

University of Tartu
Faculty of Medicine
Institute of Clinical Medicine

A scoping review on lymphoedema and nutrition

Master's Thesis

Ilona Kala

Supervisors:

Nicolas Timmermans, Drs., KU Leuven
Alastair Forbes, Dr. med., University of Tartu

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Magistritöö

Ilona Kala

Juhendajad:

Nicolas Timmermans, Drs., KU Leuven

Alastair Forbes, Dr. med., Tartu Ülikool

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Summary

Background: The internationally accepted conservative treatment for lymphoedema is Complex Decongestive Therapy (CDT), which currently does not include nutritional guidance. The role of nutrition in lymphoedema management remains unclear and underexplored.

Objectives: This scoping review examined the size and scope of existing nutrition research on patients with lymphoedema. Main research question: In individuals of all ages with primary or secondary lymphoedema, how do specific dietary or nutraceutical interventions, compared with standard care or no dietary intervention, affect lymphoedema outcomes such as limb volume, quality of life, function or other symptoms?

Sources of evidence and methods: We performed a systematic search of CINAHL (EBSCOhost), PubMed, Scopus, and the Web of Science Core Collection in January 2026. Eligible sources included English-language interventional and observational nutrition studies involving individuals of any age with primary or secondary lymphoedema. We used Rayyan to screen titles, abstracts and full texts. For all included studies, we extracted study characteristics, participant details and key outcomes into a Microsoft Excel spreadsheet.

Results: We identified 2650 articles, of which 46 we included in the review. Most studies were observational and focused on women with breast cancer-related secondary lymphoedema. Nutritional interventions included low-calorie diets, ketogenic diets, MCT diets, synbiotics and selenium supplementation. The most reported outcome measures were changes in limb volume, circumference and quality of life. No evidence-based nutritional strategy currently exists for patients with lymphoedema.

Conclusion: The available literature on nutrition and lymphoedema is expanding but remains limited, with a focus mainly on obesity-related interventions in secondary lymphoedema. Weight-loss diets in breast cancer-related lymphoedema (BCRL) patients decrease limb volume and circumference. Ketogenic diets were a novel, emerging dietary approach for patients with lymphoedema.

Keywords: primary lymphoedema, secondary lymphoedema, breast cancer-related lymphoedema, diet, nutrition, nutrition science

CERCS code: B470

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1. Introduction and Background

Lymphoedema is a chronic and progressive lymphatic disease, arising from underlying impaired lymphatic drainage and excessive fluid accumulation in the interstitium (Grada & Phillips, 2017). Accumulation of protein-rich lymphatic fluid primarily occurs in the subcutaneous tissue, leading to visible swelling (Wu et al., 2025). Lymphoedema is classified as either primary, resulting from developmental abnormalities of the lymphatic vasculature, or secondary, acquired following damage to the lymphatic system due to infection, radiation therapy, surgery, or other forms of physical trauma (Nimmana et al., 2026). Secondary lymphoedema can also arise from venous insufficiency and obesity (Wu et al., 2025). It is estimated that approximately 1 in 30 individuals worldwide are affected by lymphoedema, women being more affected than men (Wound and lymphoedema management, World Health Organisation 2010).

Lymphoedema can cause a range of complications for patients, including sensations of heaviness and discomfort, reduced range of motion, recurrent skin infections, and psychological impacts such as depression, anxiety, and negative body image (Fu et al., 2013). Additionally, chronic lymphatic congestion induces inflammation, leading to fibrosis and adipose tissue deposition in the cutaneous and subcutaneous tissues (Lee & Kim, 2024). Early detection and patient education on self-management are essential for both prevention of potential complications and effective long-term management of lymphoedema (McNeely et al., 2024). Commonly accepted conservative treatment for lymphoedema is Complex Decongestive Therapy, which combines manual lymphatic drainage, compression, exercise, skin care, and patient education (Gebruers et al., 2017).

Nutrition refers to the intake and utilisation of nutrients from food to achieve and maintain health (Nutrition, Health, and Your Environment 2026). Proper nutrition is considered fundamental to preventing disease, supporting treatment, and improving outcomes in both acute and chronic conditions (Johnston et al., 2019). Currently, there is no evidence-based nutritional treatment established for individuals with lymphoedema. Healthy eating and regular exercise that help maintain a healthy body composition are generally recommended (McNeely et al., 2024).

A high body mass index (BMI) and obesity are well-recognised risk factors for the development of lymphoedema, commonly referred to as obesity-induced lymphoedema (Sudduth & Greene, 2022). Ninety percent of morbidly obese patients with a BMI over 60 will have lymphatic dysfunction and are mainly affected by massive-localised lymphoedema (Sudduth & Greene, 2022). Research

indicates that weight loss is a critical and transformative component of managing obesity-induced lymphoedema (Tsai et al., 2020).

To date, the literature on nutritional strategies designed to reduce lymphoedema symptoms remains limited and underexplored. A narrative review by Cavezzi et al. (2019) has discussed the role of nutrition in lymphoedema. However, no comprehensive synthesis has systematically mapped the available nutrition research on patients with lymphoedema. To address this gap, a scoping review was undertaken to assess the potential size and scope of available research. Mapping the literature helps to identify gaps in the existing literature, guide future research in clinical nutrition and lymphoedema.

We chose a scoping review because the nutritional interventions are heterogeneous and therefore not comparable. Secondly, lymphoedema evaluation varies across studies, with different endpoints used (e.g., oedema volume, circumference measurements, bioimpedance spectroscopy, Lymphoedema Life Impact Scale, lymphoscintigraphy). Thirdly, the lack of multiple robust randomised clinical trials does not allow a comparison through the conduct of a systematic review.

This master's thesis is submitted as part of the University of Tartu Master's Programme in Clinical Nutrition. Work was carried out under the supervision of academic staff from two universities: KU Leuven, Biomedical Sciences Group, Department of Cardiovascular Sciences (N. Timmermans) and University of Tartu, Institute of Clinical Medicine, Department of Internal Medicine (A. Forbes).

The research questions for this scoping review are:

1. In individuals of all ages with primary or secondary lymphoedema, how do specific dietary or nutraceutical interventions, compared with standard care or no dietary intervention, affect lymphoedema outcomes such as limb volume, quality of life, function or other symptoms?
2. What nutritional status measures, dietary intake patterns or other nutritional observations are reported in people with lymphoedema?

2. Methodology

2.1. Protocol development

This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping reviews (PRISMA-ScR) checklist (Tricco et al., 2018). We also followed the PROSPERO registration formulae and developed an a priori protocol, which was not registered because PROSPERO does not allow registration of scoping reviews. We adopted the Population, Intervention, Comparison, Outcome (PICO) approach for identifying research questions and identifying and selecting relevant studies.

2.2. Identifying relevant studies

For developing the search strategy, we identified key concepts from the Population and Intervention elements. Because scoping reviews aim to capture a broad range of evidence, we excluded the comparison and outcome elements (C and O) to avoid narrowing the search and omitting relevant studies. Two key concepts were lymphoedema (Population) and nutrition (Intervention). For each concept, we considered variations, related terms, synonymous terms, and the ladder of generalisation. These keywords formed search strings that retrieved relevant articles from electronic databases. Table 1 lists the relevant keywords for each concept.

Nutrition		Lymphoedema	
"nutrition"	"micronutrient"	"lymphedema"	"lymphatic filariasis"
"dietary"	"malnutrition"	"lymphoedema"	
"diet"	"overnutrition"	"elephantiasis"	
"nutraceutical"	"body composition"	"podoconiosis"	

Table 1. List of keywords for each concept

We selected four databases, including CINAHL (EBSCOhost), PubMed, Scopus, and Web of Science Core Collection. The Web of Science Core Collection search included SCI-EXPANDED (1980–present), CPCI-S (1990–present), and ESCI (2021–present). The search string was modified to meet the specific needs of each respective database, for example, adding MeSH (Medical Subject Headings) terms in PubMed and MH (Major Headings) terms in CINAHL. We used Boolean

operators “AND” and “OR” to combine concepts within related keywords. We did not use the Boolean operator “NOT” because it can accidentally exclude relevant studies, reducing the comprehensiveness of our search. We performed the systematic search on January 9, 2026. There were no date restrictions for evidence sources. Table 2 shows the generated search strings.

