Quality in Sport. eISSN 2450-3118.

Journal Home Page
https://apcz.umk.pl/QS/index

MOŻDŻAN, Zofia, MAJTAS, Adrian, GRONEK, Konrad, ZHENG, Edward, OLEJNIK, Agnieszka, TAMBOR, Jakub, POLAK, Mateusz, TAMBOR, Igor, BŁASIAK, Aleksandra and BISKUP, Laura. Comprehensive Non-Pharmacological Management of Rheumatoid Arthritis: A Multidisciplinary Approach. Quality in Sport. 2026;55:70627. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.55.70627

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych). **© The Authors 2026.**
This article is published with open access under the License Open Journal Systems of Nicolaus Copernicus University in Torun, Poland. Open Access: This article is distributed under the terms of the Creative Commons Attribution Noncommercial License, which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non-commercial Share Alike License (http://creativecommons.org/licenses/by-nc-sa/4.0/), which permits unrestricted, non-commercial use, distribution, and reproduction in any medium, provided the work is properly cited.
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 12.04.2026. Revised: 22.04.2026. Accepted: 24.04.2026. Published: 14.05.2026.

Comprehensive Non-Pharmacological Management of Rheumatoid Arthritis: A Multidisciplinary Approach

Zofia Możdżan, ORCID: https://orcid.org/0009-0002-3999-9811

e-mail: zofia.mozdzan@stud.umed.lodz.pl

Medical University of Lodz, Poland

Adrian Majtas, ORCID: https://orcid.org/0009-0008-7829-9141

e-mail: adrian.majtas@stud.umed.lodz.pl

Medical University of Lodz, Poland

Konrad Gronek, ORCID: https://orcid.org/0009-0008-7812-5432

E-Mail: konrad.gronek1999@gmail.com

Independent Public Healthcare Institution MSWiA in Lodz, Poland

Edward Zheng, ORCID: https://orcid.org/0009-0009-0496-293X

E-Mail: edward.zheng@stud.umed.lodz.pl

Independent Public Healthcare Institution MSWiA in Lodz, Poland

Agnieszka Olejnik, ORCID: https://orcid.org/0009-0002-4180-5270

E-Mail: agnieszkv.olejnik@gmail.com

Independent Public Healthcare Institution MSWiA in Lodz, Poland

Jakub Tambor, ORCID: https://orcid.org/0000-0001-9898-0526

E-mail: jakub.tambor@stud.umed.lodz.pl

Medical University of Lodz, Poland

Mateusz Polak, ORCID: **https://orcid.org/0009-0003-1904-7044**

e-mail: mat.polak@icloud.com

Provincial Hospital in Poznań – Greater Poland Specialist Center, Poland

Igor Tambor, ORCID: https://orcid.org/0009-0007-9073-9501

E-mail: igor.tambor@stud.umed.lodz.pl

Medical University of Lodz, Poland

Aleksandra Błasiak, ORCID: https://orcid.org/0009-0000-3880-5793

Email: aleksandra.blasiak@stud.umed.lodz.pl

Medical University of Lodz, Poland

Laura Biskup, ORCID: https://orcid.org/0009-0000-9336-3705

E-Mail: laura.biskup@stud.umed.lodz.pl

Teaching Hospital No. 2 of the Medical University of Lodz, Faculty of Medicine, Medical University of Lodz, Poland

Corresponding Author

Zofia Możdżan, ORCID: https://orcid.org/0009-0002-3999-9811

e-mail: zofia.mozdzan@stud.umed.lodz.pl

Medical University of Lodz, Poland

Abstract

Background. Rheumatoid arthritis (RA) is a chronic autoimmune disease that leads to joint destruction, chronic pain, and significant functional impairment. Also, patients with RA have an increased risk of cardiovascular disease and higher risk of developing interstitial lung disease. While pharmacological treatment remains the cornerstone of therapy, it is increasingly recognized that optimal patient outcomes require a holistic approach. Non-pharmacological interventions are essential to address the physical, psychological, and social challenges faced by patients, whilst reducing the risk of premature death.

Aim. The aim of this study is to evaluate the effectiveness of various non-pharmacological strategies in the management of RA and to highlight the importance of a coordinated, multidisciplinary team in improving patient quality of life and functional status.

Material and methods. A comprehensive review of current clinical guidelines and recent literature (from databases such as PubMed and Scopus) was conducted. The analysis focused on interventions including physical therapy, occupational therapy, nutritional counseling, psychological support, and patient education programs within a multidisciplinary framework.

Results. The findings indicate that regular aerobic and resistance exercise, combined with joint protection techniques, significantly reduce pain and fatigue while improving joint mobility. Dietary interventions (e.g., Mediterranean diet) and psychological interventions (e.g., Cognitive Behavioral Therapy) contribute to better disease control and mental well-being. A multidisciplinary approach, involving rheumatologists, physiotherapists, dietitians, and psychologists, leads to higher treatment adherence and better functional outcomes compared to monodisciplinary care.

Conclusions. Non-pharmacological management is a vital component of RA care that complements medical treatment. A well-structured, multidisciplinary approach ensures personalized care, targets diverse symptoms, and empowers patients to manage their condition effectively, ultimately leading to a better quality of life.

Key words: rheumatoid arthritis, non-pharmacological treatment, multidisciplinary approach, rehabilitation, patient education.

1. Introduction

Rheumatoid arthritis (RA) is a one of the most common chronic autoimmune diseases, characterized by inflammatory symmetrical arthritis and systemic manifestations.Also, it is associated with severe complications, most notably an increased risk for cardiovascular disease (CVD), due to detrimental changes in body composition, accelerated atherosclerotic and inflammatory processes [1]. The RA affects about 1% of the world population, up to 3% among elderly [2]. Environmental factors, such as cigarette smoking and diet, contribute to the development of systemic autoimmunity as well as its complications [3].

Clinically, RA is characterized by persistent synovial joint inflammation leading to pain and prolonged morning stiffness, typically lasting more than one hour. As the disease progresses, cartilage degradation may occur, leading to functional disability.

