CIULKIEWICZ, Łukasz, FIGUROWSKA, Patrycja, MAŁEK, Natalia, KWIATKOWSKA, Anita, PLUTA, Patryk, KARŁOWICZ, Konrad, BROŻYNA, Aleksandra, EMERLA, Sara, HERMANOWSKA, Maria, LUBOMIRSKA, Julia, BYDLIŃSKI, Arkadiusz and OBRĘBSKI, Michał. The prevalence of orthorexia nervosa in patients with selected chronic diseases. Journal of Education, Health and Sport. 2024;72:51236. eISSN 2391-8306.
https://dx.doi.org/10.12775/JEHS.2024.72.51236
https://apcz.umk.pl/JEHS/article/view/51236

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).© The Authors 2024;
This article is published with open access at Licensee Open Journal Systems of Nicolaus Copernicus University in Torun, Poland

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 11.05.2024. Revised: 25.05.2024. Accepted: 28.05.2024. Published: 29.05.2024.

The prevalence of orthorexia nervosa in patients with selected chronic diseases.

MD Łukasz Ciulkiewicz [1], MD Patrycja Figurowska [2], MD Natalia Małek [3], MD Anita Kwiatkowska [4], MD Patryk Pluta [5], MD Konrad Karłowicz [6], Aleksandra Brożyna [7], Sara Emerla [8], Maria Hermanowska [9], Julia Lubomirska [10], Arkadiusz Bydliński [11], MD Michał Obrębski [12]

Affiliations

[1] Independent Public Healthcare Center in Mińsk Mazowiecki, Szpitalna 37, 05-300 Mińsk Mazowiecki, Poland, lukasz.ciulkiewicz@onet.eu, **https://orcid.org/0009-0005-4531-7532**

[2] Independent Public Healthcare Center in Mińsk Mazowiecki, Szpitalna 37, 05-300 Mińsk Mazowiecki, Poland, patrycja.figurowska@gmail.com, **https://orcid.org/0009-0003-7269-6916**

[3] Central Clinical Hospital in Warsaw, Banacha 1a, 02-097 Warsaw, Poland, n.malek2609@gmail.com, **https://orcid.org/0009-0005-9602-2929**

[4] Military Institute of Medicine - National Research Institute, Szaserów 128, 04-141 Warsaw, Poland, aw.kwiatkowska@gmail.com, **https://orcid.org/0009-0009-7250-6194**

[5] Stanisław Rybicki Regional Polyclinical Hospital in Skierniewice, Rybickiego 1, 96-100 Skierniewice, Poland, patrykpluta15@gmail.com, **https://orcid.org/0009-0005-3251-2267**

[6] Central Clinical Hospital in Warsaw, Banacha 1a, 02-097 Warsaw, Poland, konrad.karlowicz@uckwum.pl, **https://orcid.org/0009-0008-4610-6456**

[7] Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland, ola.brozyna@icloud.com, **https://orcid.org/0009-0000-9403-6212**

[8] Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland, emerlasara@gmail.com, **https://orcid.org/0009-0007-2229-9145**

[9] Jan Kochanowski University, Collegium Medicum, al. IX Wieków Kielc 19A, 25-317 Kielce, Poland, marysiah05@gmail.com, **https://orcid.org/0009-0007-5673-6403**

[10] Jan Kochanowski University, Collegium Medicum, al. IX Wieków Kielc 19A, 25-317 Kielce, Poland, lubek1999@poczta.onet.pl, **https://orcid.org/0009-0008-8557-5108**

[11] Medical University of Warsaw, Żwirki i Wigury 61, 02-091, Warsaw, Poland, bydlinskiarkadiusz@gmail.com, **https://orcid.org/0009-0001-4230-661X**

[12] University Clinical Center of the Medical University of Warsaw, Banacha 1a, 02-097 Warsaw, Poland, ninurt@yahoo.com, **https://orcid.org/0009-0000-0420-5853**

Corresponding author: Łukasz Ciulkiewicz MD, lukasz.ciulkiewicz@onet.eu

ABSTRACT

Introduction and aim. Orthorexia nervosa is described as an obsession with consuming solely healthy foods accompanied by restrictive behaviors. Patients with chronic conditions frequently require dietary interventions alongside medication to manage symptoms and slow down disease progression. However, when dietary restrictions are taken to extremes, individuals may develop orthorexia nervosa, resulting in malnutrition and weight loss. This poses risks during treatment, where maintaining a balanced diet is vital. In this review we aim to display the prevalence of orthorexia nervosa in patients suffering from selected chronic diseases.

Material and methods. A literature review was performed to investigate the prevalence of orthorexia nervosa among individuals with type 1 diabetes, inflammatory bowel disease, celiac disease, rheumatoid arthritis, and cancer.

Description of the State of Knowledge. The occurrence of orthorexia reaches up to 7% in the general population, 72% in patients with type 1 diabetes mellitus, 77% in case of inflammatory bowel disease, 71% among individuals suffering from celiac disease, 75% in those with rheumatoid arthritis, and 50% in case of cancer. Orthorexia nervosa predominantly affects females who are younger, have higher levels of education, select organic foods, prepare their own meals, and have other concurrent chronic illnesses. The distress associated

with diagnosis is considered the primary factor contributing to the development of this condition. Orthorexia ultimately leads to malnutrition, weight loss, impaired social functioning, and poses a risk of complications during the management of patients suffering from chronic diseases.

Conclusion. The prevalence of orthorexia nervosa in patients suffering from the exhibited chronic illnesses is significantly higher compared to the general population. Therefore, early detection of this condition and intervention are necessary to improve patient management. Further research is needed to assess the frequency of orthorexia among individuals suffering from other chronic diseases.