	MH "Lymphedema+" OR TI("lymphedema*" OR "lymphoedema*" OR "elephantiasis" OR "podoconiosis" OR "lymphatic filariasis") OR AB("lymphedema*" OR "lymphoedema*" OR "elephantiasis" OR "podoconiosis" OR "lymphatic filariasis")) AND (MH "Nutrition+" OR(MH "Nutritional Support+") OR(MH "Nutrition Services+") OR(MH "Food and Beverages+") OR(MH "Nutritional and Metabolic Diseases+") OR(MH "Body Composition+") ORTI("nutrition*" OR "dietary" OR "diet*" OR "nutraceutical*" OR "macronutrient*" OR "micronutrient*" OR "malnutrition" OR "overnutrition" OR "body composition")ORAB("nutrition*" OR "dietary" OR "diet*" OR "nutraceutical*" OR "macronutrient*" OR "micronutrient*" OR "malnutrition" OR "overnutrition" OR "body composition")
1. CINAHL search string:	("Nutritional Sciences"[Mesh] OR "Diet, Food, and Nutrition"[Mesh] OR "Nutrition Assessment"[Mesh] OR "Nutrition Therapy"[Mesh] OR "Nutrition Disorders"[Mesh] OR "Nutritional Status"[Mesh] OR "Nutrition*" [tiab] OR "Nutrient*" [tiab] OR "Nutraceutical" [tiab] OR "Nutrigenomics" [tiab] OR "Dietary" [tiab] OR "Diet" [tiab] OR "Diets" [tiab] OR "Dietetic*" [tiab] OR "Food*" [tiab] OR "Macronutrient*" [tiab] OR "Micronutrient*" [tiab] OR "Malnutrition" [tiab] OR "Body composition" [tiab] OR "Overnutrition" [tiab] OR "Weight loss" [tiab]) AND ("Lymphedema" [Mesh] OR "Lymphedema*" [tiab] OR "Lymphoedema*" [tiab] OR "Elephantiasis" [tiab] OR "Podoconiosis" [tiab] OR "Lymphatic filariasis" [tiab])
2. PubMed search string:	(TS=("Lymph\$edema*" OR "Elephantiasis" OR "Podoconiosis" OR "Lymphatic filariasis")) AND (TS=("Nutrition*" OR "Dietary" OR "Diet" OR "Diets" OR "Dietetic" OR "Food*" OR "Nutrigenomics" OR "Nutraceutical*" OR "Beverage*" OR "Eat*" OR "Caloric restriction" OR ("Gastrointestinal" NEAR/3 "Absorption") OR "Nutrient*" OR "Micronutrient*" OR "Macronutrient*" OR "Starvation" OR "Menu" OR "Body composition" OR "Weight loss" OR "Malnutrition" OR "Overnutrition" OR "Tea"))
3. Web of Science search string:	

4. Scopus search string:	(TITLE-ABS ("Nutrition*" OR "Dietary" OR "Diet" OR "Diets" OR "Dietetic" OR "Food*" OR "Nutrigenomics" OR "Nutraceutical*" OR "Beverage*" OR "Eat*" OR ("Gastrointestinal" W/3 "Absorption") OR "Nutrient*" OR "Micronutrient*" OR "Macronutrient*" OR "Menu" OR "Body composition" OR "Weight loss" OR "Malnutrition" OR "Overnutrition") OR AUTHKEY ("Nutrition*" OR "Dietary" OR "Diet" OR "Diets" OR "Dietetic" OR "Food*" OR "Nutrigenomics" OR "Nutraceutical*" OR "Beverage*" OR "Eat*" OR ("Gastrointestinal" W/3 "Absorption") OR "Nutrient*" OR "Micronutrient*" OR "Macronutrient*" OR "Menu" OR "Body composition" OR "Weight loss" OR "Malnutrition" OR "Overnutrition" OR "Tea")) AND (TITLE-ABS ("Lymphedema*" OR "Lymphoedema*" OR "Elephantiasis" OR "Podoconiosis" OR "Lymphatic filariasis") OR AUTHKEY ("Lymphedema*" OR "Lymphoedema*" OR "Elephantiasis" OR "Podoconiosis" OR "Lymphatic filariasis"))
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Table 2. List of search strings within four databases

2.3. Study selection

We imported all retrieved articles into the web-based systematic review platform, Rayyan (Qatar Computing Research Institute), where we identified and removed duplicates before screening. Title and abstract screening (In Rayyan) were conducted by a single reviewer using the predefined inclusion and exclusion criteria (Table 3). After excluding irrelevant articles based on abstracts, we retrieved the full texts for remaining studies. We excluded studies for which we could not obtain the full text. Two reviewers screened full texts in a blinded manner and determined final study inclusion after resolving any disagreements through discussion. The eligibility criteria were clarified where necessary.

Eligible sources included medical research, both observational and experimental. We excluded conference abstracts, book chapters, letters and comments, as they do not provide sufficient methodological detail for the required data extraction. We included animal studies that had relevant nutritional interventions. Human populations with primary or secondary lymphoedema across all age groups were included, including those with cancer-related lymphoedema, lymphatic filariasis, and podoconiosis. We excluded lymphatic dysfunctions or complications that do not result in lymphoedema, as well as conditions with different pathophysiological mechanisms, such as venous oedema, drug-induced swelling, obesity-induced lymphoedema, and lipoeedema. The nutritional aspects of the included studies were broad, encompassing dietary interventions such as diets and nutraceuticals, as well as studies reporting dietary intake and nutritional status (e.g., 24-hour recalls

and micronutrient deficiencies). The full eligibility criteria are shown in Table 3. We included studies only published in English.

Category	Inclusion criteria	Exclusion criteria
Population	Primary lymphoedema Secondary lymphoedema Cancer-related lymphoedema Lymphatic filariasis Elephantiasis Nostras Verrucosa Podoconiosis Animal models of lymphoedema	Phlebolympoedema Obesity-induced lymphoedema Massive localised lymphoedema Intestinal lymphangiectasia Yellow nail syndrome Lipoedema Venous edema Drug-induced swelling
Intervention	Dietary interventions (e.g. Mediterranean diet, Low-fat diet) Nutraceuticals (e.g. vitamins, minerals, probiotics, botanicals) Medical Nutrition Therapy Animal model mechanistic studies, if they use dietary interventions Studies reporting dietary intake and nutritional status (e.g. food frequency questionnaires, 24-hour recalls, food diaries, malnutrition screening tools, micronutrient deficiencies)	Studies not addressing nutritional interventions or observations
Study Type	Randomised controlled trials Systematic reviews Case studies Cohort studies Cross-sectional studies Animal studies and other relevant study designs	Non-scientific sources Conference abstracts Book chapters Letters Comments
Language	English	Studies not published in English
Publication Years	All dates	N/A

Table 3. Eligibility criteria

2.4. Data extraction and analysis

We developed an extraction spreadsheet in Microsoft Excel (Microsoft Corporation, 2026) to extract data from the included studies. We extracted the study characteristics (authors, title, year of publication, country, study design, methodological approach), population characteristics (lymphoedema type, aetiology, anatomical site, sample size, age and sex), nutrition topics, lymphoedema measurement methods, lymphoedema outcomes and key findings. The results of this scoping review are presented in tables, figures and narrative summaries within the review aims and questions.

3. Results

3.1. Study characteristics

A search of four databases yielded 2650 articles. After removing duplicates, 1579 articles remained for title and abstract screening. After excluding irrelevant papers, 239 full-text articles were retrieved and screened by two independent reviewers. During full-text screening, we excluded an additional 193 studies. A total of 46 articles met the eligibility criteria and were included in this scoping review. Figure 1 details the selection process and reasons for exclusion.