The 2010 ACR/EULAR classification criteria for Rheumatoid Arthritis (RA) require a score >= 6 out of 10 based on joint involvement, serology (RF or ACPA), acute-phase reactants (CRP or ESR), and duration of symptoms (>=6 weeks) [4].

Disease-modifying antirheumatic drugs (DMARDs) are still the foundation of the treatment process [5,6]. Guidelines support methotrexate (MTX) as the first line therapy for moderate to the severe RA. Recent studies claim that MTX both as monotherapy and in combination therapies is well tolerated, but adverse events were more frequent in combination with tocilizumab [7]. Patients with RA that take MTX and DMARDs are observed to have better long-term health outcomes.

Nevertheless, non-pharmacological strategies (NPTs) should not be underestimated, especially in difficult-to-treat cases. A wide range of interventions, including many exercise modalities, psychological interventions, physio- and balneotherapy, dietary interventions, education seem to have complex effects on both the immune and endocrine system. Combining pharmacology with NPTs can have significant benefits in the treatment process, especially in difficult-to-treat cases, where pharmacological options are commonly limited [8]. Difficult-to-treat rheumatoid arthritis (D2TRA) is a particularly challenging form of RA characterized by the persistence of symptoms despite the use of optimal therapeutic strategies, including biological and targeted synthetic therapies. Its underlying etiology is considered multifactorial and extends beyond

persistent inflammation alone. A variety of contributing factors have been identified, including low socioeconomic status, comorbid conditions, psychological influences, and the patient's prior treatment history [9]. Considering this complexity, effective management requires a comprehensive and individualized approach, including non-pharmacological strategies as well. One of the primary approaches is exercise therapy. It is particularly effective in older patients, those with high disease activity, and individuals with functional disability [10]. Another approach involves dietary changes, primarily including Mediterranean diet, vitamin D supplementation, and the use of fish oil supplements. Maintaining a healthy body weight is also essential, as obesity may contribute to the development and persistence of D2TRA [11].

Physiotherapy takes the lead in the non-pharmacologic approach. Positive effects have been observed, among others, following transcutaneous electrical nerve stimulation, laser acupuncture, neuromuscular electrical stimulation, underwater ultrasound therapy, transcutaneous stimulation of the cervical vagus nerve, and cryotherapy. It was confirmed that cryostimulation does not have a negative impact on heart function (no abnormalities on ECG were found). That is crucial, especially for RA patients with CVD [12].

2. Research materials and methods

This work was conducted as a narrative review of literature. The aim of the review was to evaluate the efficacy of non-pharmacological management in patients with rheumatoid arthritis.

The literature search was performed in PubMed, Embase, and the Cochrane Library, using combinations of the following terms: rheumatoid arthritis, non-pharmacological treatment, multidisciplinary approach, rehabilitation, patient education.

The search covered publications from January 2016 to April 2026. In addition, reference lists of key articles were hand-searched. Publications in English were included. Owing to heterogeneity across studies (different populations, and exercise protocols), findings were synthesized narratively without quantitative meta-analysis.

3. Physiotherapy, Balneotherapy

Physical activity (PA) plays a fundamental role in the management of patients with RA, specifically regarding joint motility, cachexia, Body Mass Index (BMI) regulation, and the

reduction of CVD incidence. Moreover, exercises improve endurance, agility, muscle strength, decrease soft tissue pain and cardiovascular risk. It can also positively impact self-efficacy and quality of life. There is much evidence, although mostly of low or moderate quality, about the positive effect of dynamic, aerobic exercise programs and muscle strengthening exercises in RA cases [13-17] and some data about positive effect on DAS28 score and inflammatory markers [18]. Patients are prone to become less physically active and prefer a sedentary lifestyle, which marks the importance of maintaining physical activity among them [19].

The "Rheumatoid Arthritis Patients in Training" (RAPIT) study investigated the correlation between intensive exercise and RA outcomes in a cohort of 146 patients (mean age 54 years; mean disease duration 5 years). Participants engaged in a two-year program consisting of bi-weekly, 75-minute sessions of strength and endurance training—including running, stair climbing, and throwing- with the regimen adjusted every eight weeks. The findings revealed that after two years, over 78% of patients were satisfied and would recommend the program to others. Notably, disease severity did not negatively impact compliance, suggesting that intensive exercise is feasible even in advanced stages of RA [20].

Several studies have evaluated the efficacy of Progressive Resistance Training (PRT) in RA. In one study, ten patients with well-controlled RA (mean age 53 ± 13) underwent PRT 2.5 times per week for 12 weeks. Compared to a control group with similar disease activity, the PRT group showed a significant increase in lean mass (particularly in the limbs) and total body protein, without any exacerbation of disease activity. Furthermore, a significant reduction in body fat was observed, suggesting that intense PRT is a safe and effective method for stimulating muscle growth in RA patients [21]. Moreover, the studies show that resistance training is equally vital to deal with rheumatoid cachexia and provide a reduction in inflammatory markers [22]. For RA patients with high disease activity, high rate of disability and long-standing disease, a person-centered, individualized exercise program can be helpful in improving self-efficacy and physical activity in the long term [23].

Similar results were observed in a six-month study involving 28 RA patients designed to investigate the role of Insulin-Like Growth Factor (IGF) in exercise-induced hypertrophy. High-intensity PRT performed twice weekly not only increased lean body mass, but also improved training-specific and knee extensor strength. These clinical improvements were accompanied by an increase in IGF-1 and IGF-binding protein 3, providing a biochemical basis for the observed muscle hypertrophy [24]. Cardiovascular health is another significant concern

in RA management, as patients face a significantly higher risk of ischemic heart disease [25]. Moderate-to-high intensity aerobic exercise (such as cycling, swimming, or brisk walking) improves VO2 max and reduces systemic inflammation without exacerbating joint symptoms [26].

Importantly, high load resistance training is not always advisable in active RA patients. However, low load or non-resistance training [27] or water-based exercises [28,29] appear to be good alternatives.

