

Orthorexia nervosa is a concern in gastroenterology: A scoping review

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Abstract

There is concern that use of restrictive therapeutic diets, such as those used in disorders of the gut-brain interaction (DGBI), may increase disordered eating. In this issue of *Neurogastroenterology and Motility*, Burton Murray et al. and Peters et al. both demonstrate a high prevalence of disordered eating in patients with gastrointestinal conditions, particularly those with DGBI. Given these findings, it is likely that orthorexia is common in this patient group, although this was not directly examined in these studies. Orthorexia nervosa is described as an obsessive and unsafe focus on eating foods perceived as healthy. This mini-review therefore focuses on orthorexia by conducting a scoping review, as per the PRISMA extension for scoping reviews, aimed to assess the prevalence of orthorexia, and associations between orthorexia and restrictive eating practices. While a wide range of orthorexia prevalence has been reported (0%–97%) across the 57 studies included, no studies assessed prevalence specifically in gastrointestinal conditions. Four of eight studies describing diseases associated with specific dietary patterns suggested that participants who followed a diet for “digestive issues” or “food intolerances” were at higher orthorexia risk. These results suggest that dietary modifications may be a factor contributing to orthorexia. Additionally, we provide a commentary on the clinical implications of the findings for gastrointestinal conditions including a clinical flow chart. Clinicians should consider if a restrictive diet is appropriate for individuals with DGBI and include screening for disordered eating prior to implementation of dietary modifications. Future prospective studies should evaluate orthorexia within this patient group.

KEYWORDS

dietary management, disordered eating, disorders of gut-brain interaction, irritable bowel syndrome, coeliac disease

Abbreviations: ARFID, avoidant/restrictive food intake disorder; BOT, Bratman Orthorexia test; DGBI, disorders of the gut-brain interaction; DOS, Dusseldorf Orthorexia Scale; EAT, eating attitudes test; ED, eating disorder; EDDA, eating disorder diagnostic scale; EDE-Q, eating disorder examination questionnaire; ESP, eating disorder screen for primary care; EHQ, eating habits questionnaire; FODMAPs, fermentable oligo-, di-, mono-saccharides and polyols; IBS, irritable bowel syndrome; ON, ION inventory; ONS, ON symptomology questionnaire; SCOFF, sick, control, one stone, fat, food; TFEQ, three-factor eating questionnaire.

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1 | INTRODUCTION

There has been recent interest in a new eating disorder (ED) termed Orthorexia Nervosa, originally conceived in 1997.¹ Orthorexia nervosa has been described as an obsessive and unsafe focus on eating foods perceived as healthy.²

No consensus has been made regarding diagnostic criteria for orthorexia, but terms frequently used by researchers include “fixation,” “obsession,” and “concern/preoccupation.”² Two key diagnostic criteria most frequently used include an obsessive focus on healthy eating, and that the compulsive behavior and mental preoccupation becomes clinically impairing such as resulting in malnutrition.³ Distinct from other ED that are diagnosed via the DSM-5 criteria, a diagnosis of orthorexia is not dependent on change in body weight or size.⁴ Likewise avoidant/restrictive food intake disorder (ARFID) is not a shape/weight-motivated ED but is thought to be distinct from orthorexia as food restriction is not focused on the health value of foods, but on concern about the aversive consequences of eating.³ Due to the lack of standardized diagnostic tools, there is a large discrepancy in orthorexia prevalence rates reported in the literature from 0% to 97%.^{5,6} Hence, the actual prevalence rates and population groups most at risk are largely unknown.

Dietary therapies are increasingly being used in patients with gastrointestinal conditions, particularly those with disorders of the gut-brain interaction (DGBI)⁷ (both patient⁷ and practitioner led⁸). This has largely occurred due to increased patient preference for non-pharmacological therapies, enhanced knowledge of diet-microbiota interactions and their potential role in disease pathogenesis, as well as the increased evidence of efficacy in dietary therapies.⁹ Although diet can provide symptom relief for many patients, there is concern for the potential role of such restrictive dietary therapies leading to orthorexia^{10,11} and gastroenterologists have been cautioned to be aware of orthorexia in their daily practice.¹² While the link between restrictive dietary therapies and orthorexia is poorly studied, it has been shown that DGBI are common among patients with other ED such as anorexia nervosa, bulimia nervosa, and binge-eating disorder.¹³ The presence of at least one DGBI in individuals with ED has been shown to be as high as 95.5%.¹⁴ Diagnosis of ARFID has been reported to occur frequently in patients with gastroparesis¹⁵ and inflammatory bowel disease,¹⁶ and ARFID symptoms are often related to fear of gastrointestinal symptoms in patients with DGBI.¹⁷ Recent studies investigating ARFID in irritable bowel syndrome (IBS) have shown those with severe food avoidance and restriction have more severe symptoms overall, reduced quality of life and reduced nutrient intake.¹⁸ The studies by Burton Murray et al. and Peters et al. published in this issue of Neurogastroenterology and Motility, both highlight the high prevalence of disordered eating behaviors in patients with gastrointestinal conditions, particularly DGBIs.^{19,20} Burton Murray et al. reported 40% of DGBI patients had ARFID, with the most frequent presentation being fear of adverse consequences.¹⁹ The systematic review by Peters et al. reported disordered eating in 13%–55% of patients with gastrointestinal disorders, with highest prevalence in those with DGBI.²⁰ Given these findings,

Key Points

- Orthorexia nervosa is an obsessive and unsafe focus on eating foods perceived as healthy.
- Limited data regarding orthorexia in patients with gastrointestinal conditions exist, but there is concern that use of restrictive therapeutic diets may lead to increased orthorexic traits.
- Specific dietary patterns may be a factor contributing to orthorexia development, hence screening prior to recommending dietary modifications is key.

it is likely that orthorexia is common in this patient group, although this was not directly examined in these studies. These data, while focusing on other forms of ED, are hypothesis-generating that use of dietary therapies may also lead to increased orthorexic behaviors.

Due to the paucity of data specific to orthorexia in gastrointestinal conditions, the aim of this scoping review was to firstly assess the prevalence of orthorexia in various population groups, and secondly assess any associations between orthorexia and restrictive eating practices. Finally, this review discusses the clinical implications of the findings within the setting of gastroenterology.

2 | MATERIALS AND METHODS

This scoping review was conducted as per the PRISMA extension for scoping reviews²¹ and followed the validated Joanna Briggs Institute (JBI) screening tool.²²

2.1 | Eligibility criteria

Due to the limited literature available regarding orthorexia in DGBI and the comprehensive nature of scoping reviews, broad eligibility criteria were used. Using the JBI guidelines,²² eligibility criteria were developed for the PCC mnemonic (population, concept, and context). For “population,” articles related to humans aged 18 years or older were included. For “concept,” one or more of three concepts were required: (i) prevalence; (ii) therapeutic diets or dietary restriction; and (iii) diagnostic tools. For “context,” articles related to orthorexic traits or orthorexia nervosa were included, and any articles related to ARFID and not orthorexia were excluded.

2.2 | Information sources and search strategy

A comprehensive literature search was conducted with assistance from a university librarian on 5th February 2021. Four electronic databases were searched including Medline, CINAHL, Scopus, and Psycinfo. The search strategy used the keywords: ‘orthorexia’ OR

"orthorexia nervosa" AND 'adult' AND 'prevalence' OR 'population' OR 'frequen*' OR 'proportion' AND "therapeutic diet*" OR "Diet* manag*" OR "restrict* diet*" OR "diet*intervention" OR "elimination diet" AND 'diagnos*' or "Eating Habits Questionnaire" OR "ORTO-15" OR "Bratman Orthorexia Test" OR "Dusseldorf Orthorexia Scale" OR "Barcelona Orthorexia Scale" OR "Orthorexia Nervosa Inventory" OR "Teruel Orthorexia Scale". All study designs were included across all date ranges, but only English language papers were included.

2.3 | Study selection process

Initial screening of titles and abstracts was conducted by two researchers (NS and MT). Full-text article review was conducted collaboratively by four researchers (CT, NS, MT, and JB) who met regularly to resolve any discrepancies. Articles were excluded if they did not meet the inclusion criteria and in cases where age range could not be clarified definitively.

2.4 | Data extraction and assessment of quality

Data extraction assessed study design, participant recruitment, and outcomes in relation to the prevalence of orthorexia, and orthorexia in the setting of therapeutic restrictive diets. Using a collaborative approach, four researchers (CT, NS, MT, and JB) extracted data addressing: study design, location, population, sample size, study quality based on the NHMRC quality assessment tool,²³ outcome measures, and key results. Any discrepancies were resolved at regular meetings. The data extraction from the selected articles is shown in [Tables 1 and 2](#).