KEY WORDS: Orthorexia nervosa, Type 1 diabetes mellitus, Inflammatory bowel disease, Celiac disease, Rheumatoid arthritis, Cancer

INTRODUCTION

The term orthorexia nervosa (ON), introduced by Steven Bratman in 1997, refers to a state of obsession with consuming only foods considered healthy.[1] This condition is characterized by a fixation on dietary purity, anxiety when selecting food products, as well as meticulous planning and preparing meals.[2] Additionally, individuals with ON experience significant emotional distress and fear of illness associated with violating self-imposed restrictions.[3]

Patients suffering from chronic diseases are often required to implement diet therapies alongside taking medications in order to manage symptoms and delay disease progression. Following diet recommendations allows them to actively participate in treatment and feel in control. However, complications arise when dietary restrictions are taken to extreme levels, which in some cases may result in developing ON.[4] Ultimately, orthorexia nervosa leads to weight loss and nutritional deficiencies, posing risk for patients with chronic diseases, as maintaining a healthy diet is essential during treatment.[5]

In this literature review, we're going to examine the prevalence of ON among individuals with selected chronic illnesses such as type 1 diabetes mellitus (T1DM), inflammatory bowel disease (IBD), celiac disease (CD), rheumatoid arthritis (RA), and cancer. Figure 1. illustrates the occurrence rate of ON in the general population as well as among patients with the selected chronic diseases. [4, 6-8]

METHODS

For this review, PubMed, Elsevier, and Google Scholar were searched to find articles concerning the prevalence of orthorexia nervosa among patients with chronic diseases. Due to the limited research available on this subject in the literature, we chose to display only the sufficiently described studies that concern connections between chronic illnesses and orthorexia nervosa. We performed a search using the keywords “Orthorexia nervosa”, “Orthorexia nervosa chronic diseases”, “Chronic diseases eating disorders”, “Orthorexia nervosa gastroenterology”, “Orthorexia nervosa rheumatoid arthritis”, Orthorexia nervosa cancer”, “Orthorexia nervosa inflammatory bowel disease”, “Orthorexia nervosa diabetes”, “Orthorexia nervosa celiac disease”. Articles were analyzed and included based on their relevance to the subject. The inclusion criteria were: abstracts and full text format published articles, written in English, comprising clinical trials and review articles. The exclusion criteria were: non English articles, duplicates, clinical trials with insufficient description to be included, and irrelevant articles. Initially 463 studies, consisting of abstracts and full texts, were taken under consideration. Subsequently, irrelevant papers and duplicates were removed. Following this 124 manuscripts were selected for detailed evaluation, which resulted in a selection of 71 articles and clinical trials that were included in this literature review.

Orthorexia nervosa

Orthorexia nervosa is an eating disorder that was first introduced in 1997 by Steven Bratman.[1] Etymology of this term derives from Greek words orthos meaning “right" and orexia meaning “appetite”.[9] The prevalence of orthorexia in the general population is approximately 6.9%.[6] In conducted studies it ranges from 2.3% in the study from 2021 by Greetfeld et al. concerning the German population to 75.2% in the study from 2019 by Haddad et al. among the Lebanese students.[10,11]

Even though ON is not officially recognised in The World Health Organization Eleventh Revision of The International Classification of Diseases (ICD11) nor The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), orthorexia is frequently classified alongside other eating disorders.[12] Furthermore, in 2003 it was acknowledged by the National Eating Disorders Association (NEDA).[9]

The clinical presentation of this condition comprises fixation on dietary purity, meticulously planning and preparing healthy meals, along with a sense of superiority regarding dietary

choices relative to others.[2] Further criteria encompass heightened anxiety involving food selections without the primary aim being weight loss, and exaggerated emotional distress linked to foods viewed as unhealthy, combined with at least one of the following: health repercussions from dietary decisions such as deficiencies, decrease in body weight or cachexia; impaired daily functioning due to dietary preferences including social, academic, or vocational aspects; or a confidence and sense of worth contingent upon nutritional choices.[3] Breach of self enforced dietary regulations triggers anxiety, shame, fear of illness, and unpleasant physical sensations. Over time, these dietary restrictions intensify, potentially resulting in the exclusion of entire food categories.[9]

In individuals with chronic diseases, dietary therapies are often necessary to alleviate symptoms and decelerate the disease progression. This approach allows the person to actively participate in their treatment and experience a sense of control. The key distinction from typically observed orthorexia nervosa in this case is that the diet is not solely self-imposed, but rather prescribed by a doctor. However, challenges arise when patients take dietary recommendations to an extreme level.[4] Perfectionists, exhibiting high levels of neuroticism, having a propensity for obsessive-compulsive behavior, and a history of dieting due to body dissatisfaction, are particularly susceptible to developing ON.[13]

The diagnosis in most cases is based on the results of Bratman Orthorexia Self - Test (BOT), ORTO-15 Questionnaire, and Eating Habits Questionnaire (EHQ).[2,14,15] Newly developed alternatives include the Düsseldorf Orthorexia Scale (DOS), Barcelona Orthorexia Scale (BOS), and Orthorexia Nervosa Inventory (ONI).[16-18]

The BOT was introduced in 2000 by Bratman and Knight. It consists of 10 items, concerning symptoms of orthorexia nervosa, with responses attributed to 1 point for a positive answer and 0 for a negative. A result ≥4 is indicative of orthorexia nervosa, if between 2 and 3 points it displays a tendency towards ON.[14] The ORTO-15 Questionnaire, based on the BOT and the Minnesota Multiphasic Personality Inventory (MMPI-2), was introduced in 2005 by Donini et al. and consists of 15 items, focusing on clinical and emotional factors, with a 4 point scale for each response, therefore the range is between 15 and 60 points. A result ≤ 40 is indicative of orthorexia nervosa. The lower the score, the greater the likelihood of ON.[2] The EHQ was introduced in 2013 by Gleaves et al. and consists of 21 items, regarding beliefs, attitude and behaviors towards healthy eating, with a 4 point scale for each response, and a range of 21 to 84 points. The greater the score, the higher the likelihood of orthorexia nervosa.[15]

The treatment for ON is centered around psychoeducation, cognitive-behavioral therapy (CBT), nutritional counseling with a dietitian, as well as mindfulness. Social support is vital in maintaining healthy eating habits.[13] Psychoeducation offers patients insight into the nature of this condition, explains the psychological factors that underlie orthorexia, and its potential health-related consequences. This knowledge enables them to identify dysfunctional beliefs and take steps towards change.[19] Cognitive behavioral therapy provides a methodical, evidence based approach aimed at addressing maladaptive cognitive patterns and behaviors. It assists individuals in cultivating healthier eating habits and acquiring coping strategies to effectively manage distress. Moreover, CBT aids patients in gradually reintroducing previously avoided foods back into their diet.[20] For optimal outcomes, it's recommended to combine psychoeducation and CBT.[13] Nutritional counseling entails collaborating with a dietitian who specializes in eating disorders to develop a meal plan intended for addressing nutritional deficiencies.[21] Mindfulness encourages awareness in the present moment and accepting without judgment. It allows patients to detach from their anxiety and obsessive thoughts surrounding food, preventing impulsive reactions.[22]

Patients with chronic illnesses might also benefit from using the therapy options mentioned above in order to deal with their primary diagnosis.

In the further paragraphs we're going to display the prevalence of orthorexia nervosa specifically among the individuals suffering from selected chronic diseases, including type 1 diabetes mellitus, inflammatory bowel disease, celiac disease, rheumatoid arthritis, and cancer.

