

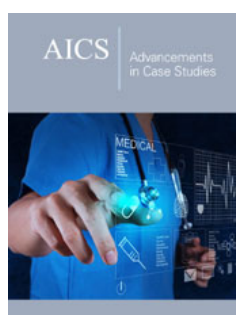
Orthorexia-Prevalence and Risk factors, Review of Literature

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Abstract

Aim: The main aim of the study was to determine the prevalence and risk factors of orthorexia nervosa based on a review of research papers published in PubMed, Wiley Online Library and Springer Link databases.

Material and method: From the available studies, 56 articles were selected for final analysis, containing research papers that used diagnostic questionnaires of orthorexia and analyzed potential risk factors for its occurrence.

Results: According to research data from 3,1 to 41,7 %, on average, 20.6% of subjects were found to be at risk of orthorexia nervosa, with the ORTO 15 questionnaire considering a score of 35 as the cutoff point. The highest score of risk was observed in the group of subjects with eating disorders of the nature of anorexia nervosa and bulimia nervosa, those who follow diets, those who are dissatisfied with the appearance of their bodies, those who engage in intense physical exercise, those with maladaptive personality traits, those who use immature defense mechanisms, and those who function poorly socially. Additional risk factors appeared to be health-related studies-especially dietetics, occupational stress (especially medics and musicians performing in orchestras).

Conclusion: It should be noted that in the ORTO 15 questionnaires, the cut-off point assumed by the authors of the tool was 40 and its use significantly overestimated the results, so the researchers' postulation to adopt a score of 35 in clinical practice, as indicating the risk of orthorexia, seems correct. In research opinion for more effective diagnosis, it would be advisable to adopt a cut-off point for orthorexia in the ORTO-15 at the level of 35 points, as postulated by some authors. The 40-point threshold is associated with considerable overdiagnosis of the phenomenon. The analysis as a whole points to the validity of placing ON in the eating disorder group, perhaps as a specific variant of anorexia nervosa. The study showed no correlation of ON with OCD. Whilst this might suggest a substantial crossover between symptoms of ON and eating pathology more generally.

Keywords: Orthorexia; Eating disorders; Prevalence; Risk factors

Introduction

In developed countries, including Poland, over the past decade or so, there has been a growing problem with unhealthy eating habits, with an increasing number of people suffering from both malnutrition and obesity. A relatively new phenomenon is Orthorexia nervosa (ON). This is a condition described as a pathological obsession with healthy eating,) first described by S. Bratman in 1997 [1]. The definition of the disorder currently proposed by Dunn and Bratman [2], indicates the need for the presence of medical symptoms secondary to dieting, resulting from malnutrition and weight loss and conflicts with others over dietary choices [2]. The above proposal is a recent attempt to frame ON from a diagnostic perspective since ON remains an entity with an unclear etiology, epidemiology, whose risk factors are variably identified and a nosological, non-determined status-Orthorexia, although clinically recognized, is not included in the ICD-11 (WHO 2022) and DSM-5 (American Psychiatric Association 2013) classifications of diseases, customarily classified as other eating disorders. However, some researchers wonder whether the disorder is not a variant of obsessive-compulsive disorder and should be included in this diagnostic category.

In consideration of the above, the authors, on the basis of a review of the literature, using electronic access to medical databases MEDLINE/PubMed, Springer Link and Wiley Online Library, attempted to summarize previous observations contained in clinical studies conducted between 2006 and 2023. In the presented review, particular emphasis was placed on the prevalence of orthorexia nervosa and the factors predisposing to its occurrence.

During the process of researching papers, the following keywords were used for the present analysis: "eating disorders" obtaining 52,781 records in the PubMed database, after narrowing the criteria with regard to the purpose of the study of eating disorders prevalence risk factors-54 records were found. Focusing on orthorexia-38 papers were extracted. From the Wiley Online Library database, 97 records were found including - 6 records on ON, prevalence, risk factors. From the Springer link database, 256 papers were found, of which 21 reports matched the purpose of the study and were extracted. Collective research studies were

excluded and 56 articles published from 2006 to 2023, in English and Polish, were analyzed.

During the first phase, papers were selected on the basis of titles and preliminary evaluation of abstracts, while in the final phase the full texts of 56 research articles were analyzed and the exclusion criteria at this stage were methodological errors and studies that did not use questionnaires identifying orthorexia. The most commonly used questionnaires were the ORTO, BOT (Bratman Test for Orthorexia), Treuel Orthorexia Scale and Dusseldorf Orthorexia Scale. We excluded from further analysis studies that estimated the prevalence of behaviors focused on healthy eating in people who, for obvious reasons, should have such attitudes, e.g., nursing mothers in the postpartum period or people with somatic illnesses, e.g., gastroenterological problems. We also excluded studies that documented the beneficial health effects of mindfulness practices (lower risk of ON in this group). The final number of papers reviewed was 47. The selection process is illustrated by the diagram below (Figure 1).