The literature extensively explores a variety of physical modalities, among which particular importance is attributed to laser acupuncture [30], ultrasound (US) therapy administered in an aquatic environment [31, 32] and transcutaneous electrical nerve stimulation [33], which have demonstrated high efficacy in the clinical modulation of pain sensations. Innovative therapeutic approaches, such as transcutaneous stimulation of the cervical vagus nerve [34] and neuromuscular electrostimulation [35, 36, 37], open up new possibilities for inhibiting the systemic inflammatory cascade and counteracting muscle atrophy, which is essential for maintaining the structural integrity of the joints. Cryotherapy also plays a significant role in reducing disease activity, and has a proven positive effect on clinical parameters and objective laboratory markers of inflammation [38, 39, 40]. The synergistic combination of regular exposure to extremely low temperatures with targeted physical activity allows for a significant reduction in pain levels and RA activity indices, which consequently leads to a significant improvement in patients' overall quality of life and constitutes an essential element in the prevention of life-threatening complications [41].

A central challenge across all exercise regimens is ensuring long-term persistence. This requires a combination of educational and psychological strategies. Successful transitioning patients from supervised to independent training in a long-term period of time can be made by personalized motivational interventions [42] and digital health platforms [43, 44].

Research consistently supports the viability of home-based routines. A systematic literature review of physical activity (PA) interventions for autoimmune rheumatic diseases, including RA, demonstrated that home-based programs yield improvements in quality of life, functional capacity, pain reduction, and disease activity comparable to center-based treatments [45]. The effectiveness and adherence to these home regimens can be significantly enhanced through targeted approaches, such as patient education, self-management, and structured training

sessions [46]. Furthermore, the necessity of home-based exercise was amplified by COVID-19 restrictions, with evidence showing that these programs also deliver critical psychological benefits, including improved mental well-being and greater vitality among RA patients [47].

4. Dietary Interventions and Weight Management

Nutrition is one of the most frequently discussed topics among RA patients. Diet plays a crucial role in modulating inflammation, with certain foods promoting inflammatory pathways, while others exert protective, anti-inflammatory effects [48]. Multiple studies consistently demonstrate a higher prevalence of RA in Western countries compared to Eastern and developing regions, a pattern that supports the contribution of environmental factors to disease development [49]. Elevated levels of C-reactive protein and interleukin-6 have been observed in individuals consuming diets high in red meat; both markers are associated with increased disease activity in RA [50]. Dietary meat proteins can alter the composition of the gut microbiota, promoting the growth of protein-fermenting bacteria that generate potentially proinflammatory metabolites. These byproducts may impair intestinal barrier integrity and drive systemic immune activation, thereby potentially exacerbating autoimmune processes in RA. High dietary sodium intake, characteristic of Western dietary patterns, has been associated with an increased risk of RA [51]. High salt intake has been shown to promote the differentiation of naïve $CD4^{+}$ T cells into Th17 cells, leading to increased IL-17 production, a key mediator in RA pathogenesis that drives synovial inflammation, osteoclastogenesis, and cartilage destruction [52]. High sodium intake in smokers is associated with an increased risk of anti-citrullinated protein antibody (ACPA) positivity [53]. High consumption of sugar-sweetened beverages has been associated with the development of RA. Data from the NHS indicate that regular intake of sugar-sweetened soda increases RA risk; in particular, high-fructose soft drinks may promote disease onset in younger adults, potentially through the accumulation of advanced glycation end products that enhance inflammatory pathways [54].

On the contrary, one of the healthiest diets for RA patients is the Mediterranean diet. Rich in olive oil, legumes, unrefined cereals, fruits, vegetables, fermented dairy and fish- is the most evidence-backed nutritional intervention for RA. The high concentration of Omega-3 fatty acids (EPA and DHA) found in fatty fish acts as a natural anti-inflammatory by inhibiting the production of pro-inflammatory cytokines like TNF-alpha and IL-1. The studies have shown that they appear to be exerting a protective effect against the development of RA. Certain Mediterranean diet components have direct anti-inflammatory effects; extra-virgin olive oil, for

instance, decreases thromboxane B2 (TXB2) and leukotriene B4 (LTB4) levels [55]. It also reduces the low-density lipoprotein (LDL) oxidation. Tomatoes, a key component of the Mediterranean diet, provide lycopene, a highly potent antioxidant carotenoid [56].

The supplementation of vitamin D significantly improves the disease activity in patients. Buondonno et al. demonstrated a role for vitamin D in RA, showing that patients with persistently active disease had significantly lower serum 25-hydroxyvitamin D levels compared with those in low disease activity or remission at baseline. Patients with low vitamin D levels also tended to have longer disease duration; however, no direct correlation was observed between disease duration and vitamin D concentration [57].

Certain foods, including yogurt, kefir, and other fermented products, as well as dietary supplements, are sources of probiotics, with the most common probiotic bacteria being Bifidobacterium and Lactobacillus species. Metabolites derived from xylooligosaccharides have been shown to reduce the levels of IFN-γ, IL-6, IL-17, and TNF-α in cell cultures from both immunized and non-immunized mice. (58)

Weight management is another important factor to monitor in RA patients. Obesity is a major barrier to successful RA treatment. Adipose tissue is not merely fat storage; it is an active endocrine organ that secretes proinflammatory cytokines, including TNF-α and IL-6 [59]. Excess pro-inflammatory molecules create a permissive environment for autoimmunity, with leptin amplifying innate and adaptive immune responses while suppressing regulatory T-cell function [60]. Furthermore, excess weight increases the mechanical loading on weight-bearing joints (knees, hips, and ankles), accelerating cartilage degradation. Schafer et al. showed that obesity negatively affected disease activity improvement in patients with RA treated with csDMARDs or biologic DMARDs, including 1,173 patients receiving tocilizumab [61]. Weight loss has been shown to improve the efficacy of DMARDs and increase the likelihood of achieving clinical remission. Studies indicate that calorie restriction can reduce RA activity, with notable improvement in subjective disease symptoms. Among the different fasting approaches, complete fasting for defined periods appears most effective; however, it is generally not sustainable over the long term.

5. Psychosocial Interventions and Patient Education

Living with a chronic and painful disease has a significant impact on mental health. Depression and anxiety are twice as common in RA patients as in the general population. A multicenter

study found that patients' expectations and needs regarding rheumatology care primarily focus on education, self-care support and emotional guidance [62]. The chronic nature of RA and the diversity of treatment options have raised the development of patient education as an important addition to traditional medical care [63].

