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Optimizing Exercise in Rheumatoid Arthritis: A Systematic Comparison of Aerobic, Resistance, Flexibility, and Lifestyle Approaches

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ABSTRACT

Background: Rheumatoid arthritis (RA) is a chronic autoimmune disease characterized by inflammation, pain, fatigue, and reduced joint function. While pharmacotherapy is essential, growing evidence supports exercise as an adjunct therapy. This systematic review evaluates the effects of various exercise modalities on disease activity, function, fatigue, pain, and quality of life in rheumatoid arthritis. **Aim:** This study aims to systematically review research investigating the effects of regular exercise across various modalities on disease activity, physical function, fatigue, and quality of life (QoL) in RA, and how it may enhance pharmacologic treatment. **Methods:** We reviewed the available literature using the PRISMA checklist and guidelines in which we conducted an electronic search in PubMed, Embase, and Cochrane library from 1994 to 2024. We involved 17 studies that fulfilled the inclusion criteria and analyzed them by qualitative synthesis of clinical/patient reported outcomes. **Results:** Aerobic training was associated with improvements in cardiovascular fitness, Disease Activity Score-28 (DAS-28), and energy levels. Resistance training increased muscular strength and physical capacity, and reduced inflammatory markers such as C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR). Flexibility exercises improved joint mobility and helped with pain control. Everyday lifestyle activities, such as walking, were linked to lower fatigue and greater independence in daily life. **Conclusion:** Exercise is generally safe for people with rheumatoid arthritis (RA) and can improve both clinical outcomes and how patients feel in everyday life. Adapting exercise plans to individual needs may also help make pharmacological treatments more effective overall.

Keywords: Rheumatoid arthritis, Physical activity, Exercise, Functional capacity, Inflammation, Quality of life, Systematic review

1. INTRODUCTION

Rheumatoid Arthritis (RA) is a chronic systemic autoimmune disease that is marked by persistent synovial inflammation, joint destruction, fatigue, and extra-articular

manifestations such as cardiovascular disease and osteoporosis. It is estimated to affect 0.5–1.0% of the adult population worldwide, with a higher prevalence among women and the older population. It has shown an increase in the number of disability-adjusted life-years in recent years (Smolen et al., 2016). Patients with rheumatoid arthritis frequently experience fatigue. It has negative impact on daily functioning, participation in social activities, and overall quality of life (Choy & Dures, 2019). Despite significant progress in pharmacological therapies, including biologics, conventional synthetic disease-modifying antirheumatic drugs (csDMARDs), and targeted synthetic agents such as tofacitinib or baricitinib – many patients continue to experience pain, fatigue, impaired physical function, making it hard to maintain a high quality of life (HRQoL) (Smolen et al., 2016, Choy & Dures, 2019). These persistent deficits highlight the necessity for complementary non-pharmacologic strategies

These ongoing deficits suggest that pharmacological treatment alone may be insufficient and highlight the value of complementary non-pharmacological therapies. There is evidence for the use of regular exercise, including aerobic, resistance, flexibility, and lifestyle physical activity, as a safe and effective adjunct in the treatment of RA. Aerobic conditioning has a positive impact on aerobic capacity, cardiovascular risk, pain, and inflammation, while resistance training enhances muscle strength and daily functioning (Sveaas et al., 2017). Exercise is getting widely recognized as an important component of RA care. A recent systematic review showed that regular exercise can improve cardiorespiratory fitness as well as several aspects of quality of life, including pain, fatigue, vitality, and mental health (Athanasίου et al., 2024).

Patient-reported outcomes like fatigue, physical functioning, and quality of life are viewed as important targets in rheumatoid arthritis research and clinical practice. Fatigue, for example, remains one of the most common symptoms experienced by patients and may remain despite adequate control of disease activity. As a result, it can affect daily functioning, participation in social and occupational activities, and overall well-being (Choy & Dures, 2019). Therefore, exercise and physical activity interventions have attracted increasing interest as complementary strategies to improve fatigue, physical function, and quality of life in patients with RA (Sveaas et al., 2017). The focus on these patient outcomes through targeted exercise is consistent with contemporary models of care that focus on the overall well-being of the patient.