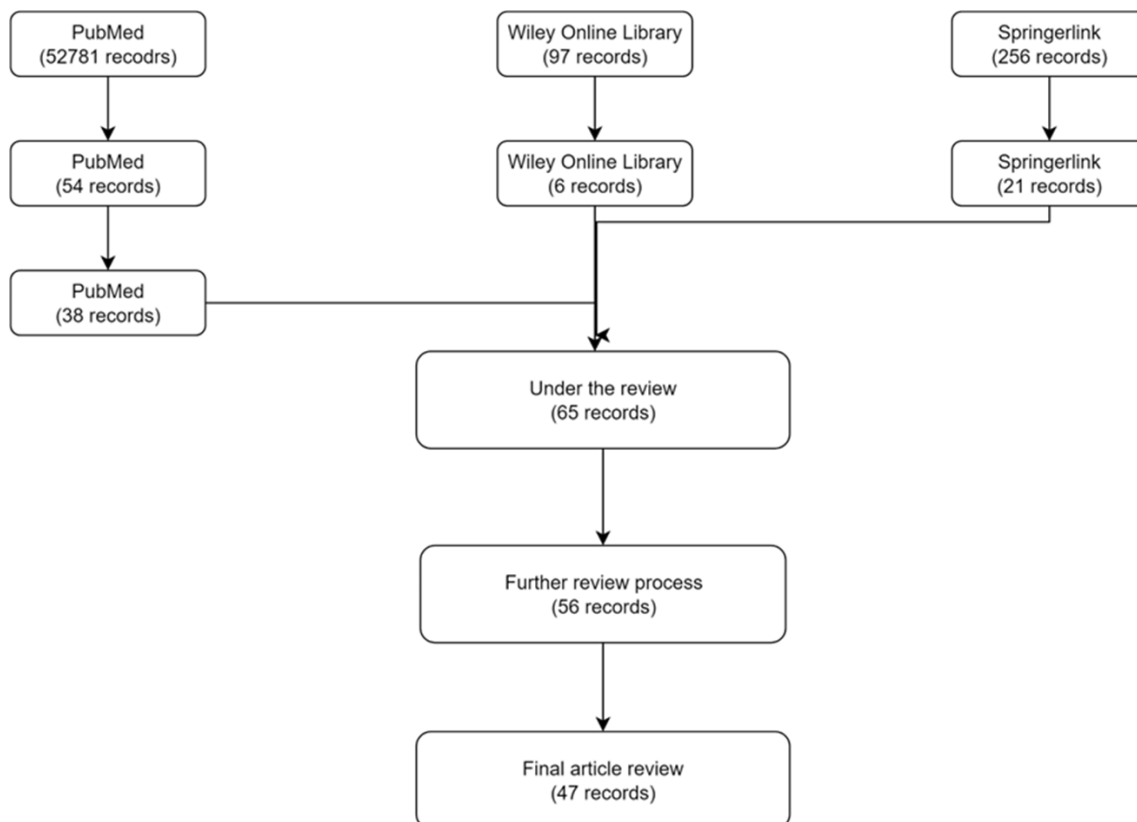


Figure 1: Decision-making diagram.

Overview of the research review

The study included a group of 22230 people of both sexes. On the basis of a review of case reports, an attempt was made to estimate the prevalence of orthorexia nervosa and to isolate potential factors contributing to the development of this disorder. Said task is demanding due to the different groups analyzed, some of the papers deal with population studies, others deal with specific, selected groups, e.g.: people diagnosed with eating

disorders, athletes, artists, presumably social media addicts (here the prevalence of orthorexia was estimated as high as 90.6%). It should be noted that different diagnostic questionnaires were used in the researched papers, which makes it significantly more challenging to obtain a potentially objective result. Additionally, in the ORTO-15 questionnaires, the cutoff point assumed by the authors of the tool was set to 40 and it was applied by some researchers which significantly overestimated their results; using said cutoff point, the prevalence of the phenomenon reached as

high as 86% (range of results 56.4 - 86, 90.6%). Thus, the postulates of researchers who recognized these results as overestimates and rather advocated to adopt in clinical practice, using the ORTO-15 diagnostic questionnaires, a score of 35 as the cutoff point [3-6] seem correct. Given this approach, discarding of the extremely high scores and taking into account the other ORTO./BOT (Bratman Test for Orthorexia) questionnaires, the prevalence of orthorexia

nervosa ranges from 6.5% to 41.7%, depending on the study, so it should be considered that an average of 24% of subjects were found to be at risk of orthorexia nervosa.

Researchers in twelve reports indicated that the highest score of risk was observed in the group of subjects with eating disorders of anorexia nervosa and bulimia nervosa [5-16], (Table 1).