Approximately 14–48% of RA patients experience depressive and anxiety disorders. These comorbidities significantly influence adherence to recommendations and affect disease course, patients' subjective experience of illness, and overall disease outcomes [64]. These findings highlight the need for psychological support in patients with RA, with studies demonstrating the efficacy of cognitive–behavioural therapy (CBT) - the gold-standard intervention for chronic pain. It helps patients to identify and transform dysfunctional thought patterns, such as catastrophizing. By developing coping strategies and relaxation techniques, patients can lower their pain interference levels. Barsky et al., using progressive muscle relaxation, demonstrated that the intervention was associated with reduced pain and increased social participation, as measured by the Arthritis Impact Measurement Scale - a patient-reported instrument assessing well-being in individuals with rheumatic disorders. The magnitude of effect was low to moderate [65].

6. Limitation

Several limitations of this review should be acknowledged. First, this study was conducted as a narrative review rather than a formal systematic review or meta-analysis. Although a structured search of the literature was performed, the selection of studies was not guided by a standardized risk-of-bias tool or predefined registration protocols. Consequently, the findings should be interpreted as an integrative synthesis of current evidence rather than a definitive quantitative evaluation.

Second, a significant constraint in the current literature is the scarcity of large-scale, high-quality cohort studies. Most available evidence regarding non-pharmacological interventions in RA is derived from trials with small sample sizes, which limits the statistical power and the generalizability of the results to the broader population of RA patients. This lack of robust, long-term data makes it difficult to draw firm conclusions about the sustained efficacy of these interventions over the course of the disease.

Third, the multidisciplinary nature of the interventions introduces substantial complexity and a high degree of heterogeneity. The presence of numerous confounding variables—including

differences in intervention protocols, varying levels of patient adherence, and the diversity of clinical presentations—complicates the isolation of specific therapeutic effects. Furthermore, establishing prospective, blinded control groups for non-pharmacological treatments (such as physiotherapy, psychological support, or dietary changes) is inherently challenging, often leading to methodological inconsistencies across studies.

Finally, while theoretical models suggest a synergy between pharmacological and non-pharmacological care, there is a limited number of direct randomized controlled trials comparing combined multidisciplinary approaches against standard medical monotherapy. Most clinical studies focus on short-term symptom reduction, while long-term functional outcomes, joint preservation, and the cost-effectiveness of integrated care models remain insufficiently explored. High-quality longitudinal trials with standardized endpoints are necessary to clarify the additive effects of these comprehensive management strategies

7. Conclusion

The management of RA has shifted from a purely reactive model to a proactive, holistic one. Non-pharmacological interventions are not merely alternatives to medicine - they are essential components of a dual-track treatment strategy.

By combining the biological control provided by modern pharmaceuticals with the functional and psychological support of exercise, nutrition, occupational therapy, and mental health care, we can move beyond simply suppressing inflammation. The goal is to return the patient to a life of full activity, autonomy, and well-being. A truly effective RA management plan is one where the patient is not a passive recipient of drugs, but an active, informed participant in their own health.

Rheumatoid arthritis often coexists with anxiety and depression. Therefore, psychological interventions, such as educational techniques, stress management strategies, and specialized psychotherapy, can help reduce disease symptoms.

Author Contributions

Conceptualization: Zofia Możdżan, Laura Biskup

Methodology: Zofia Możdżan, Adrian Majtas, Konrad Gronek, Agnieszka Olejnik

Investigation: Edward Zheng, Jakub Tambor, Igor Tambor, Aleksandra Błasiak

Resources: Aleksandra Błasiak, Agnieszka Olejnik, Edward Zheng, Mateusz Polak

Data curation: Konrad Gronek, Laura Biskup, Mateusz Polak

Writing-rough preparation: Igor Tambor, Agnieszka Olejnik, Konrad Gronek

Writing review and editing: Zofia Możdżan, Adrian Majtas, Edward Zheng, Jakub Tambor, Laura Biskup

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

Funding

This research received no external funding

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable

Data Availability Statement

No new data were generated or analyzed in this study.

Conflicts of Interest

The authors declare no conflict of interest.

Declaration on the Use of Artificial Intelligence

AI-assisted tools were used exclusively for linguistic refinement and structural editing of the manuscript. The authors take full responsibility for the scientific content, interpretation of the data, and final version of the manuscript.

References

1. Zegkos T, Kitas G, Dimitroulas T. Cardiovascular risk in rheumatoid arthritis: assessment, management and next steps. Ther Adv Musculoskelet Dis. 2016 Jun;8(3):86-101. doi: 10.1177/1759720X16643340. Epub 2016 Apr 30. PMID: 27247635; PMCID: PMC4872174.

2. Turk MA, Liu Y, Pope JE. Non-pharmacological interventions in the treatment of rheumatoid arthritis: A systematic review and meta-analysis. Autoimmun Rev. 2023 Jun;22(6):103323. doi: 10.1016/j.autrev.2023.103323. Epub 2023 Mar 20. PMID: 36940841.

3. Ziembicki H, Górski J, Gajewski W, Skrzypska N, Skoczek W. Environmental and Lifestyle Factors in the Risk and Prevention of Rheumatoid Arthritis: A Narrative Review. Cureus. 2025 Sep 25;17(9):e93164. doi: 10.7759/cureus.93164. PMID: 41141040; PMCID: PMC12553399.

4. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO 3rd, Birnbaum NS, Burmester GR, Bykerk VP, Cohen MD, Combe B, Costenbader KH, Dougados M, Emery P, Ferraccioli G, Hazes JM, Hobbs K, Huizinga TW, Kavanaugh A, Kay J, Kvien TK, Laing T, Mease P, Ménard HA, Moreland LW, Naden RL, Pincus T, Smolen JS, Stanislawska-Biernat E, Symmons D, Tak PP, Upchurch KS, Vencovský J, Wolfe F, Hawker G. 2010 Rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. Arthritis Rheum. 2010 Sep;62(9):2569-81. doi: 10.1002/art.27584. PMID: 20872595.