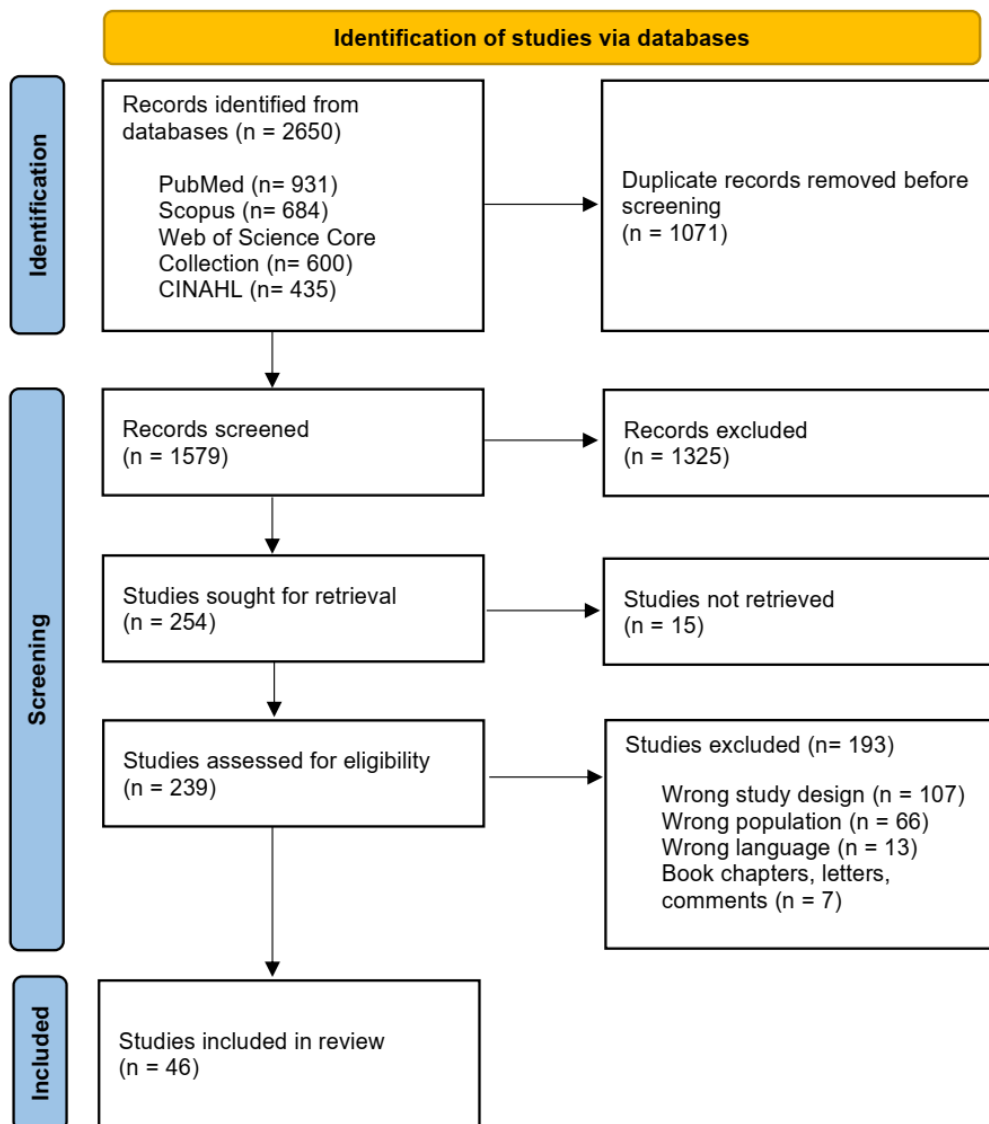


Figure 1. PRISMA 2020 flow diagram for new systematic reviews (Page MJ et al. BMJ 2021)

Included articles were published between 1994 and 2025. Publication frequency increased progressively over time (Figure 2), from one study (2,2%) in the 1990s and four (8,7%) in the 2000s, to 11 studies (23,9%) in the 2010s, with the largest number of publications ($n = 30$; 65,2%) published between 2020 and 2025.

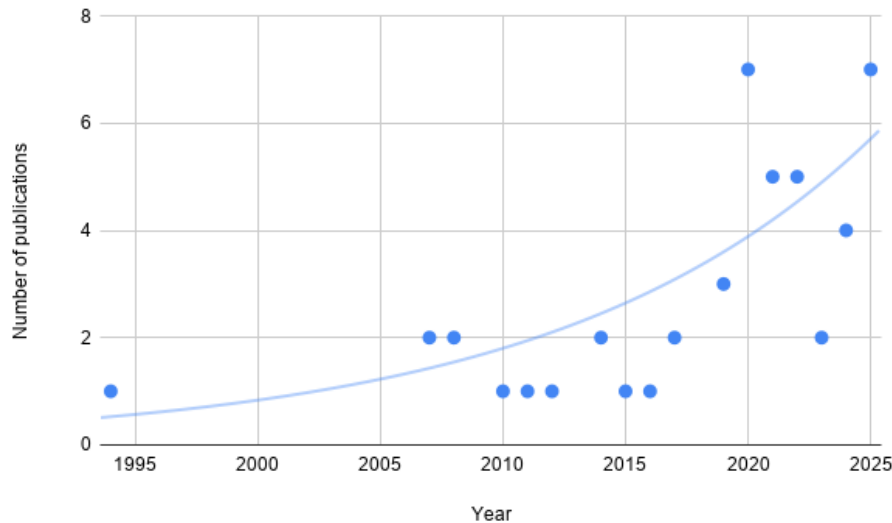


Figure 2. Publication frequency

At the country level, the largest number of studies were conducted in the United States ($n = 7$), followed by China ($n = 5$), Iran ($n = 5$), and South Korea ($n = 5$). Three studies were from Italy, Canada and Spain. Two studies from Belgium, Switzerland, Turkey and the United Kingdom, and one study from Brazil, Ghana, Germany, Indonesia, Israel, Norway, Poland and a joint study within Italy and India. Regionally, most studies originated from Europe ($n = 15$), with similar numbers from North America ($n = 10$) and Asia ($n = 10$). Figure 3 shows the global distribution of study locations using a choropleth map.