3 | RESULTS

Due to the higher volume of articles found than anticipated, for the purpose of this review only two concepts are discussed: (i) prevalence and (ii) therapeutic diets. A total of 1296 articles were found through database searching; after removing duplicates, this reduced to 322 ([Figure 1](#)). Upon screening, 125 studies did not meet inclusion criteria, while 42 did not have full-text available, leaving 155 papers for full-text review. During this stage, 49 articles were excluded as they were only relevant to concept (iii) diagnostic tools, 35 did not meet eligibility criteria and two were found to be duplicates. Thus, 69 articles were included in this review.

3.1 | Outcome Measures

Several tools were used to assess orthorexia across the studies. The majority, 57, used a variation of the ORTO (including the ORTO-15 or ORTO-11), 22 used the Dusseldorf Orthorexia Scale (DOS), five used the Bratman Orthorexia Test (BOT), three used the Eating Habits Questionnaire (EHQ), two used the ON Inventory (ONI), and one

used the ON Symptomology Questionnaire (ONS). Five studies used qualitative methods. To further assess orthorexia, some studies also used validated disordered eating scales. Six used the Eating Attitudes Test (EAT), four used the Eating Disorder Examination Questionnaire (EDE-Q), three used the Three-Factor Eating Questionnaire (TFEQ), one used the Eating Disorder Diagnostic Scale (EDDA), and one used the Eating Disorder Screen for Primary Care (ESP).

3.2 | Concept 1: Prevalence rates of orthorexia nervosa

Fifty-seven studies assessed orthorexia prevalence ([Table 1](#)). Most studies were conducted in Europe, and the majority were cross-sectional. Sample sizes ranged from 10 to 2826 participants, with an age range of 18–92 years. Six population groups were identified; twenty-six focused on university students,^{6,24–48} 12 on the general population,^{49–60} 10 on "health-minded" individuals,^{5,61–69} four on dietitians and health professionals,^{70–73} four on people with a chronic illness,^{74–77} and two on people with ED.^{77,78}

3.2.1 | Effect of cutoff scores on prevalence rates

As shown in [Table 3](#), the ORTO-15 with a cutoff score of 40 was the most widely used, in 18 studies, where orthorexia prevalence ranged from 41.9% to 96.5%. The DOS 30+ was the second most used, in 15 studies, where prevalence ranged from 2.3% to 48.0%.

3.2.2 | General population

The average orthorexia prevalence in the general population was 26.76% (range 2.3%–80%). The lowest overall orthorexia prevalence was reported in the German population (4.7%, 2.3%–6.9%),^{52,53,58} while the highest overall orthorexia prevalence was reported in the UK population (72%, 64%–80%).^{55,56}

3.2.3 | University students

The average orthorexia prevalence in the general university population was 27.81% (range 2.3%–74.2%).^{28–31,39–43,45,47,48} Orthorexia prevalence was highest in medical students (74.5%),³³ followed by business students (65.4%)³⁷; nutrition and dietetic students (51.3%, 4.5%–96.51%)^{6,24,25,27,35,38}; and art students (50.1%).²⁶

3.2.4 | Health-focused groups

Ten studies assessed health-focused groups including people who followed health-focused online pages, attended health centers, attended yoga classes, played sports, or who were food-focused.

TABLE 1 Orthorexia prevalence per population group

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measure (cutoff)	Key results
Orthorexia prevalence in university students							
Abdullah, Al Hourani & Alkhatib, (2020) ²⁴	Jordan	Nutrition university students and nutritionists	N = 421, age range 18+	Cross-sectional survey	V	ORTO-15 (<35, <40)	<40 = 72.0% <35 = 31.8%
Agopyan et al. (2019) ²⁵	Turkey	Female university students from the Department of Nutrition and Dietetics	N = 136, age range 18–30	Cross-sectional survey	IV	ORTO-11, Turkish version (<27)	70.6%
Aksoydan & Camci (2009) ²⁶	Turkey	Performance artists in the State Opera and Ballet and Symphony Orchestra	N = 94, age range 20–59	Cross-sectional survey	IV	ORTO-15, Turkish version (<40)	56.4% (opera singers = 81.8%; symphony orchestra musicians = 36.4%; ballet dancers = 32.1%)
Bo et al. (2014) ²⁷	Italy	University students studying Dietetics, Exercise and Sports Science, and Biology	N = 449, mean age 19.8	Cross-sectional survey	III-2	ORTO-15 (<35)	25.9% (dietetics = 35.9%; exercise and sports science = 26.5%; biology: 22.5%)
Brytek-Matera (2021) ²⁸	Poland	University students	N = 412, age range 18–64	Cross-sectional survey	V	DOS, Polish version (30+)	6.6%
Brytek-Matera et al. (2020) ²⁹	Spain and Poland	University students	N = 860 (n = 560 women, n = 300 men), mean age 21.17	Cross-sectional survey	IV	DOS, Spanish and Polish versions (30+)	DOS-Spanish = 2.3% DOS-Polish = 2.9%
Dell'Osso et al. (2016) ³⁰	Italy	University students and University staff	N = 2826 (n = 1148 women, N = 1678 men), mean age 28.9	Cross-sectional survey	IV	ORTO-15 (<35)	32.7%
Dell'Osso et al. (2018) ³¹	Italy	University students	N = 2130 (n = 1274 women, n = 876 men), mean age 23	Cross-sectional survey	IV	ORTO-15, Italian version (<35)	34.9%
Depa et al. (2017) ³²	Germany	University students studying Nursing Science and Exercise Science	n = 456	Cross-sectional survey	III-2	DOS (30+)	3.3%
Farchakh, Hallit & Soufia (2019) ³³	Lebanon	University medical students	N = 627 (n = 31 women, n = 311 men), mean age 21.81	Cross-sectional survey	IV	ORTO-15, Arabic version (<40)	74.5%
Gorrasi et al. (2020) ³⁴	Italy	University students studying Health Science, Economic-Humanistic Science, and Sports Science	N = 918 (n = 503 women), mean age 20.2	Cross-sectional survey	IV	ORTO-15 (<35)	23.5%

TABLE 1 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measure (cutoff)	Key results
Grammatikopoulou et al. (2018) ³⁵	Greece	Undergraduate students from a Department of Nutrition and Dietetics	N = 176, age range 18–40	Cross-sectional survey	IV	BOT	68.2%
Kamari Altun, Keser & Bozkurt (2020) ³⁶	Turkey	University students studying health sciences and social sciences	N = 304 (61.5% women)	Cross-sectional survey	III-2	ORTO-11, Turkish version (<27)	42.8% (health-related courses = 41.8%; non-health-related courses = 43.8%)
Malmberg et al. (2017) ³⁷	Sweden	University students studying exercise science or business programs	N = 207, age range 19–29	Cross-sectional survey	IV	ORTO-15, English version (<40)	76.6% (exercise science students = 84.5%; business students = 65.4%)
Oberle, De Nadai & Madrid (2021) ³⁸	United States	University students studying nutrition and psychology and social media advertisements targeting healthy and normal eaters	N = 847 (82% women), mean age 21.72	Cross-sectional survey	IV	ONI	4.5%
Parra Carriedo et al. (2020) ³⁹	Mexico	University students	N = 911 (65.4% women), mean age 21	Cross-sectional survey	IV	ORTO-14MX (Mexican version) (≤35, ≤40)	≤40 = 61.8% ≤35 = 34.3%
Parra-Fernandez et al. (2019) ⁴⁰	Spain	University students	N = 492 (56.9% women)	Cross-sectional survey	IV	ORTO-11-ES (<25); DOS-ES (30+)	DOS-ES = 10.5%; ORTO-11-ES: 25.2%
Parra-Fernandez et al. (2018) ⁴¹	Spain	University students	N = 454, age range 18–41	Cross-sectional online survey	IV	ORTO-11-ES, Spanish version (<25)	17%
Plichta & Jezewska-Zychowicz (2019) ⁴²	Poland	University students	N = 1120, age range 18–35	Cross-sectional survey	IV	ORTO-15, Polish version (<35, <40)	<40 = 46.7% <35 = 28.7%
Plichta & Jezewska-Zychowicz (2020) ⁴³	Poland	University students	N = 1120, age range 18–35	Cross-sectional survey	IV	ORTO-15, Polish version (<35)	15.3%
Plichta., Jezewska-Zychowicz & Gebski (2019) ⁴⁴	Poland	University students	N = 1120, age range 18–35	Cross-sectional survey	V	ORTO-15, Polish version (<35, <40)	<40 = 75% (health-related majors = 79.3%; other majors = 70.9%); <35 = 28.3% (health-related majors = 32.9%; other majors = 23.9%)