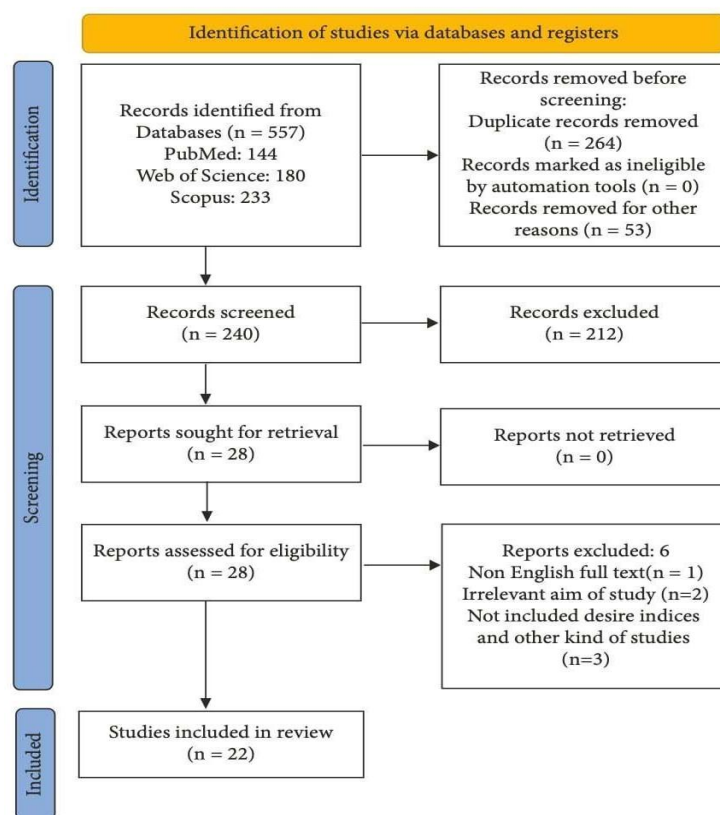


Figure 1: PRISMA flow diagram.

Although numerous systematic reviews have assessed the effects of particular exercise modalities (for example, aerobic or resistance exercise), the existing literature is still scattered according to intervention type, outcome variables, and follow-up times.

Furthermore, there is a requirement for new evidence that combines these interventions targeting both biomedical outcomes, such as disease activity scores, inflammation, and physical function, as well as the psychosocial domain of fatigue and HRQoL. This systematic review seeks to synthesize evidence from the PubMed, Cochrane, and EMBASE databases concerning the effects of regular exercise – including aerobic, resistance, flexibility, and lifestyle physical activity – on disease activity, physical function, fatigue, and health-related quality of life (HRQoL) in adults with rheumatoid arthritis (RA). By evaluating both clinical and well-being outcomes, the review intends to inform best-practice exercise guidelines and highlight existing knowledge gaps.

2. REVIEW METHODS

This review followed PRISMA guidelines. We searched PubMed, Cochrane Library, and Embase to find studies on physical activity in rheumatoid arthritis. The search combined predefined keywords with Boolean operators and included terms such as “rheumatoid arthritis,” “exercise,” “physical activity,” “aerobic training,” “resistance training,” “flexibility,” “fatigue,” “pain,” “quality of life,” “disease activity,” and “functional capacity.” Only studies published between 2000 and 2024 were considered.

To be included, studies had to involve adults diagnosed with rheumatoid arthritis according to ACR or EULAR criteria and evaluate structured exercise or physical activity interventions. Eligible studies also needed to report at least one relevant outcome, such as disease activity, physical function, fatigue, or quality of life. We considered randomized controlled trials, cohort studies, and controlled clinical trials published in English. We excluded case reports, conference abstracts without full data, and studies that did not include outcome measures aligned with the aims of this review.

We documented the study selection process by using the PRISMA 2020 Flow Diagram. Methodological quality, intervention characteristics, and outcome domains were extracted and analyzed in a standardized format for comparison across studies (Figure 1).

3. RESULTS AND DISCUSSION

Impact of aerobic training on RA patients

Aerobic exercise has been broadly investigated as a complementary therapeutic approach in rheumatoid arthritis, with several studies confirming its benefits on cardiovascular fitness, disease activity, fatigue, and quality of life. Aerobic exercise resulted in significant improvements in cardiorespiratory function, as evident by the increase in peak oxygen uptake (VO₂ peak), walking distance, and endurance tests.

A meta-analysis performed by Sveaas et al., (2017) found that Participants in the aerobic exercise group showed a significant 2.41 ml/kg/min increase in VO₂ peak compared to the control group, reflecting improved cardiovascular function and physical capacity. The improvements were observed in interventions that included walking, cycling, water-based exercise, and treadmill training for at least 8 weeks, 2-3 times a week. Lemmey et al., (2009) observed that aerobic interval training in patients with stable RA resulted in an improvement in aerobic function without worsening joint symptoms.