5. Findeisen KE, Sewell J, Ostor AJK. Biological Therapies for Rheumatoid Arthritis: An Overview for the Clinician. Biologics. 2021 Aug 12;15:343-352. doi: 10.2147/BTT.S252575. PMID: 34413630; PMCID: PMC8370108.

6. Park JK, Ghang B, Han SW, Ju JH. Current and future treatment of rheumatoid arthritis. J Rheum Dis. 2026 Jan 1;33(1):7-18. doi: 10.4078/jrd.2025.0034. Epub 2025 Oct 21. PMID: 41409811; PMCID: PMC12706429.

7. Lend K, Koopman FA, Lampa J, et al. Methotrexate Safety and Efficacy in Combination Therapies in Patients With Early Rheumatoid Arthritis: A Post Hoc Analysis of a Randomized Controlled Trial. *Arthritis Rheumatol*. 2024;76(3):363-376. doi:10.1002/art.42730

8. Bender T, Nagy G. Non-pharmacological treatment in difficult-to-treat rheumatoid arthritis. Front Med (Lausanne). 2022 Aug 29;9:991677. doi: 10.3389/fmed.2022.991677. PMID: 36106320; PMCID: PMC9465607.

8. Lend K, Koopman FA, Lampa J, Jansen G, Hetland ML, Uhlig T, Nordström D, Nurmohamed M, Gudbjornsson B, Rudin A, Østergaard M, Heiberg MS, Sokka-Isler T, Hørslev-Petersen K, Haavardsholm EA, Grondal G, Twisk JWR, van Vollenhoven R. Methotrexate Safety and Efficacy in Combination Therapies in Patients With Early Rheumatoid Arthritis: A Post Hoc Analysis of a Randomized Controlled Trial. Arthritis Rheumatol. 2024 Mar;76(3):363-376. doi: 10.1002/art.42730. Epub 2024 Jan 18. PMID: 37846618.

9. Roodenrijs NMT, van der Goes MC, Welsing PMJ, Tekstra J, Lafeber FPJG, Jacobs JWG, van Laar JM. Difficult-to-treat rheumatoid arthritis: contributing factors and burden of disease. Rheumatology (Oxford). 2021 Aug 2;60(8):3778-3788. doi: 10.1093/rheumatology/keaa860. PMID: 33331946.

10. Andonian BJ, Johannemann A, Hubal MJ, Pober DM, Koss A, Kraus WE, Bartlett DB, Huffman KM. Altered skeletal muscle metabolic pathways, age, systemic inflammation, and low cardiorespiratory fitness associate with improvements in disease activity following high-intensity interval training in persons with rheumatoid arthritis. Arthritis Res Ther. 2021 Jul 10;23(1):187. doi: 10.1186/s13075-021-02570-3. PMID: 34246305; PMCID: PMC8272378.

11. Kreps DJ, Halperin F, Desai SP, Zhang ZZ, Losina E, Olson AT, Karlson EW, Bermas BL, Sparks JA. Association of weight loss with improved disease activity in patients with rheumatoid arthritis: A retrospective analysis using electronic medical record data. Int J Clin Rheumtol. 2018;13(1):1-10. doi: 10.4172/1758-4272.1000154. PMID: 29606976; PMCID: PMC5875117.

12. STROŃSKA, Aleksandra, PLUTA, Waldemar Wojciech, LALKO, Alicja and LUBKOWSKA, Anna. Diagnostics and physiotherapy in rheumatoid arthritis. Journal of Education, Health and Sport. Online. 10 May 2021. Vol. 11, no. 5, pp. 26-32. [Accessed 2 April 2026]. DOI 10.12775/JEHS.2021.11.05.002.

13. Hurkmans E, van der Giesen FJ, Vliet Vlieland TP, Schoones J, Van den Ende EC. Dynamic exercise programs (aerobic capacity and/or muscle strength training) in patients with rheumatoid arthritis. Cochrane Database Syst Rev. 2009 Oct 7;2009(4):CD006853. doi: 10.1002/14651858.CD006853.pub2. PMID: 19821388; PMCID: PMC6769170.

14. Hurkmans EJ, van den Berg MH, Ronday KH, Peeters AJ, le Cessie S, Vlieland TP. Maintenance of physical activity after Internet-based physical activity interventions in patients with rheumatoid arthritis. Rheumatology (Oxford). 2010 Jan;49(1):167-72. doi: 10.1093/rheumatology/kep285. PMID: 19995857.

15. Sobue Y, Kojima T, Ito H, Nishida K, Matsushita I, Kaneko Y, Kishimoto M, Kohno M, Sugihara T, Seto Y, Tanaka E, Nakayama T, Hirata S, Murashima A, Morinobu A, Mori M, Kojima M, Kawahito Y, Harigai M. Does exercise therapy improve patient-reported outcomes in rheumatoid arthritis? A systematic review and meta-analysis for the update of the 2020 JCR guidelines for the management of rheumatoid arthritis. Mod Rheumatol. 2022 Jan 5;32(1):96-104. doi: 10.1080/14397595.2021.1886653. PMID: 33565350.

16. Manning VL, Hurley MV, Scott DL, Coker B, Choy E, Bearne LM. Education, self-management, and upper extremity exercise training in people with rheumatoid arthritis: a randomized controlled trial. Arthritis Care Res (Hoboken). 2014 Feb;66(2):217-27. doi: 10.1002/acr.22102. PMID: 23925924.

17. Cramp F, Hewlett S, Almeida C, Kirwan JR, Choy EH, Chalder T, Pollock J, Christensen R. Non-pharmacological interventions for fatigue in rheumatoid arthritis. Cochrane Database Syst Rev. 2013 Aug 23;2013(8):CD008322. doi: 10.1002/14651858.CD008322.pub2. PMID: 23975674; PMCID: PMC11748118.

18. Wen Z, Chai Y. Effectiveness of resistance exercises in the treatment of rheumatoid arthritis: A meta-analysis. Medicine (Baltimore). 2021 Apr 2;100(13):e25019. doi: 10.1097/MD.0000000000025019. PMID: 33787585; PMCID: PMC8021371.

19. Summers G, Booth A, Brooke-Wavell K, Barami T, Clemes S. Physical activity and sedentary behavior in women with rheumatoid arthritis: a comparison of patients with low and high disease activity and healthy controls. Open Access Rheumatol. 2019 Jun 20;11:133-142. doi: 10.2147/OARRR.S203511. PMID: 31417323; PMCID: PMC6592056.