Table 1: Correlation of ON with eating disorders

No.	Researcher	Type of Study	Objective of the Study	Research Tools	Study Group	Prevalence	Findings	Risk Factors
1	Łucka I [5,6]	Descriptive survey	Prevalence of ON, ON's relationship with ED, OCD	ORTO-15, EAT-26, MOCI, individual questionnaire	864	27% [High prevalence level ON]	The risk of ED increases the risk of ON, high BMI was also classified as one of the ON factors	Eating Disorders
2	Segura-Garcia C, et al. [7]	Descriptive survey	Prevalence of ON among women with AN and BN	ORTO-15, YBC-EDS, Eat-26	64 [32 female ED patients and 32 healthy women (control group)]	High prevalence of ON among women with AN and BN	AN and BN predisposed to ON	Eating Disorders
3	Segura-Garcia C, et al. [7]	Descriptive survey	Similarities and differences between ON and ED among women with AN and BN	ORTO-15, EAT-26, MDBSRQ	52 [female ED patients]	High prevalence of ON among women with AN and BN	AN and BN predisposed to ON	Eating Disorders
4	Gramaglia C, et al. [9]	Descriptive survey	Similarities between ON and AN among women with AN and healthy patients	ORTO-15	136 [58 patients with AN and 78 healthy women (control group)]	High prevalence of ON among women with AN	AN predisposed to ON	Eating Disorders
5	Parra-Fernández ML et al. [10]	Descriptive survey	Prevalence of ON in a population of Spanish university students; Analyzation of the possible associations between ON and psychological traits and behaviors that are common to ED.	ORTO-11-ES Eating Disorder Inventory (EDI-2)	454	17%	Many of the psychological and behavioral aspects of ED are shared by people who are at risk of ON.	Eating Disorders
6	Domingues RB [11]	Descriptive survey	Observe the relationships between orthorexia nervosa (ON) and potential risk factors for ON, in an international sample of experienced yoga practitioners.	Teruel orthorexia scale, Yoga immersion scale, Passion scale, Frost multidimensional perfectionism scale, Self-discipline scale of NEO-PI-R, Drive for thinness scale of EDI, and Beliefs about appearance scale.	469	Not specified	The drive for thinness was selected as a main potential risk factor for ON, however the mindfulness was categorized as counteracting factor	Eating Disorders

7	Barnes MA [12]	Descriptive survey	Study of Orthorexia nervosa shares similarities with anorexia nervosa and bulimia nervosa with regards to perfectionism, body image attitudes, and attachment style.	ORTO-15, the Multidimensional Perfectionism Scale (MPS), the Multidimensional Body-Self Relations Questionnaire-Appearance Scale (MBSRQ-AS), the Relationship Scales Questionnaire (RSQ), Rosenberg's Self-Esteem Scale (RSES).	220	28%-58%	Higher orthorexic tendencies significantly correlated with higher scores for perfectionism. Higher orthorexic tendencies also correlated with lower scores for body areas satisfaction and a secure attachment style. Additionally the history of an eating disorder strongly predicts orthorexia nervosa. These findings suggest that these disorders might be on the same spectrum of disordered eating.	Eating Disorders
8	Kiss-Leizer M [13]	Descriptive survey	The aim was to measure the personality profile of people with high orthorexic tendency using an assessment method which is acknowledged in the research of the classical eating disorders (anorexia nervosa, bulimia nervosa) and obsessive-compulsive disorder (OCD)	Temperament Character Inventory-56 (TCI-56) Ortho-11-Hu.	739	Not specified	The psychological factors describe as risk factor for AN and BN seems to be an important parameter of orthorexia	Eating Disorders
9	Jayson J [14]	Descriptive survey	Hypothesis that perfectionism among people who eat healthily (or who want to eat healthily) fosters ON symptoms indirectly by cultivating a health-focused self-concept (i.e., placing overriding importance on health for self-definition and self-worth). Additionally it was hypothesized that a health-focused self-concept would be associated with ON symptoms among people who have erroneous beliefs about the safety and efficacy of maladaptive healthy eating strategies.	12-item Clinical Perfectionism Questionnaire 20-item Beliefs About Appearance Scale (BAAS Orthorexia Nervosa Inventory (ONI)	456	4.80%	Perfectionism is indirectly associated with ON symptoms via a health-focused self-concept.	Eating Disorders
10	Noebel N [15]	Descriptive survey	Research explored whether orthorexia nervosa is associated with deficits in executive function [People with executive functioning deficits have difficulty monitoring and regulating their behaviors. These difficulties can include monitoring and changing behavior as needed, planning future behavior when faced with new tasks and situations, and anticipating outcomes and adapting to changing situations.]	Orthorexia Nervosa Inventory (ONI) the Behavior Rating Inventory of Executive Function—Adult version (BRIEF-A).	405	Not specified	Despite unique manifestations, orthorexia and anorexia may possess an overlapping neuropsychological profile marked by deficits in executive function, which may negatively impact daily life	Eating Disorders

11	Eriksson L [16]	Descriptive survey	This study investigates how scores on the Social Physique Anxiety Scale (SPAS) and the Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ) relate to Bratman's orthorexia test (BOT) scores with regard to age, sex, and self-reported exercise frequency and duration in a sample of Swedish participants in fitness center activity	Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ) relate to Bratman's orthorexia test (BOT)	251	Not specified	Female fitness center participants who exercised excessively had high BOT scores. This result supports findings linking high amounts of exercise to pathological weight control behavior and eating disorders. Further demonstrated that the cultural norms of the fitness center uphold a slim body ideal for women and a muscular body ideal for men	Eating Disorders
12	Costanzo G [17]	Descriptive survey	Investigate the associations between ON and the core features of eating disorders (EDs), psychopathological symptoms and defense mechanisms,	ON (EHQ-21), eating psychopathology (EDI-3), psychopathological symptoms (BSI) defense mechanisms (DSQ-40).	270	Not specified	The ON symptoms group reported greater EDs' features, higher psychopathological symptoms and greater employment of different neurotic and immature defense mechanisms.	Eating Disorders