Orthorexia nervosa and type 1 diabetes mellitus

Type 1 diabetes mellitus is a chronic autoimmune condition characterized by the destruction of β-cells in the pancreas, responsible for insulin production, by CD4+ and CD8+ T cells along with macrophages, which produce interleukin-22 (IL-22), interferon-α (INF-α), and tumor necrosis factor-β (TNF-β), and infiltrate the islets of Langerhans. Subsequently, insulin deficiency leads to hyperglycemia.[23] The prevalence of T1DM in the general population is approximately 0.15%.[24] Risk factors for T1DM include genetic predisposition, adolescence, immune and environmental influences, as well as having a positive family history.[25] Dietary and lifestyle factors, such as childhood obesity, advanced maternal age, rapid infant growth, and short duration of breastfeeding, also play a role in the pathogenesis of type 1 diabetes mellitus.[26] Clinically, the disease manifests with symptoms comprising polydipsia, polyuria, polyphagia, fatigue, nausea, vomiting, abdominal pain, weight loss, recurring skin infections,

blurred vision, and diabetic ketoacidosis with Kussmaul breathing and the acetone odor. Diagnosis is based on criteria such as fasting blood glucose concentration exceeding 126 mg/dL, random blood glucose concentration exceeding 200 mg/dL with accompanying symptoms, abnormal results from an oral glucose tolerance test, or a glycated hemoglobin (HbA1c) concentration exceeding 6.5%. Low levels of C-peptide serve as an indicator of severe endogenous insulin deficiency. The majority of patients diagnosed with T1DM exhibit antibodies against insulin, glutamate decarboxylase, islet antigen 2, tetraspanin-7, and zinc transporter 8.[27] Treatment primarily revolves around insulin replacement therapy administered either through injections or via a pump. Additionally, hypoglycemic agents such as metformin may be prescribed. Monitoring blood glucose levels, adhering to a balanced diet with carbohydrates counting, and engaging in regular physical activity are also crucial components of managing the condition.[26]

Eating disorders, resulting from strict self imposed food restrictions in individuals with T1DM are associated with increased complications and worse metabolic control.[28]

In a 2023 study by Cosentino et al. 44 patients, with a median age of 39.7 years, with median BMI 24.3 kg/m^2, all diagnosed with type 1 diabetes mellitus, underwent assessment using the ORTO-15 questionnaire, DOS, Eating Disorder Examination Questionnaire version 6 (EDE-Q6), and Brief Symptom Inventory (BSI). Each individual was required to indicate 1 healthy acquaintance of the same sex and similar age to serve as a control group. According to the ORTO-15 questionnaire, 72% of patients with T1DM and 29% of healthy controls had orthorexia nervosa. Additionally, 4.5% of patients with diabetes and 0% of the controls exhibited orthorexia based on the DOS.[7]

In a 2022 cross-sectional study by Elhabashy et al. 138 adolescent patients with T1DM participated and completed the Eating Attitude Test (EAT-26), ORTO-15 questionnaire, and EDE-Q6. Among them, 17.4% had an eating disorder based on the EAT-26 score, 38.4% exhibited orthorexia nervosa based on the ORTO-15, and 32.6% displayed disordered eating behavior based on the EDE-Q6. Individuals at risk of developing eating disorders showed lower ORTO-15 scores and higher EDE-Q6 scores. Furthermore, there was a positive correlation between ORTO-15 scores and the duration of diabetes type 1. Patients with eating disorders were found to have a higher prevalence of peripheral neuropathy, ketoacidosis, and microalbuminuria. Episodes of hypoglycemia were more frequent among those with high EAT-26 and EDE-Q6 scores.[29]

Orthorexia nervosa and inflammatory bowel disease

Inflammatory bowel disease is a chronic inflammatory disorder of the gastrointestinal (GI) tract, distinguished by recurrent periods of relapses and remissions. It comprises ulcerative colitis and Crohn's disease.[30] The prevalence of IBD in the general population is estimated to be around 1.3%.[31] In Crohn's disease, granulomatous inflammation can impact the entire GI tract and extend through all layers of its walls. Damaged areas typically occur as patches alongside healthy tissue. In ulcerative colitis, inflammation is confined to the colon and rectum, affecting solely the mucosal layer. Impaired areas are continuous, commonly originating at the rectum and expanding further into the colon.[32] Genetic factors and the immune response to intestinal microbiota are engaged in the pathogenesis of IBD.[33] The symptoms encompass abdominal pain, anemia, cramping, diarrhea, eye inflammation, fatigue, fever, joint pain, reduced appetite, rectal bleeding, skin rashes, and weight loss. Infrequent complications associated with ulcerative colitis are toxic megacolon and primary sclerosing cholangitis.[34-37] The diagnosis can be established based on clinical presentation, physical examination, and laboratory tests such as faecal calprotectin, C-reactive protein (CRP), and erythrocyte sedimentation rate (ESR). Serological markers entail anti-Saccharomyces cerevisiae antibody (ASCA) mainly present in Crohn's disease and perinuclear antineutrophil cytoplasmic antibody (pANCA) largely occuring in ulcerative colitis. Additional diagnostic modalities comprise contrast radiography (RT), computed tomography (CT), magnetic resonance imaging (MRI), colonoscopy with biopsies collected from various parts of the GI tract, and wireless video capsule endoscopy.[38] Management of IBD aims to decrease inflammation and prolong remission as much as possible. Therapy consists of glucocorticosteroids, 5-aminosalicylic acids, immunomodulation (methotrexate, calcineurin inhibitors, Janus kinase inhibitors, thiopurines), and biological drugs (anti-TNF therapy, anti-integrin therapy).[39] In Crohn's disease, surgeries are generally conservative, aiming to remove only the damaged segments of the gastrointestinal tract. Due to the recurrent nature of Crohn's disease, more surgical procedures may be required over time.[40] In ulcerative colitis colectomy is considered a cure since inflammation is confined to the large intestine.[41] A significant link has been noted between symptomatology, disease activity, and eating habits in individuals with IBD. It's common for patients with this condition to impose food restrictions upon themselves, which may potentially result in the development of orthorexia nervosa.[4,42]

In a 2023 study by Di Giorgio et al. 158 patients (113 with IBD diagnosis and 45 healthy individuals) were assessed for the risk of ON using the ORTO-15 questionnaire. In the group

with inflammatory bowel disease, 74 patients were receiving biologic drugs, 28 were undergoing conventional therapy, and 12 were admitted due to disease flares. The prevalence of orthorexia in patients with IBD reached 77% compared to 47% in the healthy group. The prevalence of ON remained consistent regardless of whether the individual was diagnosed with ulcerative colitis or Crohn's disease. Among patients with orthorexia nervosa, 19.5% underwent surgery for inflammatory bowel disease, compared to 3.8% without orthorexia. There were no statistically significant differences observed regarding, age, gender, socioeconomic status, marital status, and occupation.[4]