20.. Munneke M, de Jong Z, Zwinderman AH, Jansen A, Ronday HK, Peter WF, Boonman DC, van den Ende CH, Vliet Vlieland TP, Hazes JM. Adherence and satisfaction of rheumatoid arthritis patients with a long-term intensive dynamic exercise program (RAPIT program). Arthritis Rheum. 2003 Oct 15;49(5):665-72. doi: 10.1002/art.11382. PMID: 14558052.

21. . Marcora SM, Lemmey AB, Maddison PJ. Can progressive resistance training reverse cachexia in patients with rheumatoid arthritis? Results of a pilot study. J Rheumatol. 2005 Jun;32(6):1031-9. PMID: 15940763.

22.Wen Z, Chai Y. Effectiveness of resistance exercises in the treatment of rheumatoid arthritis: A meta-analysis. Medicine (Baltimore). 2021 Apr 2;100(13):e25019. doi: 10.1097/MD.0000000000025019. PMID: 33787585; PMCID: PMC8021371.

23. Feldthusen C, Dean E, Forsblad-d'Elia H, Mannerkorpi K. Effects of Person-Centered Physical Therapy on Fatigue-Related Variables in Persons With Rheumatoid Arthritis: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2016 Jan;97(1):26-36. doi: 10.1016/j.apmr.2015.09.022. Epub 2015 Oct 16. PMID: 26482574.

24. Lemmey AB, Marcora SM, Chester K, Wilson S, Casanova F, Maddison PJ. Effects of high-intensity resistance training in patients with rheumatoid arthritis: a randomized controlled trial. Arthritis Rheum. 2009 Dec 15;61(12):1726-34. doi: 10.1002/art.24891. PMID: 19950325.

25. Alnaimat F, Ghazzal H, Kajjoun G, Kajjoun F, Mutalipova G, Imanbayeva N. Cardiovascular rehabilitation in rheumatoid arthritis: evidence and future directions. Rheumatol Int. 2025 Dec 23;46(1):23. doi: 10.1007/s00296-025-06055-3. PMID: 41430002.

26. Ye H, Weng H, Xu Y, Wang L, Wang Q, Xu G. Effectiveness and safety of aerobic exercise for rheumatoid arthritis: a systematic review and meta-analysis of randomized controlled trials. BMC Sports Sci Med Rehabil. 2022 Feb 5;14(1):17. doi: 10.1186/s13102-022-00408-2. PMID: 35123568; PMCID: PMC8818158.

27. Liao CD, Chen HC, Huang SW, Liou TH. Exercise therapy for sarcopenia in rheumatoid arthritis: A meta-analysis and meta-regression of randomized controlled trials. Clin Rehabil. 2022 Feb;36(2):145-157. doi: 10.1177/02692155211035539. Epub 2021 Aug 18. PMID: 34404254.

28. Eversden L, Maggs F, Nightingale P, Jobanputra P. A pragmatic randomised controlled trial of hydrotherapy and land exercises on overall well being and quality of life in rheumatoid arthritis. BMC Musculoskelet Disord. 2007 Mar 1;8:23. doi: 10.1186/1471-2474-8-23. PMID: 17331241; PMCID: PMC1821024.

29. Siqueira US, Orsini Valente LG, de Mello MT, Szejnfeld VL, Pinheiro MM. Effectiveness of Aquatic Exercises in Women With Rheumatoid Arthritis: A Randomized, Controlled, 16-Week Intervention-The HydRA Trial. Am J Phys Med Rehabil. 2017 Mar;96(3):167-175. doi: 10.1097/PHM.0000000000000564. PMID: 27386811.

30. Attia AM, Ibrahim FA, Abd El-Latif NA, Aziz SW, Elwan AM, Abdel Aziz AA, Elgendy A, Elgengehy FT. Therapeutic antioxidant and anti-inflammatory effects of laser acupuncture on patients with rheumatoid arthritis. Lasers Surg Med. 2016 Jul;48(5):490-7. doi: 10.1002/lsm.22487. Epub 2016 Feb 14. PMID: 26875769.

31. Casimiro L, Brosseau L, Robinson V, Milne S, Judd M, Well G, Tugwell P, Shea B. Therapeutic ultrasound for the treatment of rheumatoid arthritis. Cochrane Database Syst Rev. 2002;(3):CD003787. doi: 10.1002/14651858.CD003787. PMID: 12137714.

32. Király M, Varga Z, Szanyó F, Kiss R, Hodosi K, Bender T. Effects of underwater ultrasound therapy on pain, inflammation, hand function and quality of life in patients with rheumatoid arthritis - a randomized controlled trial. Braz J Phys Ther. 2017 May-Jun;21(3):199-205. doi: 10.1016/j.bjpt.2017.04.002. Epub 2017 Apr 13. PMID: 28442212; PMCID: PMC5537462.

33. Brosseau L, Judd MG, Marchand S, Robinson VA, Tugwell P, Wells G, Yonge K. Transcutaneous electrical nerve stimulation (TENS) for the treatment of rheumatoid arthritis in the hand. Cochrane Database Syst Rev. 2003;2003(3):CD004377. doi: 10.1002/14651858.CD004377. PMID: 12918009; PMCID: PMC8826159.

34. Drewes AM, Brock C, Rasmussen SE, Møller HJ, Brock B, Deleuran BW, Farmer AD, Pfeiffer-Jensen M. Short-term transcutaneous non-invasive vagus nerve stimulation may reduce disease activity and pro-inflammatory cytokines in rheumatoid arthritis: results of a pilot study.

Scand J Rheumatol. 2021 Jan;50(1):20-27. doi: 10.1080/03009742.2020.1764617. Epub 2020 Oct 13. PMID: 33047630.

35. Almeida GJ, Khoja SS, Piva SR. Dose-Response Relationship Between Neuromuscular Electrical Stimulation and Muscle Function in People With Rheumatoid Arthritis. Phys Ther. 2019 Sep 1;99(9):1167-1176. doi: 10.1093/ptj/pzz079. PMID: 31197369; PMCID: PMC6735838.