(Continues)

TABLE 1 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measure (cutoff)	Key results
Reynolds (2018) ⁴⁵	Australia	University staff and students	N = 92, age range 18+	Cross-sectional survey	V	ORTO-15 (<35)	21%
Varga et al. (2014) ⁴⁶	Hungary	University students	N = 810 (89.4% women), mean age 32.39	Cross-sectional survey	IV	ORTO-11-Hu (<40)	74.2%
White, Berry & Rodgers (2020) ⁴⁷	United States	University students	N = 103 (100% men), mean age 19.84	Cross-sectional survey	IV	ORTO-7 (<19)	43.7%
Zańko et al. (2019) ⁶	Poland	University students studying dietetics	N = 87 (n = 76 women), mean age 21	Cross-sectional survey	IV	ORTO-15 (<40); BOT	ORTO-15 (<40) = 96.51% BOT = 58.14%
Zhou et al. (2020) ⁴⁸	China	University students	N = 418 (n = 199 men), age range 18–24	Cross-sectional survey	IV	ONS part A	15%
Orthorexia prevalence in health professionals							
Asil & Surucuoğlu (2015) ⁷⁰	Ankara, Turkey	Dietitians	N = 117 (n = 101 women)	Cross-sectional survey	IV	ORTO-15, Turkish version (<40); EAT-40, Turkish version (>21)	ORTO-15 = 41.9% EAT-40 = 13.7%
Bagci Bosi, Camur & Guler (2007) ⁷¹	Ankara, Turkey	Resident medical doctors	N = 318 (n = 149 women, n = 169 men) mean age 27.2	Cross-sectional survey	IV	ORTO-15, Turkish version (<40)	45%
Kinzl et al. (2006) ⁷²	Austria	Female dietitians	N = 283 (100% women), mean age 36.2	Cross-sectional survey	IV	BOT	12.8%
Tremelling et al. (2017) ⁷³	United States	Registered dietitians and nutritionists	N = 636 (n = 615 women)	Cross-sectional survey	IV	ORTO-15 (<40)	49.5%
Orthorexia prevalence in people with chronic illnesses							
Aslan & Akturk (2020) ⁷⁴	Turkey	Patients diagnosed with breast cancer	N = 402 (n = 238 cancer patients, n = 164 control)	Case-control study	III-2	ORTO-15, Turkish version (<33)	Cancer patients = 23.5% Control = 6.7%
Barbanti et al. (2020) ⁷⁵	Italy	Type 2 diabetes	N = 887 mean age 67	Cross-sectional survey	III-2	BOT	65.5%
Bartheis et al. (2019) ⁵	Switzerland	People diagnosed with somatoform disorders	N = 61 (n = 30 women, n = 31 men)	Cross-sectional survey	III	DOS (30+)	Somatoform disorder = 6.67% Control = 0%

TABLE 1 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measure (cutoff)	Key results
Hessler-Kaufmann et al. (2021) ¹⁰⁰	Germany	Inpatients with mental disorders	N = 1167 (75% women), mean age 34.6	Cross-sectional survey	IV	DOS (30+)	Depressive episode = 1.3% Recurrent depressive disorder = 3.2% Phobic disorders = 0% Obsessive-compulsive disorder = 2.0% Trauma-related disorders = 1.3% Somatoform disorders = 0%
Orthorexia prevalence in "health-minded" individuals							
Almeida, Vieira Borba, & Santos (2018) ⁶¹	Portugal	Gym members	N = 193 (n = 113 women) mean age 32.81	Descriptive study	IV	ORTO-15, Portuguese version (<35)	51.8+
Barthels, Meyer & Pietrowsky (2018) ⁸⁶	Germany	Study 1: Vegans, vegetarians and omnivores Study 2: Dieting individuals	N = 757 (71.15% female)	Cross-sectional online survey	III	DOS (30+)	Vegans = 7.9% Vegetarians = 3.8% Rare meat consumption = 3.6% Frequent meat consumption = 0% Dietary change = 6.7% No dietary change = 2.7% Controls = 1.5%
Bert et al. (2019) ⁶²	Italy	Participants in local sports events	N = 549, age range 18–40	Cross-sectional survey	IV	ORTO-15 (<40)	No sport = 68.8% Sport <150 min/week = 71.1% Sport >150 min/week = 72.8%
Brytek-Matera, Staniszewska & Hallit (2020) ⁶³	Poland	Universities, companies and health centers	N = 230 (n = 175 women), mean age 26.52	Cross-sectional survey	IV	DOS, Polish version (30+)	3%
Erkin & Gol (2019) ⁶⁴	Turkey	Yoga center registrants	N = 153 (92.45% female), mean age 30.48	Cross-sectional survey	IV	ORTO-11 (<27)	75.4%
Heiss, Coffino, & Hormes (2019) ⁶⁵	United States	Facebook pages on vegetarianism, veganism, and other websites about food or psychology	N = 381 (80.8% female), mean age 31	Cross-sectional survey	IV	ORTO-15 (<40)	77%
Herranz Valera et al. (2014) ⁶⁶	Spain	Yoga members	N = 136, age range 20–55	Online survey	IV	ORTO-15, Spanish version (<40)	86%
Kiss-Leizer & Rigo (2019) ⁶⁷	Hungary	Online social media, university groups, healthy eating groups, social media pages of Olympic athletes, lifestyle consultants, fitness coaches	N = 739 (n = 585 women, n = 154 men)	Cross-sectional survey	III-2	ORTO-11, Hungarian version (<29)	42%

(Continues)

TABLE 1 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measure (cutoff)	Key results
Turner & Lefevre (2017) ⁶⁸	United Kingdom	Social media users following health food accounts	n = 680 (100% female), mean age 24.7	Cross-sectional survey	IV	ORTO-15 (<35 and <40)	<35: 49% <40: 90.6%
Vogliano et al. (2021) ⁶⁹	Italy	Organic store customers	N = 240 (68.8% female), median age 44	Cross-sectional survey	IV	ORTO-15 (<35 and <40)	Organic store customers = 69.4% (<40), 23.1% (<35) Non-organic store customers = 52.9% (<40), 9.2% (<35)
Orthorexia prevalence in the general population							
Brytek-Matera et al. (2020) ⁴⁹	Poland and Lebanon	Poland: General population via online Lebanon: Community pharmacies	N = 1262 Poland: n = 743, (n = 571 women, mean age 24.8 Lebanon: n = 519 (n = 282 women) mean age 35.83	Cross-cultural-cross-sectional survey	IV	DOS, Polish version (30+) DOS, Lebanese version (30+)	Polish sample = 2.6% Lebanese sample = 8.4%
Dabal (2020) ⁵⁰	Poland	General population	N = 236 (n = 117 women, n = 119 men) age range 18–35	Cross-sectional survey	IV	ORTO-15 Polish version (<36)	27.1%
Ferreira & Coimbra (2020) ⁵¹	Portugal	General population	N = 513 (n = 454 women) mean age 27.65	Validation study	IV	DOS, Portuguese version (31+)	10.52%
Greetfield et al. (2021) ⁵²	Germany	General population	n = 511 (63.4% women), mean age 43.39	Cross-sectional survey	IV	DOS (30+)	2.3%
He et al. (2021) ⁶⁰	China	Elderly general population	N = 313 (n = 162 women), mean age 67.9	Cross-sectional survey	IV	DOS Chinese version (30+ and 34+)	DOS 30+ : 19.5% DOS 34+ : 5.1%
Luck-Sikorski et al. (2019) ⁵³	Germany	General population	N = 1007, mean age 50.6	Cross-sectional survey	V	DOS (30+)	6.9%
Missbach et al. (2015) ⁵⁴	Austria	General population	N = 1029 (74.6% women), mean age 31.21	Cross-sectional survey	IV	ORTO-9-GE (<26.7)	69.1%
Mitrofanova, Mulrooney & Petroczi (2020) ⁵⁵	United Kingdom	General population	N = 10 (n = 8 women, n = 2 men)	Combined qualitative interviews and cross-sectional survey	IV	ORTO-15 (<35)	80%
Mitrofanova et al. (2020) ⁵⁶	United Kingdom	General population	N = 50 (n = 30 women, n = 20 men)	Cross-sectional descriptive study	IV	ORTO-15 (<40)	64%

TABLE 1 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measure (cutoff)	Key results
Ramacciotti et al. (2011) ⁵⁷	Italy	General population	N = 177, mean age 39.8	Cross-sectional survey	V	ORTO-15, Italian version (<35 and <40)	ORTO-15 (<40) = 57.6% ORTO-15 (<35) = 21% Lower prevalence of subjects with a graduate or post-graduate degree among orthorexics
Strahler et al. (2020) ⁵⁸	Germany and Lebanon	General population	N = 910 Germany: n = 391 (80.3% women), mean age 27yr Lebanon: n = 519 (56% women), mean age 36	Cross-sectional survey	IV	DOS (30+)	Lebanese sample = 8.4% German sample = 4.9%
Stutts (2020) ⁵⁹	United States	General population	N = 217 (n = 115 women, n = 99 men, n = 3 other), mean age 34.89	Cross-sectional survey	IV	DOS (30+)	9.7%
Orthorexia prevalence in people with eating disorders							
Gramaglia et al. (2017) ⁷⁸	Italy and Poland	Those with DSM-5 AN diagnosis and healthy controls from general population	N = 136, mean age 27.7	Case-control study	III-3	ORTO-15, Italian and Polish versions (<40)	Italian anorexia = 60.9% Italian controls = 46% Polish anorexia = 85.6% Polish control = 82%
Hessler-Kaufmann et al. (2021) ¹⁰⁰	Germany	Inpatients with mental disorders	N = 1167 (75% women), mean age 34.6	Cross-sectional survey	IV	DOS (30+)	Anorexia = 48% Bulimia = 33%

Note: Age is presented in years.