Of particular relevance appear the studies on personality traits of people at risk of orthorexia, the most important of which are dissatisfaction with one's body, striving for weight reduction, preoccupation with appearance and weight, difficulty adapting to new situations, use of immature defense mechanisms, low levels of self-compassion [13,15,17-21]. The aforementioned traits seem to be common to all individuals affected by eating disorders. An intriguing research finding is that both ON and ED sufferers have great difficulty identifying and regulating emotions but ON patients are able to describe emotions unlike those with other eating disorders [22]. The results of the analysis seem to confirm data emphasizing commonalities between ON and anorexia nervosa (AN). Orthorexia appears to be strongly associated with the symptoms observed in anorexia nervosa, particularly noteworthy are the tendency toward perfectionism, the tendency to over-exercise, the low level of social skills and the attitude toward nutrition, which is viewed as the primary means of feeling in control of oneself and one's life [10,21,23-38]. Individuals with these disorders tend to also display abnormal attachment styles. Thus, it seems legitimate to classify orthorexia in the eating disorder division. We propose interpreting ON as a variant of eating disorders, as do most researchers who find many shared features in the examined individuals, both in the areas of personality, clinical symptoms and individuals' functioning.

Studies analyzing the association between body mass index and the occurrence of orthorexia included a group of 5048 people, with two studies on 1312 people indicating a statistically significant association between high body mass index and orthorexia [6,39], a study on 1120 people found no association between BMI and orthorexia [40]. Three studies consisting of a group of 2,616 people indicated a statistically significant association between low BMI

and orthorexia [23,41,42]. This observation seems interesting and warrants further analysis-perhaps the diagnostic tools are not precise enough, perhaps, like all screening tests, they isolate a risk group that includes both those who are affected and those who are just at risk of developing a full-blown disorder.

Additional risk factors for ON appeared to be health-related studies in the five studies conducted-particularly dietitians [40,42-45]. Two reports pointed to occupational stress, particularly for medics and orchestra-playing musicians [46,47]. It seems worthy to consider the suggestion made by researchers. Pointing out the higher risk of orthorexia in those undertaking health-related studies, that their motivation (most likely unconscious) may be an attempt at self-medication through the knowledge they gain. Another intriguing thread for further observation is the implication of social-media influence on eating behavior; researchers have noted both positive and negative effects of content presented online on the prevalence of this phenomenon. Nevertheless-a significant association was found between the use of social media in excess and the risk of orthorexia [41,48-51]. The prevalence of orthorexia among those likely to be addicted to social media was estimated to be as high as 90.6% [48].

Observations on the correlation of the gender of the subjects with the risk of orthorexia-in two cases indicated the female gender as predisposing to the disorder. Other researchers have not observed this phenomenon [41,52]. Relevant in the consideration of the diagnostic classification of the disorder seem to be the observations of the authors of three studies involving 1254 people [5,17,24], who did not indicate an association of orthorexia nervosa with obsessive-compulsive disorder (Table 2).

Table 2: Additional risk factors.

No.	Researcher	Type of Study	Objective of the Study	Research Tools	Study Group	Prevalence	Findings	Risk Factors
1	Kinzl JF [18]	Descriptive survey	Examine prevalence of orthorexia and risk factor in Austrian female dietitians	FEV-German 3 factor eating questionnaire Bartman test (BOT)	283	12,8%	Stress, emotional crisis, serious emotional and physical distress	Personality traits
2	Mutluer G [19]	Descriptive survey	The study shown the importance of understanding the effects of previous family experiences with ED	The Family Problems of Young Adulthood Evaluation Scale was developed by Tugrul Eating attitude test (EAT-26) Teruel Orthorexia Scale (TOS)	225	Not specified	While healthy orthorexia (HO) may be affected by limited social activities, health issues, and social problems in the family, HEF may be affected by the family's limited social activities.	Personality traits
3	Noebel NA [15]	Descriptive survey	Research explored whether orthorexia nervosa is associated with deficits in executive function	Orthorexia Nervosa Inventory (ONI) the Behavior Rating Inventory of Executive Function-Adult version (BRIEF-A).	405	Not specified	Despite unique manifestations, orthorexia and anorexia may possess an overlapping neuropsychological profile marked by deficits in executive function, which may negatively impact daily life	Personality traits
4	Costanzo G [17]	Descriptive survey	Investigate the associations between ON and the core features of eating disorders (EDs), psychopathological symptoms and defense mechanisms,	ON (EHQ-21), eating psychopathology (EDI-3), psychopathological symptoms (BSI) defense mechanisms (DSQ-40).	270	Not specified	ON related to higher psychopathological symptoms and greater employment of different neurotic and immature defense mechanisms.	Personality traits
5	Lasson C [20]	Descriptive survey	The aim was to find out about ON risks and protective factors, in particular with regards to personality.	Answered self-administered questionnaires assessing ON,	3235	3,1%	ON can be associated with different personality profiles, some of them displaying significant psychopathological levels	Personality traits
6	Kiss-Leizer M [13]	Descriptive survey	The aim was to measure orthorexia using an assessment method which is acknowledged in the research of the classical eating disorders	Temperament Character Inventory-56 (TCI-56) Ortho-11-Hu.	739	Not specified	The psychological factors described as risk factor for AN and BN seems to be an important parameter of orthorexia	Personality traits
7	Barnes MA [21]	Descriptive survey	Orthorexia nervosa shares similarities with anorexia nervosa and bulimia nervosa with regards to perfectionism, body image attitudes, and attachment style.	ORTO-15, the Multidimensional Perfectionism Scale (MPS), the Multidimensional Body-Self Relations Questionnaire-Appearance Scale (MBSRQ-AS), the Relationship Scales Questionnaire (RSQ), Rosenberg's Self-Esteem Scale (RSES).	220	Not specified	Higher orthorexic tendencies significantly correlated with higher scores for perfectionism. Higher orthorexic tendencies also correlated with lower scores for body areas satisfaction and a secure attachment style.	Personality traits