36. Piva SR, Khoja SS, Toledo FGS, Chester-Wasko M, Fitzgerald GK, Goodpaster BH, Smith CN, Delitto A. Neuromuscular Electrical Stimulation Compared to Volitional Exercise for Improving Muscle Function in Rheumatoid Arthritis: A Randomized Pilot Study. Arthritis Care Res (Hoboken). 2019 Mar;71(3):352-361. doi: 10.1002/acr.23602. Epub 2019 Feb 12. PMID: 29781580; PMCID: PMC6249117.

37. Brosseau LU, Pelland LU, Casimiro LY, Robinson VI, Tugwell PE, Wells GE. Electrical stimulation for the treatment of rheumatoid arthritis. Cochrane Database Syst Rev. 2002;2002(2):CD003687. doi: 10.1002/14651858.CD003687. PMID: 12076504; PMCID: PMC8725644.

38. Gizińska M, Rutkowski R, Romanowski W, Lewandowski J, Straburzyńska-Lupa A. Effects of Whole-Body Cryotherapy in Comparison with Other Physical Modalities Used with Kinesitherapy in Rheumatoid Arthritis. Biomed Res Int. 2015;2015:409174. doi: 10.1155/2015/409174. Epub 2015 Oct 21. PMID: 26576422; PMCID: PMC4631852.

39. Hirvonen H, Kautiainen H, Moilanen E, Mikkelsson M, Leirisalo-Repo M. The effect of cryotherapy on total antioxidative capacity in patients with active seropositive rheumatoid arthritis. Rheumatol Int. 2017 Sep;37(9):1481-1487. doi: 10.1007/s00296-017-3771-9. Epub 2017 Jul 11. PMID: 28698947.

40. Jastrząbek R, Straburzyńska-Lupa A, Rutkowski R, Romanowski W. Effects of different local cryotherapies on systemic levels of TNF-α, IL-6, and clinical parameters in active rheumatoid arthritis. Rheumatol Int. 2013 Aug;33(8):2053-60. doi: 10.1007/s00296-013-2692-5. Epub 2013 Feb 10. PMID: 23397259.

41. Sadura-Sieklucka T, Sołtysiuk B, Karlicka A, Sokołowska B, Kontny E, Księżopolska-Orłowska K. Effects of whole body cryotherapy in patients with rheumatoid arthritis

considering immune parameters. Reumatologia. 2019;57(6):320-325. doi: 10.5114/reum.2019.90825. Epub 2019 Dec 31. PMID: 32226165; PMCID: PMC7091479.

42. Knittle K, De Gucht V, Hurkmans E, Peeters A, Ronday K, Maes S, Vlieland TV. Targeting motivation and self-regulation to increase physical activity among patients with rheumatoid arthritis: a randomised controlled trial. Clin Rheumatol. 2015 Feb;34(2):231-8. doi: 10.1007/s10067-013-2425-x. Epub 2013 Nov 9. PMID: 24213780.

43. Hurkmans EJ, Maes S, de Gucht V, Knittle K, Peeters AJ, Ronday HK, Vlieland TP. Motivation as a determinant of physical activity in patients with rheumatoid arthritis. Arthritis Care Res (Hoboken). 2010 Mar;62(3):371-7. doi: 10.1002/acr.20106. PMID: 20391483.

44. Srikesavan C, Williamson E, Thompson JY, Cranston T, Swales C, Lamb SE. The online version of an evidence-based hand exercise program for people with rheumatoid arthritis: A mixed-method, proof-of-concept study. J Hand Ther. 2022 Jul-Sep;35(3):468-476. doi: 10.1016/j.jht.2020.10.011. Epub 2020 Oct 26. PMID: 33279362.

45. Sieczkowska SM, Smaira FI, Mazzolani BC, Gualano B, Roschel H, Peçanha T. Efficacy of home-based physical activity interventions in patients with autoimmune rheumatic diseases: A systematic review and meta-analysis. Semin Arthritis Rheum. 2021 Jun;51(3):576-587. doi: 10.1016/j.semarthrit.2021.04.004. Epub 2021 Apr 16. PMID: 33945907.

46. Manning VL, Hurley MV, Scott DL, Coker B, Choy E, Bearne LM. Education, self-management, and upper extremity exercise training in people with rheumatoid arthritis: a randomized controlled trial. Arthritis Care Res (Hoboken). 2014 Feb;66(2):217-27. doi: 10.1002/acr.22102. PMID: 23925924.

47. Brady SM, Fenton SAM, Metsios GS, Bosworth A, Duda JL, Kitas GD, Veldhuijzen van Zanten JJCS. Different types of physical activity are positively associated with indicators of mental health and psychological wellbeing in rheumatoid arthritis during COVID-19. Rheumatol Int. 2021 Feb;41(2):335-344. doi: 10.1007/s00296-020-04751-w. Epub 2020 Nov 30. PMID: 33258004; PMCID: PMC7703721.

48. Kupczyk D, Bilski R, Szeleszczuk Ł, Mądra-Gackowska K, Studzińska R. The Role of Diet in Modulating Inflammation and Oxidative Stress in Rheumatoid Arthritis, Ankylosing Spondylitis, and Psoriatic Arthritis. Nutrients. 2025 May 7;17(9):1603. doi: 10.3390/nu17091603. PMID: 40362911; PMCID: PMC12073256.

49. Rudan I, Sidhu S, Papana A, Meng SJ, Xin-Wei Y, Wang W, Campbell-Page RM, Demaio AR, Nair H, Sridhar D, Theodoratou E, Dowman B, Adeloye D, Majeed A, Car J, Campbell H, Wang W, Chan KY; Global Health Epidemiology Reference Group (GHERG). Prevalence of rheumatoid arthritis in low- and middle-income countries: A systematic review and analysis. J Glob Health. 2015 Jun;5(1):010409. doi: 10.7189/jogh.05.010409. PMID: 25969732; PMCID: PMC4416333.

50. Zinöcker MK, Lindseth IA. The Western Diet-Microbiome-Host Interaction and Its Role in Metabolic Disease. Nutrients. 2018 Mar 17;10(3):365. doi: 10.3390/nu10030365. PMID: 29562591; PMCID: PMC5872783.