Abbreviations: BOT, Bratman's Orthorexia Test; DOS, Düsseldorf Orthorexia Scale; ONI, Orthorexia Nervosa Inventory.

TABLE 2 Orthorexia in the setting of therapeutic restrictive diets

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measures	Key results
Diet as a result of orthorexia							
Barnett et al. (2016) ⁸²	USA	University students, local alternative food network (AFN) hubs and environmental organizations	N = 284 (83.4% women), mean age 38.2	Cross-sectional	IV	1. Alternative Food Network Engagement Scale (assesses degree consumers prefer organic, local, sustainable, and other niche foods over conventional food products) 2. Adherence to special diet 3. Eating Disorder Examination Questionnaire 4. ORTO-15 5. Eating Disorder Diagnostic Scale	Participants that followed special diet significantly more engaged in AFN and had more ON tendencies compared to no special diet (p<.001) Those following vegetarian, pescatarian, or vegan "raw foods" diet significantly more engaged in AFN than those following GF diet (p<.05), and those engaged in special diet excluding meat significantly more engaged in AFN than those following diet including meat (p<.01)
Barthels et al. (2018) ¹⁰¹	Germany	Study 1: Vegans, vegetarians, and omnivores Study 2: Dieting individuals	Study 1: n = 351 (63% women, mean age 32.2) Vegans: 114 Vegetarians: 63 Rare meat eaters: 83 Frequent meat eaters: 91 Study 2: n = 406 (79.3% women, mean age 30.7) On diet with dietary change: 104 (low carb, weight watchers, change of lifestyle, counting calories, combination of diets) On diet without dietary change (NoDC): 37 (eat less, exercise more) Control group: 258	Cross-sectional	III-2	1. Dusseldorf Orthorexia Scale (DOS) 2. Restrained Eating Scale	Study 1: Vegans and vegetarians had significantly higher orthorexia DOS scores than omnivores Study 2: Participants on diets scored significantly higher DOS than controls
Barthels et al. (2020) ⁸⁷	Germany	Vegans	N = 65 (n = 35 women, mean age 28.22)	Cross-sectional	IV	1. Details of veganism 2. DOS	Mean DOS score 20.49 in vegan group. Orthorexic behaviors in vegans largely related to importance of health motives, aesthetics, and healing (with lower correlations to athletics, habit/upbringing, allergy, weight loss).
Bo et al. (2014) ²⁷	Italy	University students	Dietetics: n = 32, mean age 19.8; Exercise and Sports Science: n = 230, mean age 19.9, Biology: n = 187, mean age 19.7	Cross-sectional survey	III-2	1. ORTO-15 2. The Muscle Dysmorphic Disorder Inventory 3. Eating Attitudes Test-26	People with orthorexia on diets: 45.5% on hypocaloric, 27.3% on vegetarian, 27.3% on hyperproteic diets

TABLE 2 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measures	Key results
Brytek-Matera (2020) ⁸⁸	Poland	Health food stores, vegan or vegetarian restaurants, fitness centers, universities, vegan or vegetarian online social networking	N = 254, age range 18+	Cross-sectional	IV	1. The Three-Factor Eating Questionnaire 2. Eating Habits Questionnaire 3. Perseverative Thinking Questionnaire	Vegetarian and vegans displayed more orthorexic behaviors than omnivores.
Brytek-Matera et al. (2019) ⁸³	Poland	Health-minded individuals: vegan and vegetarians	Meat-free diet group: N = 105 -Semi-vegetarian, vegetarian, vegan, and raw food diet Control group: N = 41	Cross-sectional	III-3	1. EHQ 2. Three-Factor Eating Questionnaire (TFEQ)	Significantly more orthorexic traits found in meat-free diet group ($p < 0.01$). EHQ domains: Problems: vegans and vegetarians higher than control group ($p < 0.01$) Knowledge: vegans higher than vegetarians ($p < 0.05$) and control group ($p < 0.001$). Vegetarians also scored higher than control group ($p < 0.01$) Feelings: Vegans and vegetarians scored higher than control group ($p < 0.01$)
Cicekoglu et al. (2018) ⁸⁵	Turkey	Health-minded individuals: vegans and vegetarians	Total N = 62 Vegan/vegetarian, n = 31 (n = 9 male) nonvegan/nonvegetarian, n = 31 (n = 15 male). Age range 18+	Cross-sectional	III-2	1. Descriptive characteristics 2. ORTO-11 3. Eating attitudes test-40 4. Maudsley Obsessive-Compulsive Inventory	There was no difference in attitudes to eating, obsessive symptoms, and orthorexia scores between the vegans/vegetarians and the nonvegans/nonvegetarians ($p > 0.05$)
Coimbra & Ferreira (2020) ⁹⁰	Portugal	General population (females)	Total N = 451, mean age = 33.84 Omnivores (S1): N = 281 Non-omnivores (S2): N = 170	Cross-sectional	IV	1. DOS 2. Inflexible Eating Questionnaire 3. Intuitive Eating Scale-2 4. EDE-Q	Participants from non-omnivore group had higher ON levels when compared to omnivore group ($p < 0.001$)
Dabal (2020) ⁵⁰	Poland	General population	Total N = 236 (women n = 117), age range 18–35	Cross-sectional	IV	1. ORTO-15 (<36) 2. TFEQ-13 3. Obsessive-Compulsive Inventory-Revised 4. Hypochondriasis scale of the Minnesota Multiphasic Personality Inventory-2	People with more orthorexic traits reported higher rates of special diets compared to people with less orthorexic traits ($p < 0.001$) Motives for dietary choices: High ON group was mainly motivated by health ($p = 0.001$) and appearance ($p < 0.001$). Convenience main motivating factor in low ON group ($p = 0.002$)

(Continues)

TABLE 2 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measures	Key results
Dell'Osso et al. (2016) ³⁰	Italy	University students and staff	Total N = 2826 (women n = 1148 mean age = 28.9, age range 18–70)	Cross-sectional	IV	1. ORTO-15 (<35)	Vegetarian or vegan subjects showed lower scores on ORTO-15 and higher rates of orthorexic symptoms ($p < 0.05$)
Dell'Osso et al. (2018) ³¹	Italy	University students	Total N = 2130 (women n = 1274), mean age = 23.82	Cross-sectional	IV	1. ORTO-15	Higher rate of ON in vegetarians/vegans than those with a standard diet ($p < 0.001$)
Erkin & Gol (2019) ⁶⁴	Turkey	Yoga center registrants	N = 153 (92.45% women; mean age 30.48y)	Cross-sectional	IV	1. Perception of health status scale 2. ORTO-11 scale	Mean ORTO-11 score reported for vegetarian 23.92, vegan 26.62, doing diet 22.07 (but not when compared to omnivores)
Ferreira & Coimbra (2020) ⁵¹	Portugal	General population	Sample 1: N = 513 (women n = 454, mean age 27.65) Sample 2: N = 541 (women n = 447, mean age 34.66)	Validation study and cross-sectional survey	IV	1. DOS 2. Depression anxiety and stress scales-21 3. External and internal shame scale 4. Body image shame scale 5. IEQ 6. IES-2 7. Binge eating scale 8. EDE-Q	Omnivores presented lower levels of orthorexia tendencies compared to other dietary patterns ($p < 0.001$)
Heiss et al. (2019) ⁶⁵	USA	Health-minded individuals: Facebook pages on vegetarianism, veganism, and other websites about food or psychology	N = 381 (80.8% women; mean age 31)	Cross-sectional	IV	1. ORTO-15 2. EDE-Q	Significant effect of meat avoidance on ORTO-15 scores, with vegans scoring lower than omnivores and lacto-ovo-vegetarians, meaning that they were at higher risk of orthorexia
Herranz Valera et al. (2014) ⁶⁶	Spain	Yoga practitioners	n = 136 (age range 20–55)	Cross-sectional	IV	1. Years of yoga practice 2. Vegetarianism, veganism, and fasting habits 3. ORTO-15	ORTO-15 score was lower among vegetarians
Hessler-Kaufmann et al. (2020) ⁷⁷	Germany	General population	n = 511 (63.4% women: 71.2% omnivores (mean age 45.3), 19.2% semi-vegetarians (mean age 41.1), 9.6% vegetarians (mean age 33.8))	Cross-sectional	III-2	1. PHQ-9 2. DOS	Mean DOS scores: omnivores 16; semi-veg 16.8; vegetarians 19. Interaction effect between diet (omnivore vs. semi-vegetarianism vs. vegetarianism) and DOS scores when predicting PHQ depression scores