Orthorexia nervosa and celiac disease

Celiac disease is a chronic autoimmune condition affecting the mucosa of the small intestine, leading to malabsorption due to persistent inflammation triggered by the ingestion of gluten.[43] The prevalence of CD in the general population is estimated to be around 1%. The presence of HLA-DQ2 and HLA-DQ8 heterodimers, early introduction of gluten during childhood, infections, and socioeconomic factors, all promote the development of the disease.[44] The majority of individuals diagnosed with CD are women, primarily due to the higher occurrence of this condition. Furthermore, women are more likely than men to undergo diagnostic testing, which contributes to this gender disparity in diagnosis.[45,46] The typical symptoms of celiac disease include abdominal pain, anemia, ataxia, bloating, constipation, decrease in body weight, dermatitis herpetiformis, diarrhea, depression along with anxiety, elevated liver enzymes, eosinophilic oesophagitis, fatigue, headaches, hyposplenism, mouth ulcers, nausea, neuropathy, osteoporosis, and reflux oesophagitis.[47] Adhering to a gluten-free diet is advised in the long term control of celiac disease.[48] This dietary approach proves highly successful in alleviating symptoms, often resulting in noticeable improvements in the psychosocial health and overall quality of life.[49] During the initial stages of transitioning to a gluten free diet, patients may experience distress, which can increase the risk of developing eating disorders, among others ON.[50]

In a 2022 study by Kujawowicz et al. 123 females, with a median age of 34 years, median BMI 21.5 kg/m2, and with celiac disease diagnosis were evaluated for the risk of orthorexia nervosa using the ORTO-15 questionnaire. With a cut-off at 40 points on the ORTO-15 test, a risk of orthorexia nervosa was found in 71% of patients. Using a cut-off at 35 points, a risk was identified in 32% of patients. Individuals were also able to self-assess the impact of CD on their diet on a 5 point scale. Among women with increased probability of ON, 94% were

self preparing their meals compared to 78% of those with no risk. Females at risk of ON were paying attention to the kcal content of food only in 46% of cases, compared to 69% of those with no risk. Moreover, 64% of women at risk of orthorexia nervosa admitted to worrying about food, compared to 8% with no risk. The study indicated a tendency where prevalence of ON decreases with age.[6]

Orthorexia nervosa and rheumatoid arthritis

Rheumatoid arthritis is a chronic autoimmune condition, likely with a genetic component, that affects the musculoskeletal system.[51] The progressive inflammation of the joints activates various signaling molecules such as interleukin-1 (IL-1), interleukin-6 (IL-6), and TNF-α within the osteoclasts, prompting bone resorption and cartilage erosion, ultimately resulting in joint destruction and disability.[8,52] The prevalence of RA in the general population is approximately 1%.[53] Risk factors for rheumatoid arthritis are female gender, older age, having a positive family history, smoking, and obesity.[54] Symptoms include morning stiffness for > 30 min, swelling, warmth, redness, and the presence of nodules under the skin around joints. Other common manifestations consist of fatigue, fever, sweating, weight loss, dry eyes, and chest pain if the lungs or heart are affected.[52,55] According to the criteria established in 2010 by the American College of Rheumatology and European League Against Rheumatism (ACR/EULAR), the diagnosis of RA requires the presence of at least one joint with evident swelling that cannot be explained by another disease. Additionally, a total score of 6 or more in 4 domains is necessary for diagnosis. These domains include joint symptoms, serology, acute phase response, and duration.[56] During laboratory assessment elevated CRP and ESR are examined. In serological tests rheumatoid factor (RF) and anti-citrullinated protein antibodies (anti-CCP) are prominent. Diagnostic imaging techniques such as X-ray are utilized to monitor progression, while MRI and ultrasound (USG) are employed to measure severity.[52,57] Treatment consists of glucocorticosteroids, nonsteroidal anti inflammatory drugs (NSAID), immunomodulatory agents (methotrexate, rituximab, cyclosporine A, azathioprine, sulfasalazine, leflunomide, hydroxychloroquine, TNF-α inhibitors, T-cell costimulatory blocking agents, and IL-1 receptor antagonists), as well as surgical interventions. To maintain remission and enhance the quality of life, alongside pharmacotherapy, lifestyle modifications are indispensable. A dietary approach is essential for correcting nutritional deficiencies, reducing the need for NSAIDs, and minimizing drug toxicity. Patients with autoimmune diseases frequently experience eating disorders due to self imposed food restrictions.[8,58]

In a 2023 cross-sectional study by Sifakaki et al. 133 patients, mostly females (95%), with a median age of 46 years, median BMI 25.83 kg/m2, and with rheumatoid arthritis, were analyzed for the risk of orthorexia nervosa with the ORTO-15 questionnaire. Among them, 55% of patients with RA were in remission, while 45% were actively experiencing symptoms. Furthermore, 53% of individuals were overweight, 44% had normal weight, and the 3% were underweight. The prevalence of orthorexia nervosa reached over 75%.
In this research, there was a higher inclination towards developing ON observed amid females, while lower tendencies were noted with increasing age and BMI.[8]

Orthorexia nervosa and cancer

The term cancer refers to a group of chronic diseases characterized by the abnormal proliferation of cells beyond their typical boundaries. These cells can spread to other parts of the body via circulatory and lymphatic systems, resulting in the formation of metastases. Ultimately, death occurs due to widespread metastasis and cachexia.[59] The overall lifetime risk of developing cancer is estimated to be approximately 20%.[60] Based on U.S. data from 2023, the majority of new cancer cases in men affect the prostate (29%), lungs (12%), colorectum (8%), urinary bladder (6%), and the skin (6%). In women, the most common sites are the breast (31%), lungs (13%), colorectum (8%), uterus (7%), and the skin (4%). The leading causes of cancer related death in men are lung cancer (21%), prostate cancer (11%), colorectal cancer (9%), pancreatic cancer (8%), and liver cancer (6%). In women, the most frequent causes of cancer related death are lung cancer (21%), breast cancer (15%), colorectal cancer (8%), pancreatic cancer (8%), and ovarian cancer (5%).[61] Risk factors vary between different types of cancer. Among the most prominent are smoking cigarettes, excessive alcohol consumption, genetic factors, age, obesity, infectious diseases, exposure to sunlight, immunosuppression, and hormonal therapy.[62] Symptoms of cancer are different depending on the location of the tumor. General nonspecific signs include fatigue, localized pain, a lump under the skin, unexpected weight gain or weight loss, changes in the skin, altered bowel movements, hoarseness, cough, dysphagia, chronic indigestion, infections, fever, and persistent unexpected bleeding.[63] Diagnosis can be made upon physical examination, laboratory tests, detecting cancer biomarkers, diagnostic imaging, and biopsies. Once detected, cancer undergoes a staging process to assess its extent and spread.[64] The cancerous mass can be treated through several methods such as surgical removal, chemotherapy, radiation therapy,

immunotherapy, hormonal therapy, targeted drug therapy, cryoablation, or in rare cases it may regress on its own.[65-67]