8	Parra-Fernández ML [10]	Descriptive survey	Prevalence of ON in a population of Spanish university students; Analyzation of the possible associations between ON and psychological traits and behaviors that are common to ED.	ORTO-11-ES Eating Disorder Inventory (EDI-2)	454	17%	Many of the psychological and behavioral aspects of ED are shared by people who are at risk of ON.	Personality traits
9	Vuillier L [22]	Descriptive survey	The aim was to find a correlation between maladaptive social behavior as well as regulating them and ON within individuals with eating disorders.	ON (ORTO-15 – reduced to ORTO-7CS), eating psychopathology (EAT-26), alexithymia (TAS-20) emotion dysregulation (DERS-16).	196	Not specified	Difficulties identifying and regulating their emotions, similarly to other eating disorders are linked with higher ON scores. However, ON symptoms did not seem to be associated with difficulties describing emotions. It was suggested that ON behaviors may be used as a coping strategy	Personality traits
10	Reynolds R [23]	Descriptive survey	Study tendencies and to estimate the prevalence of ON with regard to orthorexia proposed risk factors (eating behaviors, and body image.) within the study group.	Eating Attitudes Test-26 the Body Shape Questionnaire-34 ORTO-15 .	92 [adult students]	6,5%	The main ON risk factors are being underweight, dissatisfaction with body appearance, unsatisfactory social functioning	Body Image
11	Brytek-Matera A [24]	Descriptive survey	To investigate the relationship between ORTO-15 score and obsessive-compulsive symptoms, disordered eating patterns and body uneasiness	ORTO-15 test, the Maudsley Obsessive-Compulsive Questionnaire, the Eating Attitudes Test-26 the Body Uneasiness Test	120 [adult students]	Not specified	Lower the ORTO-15 scores the less pathological body image discomfort and obsessive-compulsive signs as well as improved eating patterns.	Body Image
12	Duran S [25]	Descriptive survey	Study aimed to identify the relationships between Orthorexia nervosa, social appearance anxiety and women's self-esteem	Orthorexia Scale	222 women	27%	There was a negative relationship between the social appearance anxiety scale (SAAS) and the Rosenberg Self-Esteem Scale (RSES) which were further identified as risk factors for ON.	Body Image
13	Messer M [26]	Descriptive survey	Study examined the prospective associations between five components of body image and ON symptoms in community-based adult women	Other	558 women	Not specified	Negative body image might be implicated in the onset or maintenance of ON symptoms	Body Image
14	Duran S [25]	Descriptive survey	Study aims to determine the prevalence of muscular dysmorphic disorder and orthorexia nervosa in male students and to evaluate the relationship between these conditions and self-esteem.	Other	430 male students	Orthorexia among sports sciences' students was 28.8%, 16.3% for nursing; Tendency to bigorexia, was found to be 16.3% in FSS students and 6% in ND.	Lower self-confidence the higher risk of ON There was a negative correlation between the orthorexia scale and self-confidence scales. And, there was a weak negative correlation between the bigorexia Inventory and the self confidence scale	Body Image