TABLE 2 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measures	Key results
Kamarli Altun et al. (2020) ³⁶	Turkey	University students	Total <i>n</i> = 304 (61.5% women). Medical Faculty: 88, Nursing Faculty: 70, Law Faculty: 79, Communication Faculty: 67	Cross-sectional survey	III-2	1. ORTO-11 2. EAT-40 3. MOCI	Orthorexia was higher in students who were dieting "under the guidance of a professional" (<i>p</i> = 0.001)
Kiss-Leizer & Rigo (2019) ⁶⁷	Hungary	Health-minded individuals: recruited via online media with advertisement through healthy lifestyle role models, for example, Olympians.	Total <i>n</i> = 739 (79% women) Professions: doctors (<i>n</i> = 112), athletes (<i>n</i> = 85), dietitians (<i>n</i> = 74), performance artists (<i>n</i> = 32), yoga instructors (<i>n</i> = 35). Eating disorders (<i>n</i> = 42). Special diet (<i>n</i> = 177)	Cross-sectional survey	III-2	1. ORTO-11 2. Temperament and Character Inventory	Special diet group at higher risk of orthorexia (<i>p</i> < 0.001) and 3.01x more likely to have orthorexic tendencies
Luck-Sikorski et al. (2019) ⁵³	Germany	General population	<i>n</i> = 1007, mean age 50.6	Cross-sectional	IV	1. DOS 2. Depressive symptoms 3. Patient Health Questionnaire. 4. Indicate if they adhered to omnivore, vegetarian, vegan or a different kind of diet due to allergies	Vegetarian diet was associated with orthorexic behavior (multivariate analysis OR4.37; 95%CI 1.47–12.99; <i>p</i> = 0.008). Following a diet for "specific needs" was not associated with orthorexic behavior <i>p</i> = 0.264)
Mitrofanova et al. (2020) ⁵⁶	UK	Health-minded individuals: "clean-eaters" or "healthy eaters" known to the research team	<i>n</i> = 10 (women <i>n</i> = 8)	Combined qualitative interviews and cross-sectional survey	IV	1. Qualitative interviews 2. 24-h diet recall 3. Questionnaire to assess psychometric measures 4. ORTO-15 (cutoff 35)	50% of participants were either vegan or vegetarian. 80% of participants had orthorexia. Orthorexia was not compared between vegan/vegetarians and omnivores.
Parra-Fernández et al. (2020) ⁸⁴	Spain	Health-minded individuals: vegetarians and people from the general population recruited from social media	<i>n</i> = 466 (55% omnivore, 23.5% vegetarian, 21.7% vegan) (<i>n</i> = 354 women; mean age 32.2)	Cross-sectional	III-2	1. ORTO-11-ES 2. Food Choice Questionnaire	Risk of ON (score <25): vegans 58.2%, vegetarians 24.1%, omnivores 17.7%
Turner & Lefevre (2017) ⁶⁸	UK	Social media users following health food accounts	<i>N</i> = 680 (100% women; mean age 24.70)	Cross-sectional	IV	1. Social media use 2. Eating behaviors 3. ORTO-15	No differences in ORTO-15 score between diet types (vegan, omnivorous, vegetarian, pescatarian, paleo, plant based, high carb low fat, raw vegan, other)

(Continues)

TABLE 2 (Continued)

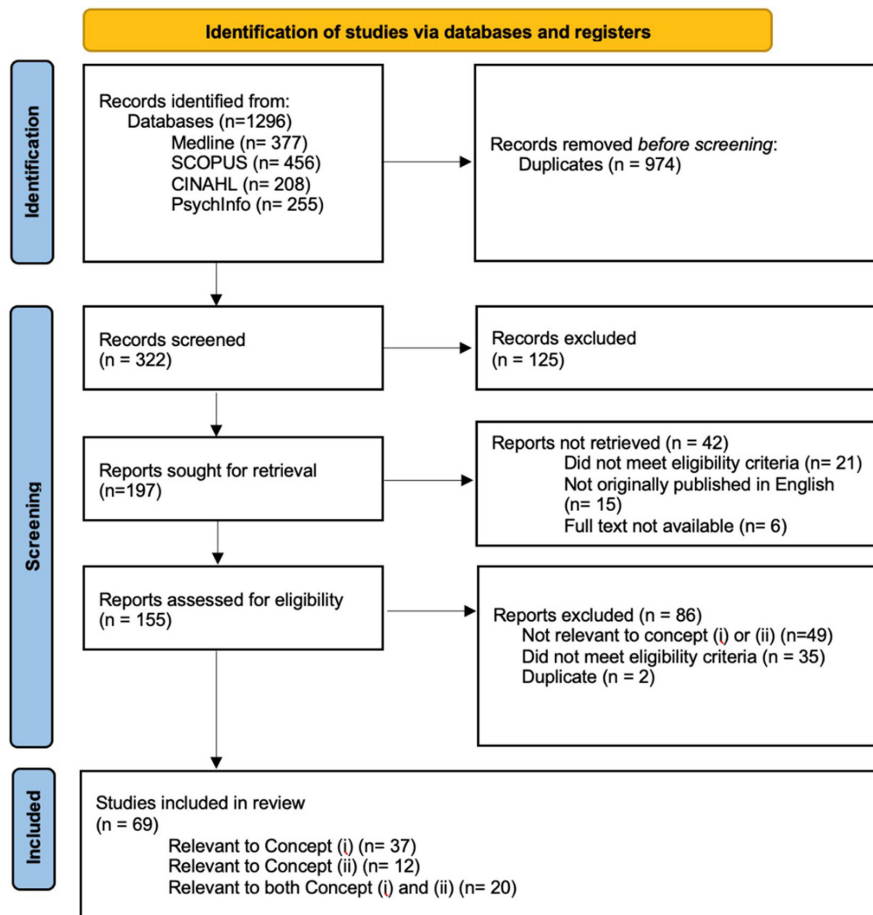
Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measures	Key results
Varga et al. (2014) ⁸⁹	Hungary	University students	n = 810 (89.4% women; mean age 32.39 years)	Cross-sectional	IV	1. ORTO-11-Hu 2. Lifestyle habits 3. Food choice list 4. Additional orthorexia-related questions	Individuals on "special diets" had lower OTRO-11-Hu scores than non-dieting individuals. No description of "special diet."
Voglino et al. (2020) ⁶⁹	Italy	Organic store customers	n = 121 organic store customers n = 119 non-organic store customers (68.8% women; median age 44 years)	Cross-sectional	III-2	1. Current dietary habits 2. ORTO-15 3. EHQ	Predictors of ON symptoms at ORTO cutoff at 40 included those following food restrictions "other" than vegetarian, vegan, and healthy diets. Cutoff at 35 showed only vegetarian diet as risk factor for ON symptoms
Diet as a cause for orthorexia							
Barbanti et al. (2020) ⁷⁵	Italy	Individuals with type 2 diabetes mellitus	Total n = 887, mean age 67. Group A: no disordered eating, no orthorexic traits; Group B: no disordered eating, with orthorexic traits; Group C: disordered eating and orthorexic traits	Cross-sectional survey	III-2	1. Bratman Orthorexia Test 2. Eating Attitudes Test (EAT-26)	Groups B and C scored higher than Group A on adhering to Mediterranean diet ($p < 0.001$). No difference based on diabetes duration, education, HBA1c levels. More people in Groups B and C had received recent nutritional counseling compared to Group A (Group A 32.7%, Group B 50.2%, Group C 43.9%, $p < 0.001$)
Cheshire et al. (2020) ⁷⁹	UK and USA	Health-minded individuals; recruited via fitness centers and online eating disorder discussion groups	Individuals who self-identify as orthorexic: n = 9 Health professionals: n = 7	Qualitative interviews	N/A	Interviews were conducted to explore features of orthorexia and its development	Several participants noted that their orthorexia developed due to adopting specific diets to improve health problems, specifically to fix acne and for digestive issues.
Greville-Harris et al. (2020) ⁸¹	UK, USA, England, Australia, and India	Female online health bloggers who self-identified as having orthorexia	N = 15, age range 19–32	Qualitative review of blog posts on orthorexia	N/A	Qualitative analysis of blog posts	Initial motivation for a healthier lifestyle included following a diet for digestive issues
McGovern et al. (2020) ⁹¹	Ireland	People who had been diagnosed with orthorexia	N = 8 (75% women), age range 26–46	Qualitative interviews	N/A	Qualitative interviews on experiences with orthorexia	Participants reported that orthorexia began as a diet, characterized by categorization of foods