Psychological distress following a cancer diagnosis may drive individuals to modify dietary habits thought to impact prognosis or risk of recurrence. However, this pursuit of better health can sometimes become excessive if not approached with moderation.[68-70] Patients who are highly educated, consume organic foods, and have concurrent chronic diseases are at a particularly higher risk for orthorexia nervosa, which may lead to malnutrition, weight loss, and social impairment. This condition poses significant risk for cancer patients, as maintaining a healthy diet is crucial during the treatment. Especially since around 20% of cancer patients die as a result of undernourishment.[5]

In a 2023 monocentric cross-sectional study by Zoghbi et al. 366 Lebanese patients with cancer were assessed based on the results of the Düsseldorf Orthorexia Scale. Roughly 22% of participants displayed definite orthorexic tendencies, and 9% were at risk of ON. Hormonotherapy, female gender, and breast cancer diagnosis were associated with a higher risk of orthorexia nervosa, whereas prostate cancer patients exhibited a lower risk of ON.[70]

In a 2022 study by Waterman et al. 93 women with cancer answered the DOS and the EHQ. Nearly 36% of participants scored positive for orthorexia nervosa. Additionally, 44% of the patients reported altering their eating habits since the diagnosis, and 79% planned to do so in the subsequent year. Factors such as disease related stress, fear of recurrence, female gender, and young age were linked to a greater risk of disordered eating behaviors.[69]

In a 2020 study by Aslan and Aktürk, 238 women diagnosed with breast cancer and 164 healthy individuals in the control group participated. They completed an information form and the ORTO-15 questionnaire. With a cut-off score of 40 points, approximately 50% of women suffering from breast cancer were identified as being at risk of orthorexia nervosa. With a cut-off of 33 points, a significant difference in results was observed between women with cancer and those in the control group. Specifically, 23.5% of women with breast cancer were found to have a high risk of ON, in comparison to only 6.7% in the healthy group. Furthermore, the ORTO-15 scores were lower among patients with higher education, higher income, and concurrent other chronic disease.[71]

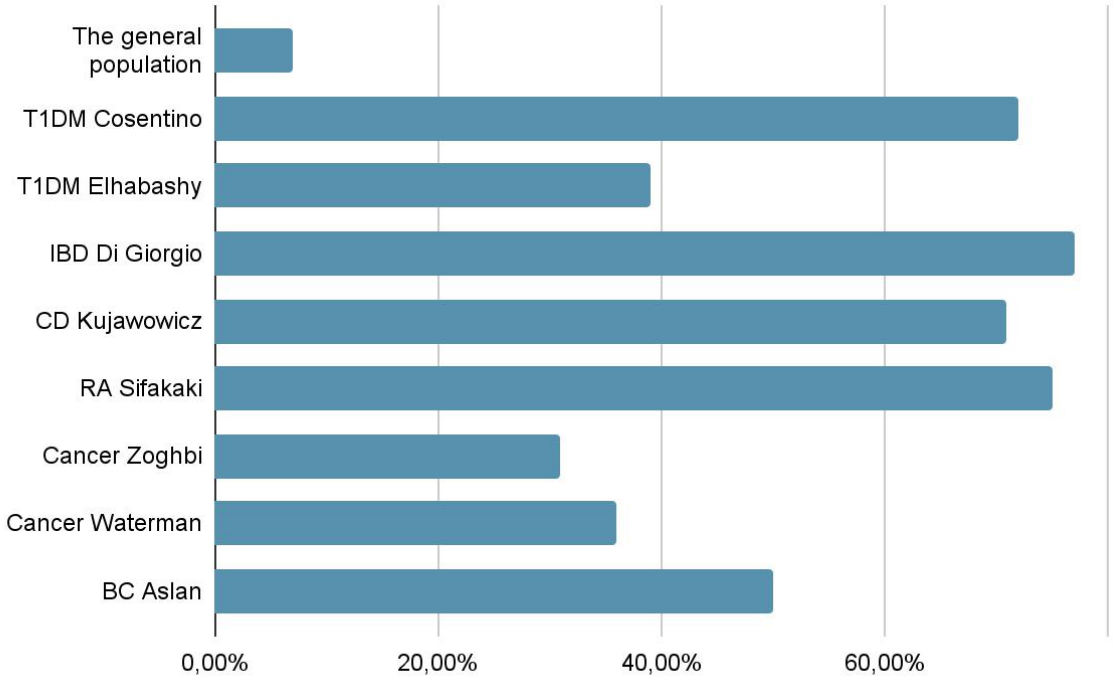

Fig. 1. The prevalence of orthorexia nervosa in the general population and among patients diagnosed with type 1 diabetes mellitus, Inflammatory bowel disease, celiac disease, rheumatoid arthritis, and cancer.[6],[7],[4],[8]

CONCLUSION

The research indicates that individuals with chronic diseases, who often require dietary therapies, exhibit a significantly increased prevalence of orthorexia nervosa compared to the general population. Specifically, the risk reaches up to 72% in patients with type 1 diabetes mellitus, 77% among those with inflammatory bowel disease, 71% in case of celiac disease, 75% in individuals suffering from rheumatoid arthritis, 50% in case of cancer, and approximately 7% in the general population.[4,6-8,71] Furthermore, ON particularly impacts patients of the female gender, who are younger, have higher levels of education, higher income, consume organic foods, prepare their own meals, and have concurrent chronic diseases. Especially the stress associated with the disease during the initial stages of diagnosis, adapting to a new diet, and the fear of recurrence can cause patients to experience distress, potentially triggering the onset of orthorexia nervosa. Eating disorders resulting from self imposed dietary restrictions among patients with chronic illnesses are linked to heightened complications. ON ultimately leads to weight loss, nutritional deficiencies, and impaired social functioning. This poses a risk for patients with chronic diseases because maintaining a

healthy diet is indispensable during treatment. For instance, malnutrition contributes to the deaths of around 20% of cancer patients, whereas in case of type 1 diabetes mellitus peripheral neuropathy, ketoacidosis, and microalbuminuria occur more frequently in individuals with orthorexia.[5,29]

Early detection of ON and appropriate intervention are crucial to enhance the management of patients with chronic illnesses. Therefore, they should be assessed for the risk of developing this condition. Further research is necessary to determine the prevalence of orthorexia nervosa in patients with other chronic diseases.