15	Parra-Fernández ML [10]	Descriptive survey	The prevalence of ON and to analyze the possible associations between ON and psychological traits and behaviors that are common to ED.	The ORTO-11-ES questionnaire the Eating Disorder Inventory (EDI-2)	454	17% students	The scores on the EDI-2 for the group at risk of ON suggested that certain personality traits are a risk factor for ON. The traits listed: drive for thinness, bulimia, body dissatisfaction, perfectionism, interoceptive awareness, asceticism and impulsiveness.	Body Image
16	Sfeir M [27]	Descriptive survey	Evaluation of the relationship between religiosity and orthorexia nervosa via either trait or state self-esteem	Teruel Orthorexia Nervosa	428	Not specified	A high state self-esteem was correlated with a lower level of orthorexia nervosa. Higher religiosity was shown to be associated with higher self-esteem, which in turn was associated with a decrease in the scores of orthorexia nervosa.	Body Image
17	Eriksson L [28]	Descriptive survey	This study investigates how scores on the mentioned test methods correlates with BOT scores with regard to age, sex, and self-reported exercise frequency and duration	Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ) relate to Bratman's orthorexia test (BOT)	251	Not specified	Female fitness center participants who exercised more frequently had high BOT scores. This supports findings linking high amounts of exercise to pathological weight control behavior and eating disorders. Further demonstrated that the cultural norms of the fitness center uphold a slim body ideal for women and a muscular body ideal for men	Excessive Exercising
18	Rudolph S [29]	Descriptive survey	The aim was to analyze the connection between exercise addiction (EA) and orthorexia nervosa (ON)	The Exercise Addiction Inventory (EAI) Düsseldorfer Orthorexia Skala (DOS)	1008 [559 male and 449 female active members of three fitness studios]	10.2% exhibit EA, while ON is prevalent in 3.4%. Twenty-three (2.3%) individuals suffer from both.	Exercise addiction and excessive exercising connected with higher ON	Excessive Exercising
19	Clifford T [30]	Descriptive survey	The aim was to explore the prevalence of ON in University students to determine whether those who compete in University sports have higher orthorexic tendencies.	ORTO-15	215 [116 male and female student athletes (age 21 ± 1 years) and 99 non-athlete controls]	76% [Cut-off point 40]	ON appears to be a greater risk for students in general, furthermore for student athletes who undertake high volumes of exercise	Excessive Exercising
20	Herranz Valera J [31]	Descriptive survey	Is ashtanga yoga a predisposition to ON?	ORTO-15)	136	86 %	Ashtanga yoga predisposes ON	Excessive Exercising
21	Bóna E [32]	Descriptive survey	The aim was to assess the prevalence and certain psychological and other correlates of orthorexic tendencies: health and exercise behaviors and demographic variables among gym attendees in Hungary	(Orto-11-Hu) and the independent variables (Eating Disorder Inventory, Maudsley Obsessional-Compulsive Inventory, health and exercise habits, and demographics).	207	27.7	The data suggest and overlap between certain eating disorder traits, and a link between ON and frequent exercising and younger age.	Excessive Exercising

22	Dittfeld A [33]	Descriptive survey	The aim was to study the relationship between vegetarianism and orthorexia nervosa (ON)	general characteristics, anthropometric data, the Bratman Test for Orthorexia (BOT), and questions assessing attitudes toward food and nutrition.	2611	41,7%	Fanaticism about healthy food applies at a higher rate to vegetarians Most healthy food fanatics are among lactovegetarians, The prevalence of ON decreased with age	Eating Habits
23	Guglielmetti M [34]	Descriptive survey	Study to investigate whether there was a difference in ON risk between different studies majors, and to evaluate if lifestyle-related ON risk factors (dieting, physical activity, drugs and supplements use)	ORTO-15	671	31.20%	Dieting was confirmed as the major ON risk factor	Eating Habits
24	Voglino G [35]	Descriptive survey	The aims of this study were to assess ON symptoms prevalence among them, comparing them with non-OSCs and investigate potential predictors of ON	ORTO-15 Eating Habits Questionnaire (EHQ)	carried among 121 OSCs and 119 non-OSCs.	prevalence among OSCs was 69.4% and 23.1% (using ORTO-15 with 40 and 35 cut-offs)	The organic store customers (OSCs) can be a population at risk for ON	Eating Habits
25	Dell'Osso L [36]	Descriptive survey	The aim of the study was to investigate the prevalence of ON and its relationship with gender and nutritional style among young adults	ORTO-15	2130	34,9%	Significantly higher rate of ON in women than in men (37.8 vs. 30.7%), in vegans/vegetarians compared to those with a standard diet (56.3 vs. 32.2%), and among those with a low BMI compared to those with a normal or high BMI (42.8 vs. 34.2%).	Eating Habits
26	Kalika E [37]	Descriptive survey	The aim was to explore problematic eating behaviors in a vegan population, and to explore whether mindful eating and self-compassion have an impact on ON	scales in Orthorexia, Self-Compassion, Mindful, Emotional, External and Restraint Eating.	Two hundred and eighty-seven females and twenty-eight males	Not specified	Individuals with high levels of ON display low levels of self-compassion, and high levels of restrained eating. Moreover, the findings indicated that self-compassion, but not mindful eating, partially mediated the relationship between restrained eating and orthorexia nervosa	Eating Habits
27	Miley M [38]	Descriptive survey	The study examined the associations between Mindful Eating (ME) and perfectionism in the etiology and treatment of eating disorders (ED),	Düsseldorf Orthorexia scale, the Mindful Eating Behavior scale, the Big-Three Perfectionism scale Short-form	670	Not specified	Perfectionism demonstrated a significant negative correlation with three out of four ME facets, with "eating without distraction" displaying the highest correlation. The "eating with awareness" facet of ME demonstrated a significant relationship with ON, in a negative direction. An unexpected relationship was observed between the focused eating facet of ME and ON, with a positive association being found. A further regression analysis revealed both perfectionism and ME to predict orthorexic tendencies.	Eating Habits