Several studies revealed that regular aerobic exercise is associated with reduced disease activity. In an umbrella review, aerobic exercise resulted in a statistically significant reduction in DAS-28 scores and CRP levels, particularly in low to moderate intensity programs lasting ≥12 weeks (Sveaas et al., 2017). In a randomized controlled trial, van den Ende et al., (2000) reported that an exercise program which included bicycle training improved muscle strength and physical functioning without worsening disease activity. Neuberger et al., (2007) found that patients with rheumatoid arthritis who took part in a structured aerobic exercise program experienced noticeable improvements in aerobic fitness and functional capacity. The intervention did not cause disease activity or other disease outcomes, supporting the safety and effectiveness of aerobic exercise as a component of comprehensive rheumatoid arthritis management.

Aerobic exercise seems to help reduce fatigue and improve energy levels. A systematic review by Metsios et al., (2008) found that people who took part in structured aerobic training reported a moderate reduction in fatigue compared with those who remained inactive. Reduction in pain intensity was also noted, especially in trials where aerobic training was combined with education or behavioral interventions (Cramp et al., 2013).

Patients undergoing aerobic training showed improved HRQoL, particularly in the domains of vitality, physical function, and mental health. Twelve-week moderately intense aquatic aerobic workouts were linked to significant improvements in selected aspects of quality of life related to health, especially vitality and physical function, among patients suffering from RA. This type of exercise did not increase disease activity levels. Regular aquatic aerobic exercise performed at moderate intensity levels over a period of 12 weeks was effective in improving quality of life for the RA patients. This type of exercise did not increase disease activity levels (Bilberg et al.,

2005). In one trial, aerobic training drove a 22% improvement in HAQ-DI scores, reflecting improved functional ability and independence (Häkkinen et al., 2001).

Aerobic exercises have been shown to be safe and tolerated in RA patients. There were no studies that reported significant adverse events or dropouts due to exacerbation of symptoms (Sveaas et al., 2017). Moderate-intensity 30- to 60-minute aerobic workouts, two to three times a week, were most commonly associated with successful outcomes with minimal risk (Athanasίου et al., 2024).

Impact of strength training on RA patients

Strength training is an effective and safe non-pharmacologic treatment for patients with rheumatoid arthritis. Resistance exercise like dynamic strength training with rubber bands, resistance machines, and dumbbells is proven to significantly decrease the disease activity score measured by DAS-28 (SMD = -0.69; 95% CI: -1.26 to -0.11) and lower erythrocyte sedimentation rate (ESR) (SMD = -0.86; 95% CI: -1.65 to -0.07) (Baillet et al., 2012). These effects are especially prominent in programs that incorporate progressive overload with moderate to high intensity (40–90% of one-repetition maximum, 1RM) (Sveaas et al., 2017).

Many studies showed improvements in functional ability, especially in walking function, lower limb strength, and climbing ability. Strength gains of 30–44% in knee extensors were achieved after 12–24 weeks of progressive resistance training (Lemmey et al., 2009; Häkkinen et al., 2001). Strength training was also linked to moderate decreases in patient-reported fatigue. Interventions that included 2 to 3 strength training sessions per week for more than 8 weeks lead to significant reductions in fatigue severity levels as measured by the Fatigue Severity Scale (FSS) and Visual Analog Scale (VAS) (de Jong et al., 2009). Pain relief was also often seen in studies that combined strength exercise with physical therapy or education components. One trial showed a mean reduction of 1.8 points on a 10-point pain scale after a 10-week high-intensity strength training program (Häkkinen et al., 2001). Strength training was also not found to have any negative effects on disease symptoms and joint integrity, indicating that strength training is safe in patients with RA (Sveaas et al., 2017; de Jong et al., 2009).

In addition to the physical benefits, there were also psychological benefits. Patients who underwent resistance training showed improved scores in areas such as emotional well-being, vitality, and physical functioning, as measured by the SF-36 and HAQ-DI scales (Metsios et al., 2008; van den Berg et al., 2007).

All the clinical trials reviewed showed that strength training was effectively managed by patients with RA. The training was closely monitored by physiotherapists or exercise instructors, and there were few adverse events. There was no increase in joint damage, disease flares, or withdrawal from training due to pain (Sveaas et al., 2017; Metsios et al., 2008; Häkkinen et al., 2001). In summary, resistance training can help decrease disease activity, enhance quality of life, and relieve symptoms of pain and fatigue.

Impact of flexibility training on RA patients

Flexibility training, which includes stretching, range-of-motion exercises, and mobility exercises, is a crucial part of physical therapy in patients with rheumatoid arthritis (RA). While it has been observed to be effective when combined with other treatments, its individual efficacy has also been explored, especially in relation to joint function, pain management, and quality of life.