DECLARATION

Author's contribution

Conceptualization, ŁC, PF, ABr, NM ; Methodology, ŁC, AK, PP, ABy ; Software, KK, SE, MH, JL ; Check, NM, MO ; Formal analysis, ŁC, SE, MH, JL ; Investigation, PF, AK, PP, KK ; Resources, ŁC, NM, ABy ; Data curation, ABr, MH, JL ; Writing - Rough preparation ŁC, PF, NM, SE, ABy ; Writing - Review and editing, ŁC, PF, NM, AK, PP, KK, ABr, SE, MH, JL, ABy, MO ; Visualization, PP, KK ; Supervision, ŁC, MO;.

All authors have read and agreed with the published version of the manuscript.

Funding Statement

The study did not receive funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflict of Interest Statement

The authors declare no conflicts of interest.

REFERENCES

1 Bratman, S. and Knight, D. (2000) Health Food Junkies: Overcoming the Obsession with Healthful Eating. Broadway Books, New York.

2 Donini LM, Marsili D, Graziani MP, Imbriale M, Cannella C. Orthorexia nervosa: a preliminary study with a proposal for diagnosis and an attempt to measure the dimension of the phenomenon. *Eat Weight Disord*. 2004;9(2):151-157. doi:10.1007/BF03325060

3 Dunn TM, Bratman S. On orthorexia nervosa: A review of the literature and proposed diagnostic criteria. *Eat Behav*. 2016;21:11-17. doi:10.1016/j.eatbeh.2015.12.006

4 F M Di Giorgio, S P Modica, S Ciminnisi, M Saladino, S Muscarella, P Melatti, D Brinch, S Petta, M Cappello, P848 Risk of Orthorexia Nervosa in Patients with Inflammatory Bowel Disease: A Link with Eating Disorders?, *Journal of Crohn's and Colitis*, Volume 17, Issue Supplement_1, February 2023, Page i972, https://doi.org/10.1093/ecco-jcc/jjac190.0978

5 Nucci D, Santangelo OE, Provenzano S, Nardi M, Firenze A, Gianfredi V. Altered Food Behavior and Cancer: A Systematic Review of the Literature. *Int J Environ Res Public Health*. 2022;19(16):10299. Published 2022 Aug 18. doi:10.3390/ijerph191610299

6 Kujawowicz K, Mirończuk-Chodakowska I, Witkowska AM. Dietary Behavior and Risk of Orthorexia in Women with Celiac Disease. *Nutrients*. 2022;14(4):904. Published 2022 Feb 21. doi:10.3390/nu14040904

7 Cosentino C, Rossi E, Pala L, et al. Orthorexia nervosa and type 1 diabetes: results of a cross-sectional study [published correction appears in Acta Diabetol. 2023 Aug;60(8):1153]. *Acta Diabetol*. 2023;60(5):681-686. doi:10.1007/s00592-023-02044-9

8 Sifakaki M, Gkiouras K, Lindqvist HM, et al. Orthorexia Nervosa Practices in Rheumatoid Arthritis: The DORA Study. *Nutrients*. 2023;15(3):713. Published 2023 Jan 31. doi:10.3390/nu15030713

9 OLEJNICZAK, Dominik and SKONIECZNA, Joanna. Orthorexia nervosa – a new health problem - characteristics. *Journal of Education, Health and Sport*. Online. 15 September 2018. Vol. 8, no. 9, pp. 1690-1696. [Accessed 15 March 2024].4 OLEJNICZAK, Dominik and SKONIECZNA, Joanna. Orthorexia nervosa – a new health problem - characteristics. *Journal of Education, Health and Sport*. Online. 15 September 2018. Vol. 8, no. 9, pp. 1690-1696. [Accessed 15 March 2024].

10 Greetfeld M, Hessler-Kaufmann JB, Brandl B, et al. Orthorexic tendencies in the general population: association with demographic data, psychiatric symptoms, and utilization of

mental health services. *Eat Weight Disord*. 2021;26(5):1511-1519. doi:10.1007/s40519-020-00961-0

11 Haddad C, Obeid S, Akel M, et al. Correlates of orthorexia nervosa among a representative sample of the Lebanese population. *Eat Weight Disord*. 2019;24(3):481-493. doi:10.1007/s40519-018-0631-x

12 Chey WD. Elimination Diets for Irritable Bowel Syndrome: Approaching the End of the Beginning. *Am J Gastroenterol*. 2019;114(2):201-203. doi:10.14309/ajg.0000000000000099

13 Horovitz O, Argyrides M. Orthorexia and Orthorexia Nervosa: A Comprehensive Examination of Prevalence, Risk Factors, Diagnosis, and Treatment. *Nutrients*. 2023;15(17):3851. Published 2023 Sep 3. doi:10.3390/nu15173851

14 Niedzielski A, Kaźmierczak-Wojtaś N. Prevalence of Orthorexia Nervosa and Its Diagnostic Tools-A Literature Review. *Int J Environ Res Public Health*. 2021;18(10):5488. Published 2021 May 20. doi:10.3390/ijerph18105488

15 Gleaves D.H., Graham E.C., Ambwani S. Measuring "Orthorexia": Development of the eating habits Questionnaire. The International Journal of Educational and Psychological Assessment. *Assess.* 2013;**12**:1–18.

16 Chard CA, Hilzendegen C, Barthels F, Stroebele-Benschop N. Psychometric evaluation of the English version of the Düsseldorf Orthorexie Scale (DOS) and the prevalence of orthorexia nervosa among a U.S. student sample. *Eat Weight Disord*. 2019;24(2):275-281. doi:10.1007/s40519-018-0570-6

17 Bauer SM, Fusté A, Andrés A, Saldaña C. The Barcelona Orthorexia Scale (BOS): development process using the Delphi method. *Eat Weight Disord*. 2019;24(2):247-255. doi:10.1007/s40519-018-0556-4

18 Oberle CD, De Nadai AS, Madrid AL. Orthorexia Nervosa Inventory (ONI): development and validation of a new measure of orthorexic symptomatology. *Eat Weight Disord*. 2021;26(2):609-622. doi:10.1007/s40519-020-00896-6

19 Koven NS, Abry AW. The clinical basis of orthorexia nervosa: emerging perspectives. *Neuropsychiatr Dis Treat*. 2015;11:385-394. Published 2015 Feb 18. doi:10.2147/NDT.S61665

20 Murphy R, Straebler S, Cooper Z, Fairburn CG. Cognitive behavioral therapy for eating disorders. *Psychiatr Clin North Am*. 2010;33(3):611-627. doi:10.1016/j.psc.2010.04.004

21 Herrin, M., & Larkin, M. (2012). Nutrition Counseling in the Treatment of Eating Disorders (2nd ed.). Routledge. https://doi.org/10.4324/9780203870600

22 Baer, Ruth & Fischer, Sarah & Huss, Debra. (2005). Mindfulness and Acceptance in the Treatment of Disordered Eating. Journal of Rational-Emotive & Cognitive-Behavior Therapy. 23. 281-300. 10.1007/s10942-005-0015-9.