28	Łucka I [5,6]	Descriptive survey	Prevalence and risk factors of ON	ORTO-15, EAT-26, MOCI, BDI-II, individual question- naire	864	27% [High prevalence level ON]	Individuals with a higher BMI categorized as the highest risk of ON among adolescents aged 13-16.	BMI
29	Bundros J [39]	Descriptive survey	the Bratman Orthorexia Test (BOT) for ON diagnosis, and its relationship to validated tools for assessing disordered eating, body dysmorphic, and obsessive-compulsive tendencies	survey that included the BOT, Eating Attitudes Test-26 (EAT-26), Body Dysmorphic Disorder Questionnaire (BDDQ), Obsessive Compulsive Inventory, Revised (OCI-R)	448	Not specified	Hispanic/Latino and overweight/obese as a predisposition for ON	BMI
30	Dell'Osso L [36]	Descriptive survey	The aim of the study was to investigate the prevalence of ON and its relationship with gender and nutritional style among young adults	ORTO-15	2130	34,9%	Significantly higher rate of ON among those with a low BMI compared to those with a normal or high BMI (42.8 vs. 34.2%).	BMI
31	Reynolds R [23]	Descriptive survey	Study aims to display tendencies and estimate the prevalence of ON with regard to orthorexia proposed risk factors	Eating Attitudes Test-26 the Body Shape Questionnaire-34 ORTO-15 .	92 [adult students]	6,5%	The main ON risk factors are being underweight, dissatisfaction with body appearance, unsatisfactory social functioning	BMI
32	Plichta M [40]	Descriptive survey	To study the prevalence of ON with regard to eating habits and Body Satisfaction within students	ORTO-15, BPPPS, FFQ-6	1120	28,3% [High prevalence level ON]	Students of health-related studies at high risk for ON	BMI
33	Karniej P [42]	Descriptive survey	Study to identifying demographic factors and unique predictors of ON e.g., the use of pre-exposure prophylaxis (PrEP), the use of social media and the Grindr @ dating application among a sample group	ORTO-15 EAT-26	394 gay men	Not specified	The most important predictors of orthorexia nervosa in gay men are: low BMI and the use of Grindr. The effect of daily usage of PrEP is associated with lower risk, and occasional use is associated with increased risk of orthorexia nervosa.	BMI
34	Dittfeld A [43]	Descriptive survey	Assessment of risk of orthorexia nervosa among dietetics students compared to physiotherapy student	Bratman Test for Orthorexia (BOT) questions posed by the authors	430	26.6% of the dietetics students and only 14.9% of physiotherapy students	Highly sensitive behaviors towards healthy eating are very common in both surveyed groups, however with a stronger tendency among the students of dietetics.	Health-Related Studies
35	Plichta M [40]	Descriptive survey	To study the prevalence of ON with regard to eating habits and Body Satisfaction within students	ORTO-15, BPPPS, FFQ-6	1120	28,3% [High prevalence level ON]	Students of health-related studies at high risk for ON	Health-Related Studies

36	King E [44]	Descriptive survey	Study associations between level of interest in nutrition, knowledge of nutrition, and prevalence of orthorexia traits in a population of college students enrolled in a general education nutrition course	The Eating Habits Questionnaire (EHQ)	221 students	Not specified	Nutrition knowledge was inversely associated with prevalence of orthorexia traits Interest in nutrition is associated with increased prevalence of orthorexia traits, however, higher levels of nutrition knowledge are associated with decreased prevalence of orthorexia traits	Health-Related Studies
37	Aktürk U [45]	Descriptive survey	The study was conducted to determine the Orthorexia Nervosa (ON) level in the nursing faculty students and the effective factors.	Questionnaire ORTO-15	558 students	73.5% of the students had ON	Medical professionals including nursing are at serious risk of ON. Focusing on risk factors for ON, an increasing prevalence was observed, and all factors except Dieting were identified as important risk factors for ON, with the strongest associations for Weight satisfaction, age, and gender.	Health-Related Studies
38	Bo Simona [46]	Descriptive survey	Study to evaluate the prevalence of the traits of orthorexia and muscle dysmorphia among freshmen attending university courses focused on nutrition and body care.	ORTO-15 Muscle-Dysmorphic-Disorder-Inventory Eating Attitudes Test-26	440	The prevalence of the traits of EDs, orthorexia, and muscle dysmorphia was 9.1%, 25.9%, and 5.9%, respectively	The prevalence of orthorexia traits was high in all schools Overall, individuals with traits of any of these disorders were more frequently on diet or on supplement use. The choice of the university courses might be influenced by pre-existing disorders in eating behaviors, which were relatively frequent in the considered sample.	Health-Related Studies
39	Erkin Ö [47]	Descriptive survey	Study to determine the perception of academicians' health status, identify academicians' orthorexia nervosa (ON) tendencies, and identify the factors associated with academicians' ON tendencies	ORTO-11	Not specified	Not specified	Most of the academicians had a high tendency to ON. High stress jobs with higher ON risk	Profession related stress
40	Aksoydan E [48]	Descriptive survey	The study was to determine the prevalence of orthorexia nervosa among the performance artists in the State Opera and Ballet and in the Bilkent University Symphony Orchestra.	ORTO-15	39 men and 55 women for a total of 94 artists	56.40%	Opera singers with the highest ON rate (81.8%) further advanced symphony orchestra musicians(36.4%) and 32.1% among ballet dancers. The differences between the three groups were statistically significant.	Profession related stress
41	Turner P [49]	Descriptive survey	The prevalence of ON among social media users	ORTO-15, survey of internet usage habits and eating habits	680	90,6%	The amount of time spent on the social medium was a significant risk factor	Social Media
42	Villa M [50]	Descriptive survey	Study intends to identify risk factors for orthorexia nervosa in a sample of Nutrition and Dietetics students	The ORTHO-11-ES	90	23,3%	Physical activity limits are associated with the risk of suffering ON as well as time spent on the social network Instagram. Conditions associated with the risk of orthorexia nervosa: number of hours spent using Instagram, limited cohabitation, extreme physical activity, and number of years in the major.	Social Media