TABLE 2 (Continued)

Authors (Year)	Location	Population	Sample size	Study design	Level of evidence (NHMRC)	Outcome measures	Key results
Missbach et al. (2015) ⁵⁴	Austria	General population	N = 1029 (74.6% or n = 768 women; mean age 31.21)	Cross-sectional	IV	ORTO-15 1. Lifestyle and eating behavior habits 2. Additional ON related questions	Orthorexia associated with special eating behaviors such as dieting (21.200), vegetarian (23.47), and vegan (22.6). Self-reported food intolerances showed orthorexia (22.11).
Oberle et al. (2020) ³⁸	USA	University students	n = 847 (82% women; mean age 21.72)	Cross-sectional	IV	ON inventory 1. Eating Attitudes Test-26 (EAT-26) 2. Yale-Brown Obsessive Compulsive Scale 3. PHQ-9 4. Compulsive Exercise Test 5. Lie Scale (LS) of the Eysenck Personality Questionnaire-Revised Short Form (EPQ-R-SF)	Orthorexia (total and item subset) scores greater among vegetarians, vegans, and semi-veg (all $p < 0.001$). Orthorexia scores also higher with disordered eating (anorexia nervosa, bulimia nervosa, binge eating disorder, avoidant/restrictive food intake disorder) (all $p < 0.001$)
Plichta & Jezewska-Zychowicz (2020) ⁴³	Poland	University students	N = 1120, age range 18–35	Cross-sectional	IV	ORTO-15 1. Eating Disorder Screen for Primary Care 2. Food Frequency Questionnaire (FFQ-6) 3. Questions about eating habits and special diets	41.9% reported having followed a special diet in the past, while only 12.6% of the students reported as following a special diet currently. The risk of displaying both ON tendency and ED symptoms was lower in students who did not follow a special diet in the past or currently (ORs: 0.34 and 0.26, respectively) than those who followed such a diet
Valente et al. (2020) ⁸⁰	The Netherlands	Health-minded individuals: self-identified "healthy eater"	Survey sample: n = 82 (mean age 24) Interview sample: n = 12 (mean age 23)	Mixed methods: quantitative survey and qualitative interviews	IV	1. Researcher designed questionnaire and interview 2. ORTO-15	Participants reported that factors leading to orthorexia included eating for chronic disease and food intolerances

Note: Age is presented in years.

FIGURE 1 Study selection flow chart



Overall, people who attended yoga classes had the highest orthorexia prevalence (80.7%, 75.4%–86%),^{64,66} followed by those who took part in sports (71.95%; >150min/week = 72.8%, <150min/week = 71.1%),⁶² and people who visited health-focused online pages (69.8%, 42%–90.6%).^{65,67,68} Those who shopped at organic food stores had a higher orthorexia prevalence than those who did not (ORTO-15 < 35: 23.1% vs. 9.2%; ORTO-15 < 40: 69.4% vs. 52.9%).⁶⁹ Orthorexia prevalence varied when examining specific diets, ranging from those who frequently ate meat with the lowest orthorexia prevalence (0%) to vegans (7.9%).⁵

3.2.5 | Health professionals

From three studies, the average orthorexia prevalence in dietitians was 41.9% (12.8%–49.5%),^{70,72,73} and from one study, the prevalence in doctors was 45%.⁷¹

3.2.6 | Chronic illnesses

Four studies were conducted in people with chronic illness, with the highest prevalence in those with type 2 diabetes (65.5%).⁷⁵ The prevalence in breast cancer patients was 23.5%.⁷⁴ Prevalence in patients with mental disorders varied from 0.0% to 3.2%.⁷⁷

3.2.7 | Eating disorders

Two studies looked at orthorexia prevalence in people with ED. One study assessed people with anorexia nervosa compared to controls in Italy and Poland,⁷⁸ and found that the Polish anorexia group (85.6%) and the Polish control group (82%) had a much higher orthorexia prevalence than both the Italian anorexia (60.9%) and control groups (46%). Another study looked at patients with anorexia and bulimia,⁷⁷ and found that the orthorexia prevalence was higher in anorexia patients (48%) compared to bulimia patients (33%).

3.3 | Concept 2: Orthorexia in the setting of therapeutic restrictive diets

Thirty-two articles explored orthorexia in the setting of therapeutic diets (Table 2). Most studies were conducted across Europe, and all studies followed a cross-sectional design. Sample sizes ranged from 8 to 2826 people. Sixteen studies focused on “health-minded” individuals,^{64–69,79–88} seven on university students,^{27,30,31,36,38,43,89} six on the general population,^{50,51,53,54,77,90} one on people with diagnosed orthorexia,⁹¹ one on people with type 2 diabetes mellitus⁷⁵ and one on a small group personally known to the research team.⁵⁶ Most found that individuals with

TABLE 3 Reported prevalence rates based on diagnostic tools used

Orthorexia diagnostic tool used (cutoff score)	Orthorexia prevalence range	Orthorexia prevalence average
Diagnostic tools used on university students		
ORTO-7 (<19) ⁴⁷	43.7%	43.7%
ORTO-11(27) ^{25,36}	42.8%–70.6%	56.7%
ORTO-11-ES (<25) ^{40,41}	17%–25.2%	21.1%
ORTO-11-Hu (<40) ⁴⁶	74.2%	74.2%
ORTO-14MX (<35) ³⁹	34.3%	34.3%
ORTO-14MX (<40) ³⁹	61.8%	61.8%
ORTO-15 (<35) ^{24,27,30,31,34,42–45}	15.3%–34.9%	26.9%
ORTO-15 (<40) ^{6,24,26,33,37,42,44}	46.7%–96.51%	71.1%
DOS (30+) ^{28,29,32,40}	2.3%–10.5%	5.12%
BOT ^{6,35}	58.14%–68.2%	63.17%
Orthorexia Nervosa Inventory (ONI) ³⁸	4.5%	4.5%
ONS ⁴⁸	15%	15%
Diagnostic tools used on dietitians and health professionals		
ORTO-15 (<40) ^{70,71,73}	41.9%–49.5%	45.35%
EAT-40 (>21) ⁷⁰	13.7%	13.7%
BOT ⁷²	12.8%	12.8%
Diagnostic tools used on people with chronic illnesses		
ORTO-15 (<33) ⁷⁴	23.5%	23.5%
BOT ⁷⁵	65.5%	65.5%
DOS 30+ ^{5,77}	0%–6.67%	2.07%
Diagnostic tools used on “health-minded” individuals		
PL-DOS (30+) ⁶³	3%	3%
DOS (30+) ^{63,86}	0%–7.9%	3.7%
ORTO-11 (<27) ⁶⁴	75.4%	75.4%
ORTO-11 (<29) ⁶⁷	42%	42%
ORTO-15 (<35) ^{61,68,69}	9.2%–90.6%	44.74%
ORTO-15 (<40) ^{62,65,66,68,69}	52.9%–77%	68.6%
Diagnostic tools used on the general population		
DOS (30+) ^{49,52,53,58–60}	2.3%–19.5%	8.58%
DOS (31+) ⁵¹	10.52%	10.52%
DOS (34+) ⁶⁰	5.1%	5.1%
PL-DOS (30+) ⁴⁹	2.6%	2.6%
ORTO-9-GE (<26.7) ⁵⁴	69.1%	69.1%
ORTO-15 (<35) ^{55,57}	21%–80%	50.5%
ORTO-15 (<36) ⁵⁰	27.1%	27.1%
ORTO-15 (<40) ^{56,57}	57.6%–64%	60.8%
Diagnostic tools used on people with eating disorders		
ORTO-15 (<40) ⁷⁸	46%–85.6%	68.6%
DOS (30+) ⁷⁷	33%–48%	40.5%

orthorexia self-reported adherence to specific diets, while some explored how certain therapeutic diets may be a contributing factor to developing orthorexia.