23 Gillespie KM. Type 1 diabetes: pathogenesis and prevention. *CMAJ*. 2006;175(2):165-170. doi:10.1503/cmaj.060244

24 Mobasseri M, Shirmohammadi M, Amiri T, Vahed N, Hosseini Fard H, Ghojazadeh M. Prevalence and incidence of type 1 diabetes in the world: a systematic review and meta-analysis. *Health Promot Perspect*. 2020;10(2):98-115. Published 2020 Mar 30. doi:10.34172/hpp.2020.18

25 Rewers M, Stene LC, Norris JM. Risk Factors for Type 1 Diabetes. In: Cowie CC, Casagrande SS, Menke A, et al., eds. *Diabetes in America*. 3rd ed. Bethesda (MD): National Institute of Diabetes and Digestive and Kidney Diseases (US); August 2018.

26 Tan SY, Mei Wong JL, Sim YJ, et al. Type 1 and 2 diabetes mellitus: A review on current treatment approach and gene therapy as potential intervention. *Diabetes Metab Syndr*. 2019;13(1):364-372. doi:10.1016/j.dsx.2018.10.008

27 DiMeglio LA, Evans-Molina C, Oram RA. Type 1 diabetes. *Lancet*. 2018;391(10138):2449-2462. doi:10.1016/S0140-6736(18)31320-5

28 Toni G, Berioli MG, Cerquiglini L, et al. Eating Disorders and Disordered Eating Symptoms in Adolescents with Type 1 Diabetes. *Nutrients*. 2017;9(8):906. Published 2017 Aug 19. doi:10.3390/nu9080906

29 Elhabashy SA, Abd ElMalak MW, Elrassas HH, Thabet RA. Disordered eating and behaviors among young Egyptians with type 1 diabetes: risk factors and comorbidities. *J Pediatr Endocrinol Metab*. 2022;35(11):1385-1393. Published 2022 Sep 21. doi:10.1515/jpem-2022-0336

30 Guan Q. A Comprehensive Review and Update on the Pathogenesis of Inflammatory Bowel Disease. *J Immunol Res*. 2019;2019:7247238. Published 2019 Dec 1. doi:10.1155/2019/7247238

31 Weisman MH, Oleg Stens, Seok Kim H, Hou JK, Miller FW, Dillon CF. Inflammatory Bowel Disease Prevalence: Surveillance data from the U.S. National Health and Nutrition Examination Survey. *Prev Med Rep*. 2023;33:102173. Published 2023 Mar 9. doi:10.1016/j.pmedr.2023.102173

32 Li Q, Zheng T, Ding H, et al. Exploring the Benefits of Probiotics in Gut Inflammation and Diarrhea-From an Antioxidant Perspective. *Antioxidants (Basel)*. 2023;12(7):1342. Published 2023 Jun 26. doi:10.3390/antiox12071342

33 Seyedian SS, Nokhostin F, Malamir MD. A review of the diagnosis, prevention, and treatment methods of inflammatory bowel disease. *J Med Life*. 2019;12(2):113-122. doi:10.25122/jml-2018-0075

34 Rogler G, Singh A, Kavanaugh A, Rubin DT. Extraintestinal Manifestations of Inflammatory Bowel Disease: Current Concepts, Treatment, and Implications for Disease Management. *Gastroenterology*. 2021;161(4):1118-1132. doi:10.1053/j.gastro.2021.07.042

35 Bruner LP, White AM, Proksell S. Inflammatory Bowel Disease. *Prim Care*. 2023;50(3):411-427. doi:10.1016/j.pop.2023.03.009

36 Autenrieth DM, Baumgart DC. Toxic megacolon. *Inflamm Bowel Dis*. 2012;18(3):584-591. doi:10.1002/ibd.21847

37 Xavier JCC Júnior, Coelho KIR, Sassaki LY, Yamashiro FDS, Oliveira KCL, Rodrigues MAM. Primary sclerosing cholangitis associated with severe ulcerative colitis in a young man. *Autops Case Rep*. 2013;3(4):37-41. Published 2013 Dec 31. doi:10.4322/acr.2013.037

38 Yu YR, Rodriguez JR. Clinical presentation of Crohn's, ulcerative colitis, and indeterminate colitis: Symptoms, extraintestinal manifestations, and disease phenotypes. *Semin Pediatr Surg*. 2017;26(6):349-355. doi:10.1053/j.sempedsurg.2017.10.003

39 Cai Z, Wang S, Li J. Treatment of Inflammatory Bowel Disease: A Comprehensive Review. *Front Med (Lausanne)*. 2021;8:765474. Published 2021 Dec 20. doi:10.3389/fmed.2021.765474

40 Meima-van Praag EM, Buskens CJ, Hompes R, Bemelman WA. Surgical management of Crohn's disease: a state of the art review. *Int J Colorectal Dis*. 2021;36(6):1133-1145. doi:10.1007/s00384-021-03857-2

41 Öresland T. (2006), Review article: colon-saving medical therapy vs. colectomy in ulcerative colitis – the case for colectomy. Alimentary Pharmacology & Therapeutics, 24: 74-79. https://doi.org/10.1111/j.1365-2036.2006.03065.x

42 Corsello A, Pugliese D, Gasbarrini A, Armuzzi A. Diet and Nutrients in Gastrointestinal Chronic Diseases. *Nutrients*. 2020;12(9):2693. Published 2020 Sep 3. doi:10.3390/nu12092693

43 Catassi C, Verdu EF, Bai JC, Lionetti E. Coeliac disease. *Lancet*. 2022;399(10344):2413-2426. doi:10.1016/S0140-6736(22)00794-2

44 Tack GJ, Verbeek WH, Schreurs MW, Mulder CJ. The spectrum of celiac disease: epidemiology, clinical aspects and treatment. *Nat Rev Gastroenterol Hepatol*. 2010;7(4):204-213. doi:10.1038/nrgastro.2010.23

45 Jansson-Knodell CL, Hujoel IA, West CP, et al. Sex Difference in Celiac Disease in Undiagnosed Populations: A Systematic Review and Meta-analysis. *Clin Gastroenterol Hepatol*. 2019;17(10):1954-1968.e13. doi:10.1016/j.cgh.2018.11.013

46 Schappert SM, Burt CW. Ambulatory care visits to physician offices, hospital outpatient departments, and emergency departments: United States, 2001-02. *Vital Health Stat 13*. 2006;(159):1-66.