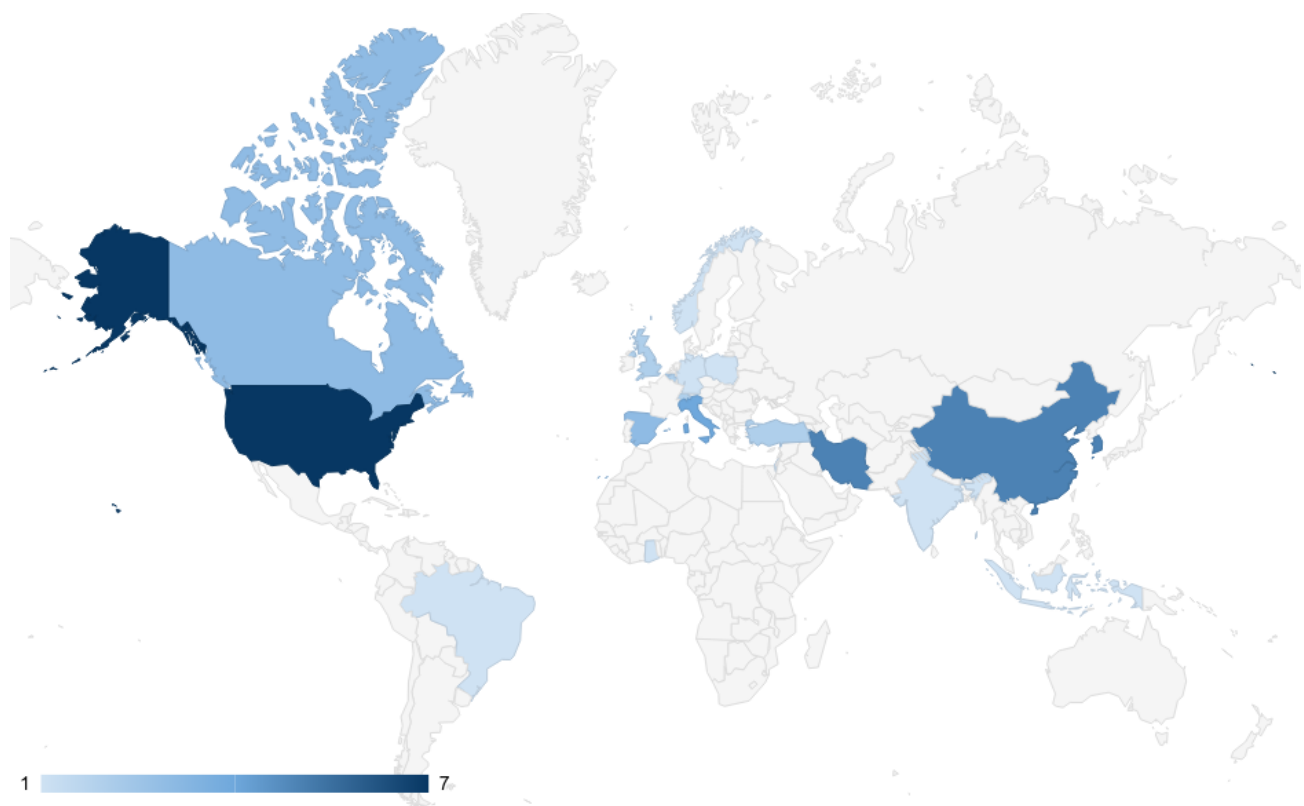


Figure 3. Choropleth map

We identified a variety in study designs, including human observational and experimental studies, evidence synthesis, and preclinical research. Human observational designs predominated ($n = 18$; 39.1%), followed by human experimental studies ($n = 11$; 23.9%), evidence synthesis ($n = 9$; 19.6%) and preclinical studies ($n = 7$; 17.4%). We identified one mixed translational study combining human observational with preclinical experiments. The most common study types were cross-sectional studies ($n = 9$; 19.6%) and randomised-controlled trials ($n = 8$; 17.4%). Narrative reviews accounted for six studies, followed by five in vivo animal experiments. Case reports accounted for three (6%) studies, describing a total of five individuals with lymphoedema. We identified two systematic reviews and meta-analyses. Additional study types are summarised in Table 4.

Sample sizes ranged from 1 to 1476 participants (median: 79.5; mean: 225.3). Thirteen studies included more than 100 participants, eight included 51 to 100 participants, nine included 10 to 50 participants, and four studies reported sample sizes of fewer than 10 patients. Most studies included participants aged 50-60 years, with 25 (54%) enrolling exclusively women, predominantly those with breast cancer-related lymphoedema. Fewer studies included both men and women ($n = 7$; 15%), and others were not reported or were animal studies ($n = 14$; 30%).

Lymphoedema was most reported as secondary lymphoedema (n = 31; 67,4%), with breast cancer-related lymphoedema reported in 29 (63%) studies. Other reported causes of lymphoedema included obesity, head and neck cancer, gynaecological cancer, lymphatic filariasis and genetic factors. Upper-limb involvement was reported in 27 (59%) of studies, and lower-limb involvement in 7 (15%) studies. Three studies (6.5%) involved patients with primary lymphoedema, while two studies (4.3%) included both primary and secondary lymphoedema. Ten studies (21,7%) involved animal models of lymphoedema.

Study/article characteristics	n / 46	Study/article characteristics	n / 46
Region where the studies were conducted		Evidence synthesis	9
Europe	15	Narrative reviews	6
Asia	10	Systematic reviews	2
North America	10	International consensus statement	1
Middle East	8	Preclinical research	8
South America	1	In vivo animal experiment	5
Africa	1	In vitro + in vivo experimental study	2
Multiple regions	1	Mixed translational study (human observational + preclinical research)	1
Number of studies by decade		Sample size	
1990s	1	<10	4
2000s	4	10–50	9
2010s	11	51–100	8
2020s	30	>100	13
Study design		Not reported / animal studies	12
Human observational studies	18	Age range	
Cross-sectional studies	9	18-65	29
Case reports	3	<18	1
Retrospective cohort study	2	Not reported / animal studies	17
Prospective cohort study	1	Sex of participants	
Secondary analysis of RCT data	1	Female only	25
Case–control study	1	Mixed (Predominantly female)	7

Qualitative study	1	Not reported / animal studies	14
Human experimental studies	11	Lymphoedema type	
RCTs	8	Secondary lymphoedema	31
Pilot intervention study	1	Primary lymphoedema	3
Quasi-experimental study	1	Animal models of lymphoedema	10
Pilot RCT	1	Mixed	2

Table 4. Description of characteristics of included studies

3.2. Nutrition evidence mapped

3.2.1. Objective lymphoedema outcomes

Two retrospective cohort studies identified an association between higher consumption of meat, fried foods or high-fat foods and an increased risk of BCRL (Wu et al., 2022; Wang et al., 2024). In a prospective observational study 62% of participants were overweight or obese, and a high BMI was associated with higher lymph fluid levels, as reflected by an increased L-Dex ratio at 4-8 weeks post-surgery (Fu et al., 2015).

D vitamin has been studied in patients with lymphoedema. A controlled cross-sectional study compared serum 25(OH)D3 levels in patients with BCRL and those with breast cancer without lymphoedema and found no difference between the groups (Doruk Analan & Kaya, 2020). Among patients with BCRL, no association was found between vitamin D levels and pain severity, disability and function, or limb circumference and volume (Doruk Analan & Kaya, 2020). Another larger case-control study reported lower vitamin D levels in the BCRL group compared with breast cancer patients without lymphoedema and healthy controls and reported lower vitamin D concentrations in individuals with more advanced stages of lymphoedema (Karakilic & Selcuk, 2025).

Selenium supplementation or status has been studied in several intervention studies and narrative reviews. Two narrative reviews noted that several intervention studies reported reductions in oedema, decreased skin infection rates, or improvements in functional outcomes following selenium supplementation (Hardy et al., 2008; Samuels et al., 2014). In a newer selenium RCT, intravenous sodium selenite was reported to improve lymphoedema stage and extracellular water measures in BCRL (Han et al., 2019). From a cross-sectional retrospective study, non-cancer patients with secondary lymphoedema showed lower selenium levels than cancer-related lymphoedema patients (Pfister et al., 2020). Selenium levels were reported to decrease with increasing lymphoedema stage,

as measured by the Stemmer's Test, sonography or fluorescence lymphography (Pfister et al., 2020). Obesity was identified as a risk factor for selenium deficiency (Pfister et al., 2020).

Hardy et al. (2008) and Samuels et al. (2014) also summarised other nutritional supplements for the relief of lymphoedema symptoms in their narrative reviews. A combination of ruscus and synthetic hesperidin was compared with a placebo and the treatment groups showed 13% reduction in limb volume (Hardy et al., 2008). The Ginkgo formula reduced limb heaviness symptoms in a study of 48 women with upper-extremity oedema and increased lymphatic migration speed, but a larger RCT using flavonoids showed only an improvement in lymphatic migration speed by scintigraphy (Hardy et al., 2008). Grape seed extract and vitamin E plus pentoxifylline showed no benefit (Hardy et al., 2008; Samuels et al., 2014).

A preclinical mouse tail lymphoedema model showed that treatment with a nutraceutical containing olive leaf extract (hydroxytyrosol), citrus bioflavonoids (hesperidin), rice seed extract (spermidine) and vitamin A was associated with reduced tail circumference and faster oedema resolution (Bhusan Tripathi et al., 2021). Xing et al. (2025) conducted an in vivo rat hind-limb model of chronic secondary lymphoedema and showed that high-fat feeding led to greater limb circumference and volume, more sustained oedema, and higher late-phase inflammatory infiltration compared with controls.