3.3.1 | Diet as a result of orthorexia

Twenty-seven studies found that individuals with greater orthorexia scores self-reported adherence to specific diets. Of those, twenty-three assessed vegan, vegetarian or pescatarian diets, eight assessed non-described “healthy” or “special” diets, three assessed hypocaloric diets, and the remaining three assessed paleolithic, hyperproteic, and gluten-free diets. Of these studies, 23 reported that individuals who followed these diets had significantly higher rates of orthorexia compared to controls, while four found that they did not.^{53,64,68,85} Several studies reported a significant correlation between veganism, vegetarianism or pescatarianism and orthorexia ($p < 0.01$).^{31,51,82,83,90} Of the participants classified as orthorexic according to the ORTO-15, 45.5% followed hypocaloric, 27.3% vegetarian and 27.3% hyperproteic diets.²⁷ The remaining studies found no association between orthorexia and vegetarian, vegan, pescatarian,^{64,68,85} “special needs” diet,⁵³ paleolithic or high carbohydrate diets.⁶⁸

When exploring food choices, one study reported that individuals with orthorexia were more motivated by health quality ($p = 0.001$) and appearance ($p < 0.001$) of food, while non-orthorexic participants tended to choose foods based on convenience ($p = 0.002$).⁵⁰ Another study found that food choices of orthorexic vegans were related to aesthetics, health quality and “healing” properties of foods, and not habit, allergies nor weight loss.⁹²

3.3.2 | Diet as a cause of orthorexia

Eight studies described specific dietary patterns, or diseases associated with dietary patterns, as a factor contributing to orthorexia development. Of these, four suggested that participants who followed a diet for “digestive issues” or “food intolerances” were at higher risk of orthorexia. One of these studies followed a quantitative survey design and reported that participants who self-reported as having food intolerances recorded an average ORTO-15 score of 22.11, suggesting that they were classified as orthorexic.⁵⁴ The final three studies were qualitative. Two involved interviews^{79,80} and one was an analysis of blog posts⁸¹ by participants with orthorexia, with all noting that an initial motivation for following a healthier diet was to manage digestive issues.

Three studies found that individuals with a history of ED categorized foods in a way that may have led to orthorexia. One study reported that participants with anorexia, bulimia, binge-eating disorder, and ARFID displayed significantly higher orthorexia scores than those without ED (all $p < 0.001$).³⁸ Another found that participants who had both orthorexia and ED, categorized according to an ED screening tool, were more likely to have followed a special diet in the past and displayed less frequent consumption of high sugar products.⁴³ Qualitative interviews of patients with diagnosed orthorexia found that orthorexia began as a diet characterized by categorization of foods, similar to that seen in patients with ED.⁹¹

Two studies reported that diets for chronic disease may influence the development of orthorexia. In individuals with type 2 diabetes who adhered more closely to the Mediterranean diet, higher orthorexia scores were recorded than those who did not adhere ($p < 0.001$); these participants were also more likely to have received recent nutritional counseling ($p < 0.001$).⁷⁵ In individuals with self-identified orthorexia, participants reported management of chronic disease led to their obsession with healthy eating.⁸⁰

4 | DISCUSSION

This is the first scoping review to assess all existing data (69 studies involving 47,827 participants) of prevalence of orthorexia in various population groups and explore potential links between orthorexia and restrictive eating practices. Studies varied greatly in their quality, methods used, and focus group studied. Although the data were sometimes conflicting, prevalence data were as high as 72% in the general population and overall points to potential high-risk groups being the health focus groups, individuals with an ED, or those who follow specific diets. This scoping review gave particular attention to data related to gastroenterology. The results highlight the limited data regarding orthorexia in gastroenterology. Some studies mentioned specific diets used in gastroenterology, such as a gluten-free diet, but no study assessed gastrointestinal conditions or specific dietary modifications. A minority of studies mentioned gastrointestinal issues as a concern for orthorexia. Only one of these studies provided quantitative evidence showing that people with food intolerances had increased risk of orthorexia.⁵⁴ Additionally, qualitative data revealed that participants with orthorexia described that the dietary management of food intolerances or digestive issues contributed to their orthorexia development, warranting further exploration.^{67,79,80} Of the few studies that investigated orthorexia in people who were on restrictive diets, none reported the prevalence of orthorexia. Therefore, the prevalence of orthorexia remains unknown in people who are on therapeutic diets in gastroenterology.

5 | CLINICAL IMPLICATIONS IN GASTROENTEROLOGY

This scoping review highlights overlapping characteristics between ED and orthorexia and that individuals with orthorexia were following a diet for digestive management.^{54,79–81} Table 4 combines the current scoping review with other published data to discuss key factors of concern in gastroenterology that may increase orthorexic traits.

5.1 | Application to clinical practice in patients with gastrointestinal conditions

Based on the findings of this review and the findings from Burton Murray et al. and Peters et al.,^{19,20} prior to prescription of any

restrictive dietary therapy, clinicians should be aware of orthorexia and other forms of disordered eating, and consider if a restrictive diet is appropriate, as shown in the clinical flowchart in Figure 2.⁹³ Burton Murray et al. recommend that clinicians should screen patients for problematic eating patterns and shape/weight-motivated eating disorders.¹⁹ Short screening questionnaires may be implemented to identify potentially at-risk patients⁹⁴ such as the five item Sick, Control, One stone, Fat, Food (SCOFF) questionnaire,⁹⁵ although this questionnaire has not been validated in gastroenterology.⁹⁶ When prescribing restrictive diets to patients with orthorexia, the language used by clinicians to describe foods is key, for example, avoiding use of wording such as “good/safe” or “bad/unsafe” as to not reinforce beliefs about foods causing harm.^{94,97} Use of “top-down” vs “bottom-up” approaches may allow for more tailored dietary modifications with reduced likelihood of resulting orthorexic traits.⁹⁸ Once dietary restriction has been implemented, regular multidisciplinary follow-up and re-screening for orthorexic traits is warranted, especially for those requiring long-term dietary restriction such as a gluten-free diet in coeliac disease. The potential for increasing orthorexic behaviors further reinforces the need to avoid long-term strict dietary restriction and highlights the need for dietary liberalization in those following diets for IBS such as the low FODMAP (fermentable oligo-, di-, mono-saccharides and polyols) diet.⁹⁸ Patients with multiple restrictive eating practices (i.e., “diet stacking”),⁹⁹ such as an individual following a gluten-free vegetarian diet, may be of particular concern and require more frequent follow-up to ensure orthorexic traits are not emerging.

5.2 | Limitations

A major limitation of the literature included is that many different diagnostic tools and cutoff scores were used to determine orthorexia prevalence. This resulted in a large range of people who met the orthorexia criteria ranging from 0% to 98%. Additionally, specific populations may not be translatable. Studies on orthorexia prevalence of the general population included participants that were not a representative sample across race or ethnicity.⁵⁹ Likewise, studies that looked at orthorexia prevalence in people who follow health-related social media accounts did not take into account the participants' activity on those accounts, that is, whether they access the social media pages regularly or rarely.^{38,65,67,68} A final limitation was the lack of data in gastroenterology, with no studies assessing orthorexia prevalence in gastrointestinal disorders or specific therapeutic diets. Only four studies looked at the potential link between self-reported digestive issues and orthorexia.^{54,79–81}

5.3 | Future directions

Future studies should prospectively follow patients prescribed restrictive dietary therapies in DGBI and ascertain prevalence of orthorexia at therapy onset as well as during use of therapeutic diets.

