless, this finding needs to be further explored in prospective studies to assess the possible risk factors which impact “newcomers” at the fitness center.

In conclusion, this study showed that tendency to ON behavior has a significant positive correlation with the tendency to narcissism in regular fitness center users. Moreover, multiple linear regression analyses showed that narcissism is a significant predictor of ON tendencies. Additionally, participants who are using fitness centers for less than a year had the lowest tendencies to ON behavior while the highest tendency was noted in those who are training for the past 1–3 years. These results are implying that fitness center users could be vulnerable to developing ON and that there is a strong association between ON and narcissism in this population. Moreover, it is possible that beginners at the fitness center possibly have a higher risk of ON; while, on the other hand, ON behavior declines over time. However, future larger-scale longitudinal studies are needed to address these findings.

## Limitations

There are several limitations in this study. Its cross-sectional design excludes the possibility of causal conclusions. Furthermore, it was conducted only in one city in Croatia so it is possible that some regional environmental factors interfered with the results. Since a questionnaire was the main tool to assess the evaluated parameters, there is a possibility that the participants failed to recall or had excess of subjectivity in some of the answers. Moreover, it is important to note that the revised ORTO-R has a better internal factorial consistency than its predecessor ORTO-15, but according to the questionnaire authors it should not be used for determining ON prevalence. However, we have initially conducted our research using the ORTO-15 but afterwards we have recalculated the results from ORTO-15 using the guidelines for the ORTO-R. Nevertheless, due to this, our ORTO-R has a 4-point Likert scale and some minor differences regarding the wording of several items.

## What is already known on this subject?

ON is an eating condition where patients obsessively try to reach health through “purity” of food. Narcissism is a personality trait characterized with the self-belief of grandiosity, importance and need of appreciation. Both of these disorders link through an individual's vision of themselves through health and body image, where one of ways of reaching it is exercising. Since several studies showed that fitness is linked with both a higher narcissism and tendencies towards eating disorders it can be hypothesized that these two traits are possibly linked. With extensive research of the available literature, there are no studies which investigated the association between these disorders in fitness center users.

## What does this study add?

This study showed that there is a significant positive correlation between ON and narcissism in fitness center users. Moreover, multiple regression analysis showed that ORTO-R score was predicted by the NPI-13 score and the duration of using the fitness center. Lastly, this study showed that tendency to ON behavior is lowest in individuals which use the fitness center for less than a year, while it is the highest in those who use it for 1–3 years. However, it seems that the ON tendency then drops overtime, while still being higher than that of the “newcomers”.

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**Data availability** All data are available upon request to the corresponding author.

**Code availability** Not applicable.

## Declarations

**Conflict of interest** Authors declare that they have no conflict of interest.

**Ethics approval** The study was approved by the Ethics committee of University of Split School of Medicine (No: 003-08/20-03/0005) and it was conducted in accordance with the latest Helsinki declaration.

**Consent to participate** All subjects were informed about the purpose of this study and they all gave a consent to participate.

**Consent for publication** All participants gave a consent to use the collected data for scientific publication.

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