47 Al-Toma A, Volta U, Auricchio R, et al. European Society for the Study of Coeliac Disease (ESsCD) guideline for coeliac disease and other gluten-related disorders. *United European Gastroenterol J*. 2019;7(5):583-613. doi:10.1177/2050640619844125

48 Chauhan JC, Kumar P, Dutta AK, Basu S, Kumar A. Assessment of dietary compliance to gluten free diet and psychosocial problems in Indian children with celiac disease. *Indian J Pediatr*. 2010;77(6):649-654. doi:10.1007/s12098-010-0092-3

49 Rodríguez Almagro J, Rodríguez Almagro D, Solano Ruiz C, Siles González J, Hernández Martínez A. The Experience of Living With a Gluten-Free Diet: An Integrative Review. *Gastroenterol Nurs*. 2018;41(3):189-200. doi:10.1097/SGA.0000000000000328

50 Fraser CN, Möller SP, Knowles SR. Understanding disease-specific and non-specific factors predicting disordered eating in adults with coeliac disease. *Appetite*. 2022;168:105744. doi:10.1016/j.appet.2021.105744

51 Radu AF, Bungau SG. Management of Rheumatoid Arthritis: An Overview. *Cells*. 2021;10(11):2857. Published 2021 Oct 23. doi:10.3390/cells10112857

52 Wu D, Luo Y, Li T, et al. Systemic complications of rheumatoid arthritis: Focus on pathogenesis and treatment. *Front Immunol*. 2022;13:1051082. Published 2022 Dec 22. doi:10.3389/fimmu.2022.1051082

53 Gibofsky A. Epidemiology, pathophysiology, and diagnosis of rheumatoid arthritis: A Synopsis. *Am J Manag Care*. 2014;20(7 Suppl):S128-S135.

54 Deane KD, Demoruelle MK, Kelmenson LB, Kuhn KA, Norris JM, Holers VM. Genetic and environmental risk factors for rheumatoid arthritis. *Best Pract Res Clin Rheumatol*. 2017;31(1):3-18. doi:10.1016/j.berh.2017.08.003

55 Bullock J, Rizvi SAA, Saleh AM, et al. Rheumatoid Arthritis: A Brief Overview of the Treatment. *Med Princ Pract*. 2018;27(6):501-507. doi:10.1159/000493390

56 Wasserman AM. Diagnosis and management of rheumatoid arthritis. *Am Fam Physician*. 2011;84(11):1245-1252.

57 Kay J, Upchurch KS. ACR/EULAR 2010 rheumatoid arthritis classification criteria. *Rheumatology (Oxford)*. 2012;51 Suppl 6:vi5-vi9. doi:10.1093/rheumatology/kes279

58 Radu AF, Bungau SG. Management of Rheumatoid Arthritis: An Overview. *Cells*. 2021;10(11):2857. Published 2021 Oct 23. doi:10.3390/cells10112857

59 Brown JS, Amend SR, Austin RH, Gatenby RA, Hammarlund EU, Pienta KJ. Updating the Definition of Cancer. *Mol Cancer Res*. 2023;21(11):1142-1147. doi:10.1158/1541-7786.MCR-23-0411

60 Mattiuzzi C, Lippi G. Current Cancer Epidemiology. *J Epidemiol Glob Health*. 2019;9(4):217-222. doi:10.2991/jegh.k.191008.001

61 Siegel RL, Miller KD, Wagle NS, Jemal A. Cancer statistics, 2023. *CA Cancer J Clin*. 2023;73(1):17-48. doi:10.3322/caac.21763

62 Stein CJ, Colditz GA. Modifiable risk factors for cancer. *Br J Cancer*. 2004;90(2):299-303. doi:10.1038/sj.bjc.6601509

63 Koo MM, Swann R, McPhail S, et al. Presenting symptoms of cancer and stage at diagnosis: evidence from a cross-sectional, population-based study. *Lancet Oncol*. 2020;21(1):73-79. doi:10.1016/S1470-2045(19)30595-9

64 Crosby D, Bhatia S, Brindle KM, et al. Early detection of cancer. *Science*. 2022;375(6586):eaay9040. doi:10.1126/science.aay9040

65 Mee T, Kirkby NF, Defourny NN, Kirkby KJ, Burnet NG. The use of radiotherapy, surgery and chemotherapy in the curative treatment of cancer: results from the FORTY (Favourable Outcomes from RadioTherapY) project. *Br J Radiol*. 2023;96(1152):20230334. doi:10.1259/bjr.20230334

66 Nicolini A, Carpi A, Ferrari P, Biava PM, Rossi G. Immunotherapy and Hormone-therapy in Metastatic Breast Cancer: A Review and an Update. *Curr Drug Targets*. 2016;17(10):1127-1139. doi:10.2174/1389450117666160201114752

67 Kwak K, Yu B, Lewandowski RJ, Kim DH. Recent progress in cryoablation cancer therapy and nanoparticles mediated cryoablation. *Theranostics*. 2022;12(5):2175-2204. Published 2022 Feb 14. doi:10.7150/thno.67530

68 Bobonis Babilonia M, Donovan KA, Lubrano di Ciccone BB, Rajasekhara S. When orthorexia nervosa meets cancer-A case review. *Psychooncology*. 2020;29(10):1507-1509. doi:10.1002/pon.5419

69 Waterman M, Lee RM, Carter JC, Garland SN. Orthorexia symptoms and disordered eating behaviors in young women with cancer. *Eat Behav*. 2022;47:101672. doi:10.1016/j.eatbeh.2022.101672

70 Zoghbi R, Awad E, Hallit S, Matta C. Prevalence of Orthorexic Tendencies and Their Correlates Among Lebanese Patients with Cancer. *Percept Mot Skills*. 2023;130(5):1952-1969. doi:10.1177/00315125231182733

71 Aslan H, Aktürk Ü. Demographic characteristics, nutritional behaviors, and orthorexic tendencies of women with breast cancer: a case-control study. *Eat Weight Disord*. 2020;25(5):1365-1375. doi:10.1007/s40519-019-00772-y