TABLE 4 Factors of concern in gastroenterology that may increase orthorexic traits

Factor of concern	Evidence	Proposed mechanisms / hypothesized links
1. Known link with eating disorders and IBS	<ul style="list-style-type: none"> A cross-sectional study showed 64.4% of people with ED had IBS, 87.7% of whom developed IBS 10 years after their ED¹⁰² Case-control study showed 88.2% of people with anorexia and 94.7% of people with bulimia had at least one DGBI¹⁴ 	<ol style="list-style-type: none"> Disordered eating behaviors may precede IBS• ED-related malnutrition impacts electrolyte depletion influencing gastric motility and emptying¹⁰³ <ul style="list-style-type: none"> Refeeding therapy improves gastrointestinal symptoms¹⁰⁴ Bidirectional relationship via brain-gut axis• Anorexia displays different composition and diversity of microbiota compared to controls¹⁰⁵ <ul style="list-style-type: none"> Anorexia displays higher levels of methane-producing bacteria linked to slow intestinal transit,¹⁰⁶ similar to differences in microbiota composition seen in patients with IBS compared to healthy controls¹⁰⁷ IBS leads to disordered eating• IBS has higher rates of disordered eating behaviors compared to controls, for example, not eating when hungry and vomiting after eating to avoid symptoms,¹⁰⁸ which is correlated with symptom severity¹⁰⁹ <ul style="list-style-type: none"> Gastrointestinal symptom severity and orthorexia positively correlated¹¹⁰
2. We use restrictive diets in gastroenterology	<p>Management of gastrointestinal disorders often involve restrictive diets employed in both the short and long term</p> <ol style="list-style-type: none"> The 3-phase low fermentable oligosaccharides disaccharides mono-saccharides and polyols (FODMAP) diet¹¹¹• 57% of IBS patients who closely adhered to the low FODMAP diet for 6 weeks displayed disordered eating characteristics, measured by the Sick, Control, One Stone, Fat, Food (SCOFF) questionnaire, compared to 17% of patients who did not closely adhere¹¹² A strict gluten-free diet is recommended in the long-term management of coeliac disease^{113,114}• This diet is highly effective in symptom reduction, and individuals with coeliac disease often experience an improvement in psychosocial health and quality of life¹¹⁵ Specific diets for inflammatory bowel disease are increasingly used• While evidence is limited, multiple diets including the Mediterranean diet and other anti-inflammatory diets have been proposed for use in inflammatory bowel disease. <ul style="list-style-type: none"> Data are suggesting high prevalence of food avoidance and restrictive dietary behaviors in this patient group¹⁶ 	<p>FODMAPs: Theorized that due to the efficacy of the diet in reducing symptoms, some patients may be reluctant to reintroduce FODMAPs and could continue to follow the restrictive phase of the diet for longer than is appropriate, especially if not guided by a dietitian, potentially contributing to orthorexia development⁹⁹</p> <p>Gluten-free diet: Similar to the low FODMAP diet, adherence to the gluten-free diet is dependent on level of knowledge and belief in the diet's efficacy in improving health.^{116,117} We hypothesize this as an area of potential concern; however, no published studies to date have investigated orthorexia in individuals with coeliac disease.</p>
3. Early data suggest link between DGBI and orthorexia	<p>Clinicians have reported concern regarding disordered eating in DGBI patient cohort.⁹⁷• Recent cross-sectional study of 644 Hungarian volunteers (published since our search was conducted) showed gastrointestinal symptoms were positively associated with orthorexia nervosa and emotional eating¹¹⁰</p> <ul style="list-style-type: none"> A prospective study of 233 IBS patients commencing a low FODMAP diet found that 23% of patients were classified to be at risk of disordered eating. Adherence to the diet was higher (57%) in those at risk of ED compared to those who were not (35%).¹¹² 	<p>With the increased use of dietary therapies in DGBI, we hypothesize this translates to increased orthorexia in populations following a specific dietary restriction.</p>

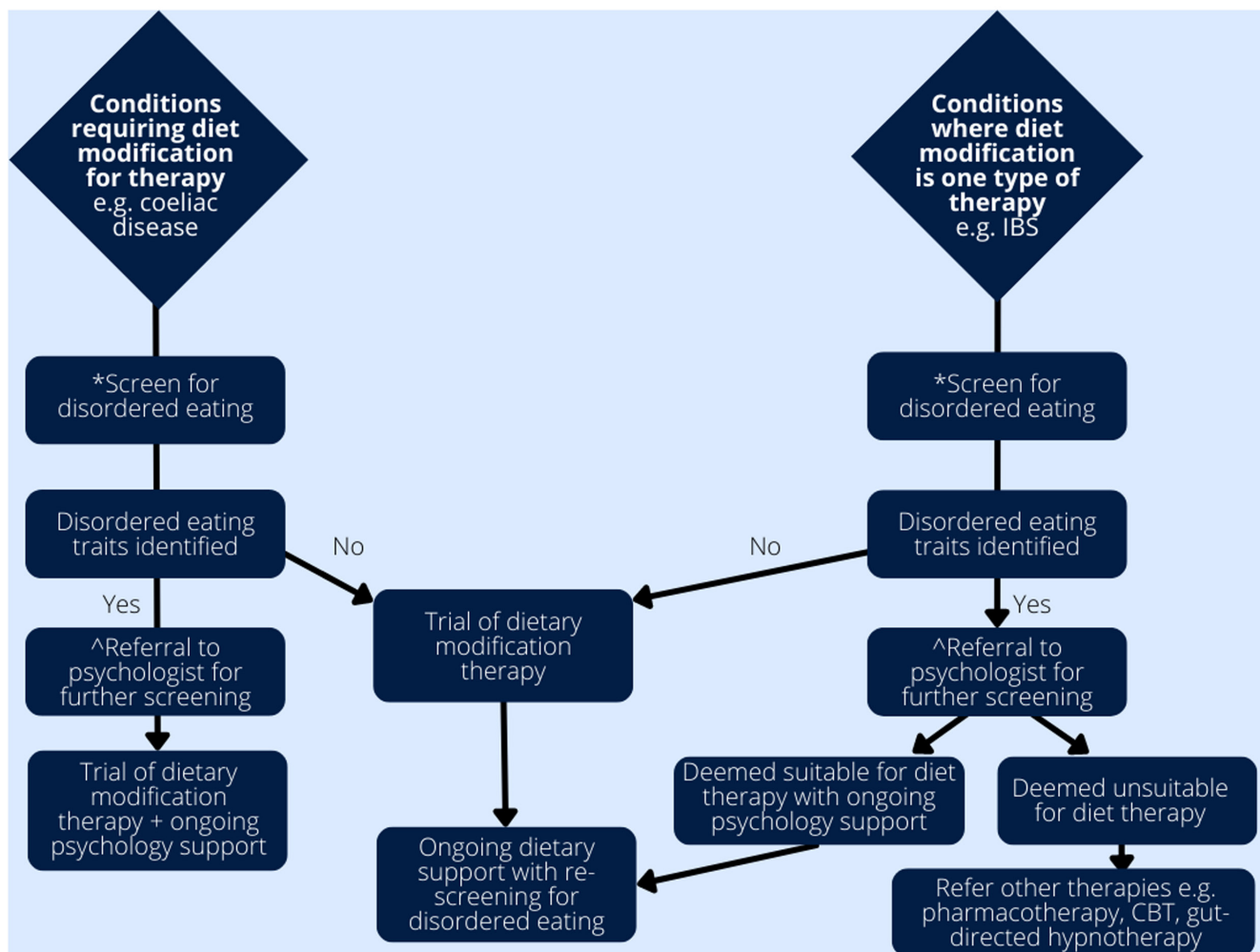


FIGURE 2 Clinical flowchart for use of diet therapies in gastroenterology. *Until there is a DGBI validated tool, recommendations for screening in clinical practice include using the SCOFF questionnaire to screen for risk of disordered eating⁹⁵ and the Food Avoidance questionnaire to screen for potential diagnosis of avoidance/restricting food intake disorder.¹¹⁸ ^If access to a psychologist is not possible, the patient should have regular follow-up and monitoring with their general practitioner. Additionally, they should work with another healthcare professional where available such as a dietitian, gastroenterologist, nurse, or counsellor who has experience with implementing dietary management or seek alternative telehealth or group-based therapies"

The language used in orthorexia measurement tools, such as "Would you say that food dominates your life?" used in the SCOFF questionnaire, may not be appropriate in DGBI, as food can be a symptom trigger.⁹⁶ Hence, development of a DGBI-specific tool may provide a more accurate picture. Studies should assess clinical characteristics that may predict a patient more likely to develop orthorexic traits if a restrictive diet is implemented. Furthermore, therapeutic approaches for patients at risk of orthorexia development should be established.

6 | CONCLUSIONS

This is the first comprehensive review of its kind, highlighting the vast range of prevalence rates of orthorexia in the literature and limited data in gastroenterology-specific populations, but, due to use of restrictive diets for therapy, orthorexia prevalence is suspected to be high in gastroenterology. Data from this scoping review suggest

that specific dietary patterns, or diseases associated with dietary patterns, may be a factor contributing to orthorexia development. As such, utilising a multidisciplinary team, including a general practitioner, gastroenterologist, dietitian and psychologist, is imperative within this patient group.

AUTHOR CONTRIBUTIONS

CT and JB designed the study. NS conducted the literature search. NS and MT conducted the title and abstract screening. All authors conducted the data extraction, were involved in the drafting of the manuscript, and approved the final version of the manuscript.

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CONFLICT OF INTEREST

No competing interests declared.

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