Flexibility exercises are an important part of rehabilitation for people with rheumatoid arthritis, as they help keep joints moving and reduce stiffness. In the randomized trial by van den Ende et al., range-of-motion exercises were included within a structured program and were associated with improved physical function, without any increase in disease activity. Similarly, Bilberg et al. demonstrated that flexibility training can be safely incorporated into rehabilitation programs and serves as a valuable complement to other forms of exercise aimed at preserving mobility and functional capacity in patients with rheumatoid arthritis. Further studies suggest that supervised exercise programs incorporating flexibility and upper extremity exercises can improve arm and hand function in patients with rheumatoid arthritis. In a randomized controlled trial, Manning et al., (2014) demonstrated that a physiotherapist-supervised upper limb exercise program led to significant improvements in upper extremity disability, function, and handgrip strength.

Flexibility exercises seem to bring small but noticeable improvements in fatigue and in how patients feel about their quality of life. In a randomized trial comparing flexibility training with walking, both approaches reduced fatigue to a similar extent, although walking offered greater cardiovascular benefits (Bilberg et al., 2005). Interestingly, people were more likely to stick with flexibility training, which may indicate that it feels easier to manage, especially for those with more active disease or stronger joint limitations. Flexibility training also seems to work better when it is part of a broader treatment approach rather than used alone. When stretching is

included in programs such as yoga, Tai Chi, or physiotherapy-based interventions, studies have reported added benefits like reduced pain and better psychological well-being (Wang et al., 2005).

In all the studies, flexibility exercises were generally well tolerated, with no adverse events or exacerbation of the disease reported. The interventions were low-intensity, required minimal equipment, and could be performed either daily or on alternate days. The programs that emphasized on individualized instruction and progressive development were associated with the highest levels of compliance.

Impact of lifestyle physical activity on RA patients

Lifestyle physical activity, which involves activities of a low to moderate level of intensity (e.g., walking, gardening, housekeeping, and active transportation), has been increasingly identified as an alternative to structured exercise programs for patients who suffer from RA. Although lifestyle physical activity has been studied less than aerobic or resistance training, there is growing evidence that it can still make a meaningful difference for people with rheumatoid arthritis (RA), particularly in terms of physical function, fatigue, and health-related quality of life (Iversen et al., 2017).

Regular daily activity has also been linked with better functioning and a lower risk of functional decline in this population. Veldhuijzen van Zanten et al., (2015) found that people with RA who stay physically active tend to report better function and quality of life than those who are inactive. At the same time, many patients still struggle to reach recommended activity levels, often because of pain, fatigue, or fear that movement might worsen their symptoms. These results were also found in a clinical trial conducted by Katz et al., which found that an increase of as few as 1,000 steps per day was associated with improved joint function and decreased morning stiffness (Katz et al., 2018).

Lifestyle physical activity helps decrease fatigue in RA patients in a manner similar to that of structured aerobic exercise, especially when performed on a regular basis over time. A randomized controlled study conducted by Durcan et al., (2014) showed that a 12-week exercise program at home resulted in a significant reduction in Fatigue Severity Scale (FSS) scores in patients with rheumatoid arthritis. Not only did the program help reduce fatigue but there were other benefits like improved quality of sleep, less pain, stiffness, and better functional status as compared to the control group. These findings indicate that even small amounts of physical activity throughout the day can help alleviate one of the most debilitating symptoms of RA. Although lifestyle physical activity is not known to directly reduce inflammatory mediators such as CRP or ESR, walking is a safe and accessible form of exercise for patients with rheumatoid arthritis. The results of a randomized controlled trial conducted by Baxter et al., (2016) which investigated the feasibility of structured walking at three to four sessions a week, indicated the feasibility and safety of walking and showed no evidence of increased pain or adverse events associated with the regimen. Even though the trial had a small sample size and therefore was underpowered to provide evidence for the effectiveness of walking in reducing symptoms, the results favor the modality.

Daily activity is also a contributing factor in the HRQoL domains of vitality, mood, and independence. In a mixed-methods study carried out by Hootman et al., (2012), RA patients who met daily step goals had higher scores in the SF-36 mental and physical health domains and reduced feelings of hopelessness. The patients highlighted the mental health benefits of feeling a sense of autonomy through regular movement, even if it is not in a physical activity class.

The first advantage of lifestyle physical activity is its accessibility and compliance. Organized physical activity classes are often reliant on tracking and equipment, but lifestyle activities can be tailored to suit the changing symptoms and fatigue levels of patients. The level of compliance with lifestyle interventions is as high as 80-90%, particularly when combined with digital tracking, self-monitoring, or behavioral interventions (Katz et al., 2018; Hootman et al., 2012). There were no adverse events or flare-ups reported in studies involving light to moderate lifestyle physical activity, making it a safe option.