Two human RCTs reported reductions in arm volume after following a weight-loss diet, regardless of whether weight loss was achieved using a low-calorie diet or an isoenergetic low-fat diet (Shaw et al., 2007a; Shaw et al., 2007b). A separate randomised trial with 10 patients compared a medium-chain triglyceride (MCT) diet with standard care and reported greater reductions in limb volume and circumference with the MCT diet (Oliveira & César, 2008). These trials were included in McNeely's systematic review, in which the weight-loss intervention was rated as Level 2 (moderate evidence) and the MCT-based dietary intervention as Level 3 (limited evidence) (McNeely et al., 2011). In a systematic review and meta-analysis by Deng et al. (2024), neither calorie restriction alone nor calorie restriction plus synbiotics was associated with reduced arm volume compared with the control group.

A 12-week pilot RCT reported greater reductions in affected-limb volume and circumference in the weight-loss intervention group, which used a hypocaloric Mediterranean diet combined with supervised exercise and optional meal replacement, compared with standard care (Ruiz-Molina et al., 2025). Another pilot intervention study reported that patients encouraged to follow a ketogenic diet (KD) lost more weight than those in the nonketogenic diet (NKD) group, and the KD group reported greater changes in limb volume and an improved quality of life (Keith, L. et al., 2020)

3.2.2. Lymphatic function and lymphangiogenesis outcomes

Some studies focused on lymphatic function or lymphangiogenesis outcomes. A 2024 quasi-experimental exploratory study reported that induced ketosis after following an isocaloric Classical Ketogenic Diet improved lymphatic function and suggests induced lymphangiogenesis, as assessed by dermal backflow scores in patients with secondary lymphoedema. Consuming the Modified Atkins Diet after an induced ketosis period maintained improved lymphatic function. Oedema volume did not decrease, although some patients experienced clinically meaningful reductions by the end of the intervention (Lodewijckx et al., 2024).

A recurring theme was the link between ketone biology and lymphangiogenesis. In a mouse tail lymphoedema models, a ketogenic diet increasing β -hydroxybutyrate is associated with enhanced lymphangiogenesis and reduced oedema, while in vitro it promotes lymphatic endothelial cell proliferation, migration and vessel sprouting (García-Caballero et al., 2019). A 2019 expert commentary explained and interpreted new experimental findings on the ketogenic diet and discussed ketogenic therapies as a potential approach in lymphoedema (Puchalska & Crawford, 2019). A 2023 in vivo and in vitro animal study by Choi et al. showed that the ketone body β -hydroxybutyrate improved the function of human dermal lymphatic endothelial cells, enhancing their proliferation, migration and tube formation, which are indicative of pro-lymphangiogenic activity.

In mice, chronic high-fat feeding was associated with impaired collecting lymphatic vessel function, and lymphatic function was lower at higher body weight (Blum et al., 2014). Khan et al. (2022) reviewed animal studies showing that diet-induced obesity directly impairs lymphatic structure and function through inflammatory mechanisms, including reduced lymphatic pumping, altered lymphangiogenesis, and increased vessel permeability. Castorena-González et al. (2022) demonstrated that Western-diet-induced obesity causes metabolic changes and lymphatic valve dysfunction in mice, which may be relevant for obesity-induced lymphoedema.

Findings were mixed in models designed to avoid obesity. In one mouse tail lymphoedema model, high-fat feeding without obesity did not worsen post-surgical oedema, fibro-adipose deposition, or collecting-vessel contractility (Gousopoulos et al., 2017). In contrast, a non-obesogenic high-fat diet intervention was reported to decrease tail volume and fibrosis compared with a standard chow diet (Choi et al., 2023). A narrative review of animal studies similarly noted that lipid exposure without obesity is not consistently associated with lymphatic dysfunction across models (Khan et al., 2022).

3.2.3. Patient-reported outcomes

A 2012 observational study from Italy looked at lifestyle behaviours in survivors of early-stage gynaecologic cancer with secondary lower-limb lymphoedema (Bifulco et al., 2012). Younger participants (<45 years) were more likely to report following a balanced diet after diagnosis, whereas midlife participants (45-65 years) were more likely to discontinue a balanced diet (Bifulco et al., 2012).

In a qualitative study, women with BCRL reported that dietitian support, routine, social support, and meal provision helped them adhere to the prescribed 22-week structured diet and exercise weight-loss intervention (Beckenstein et al., 2021). Health constraints and dissatisfaction with the meals were described as barriers (Beckenstein et al., 2021). A literature review by Anderson and Armer (2021) highlighted that culturally tailored dietary interventions may be more effective for Latina cancer survivors with BCRL.

A 2021 cross-sectional study of 77 patients with primary lymphoedema assessed their dietary habits, including olive oil (hydroxytyrosol) intake, daily and weekly caloric intake, and eating habits (Dhuli et al., 2021). Daily olive oil intake was associated with substantially higher quality-of-life scores (Dhuli et al., 2021). Vafa et al. (2020b) reported that a 10-week RCT combining calorie restriction with synbiotics improved quality of life in overweight and obese women with BCRL compared with a control group.

3.2.3. Dietary assessment outcomes

An observational study used the Mini Nutritional Assessment Short-Form in patients with lymphatic filariasis and reported a high prevalence of malnutrition risk (Amewu et al., 2025). They also employed machine-learning approaches and identified vitamin C and K status as key predictors of lymphatic filariasis progression (Amewu et al., 2025). In a cross-sectional study, gynaecologic cancer survivors with secondary lower limb lymphoedema were more likely to have a higher risk of malnutrition, defined by low albumin and low Prognostic Nutritional Index score (Zhu et al., 2024).

A cross-sectional case-control study of patients with Lymphoedema-Cholestasis Syndrome 1, outside cholestatic episodes, assessed their dietary intake using a four-day weighed record and reported lower intake of total fat, saturated fat and fish compared with the control group. Higher than recommended intake of saturated fat and lower monounsaturated fat was observed. Also, a higher-than-recommended intake of refined sugar and a lower fibre intake were observed in both groups. Lower vitamin K, but no difference in B12, folate, and zinc was found (Drivdal et al., 2010).

Dietary assessment challenges were noted in the context of obesity-associated lymphoedema, including likely under-reporting and limitations of FFQ-based assessment (Jeziorek et al., 2025). A multidisciplinary international consensus statement for BCRL prevention included dietary guidance centred on weight stability, avoiding overweight and obesity, and a focus on a realistic, sustainable diet (Martínez-Jaimez et al., 2022).

3.2.5. Biochemical and metabolic outcomes

Several studies reported biochemical and metabolic outcomes alongside clinical measures. Synbiotic trials combined with low-calorie diets reported changes in oxidative stress and inflammatory biomarkers, including reduced malondialdehyde and increased superoxide dismutase, and changes in TNF- α , leptin, adiponectin, and IL-10 (Navaei et al., 2020; Saneei Totmaj et al., 2022; Vafa et al., 2020a; Vafa et al., 2020).

Lipid-related profiling was reported in observational and translational work. A cross-sectional observational study in breast cancer survivors reported differences in serum phospholipid fatty acid composition in those with secondary lymphoedema (Ryu et al., 2016). A mixed translational study found a lower plasma PUFA: SFA ratio in patients with secondary lymphoedema, and a high-saturated-fat diet was associated with more prolonged swelling, increased cellular stress, and greater lymphatic endothelial cell death in a mouse tail lymphoedema model (Gomes et al., 2025).

A secondary metabolomics analysis of an RCT reported broad changes in metabolic pathways following sodium selenite exposure (Lee et al., 2021). Michelini et al. (2020) suggest that a hydroxytyrosol-based food supplement may support lymphoedema management by lowering leukotriene B4 levels, a molecule involved in inflammation and the onset of secondary lymphoedema.

3.2.6. Case reports, hyperkeratosis outcomes

A case report of Elephantiasis Nostras Verrucosa described a short-term clinical improvement of hyperkeratotic lesions with a weight-loss diet and acitretin supplement (Tsaqilah et al., 2023). Another case report described two breast cancer survivors who experienced heaviness, progressive swelling and fever after Ramadan fasting (Yarmohammadi et al., 2025). In primary lymphoedema, a historical case report described a reduction in thigh circumference in two patients following restriction of long-chain triglycerides and supplementation with medium-chain triglycerides, one of them was on a hypocaloric diet, and the other on an isocaloric diet (Soria et al., 1994).