43	Yilmazel G [51]	Descriptive survey	To determine orthorexia tendency and social media addiction among candidate doctors and nurses.	ORTO-15	969 candidate doctors and nurses training in a peripheral public university.	78.8% were social media addicts and 62.2% had orthorexic tendencies.	Social media addiction linked with higher ON	Social Media
44	Dell'Osso L [36]	Descriptive survey	The aim of the study was to investigate the prevalence of ON and its relationship with gender and nutritional style among young adults	ORTO-15	2130	34,9%	Significantly higher rate of ON in women than in men (37.8 vs. 30.7%),	Gender
45	Sanlier N [53]	Descriptive survey	. This study was carried out to determine the relationship of eating disorders and orthorexia nervosa to gender, BMI, and field of study in a population of university students in Turkey	EAT-40 ORTO-15,	900 students	Not specified	Higher ON prevalence in women, which can reflect the importance of gender in ON prevalence.	Gender
46	Strahler J [57]	Descriptive survey	Mindfulness, the focused, non-judgmental attention to and awareness of present events, may be an important psychological contributor to (orthorexic) eating habits.	Freiburg Mindfulness Inventory, presence and acceptance subscale) orthorexic eating (Teruel Orthorexia Scale)	314 women and 75 men	5.6 and 6.4%	Mindfulness encourages eating healthy and may protect against eating-related pathologies. Results also support the notion that orthorexia has two dimensions, healthy and nervosa, which are differently related to psychological factors, herein mindfulness.	Prevention
47	Valente M [52]	Descriptive survey	relationship between orthorexia nervosa (ON) and Instagram.	online questionnaire investigating the experience of ON	248	Conversations around #Orthorexia on Instagram generates supportive communities aiding recovery. Individuals use Instagram for helping others and themselves recovering from ON.	Supportive communities aiding recovery. Individuals use Instagram for helping others and themselves recovering from ON.	Prevention

Conclusion

In the studies analyzed, after rejecting extremely high scores, an average of 24% of subjects were found to be at risk of orthorexia nervosa. Applying the ORTO 15 orthorexia diagnostic questionnaires in clinical practice, a score of 35 should be taken as the cutoff point, otherwise the results artificially inflate the number of individuals considered as abnormal eaters, centered on a pathological fixation on healthy eating. It seems that it would be advisable to work on further refinement and standardization of the diagnostic tool that identifies orthorexia nervosa.

The main ON risk factors seem to be a correlation with ED as the highest score of risk was observed in the group of people with eating disorders, striving to achieve weight reduction, with perfectionist traits, following diets, dissatisfied with the appearance of their bodies, engaging in intense physical exercise, poor social functioning, with abnormal attachment patterns and abnormal personality traits, using immature defense mechanisms. Additional risk factors appeared to be health-related studies-especially dietetics and occupational stress. The relationship between gender and ON risk needs further observation. Further analysis of the influence of social media on the development of orthorexia nervosa also seems to be of interest. Apart from simply studying

psychological and socio-cultural risk factors it may be of interest to study biological factors such as blood plasma, especially from these individuals for the development of orthorexia. As suggested in Martins' studies [53-55], Sirtuin 1 may be linked to appetite control and focus on healthy diet & calorie restriction as well as over intense exercising, which all are to be considered major Orthorexia symptoms and risk factors. Furthermore, studies place Sirtuin 1 as a key protein needed for the proper brain function. It is believed that lack of activated Sirtuin 1 may be a risk factor for eating disorders and possibly orthorexia, thus plasma measurement of Sirtuin 1 may be of interest to the development of orthorexia and in overall eating disorders. A research paper by Strahler & all seems to summarize the role of well-being and mindfulness as major protective factors against eating disorders [56,57].

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