51. Salgado E, Bes-Rastrollo M, de Irala J, Carmona L, Gómez-Reino JJ. High Sodium Intake Is Associated With Self-Reported Rheumatoid Arthritis: A Cross Sectional and Case Control Analysis Within the SUN Cohort. Medicine (Baltimore). 2015 Sep;94(37):e0924. doi: 10.1097/MD.0000000000000924. PMID: 26376372; PMCID: PMC4635786.

52. Zhang WC, Zheng XJ, Du LJ, Sun JY, Shen ZX, Shi C, Sun S, Zhang Z, Chen XQ, Qin M, Liu X, Tao J, Jia L, Fan HY, Zhou B, Yu Y, Ying H, Hui L, Liu X, Yi X, Liu X, Zhang L, Duan SZ. High salt primes a specific activation state of macrophages, M(Na). Cell Res. 2015 Aug;25(8):893-910. doi: 10.1038/cr.2015.87. Epub 2015 Jul 24. PMID: 26206316; PMCID: PMC4528058.

53. Jiang X, Sundström B, Alfredsson L, Klareskog L, Rantapää-Dahlqvist S, Bengtsson C. High sodium chloride consumption enhances the effects of smoking but does not interact with SGK1 polymorphisms in the development of ACPA-positive status in patients with RA. Ann Rheum Dis. 2016 May;75(5):943-6. doi: 10.1136/annrheumdis-2015-209009. Epub 2016 Feb 22. PMID: 26903441.

54. Hu Y, Costenbader KH, Gao X, Al-Daabil M, Sparks JA, Solomon DH, Hu FB, Karlson EW, Lu B. Sugar-sweetened soda consumption and risk of developing rheumatoid arthritis in women. Am J Clin Nutr. 2014 Sep;100(3):959-67. doi: 10.3945/ajcn.114.086918. Epub 2014 Jul 16. PMID: 25030783; PMCID: PMC4135503.

55. Gioia C, Lucchino B, Tarsitano MG, Iannuccelli C, Di Franco M. Dietary Habits and Nutrition in Rheumatoid Arthritis: Can Diet Influence Disease Development and Clinical

Manifestations? Nutrients. 2020 May 18;12(5):1456. doi: 10.3390/nu12051456. PMID: 32443535; PMCID: PMC7284442.

56. Sesso HD, Liu S, Gaziano JM, Buring JE. Dietary lycopene, tomato-based food products and cardiovascular disease in women. J Nutr. 2003 Jul;133(7):2336-41. doi: 10.1093/jn/133.7.2336. PMID: 12840203.

57. Buondonno I, Rovera G, Sassi F, Rigoni MM, Lomater C, Parisi S, Pellerito R, Isaia GC, D'Amelio P. Vitamin D and immunomodulation in early rheumatoid arthritis: A randomized double-blind placebo-controlled study. PLoS One. 2017 Jun 5;12(6):e0178463. doi: 10.1371/journal.pone.0178463. PMID: 28582403; PMCID: PMC5459341.

58. Sredkova P, Batsalova T, Moten D, Dzhambazov B. Prebiotics can change immunomodulatory properties of probiotics. *Cent Eur J Immunol*. 2020;45(3):248-255. doi:10.5114/ceji.2020.101237

59. Vidal C, Barnetche T, Morel J, Combe B, Daïen C. Association of Body Mass Index Categories with Disease Activity and Radiographic Joint Damage in Rheumatoid Arthritis: A Systematic Review and Metaanalysis. J Rheumatol. 2015 Dec;42(12):2261-9. doi: 10.3899/jrheum.150224. Epub 2015 Nov 1. PMID: 26523023.

60. Naylor C, Petri WA Jr. Leptin Regulation of Immune Responses. Trends Mol Med. 2016 Feb;22(2):88-98. doi: 10.1016/j.molmed.2015.12.001. Epub 2016 Jan 14. PMID: 26776093.

61. Schäfer M, Meißner Y, Kekow J, Berger S, Remstedt S, Manger B, Listing J, Strangfeld A, Zink A. Obesity reduces the real-world effectiveness of cytokine-targeted but not cell-targeted disease-modifying agents in rheumatoid arthritis. Rheumatology (Oxford). 2020 Aug 1;59(8):1916-1926. doi: 10.1093/rheumatology/kez535. Erratum in: Rheumatology (Oxford). 2020 Aug 1;59(8):2191. doi: 10.1093/rheumatology/keaa049. PMID: 31745566; PMCID: PMC7382601.

62. van Eijk-Hustings Y, Ammerlaan J, Voorneveld-Nieuwenhuis H, Maat B, Veldhuizen C, Repping-Wuts H. Patients' needs and expectations with regard to rheumatology nursing care: results of multicentre focus group interviews. Ann Rheum Dis. 2013 Jun;72(6):831-5. doi: 10.1136/annrheumdis-2012-202810. Epub 2013 May 10. PMID: 23667170.

63. Bounabe A, Elammare S, Janani S, Ouabich R, Elarrachi I. Effectiveness of patient education on the quality of life of patients with rheumatoid arthritis: A systematic review and meta-analysis. Semin Arthritis Rheum. 2024 Dec;69:152569. doi: 10.1016/j.semarthrit.2024.152569. Epub 2024 Oct 11. PMID: 39423700.

64. Matcham F, Rayner L, Steer S, Hotopf M. The prevalence of depression in rheumatoid arthritis: a systematic review and meta-analysis. Rheumatology (Oxford). 2013 Dec;52(12):2136-48. doi: 10.1093/rheumatology/ket169. Epub 2013 Sep 3. PMID: 24003249; PMCID: PMC3828510.

65. Barsky AJ, Ahern DK, Orav EJ, Nestoriuc Y, Liang MH, Berman IT, Kingsbury JR, Sy JT, Wilk KG. A randomized trial of three psychosocial treatments for the symptoms of rheumatoid arthritis. Semin Arthritis Rheum. 2010 Dec;40(3):222-32. doi: 10.1016/j.semarthrit.2010.04.001. PMID: 20621334; PMCID: PMC2993818.