4. Discussion

Current lymphoedema management relies on conservative, lifelong treatment aimed at symptom control. The most widely accepted standard of care is Complex Decongestive Therapy, which combines manual lymphatic drainage, compression therapy, exercise, skin care, and patient education (Gebruers et al., 2017). Although CDT addresses multiple components of disease management, disease-specific nutritional guidance is not part of standard lymphoedema care. The nutritional advice is generally limited to broad healthy-eating recommendations (Martínez-Jaimez et al., 2022).

Findings from intervention studies showed that weight-loss interventions, achieved through hypocaloric, low-fat, or ketogenic diets, were associated with reductions in limb volume (Shaw et al., 2007a; Shaw et al., 2007b; Keith et al., 2020; Ruiz-Molina et al., 2025). Improvements with these dietary interventions may be attributable to energy balance and adiposity rather than to specific dietary components. Quality of life improved with the ketogenic weight-loss diet and calorie-restricted synbiotic intervention (Keith et al., 2020; Vafa et al., 2020b).

However, we identified ketogenic diets as a novel and emerging dietary approach in lymphoedema research, beyond weight loss. Exploratory evidence from Lodewijckx et al. (2024) shows that adherence to a classical ketogenic diet improves lymphatic function measured by lymphofluoroscopic measurements without weight loss in upper and lower limb lymphoedema. However, stronger scientific evidence is needed in humans.

Vitamin D status, selenium status and selenium supplementation have been studied in populations with lymphoedema. Two narrative reviews described several clinical trials in which selenium supplementation reduced swelling and improved limb function, and a 2019 RCT reported improvements in lymphoedema stage with intravenous selenium administration (Hardy et al., 2008; Samuels et al., 2014; Han et al., 2019). Observational evidence indicates that selenium and vitamin D levels tend to be lower in individuals with more severe lymphoedema (Pfister et al., 2020; Karakilic & Sencuk, 2025). This points to a potential relationship between micronutrient status and disease severity.

Hydroxytyrosol was discussed in three studies. Two studies reported possible benefits linked to its antioxidant and anti-inflammatory properties, while another found an association between daily olive oil intake and better quality of life (Michelini et al., 2020; Bhusan Tripathi et al., 2021; Dhuli et al., 2021). However, no human intervention trials have specifically evaluated hydroxytyrosol in

lymphoedema. Overall, the evidence supporting nutraceuticals for lymphoedema management remains limited.

Many studies included BCRL patients with overweight or obesity and consistently confirmed the fact that obesity is a risk factor for developing BCRL. Experimental studies suggest that obesity-associated inflammation and metabolic dysfunction impair lymphatic structure and function, contributing to lymphoedema development (Blum et al., 2014; Castorena-González et al., 2022). In addition to overnutrition, undernutrition may also be a concern in certain lymphoedema populations (Zhu et al., 2024; Amewu et al., 2025).

High-fat diets did not consistently worsen lymphoedema outcomes. Non-obesogenic high-fat diets sometimes showed neutral or beneficial effects in mice (Gousopoulos et al., 2017; Choi et al., 2023). This distinction underscores the importance of metabolic state over dietary composition alone. Mechanistic studies, particularly those examining ketogenic diets, suggest that metabolites such as β -hydroxybutyrate may promote lymphangiogenesis (García-Caballero et al., 2019; Puchalska & Crawford, 2019; Choi et al., 2023).

This scoping review systematically mapped the available nutrition research in patients with primary and secondary lymphoedema. We identified 46 articles published between 1994 and 2025. Research activity has increased over the years, with two-thirds of studies published since 2020, indicating growing interest in the role of nutrition in lymphoedema care. Despite this increase, the literature remains heterogeneous across study designs, populations and reported outcomes. Most studies were observational, particularly cross-sectional. Eleven intervention studies were identified, including nine randomised controlled trials.

Most of the available evidence focused on 50-60-year-old women with secondary breast cancer-related lymphoedema. This distribution is expected, given that secondary lymphoedema in Western countries commonly results from cancer treatment, and most studies were conducted in Europe or North America (Szuba & Rockson, 1998). Only five studies included individuals with primary lymphoedema, which is expected given the rarity of this condition. Notably, only one study addressed lymphatic filariasis, despite its high global prevalence.

Despite these insights, several important gaps remain. Some intervention studies did not report clinically relevant outcomes such as limb volume or function, instead, they focused on biomarkers. Future research should prioritise well-designed, adequately powered randomised controlled trials

using standardised lymphoedema outcome measures. The current evidence base from dietary interventions remains insufficient to support disease-specific dietary recommendations. Older adults with lymphoedema showed more trouble adhering to a healthy diet, which could confound, age as an increased risk factor.

Lymphoedema is a complex, poorly understood disease influenced by several mechanisms (Saito et al., 2013). Therefore, a multi-professional approach and multi-faceted therapy is necessitated. The use of complex decongestive therapy remains the state of the art to manage symptoms. However, nutrition clearly plays a role in disease development and care. Moreover, emerging evidence shows that nutrition could play a role beyond symptomatic therapy and could play a curative role as it influences the metabolic pathways interacting with secondary lymphoedema development.

Strengths and limitations

A strength of this review is the systematic literature screening approach used within this scoping review. Although, heterogeneous interventions and non-aligned lymphoedema outcome measurement do not allow for a systematic analysis. Limitations of this study include the exclusion of research from non-English-speaking countries, which may have reduced the number of studies reporting on lymphatic filariasis and Podoconiosis. Other limitations are primarily related to the scoping review methodology, where the quality of individual studies was not assessed, and the study results do not provide clinical recommendations. Scoping review results are only up to date as of January 2026.

Conclusions

This scoping review maps the nutrition and lymphoedema literature without evaluating study quality or effectiveness and therefore does not give clinical recommendations. Overall, the evidence base remains heterogeneous and is primarily focused on weight-loss interventions in overweight women with breast cancer-related secondary lymphoedema. Novel dietary approaches, such as ketogenic diets, could represent potential therapeutic options but require further evaluation. No evidence-based nutritional strategy currently exists for patients with lymphoedema.

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References

- Amewu, E. K. A., Amaglo, B., Osei-Poku, P., Abakah, A., Koney Shardow, A. L., Wright, L., & Kwarteng, A. (2025). Nutritional predictors of lymphatic filariasis progression: Insights from a machine learning approach. *PloS one*, 20(3), e0320640.
- Anderson, E. A., & Armer, J. M. (2021). Factors Impacting Management of Breast Cancer-Related Lymphedema (BCRL) in Hispanic/Latina Breast Cancer Survivors: A Literature Review. *Hispanic Health Care International*, 19(3), 190–202.
- Beckenstein, H., Slim, M., Kim, H., Plourde, H., Kilgour, R., & Cohen, T. R. (2021). Acceptability of a structured diet and exercise weight loss intervention in breast cancer survivors living with an overweight condition or obesity: A qualitative analysis. *Cancer Reports*, 4(3).
- Bhusan Tripathi, Y., Pandey, N., Mishra, P., Tripathi, P., Coatto, M., Anpilogov, K., Dhuli, K., Donato, K., Michelini, S., Cecchin, S., Beccari, T., Ceccarini, M. R., Paolacci, S., & Bertelli, M. (2021). Effect of a dietary supplement on the reduction of lymphedema-progression in mouse tail-cut model. *European Review for Medical and Pharmacological Sciences*, 25(1), 56–66.
- Bifulco, G., De Rosa, N., Tornesello, M., Piccoli, R., Bertrando, A., Lavitola, G., Morra, I., Sardo, A., Buonaguro, F., & Nappi, C. (2012). Quality of life, lifestyle behavior and employment experience: A comparison between young and midlife survivors of gynecology early stage cancers. *GYNECOLOGIC ONCOLOGY*, 124(3), 444–451.
- Blum, K. S., Karaman, S., Proulx, S. T., Ochsenbein, A. M., Luciani, P., Leroux, J.-C., Wolfrum, C., & Detmar, M. (2014). Chronic high-fat diet impairs collecting lymphatic vessel function in mice. *PLOS ONE*, 9(4).
- Castorena-Gonzalez, J. (2022). Lymphatic Valve Dysfunction in Western Diet-Fed Mice: New Insights Into Obesity-Induced Lymphedema. *FRONTIERS IN PHARMACOLOGY*, 13.
- Cavezzi, A., Urso, S., Ambrosini, L., Croci, S., Campana, F., & Mosti, G. (2019). Lymphedema and nutrition: A review. *Veins and Lymphatics*, 8.

- Choi, J., Kim, J., Kim, J., Jeong, W., Jo, T., Lee, H. W., Park, Y. S., & Park, S. W. (2023). A High-Fat Diet in the Absence of Obesity Increases Lymphangiogenesis by Inducing VEGF-C in a Murine Lymphedema Model. *Plastic and Reconstructive Surgery*, 152(1), 87–96.
- Deng C, Wu Z, Cai Z, Zheng X and Tang C (2024) Conservative medical intervention as a complement to CDT for BCRL therapy: a systematic review and meta-analysis of randomized controlled trials. *Front. Oncol.* 14:1361128.
- Dhuli, K., Ceccarini, M. R., Precone, V., Maltese, P. E., Bonetti, G., Paolacci, S., Dautaj, A., Guerri, G., Marceddu, G., Beccari, T., Michelini, S., & Bertelli, M. (2021). Improvement of quality of life by intake of hydroxytyrosol in patients with lymphedema and association of lymphedema genes with obesity. *European review for medical and pharmacological sciences*, 25(1 Suppl), 33–42.
- Doruk Analan, P., & Kaya, E. (2020). The Effect of Serum 25(OH)D3 Level on Breast Cancer-Related Lymphedema. *Lymphatic research and biology*, 18(1), 22–26.
- Drivdal, M., Løken, E. B., Hagve, T. A., Bergstad, I., & Aagaenæs, Ø. (2010). Do patients with lymphoedema cholestasis syndrome 1/Aagaenæs syndrome need dietary counselling outside cholestatic episodes?. *Clinical nutrition (Edinburgh, Scotland)*, 29(4), 525–530.
- Fu, M. R., Axelrod, D., Guth, A. A., Fletcher, J., Qiu, J. M., Scagliola, J., Kleinman, R., Ryan, C. E., Chan, N., & Haber, J. (2015). Patterns of obesity and lymph fluid level during the first year of breast cancer treatment: A prospective study. *Journal of Personalized Medicine*, 5(3), 326–340.
- Fu, M. R., Ridner, S. H., Hu, S. H., Stewart, B. R., Cormier, J. N., & Armer, J. M. (2013). Psychosocial Impact of Lymphedema: A Systematic Review of Literature from 2004–2011. *Psycho-Oncology*, 22(7), 1466–1484.
- García-Caballero, M., Zecchin, A., Souffreau, J., Truong, A.-C. K., Teuwen, L.-A., Vermaelen, W., Martín-Pérez, R., de Zeeuw, P., Bouché, A., Vinckier, S., Cornelissen, I., Eelen, G., Ghesquière, B., Mazzone, M., Dewerchin, M., & Carmeliet, P. (2019). Role and therapeutic potential of dietary ketone bodies in lymph vessel growth. *Nature Metabolism*, 1(7), 666–675.

- Gebruers, N., Verbelen, H., De Vrieze, T., Vos, L., Devoogdt, N., Fias, L., & Tjalma, W. (2017). Current and future perspectives on the evaluation, prevention and conservative management of breast cancer related lymphoedema: A best practice guideline. *European Journal of Obstetrics, Gynecology, and Reproductive Biology*, 216, 245–253.
- Gomes, K. P., Korodimas, J., Liu, E., Patel, N., Yang, X., Goruk, S., Munhoz, J., Field, C. J., & Gibson, S. B. (2025). Saturated fatty acids induce lipotoxicity in lymphatic endothelial cells contributing to secondary lymphedema development. *EMBO Molecular Medicine*, 17(9), 2384–2408.
- Gousopoulos, E., Karaman, S., Proulx, S. T., Leu, K., Buschle, D., & Detmar, M. (2017). High-Fat Diet in the Absence of Obesity Does Not Aggravate Surgically Induced Lymphoedema in Mice. *European Surgical Research*, 58(3), 180–192.
- Grada, A. A., & Phillips, T. J. (2017). Lymphedema: Pathophysiology and clinical manifestations. *Journal of the American Academy of Dermatology*, 77(6), 1009–1020.
- Han, H. W., Yang, E. J., & Lee, S. M. (2019). Sodium Selenite Alleviates Breast Cancer-Related Lymphedema Independent of Antioxidant Defense System. *Nutrients*, 11(5), 1021.
- Hardy M. L. (2008). Dietary supplement use in cancer care: help or harm. *Hematology/oncology clinics of North America*, 22(4), 581–vii.
- Jeziorek, M., Kania, G., Stanimirova, I., Konikowska, K., Szuba, A., & Chachaj, A. (2025). Insights into diet, psychological distress, and personality traits among patients with lower-extremity lymphedema and overweight/obesity in comparison to patients with lifestyle-induced overweight/obesity and patients with normal body weight. *OBESITY RESEARCH & CLINICAL PRACTICE*, 19(1), 48–53.
- Johnston, B. C., Seivenpiper, J. L., Vernooij, R. W. M., de Souza, R. J., Jenkins, D. J. A., Zeraatkar, D., Bier, D. M., & Guyatt, G. H. (2019). The Philosophy of Evidence-Based Principles and Practice in Nutrition. *Mayo Clinic Proceedings: Innovations, Quality & Outcomes*, 3(2), 189–199.
- Karakilic, G. D., & Selcuk, M. A. (2025). The Effect of Vitamin D Levels on Breast Cancer-Related Lymphedema. *Lymphology*, 58(2), 56–65.

- Keith, L., Rowsemit, C., & Richards, L. G. (2020). Lifestyle Modification Group for Lymphedema and Obesity Results in Significant Health Outcomes. *American Journal of Lifestyle Medicine*, 14(4), 420–428.
- Khan, N., Huayllani, M. T., Lu, X., Boczar, D., Cinotto, G., Ávila, F. R., Guliyeva, G., & Forte, A. J. (2022). Effects of diet-induced obesity in the development of lymphedema in the animal model: A literature review. *Obesity Research and Clinical Practice*, 16(3), 197–205.
- Lee, S., Lee, B., Kim, Y., Min, S., Yang, E., & Lee, S. (2021). Effects of Sodium Selenite Injection on Serum Metabolic Profiles in Women Diagnosed with Breast Cancer-Related Lymphedema-Secondary Analysis of a Randomized Placebo-Controlled Trial Using Global Metabolomics. *Nutrients*, 13(9), 3253.
- Lee, S.-O., & Kim, I.-K. (2024). Molecular pathophysiology of secondary lymphedema. *Frontiers in Cell and Developmental Biology*, 12.
- Lodewijckx, I., Matthys, C., Verheijen, J., Verscuren, R., Devoogdt, N., Van der Schueren, B., Goffin, K., Fourneau, I., & Thomis, S. (2024). Potential therapeutic effect of a ketogenic diet for the treatment of lymphoedema: Results of an exploratory study. *Journal of human nutrition and dietetics : the official journal of the British Dietetic Association*, 37(4), 885–891.
- Martínez-Jaimez, P., Fuster Linares, P., Piller, N., Masia, J., Yamamoto, T., López-Montoya, L., & Monforte-Royo, C. (2022). Multidisciplinary preventive intervention for breast cancer-related lymphedema: An international consensus. *European journal of cancer care*, 31(6), e13704.
- McNeely, M. L., Peddle-McIntyre, C. J., Yurick, J. L., Dayes, I. S., & Mackey, J. R. (2011). Conservative and dietary interventions for cancer-related lymphedema. *Cancer*, 117(6), 1136–1148.
- Michelini, S., Cestari, M., Michelini, S., Camilleri, G., De Antoni, L., Nelson, W., & Bertelli, M. (2020). Study of a supplement and a genetic test for lymphedema management. *Acta Biomedica*, 91, 1–8.
- Navaei, M., Haghighat, S., Janani, L., Vafa, S., Totmaj, A., Lahiji, M., Emamat, H., Salehi, Z., Amirinejad, A., Izad, M., & Zarrati, M. (2020). The Effects of Synbiotic Supplementation

- on Antioxidant Capacity and Arm Volumes in Survivors of Breast Cancer-Related Lymphedema. *NUTRITION AND CANCER-AN INTERNATIONAL JOURNAL*, 72(1), 62–73.
- Nimmana, B. K., Kimyaghalam, A., & Manna, B. (2026). Lymphedema. In *StatPearls*. StatPearls Publishing.
- Nutrition, Health, and Your Environment*. (2026, January 29). National Institute of Environmental Health Sciences. Retrieved 11 May 2026, from <https://www.niehs.nih.gov/health/topics/nutrition>
- Oliveira, J., & César, T. (2008). Influence of complex descongessive physical therapy associated with intake of medium-chain triglycerides for treating upper-limb lymphedema. *BRAZILIAN JOURNAL OF PHYSICAL THERAPY*, 12(1), 31–36.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71.
- Pfister, C., Dawczynski, H., & Schingale, F. J. (2020). Selenium Deficiency in Lymphedema and Lipedema-A Retrospective Cross-Sectional Study from a Specialized Clinic. *Nutrients*, 12(5), 1211.
- Puchalska, P., & Crawford, P. A. (2019). Ketogenic therapies for lymphedema? *Nature Metabolism*, 1(7), 656–657.
- Ruiz-Molina, Y., Padial, M., Martin-Bravo, M., Garcia-Olivares, M., Porras, N., Chicharro, A., Mora-Robles, J., González-Jiménez, A., Sasso, C., & Oliveira, G. (2025). Targeting Lymphedema in Overweight Breast Cancer Survivors: A Pilot Randomized Controlled Trial of Diet and Exercise Intervention. *NUTRIENTS*, 17(17).
- Ryu, E., Yim, S., Do, H., Lim, J., Yang, E., Shin, M., & Lee, S. (2016). Risk of secondary lymphedema in breast cancer survivors is related to serum phospholipid fatty acid desaturation. *SUPPORTIVE CARE IN CANCER*, 24(9), 3767–3774.
- Saito, Y., Nakagami, H., Kaneda, Y., & Morishita, R. (2013). Lymphedema and Therapeutic Lymphangiogenesis. *BioMed Research International*, 2013(1), 804675.

- Samuels, N., Schiff, E., & Ben-Arye, E. (2014). Non-herbal nutritional supplements for symptom relief in adjuvant breast cancer: Creating a doctor-patient dialogue. *BMJ Supportive and Palliative Care*, 4(3).
- Saneei Totmaj, A., Haghighat, S., Jaberzadeh, S., Navaei, M., Vafa, S., Janani, L., Emamat, H., Salehi, Z., Izad, M., & Zarrati, M. (2022). The Effects of Synbiotic Supplementation on Serum Anti-Inflammatory Factors in the Survivors of Breast Cancer with Lymphedema following a Low Calorie Diet: A Randomized, Double-Blind, Clinical Trial. *Nutrition and Cancer*, 74(3), 869–881.
- Shaw, C., Mortimer, P., & Judd, P. A. (2007a). A randomized controlled trial of weight reduction as a treatment for breast cancer-related lymphedema. *Cancer*, 110(8), 1868–1874.
- Shaw, C., Mortimer, P., & Judd, P. A. (2007b). Randomized controlled trial comparing a low-fat diet with a weight-reduction diet in breast cancer-related lymphedema. *Cancer*, 109(10), 1949–1956.
- Soria, P., Cuesta, A., Romero, H., Martínez, F., & Sastre, A. (1994). Dietary treatment of lymphedema of long-chain triglycerides. *Angiology*, 45(8), 703–707.
- Sudduth, C. L., & Greene, A. K. (2022). Lymphedema and Obesity. *Cold Spring Harbor Perspectives in Medicine*, 12(5), a041176.
- Szuba, A., & Rockson, S. G. (1998). Lymphedema: Classification, diagnosis and therapy. *Vascular Medicine*, 3(2), 145–156.
- Tsai, C.-L., Chih-Yang Hsu, Chang, W.-W., & Yen-Nung Lin. (2020). Effects of weight reduction on the breast cancer-related lymphedema: A systematic review and meta-analysis. *The Breast*, 52, 116–121.
- Tsaqilah, L., Octavia, N., Hidayah, R. M. N., Avriyanti, E., & Dharmadji, H. P. (2023). Elephantiasis Nostras Verrucosa: A Treated Case With Dietary Intervention and Acitretin. *Clinical, Cosmetic and Investigational Dermatology*, 16, 3535–3539.
- Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., Lewin, S., ... Straus, S. E. (2018).

PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Annals of internal medicine*, 169(7), 467–473.

- Vafa, S., Haghighat, S., Janani, L., Totmaj, A. S., Navaei, M., Amirinejad, A., Emamat, H., Salehi, Z., & Zarrati, M. (2020a). The effects of synbiotic supplementation on serum inflammatory markers and edema volume in breast cancer survivors with lymphedema. *EXCLI Journal*, 19, 1–15.
- Vafa, S., Zarrati, M., Malakootinejad, M., Totmaj, A., Zayeri, F., Salehi, M., Sanati, V., & Haghighat, S. (2020b). Calorie restriction and synbiotics effect on quality of life and edema reduction in breast cancer-related lymphedema, a clinical trial. *BREAST*, 54, 37–45.
- Wang, L., Zhen, M., Liao, L., Li, H., Yan, H., Wiley, J. A., Lu, Q., Chen, X., Yv, J., & Ding, B. (2024). Effects of dietary habits and catheterisation type on breast cancer-related lymphedema: A retrospective cohort study. *BMC Cancer*, 24(1).
- Wound and lymphoedema management*. (2010, September 10). Retrieved 11 May 2026, from <https://www.who.int/publications/i/item/9789241599139>
- Wu, T., Pu, J., Yao, Q., Chen, S., Yao, Y., Chang, S., Yang, R., & Shen, J. (2025). Advances in etiology, pathophysiology, diagnosis, and management of lymphedema: A comprehensive review. *Frontiers in Medicine*, 12, 1666522.
- Wu, X., Guan, Q., Cheng, A. S. K., Guan, C., Su, Y., Jiang, J., Zeng, Y., Zeng, L., & Wang, B. (2022). Comparison of machine learning models for predicting the risk of breast cancer-related lymphedema in Chinese women. *Asia-Pacific Journal of Oncology Nursing*, 9(12).
- Xing, C., Sun, J., Liu, Y., Zhou, J., Bai, X., Li, J., & Zhao, H. (2025). A New Secondary Chronic Lymphedema Rat Model Improved by High-Fat Diet. *Lymphatic research and biology*, 23(3), 194–202.
- Yarmohammadi, H., Taromiha, A., Soltanipur, M., & Sheikhi, Z. (2025). Breast cancer-related lymphedema triggered and exacerbated following Ramadan fasting: Report of two cases. *Journal of the Royal College of Physicians of Edinburgh*, 55(3), 193–196.
- Zhang, Y., Zhang, X., Wang, X., Han, D., & Du, J. (2022). Visual analysis of global research output of lymphedema based on bibliometrics. *Frontiers in Oncology*, 12.

Zhu, X., Liu, X., Tian, J., He, C., & Huang, S. (2024). Nutritional assessment of Chinese gynecologic cancer survivors with post-surgical lower limb lymphedema: a cross-sectional study. *Frontiers in nutrition*, 11, 1484017.