This systematic review offers evidence in favor of the incorporation of regular exercise, including aerobic, resistance, flexibility, and lifestyle exercise, into the treatment of rheumatoid arthritis (RA). The results show the safety and effectiveness of organized physical exercise in suppressing disease activity, easing pain and fatigue, and improving functional status and quality of life in patients with RA (Table 1).

Aerobic exercise seems to bring benefits that line up well with earlier research, including better cardiovascular health and lower levels of systemic inflammation, reflected in reduced DAS-28 scores and CRP levels (Sveaas et al., 2017; van den Ende et al., 2000). Importantly, longer-term moderate exercise programs did not appear to trigger disease flares or worsen joint inflammation. On top of that, improvements in VO₂ peak and walking distance suggest that aerobic activity supports both overall fitness and everyday physical function.

Resistance training, particularly when incorporating progressive overload, improves muscle strength and physical function, and also reduces fatigue (Baillet et al., 2012; Lemmey et al., 2009; Häkkinen et al., 2001). A reduction in inflammatory markers such as ESR suggests that resistance training may offer benefits beyond standard rehabilitation and could even have potential disease-modifying effects. This is consistent with previous meta-analyses highlighting the anti-inflammatory and functional benefits of high-intensity strength training in patients with stable rheumatoid arthritis (Baillet et al., 2012).

Flexibility training is an important part of rehabilitation for people with rheumatoid arthritis, as it helps maintain joint mobility and eases stiffness. Stretching and range-of-motion exercises are often included in exercise programs for RA and are generally safe, without making disease activity worse. Studies show that these types of exercises can help people maintain mobility and stay more independent in daily life, which is why they are considered an important part of overall rehabilitation (van den Ende et al., 2000; Bilberg et al., 2005). When combined with practices like yoga or Tai Chi, flexibility training may also bring additional benefits, such as improved mental well-being and less effort needed during exercise (Wang et al., 2010).

Even though lifestyle physical activity hasn't been studied as extensively, it remains a practical and effective way to manage symptoms. Programs encouraging walking, stair climbing, and general daily movement showed clear benefits, with good adherence and a low risk of harm (Katz et al., 2018; Hootman et al., 2012). These results simply underscore the increasing trend toward patient-practitioner, behaviorally based approaches to managing chronic conditions, in which physical activity is promoted outside of the structured setting.

In all modalities, the safety profile of exercise in RA patients was confirmed. There were no studies included that showed an increase in joint damage, flares, or serious adverse events. This is especially important for practicing clinicians who may be reluctant to prescribe exercise to patients with joint inflammation or systemic disease. The results of this review support promoting exercise as an adjunct to pharmacological therapy in the treatment of RA.

Overall, this dataset supports the idea that exercise should be promoted alongside medication in RA treatment. That said, there are some limitations to keep in mind. The variety in intervention designs, outcome measures, and lengths of follow-up makes it difficult to draw direct comparisons across studies. Additionally, information on how well patients stick with their exercise routines once outside the controlled environments of clinical trials is limited. Also, there is still a lack of clear evidence about how personalized exercise programs, ones tailored to the specific stage of disease, other health conditions, or patient preferences, really perform.

Future research should focus on stronger randomized controlled trials that use consistent outcome measures and follow patients for longer periods of time. It would also be helpful to directly compare different types of exercise, as well as combinations of approaches, to see what works best for different people. Overall, this kind of evidence would make it easier to design more personalized and effective exercise programs (Table 1).

Table 1. Overall comparison of exercise modalities in rheumatoid arthritis

Exercise modality	Disease activity	Pain	Fatigue	Physical function	Quality of life
Aerobic exercise	↓DAS-28, ↓CRP, reduced inflammatory activity	Moderate improvement	Moderate reduction	Improved walking distance, aerobic capacity, and daily functioning	Improved physical and mental health domains
Resistance training	↓DAS-28, ↓ESR	Moderate improvement	Significant reduction	Improvement in muscle strength and functional capacity	Improved vitality, physical functioning, and emotional well-being
Flexibility training	Minimal effect on inflammatory markers	Reduced pain and morning stiffness	Mild reduction	Improved joint mobility, ROM, hand function, and grip strength	Small improvements in patient-reported outcomes
Lifestyle physical activity (walking, daily movement, stair climbing)	Limited direct effect on inflammatory markers	Mild-to-moderate improvement	Significant reduction	Improved mobility and reduced functional decline	Improved vitality, independence, mood, and overall HRQoL

4. CONCLUSION

This review highlights the value of maintaining regular physical activity – whether aerobic, resistance, flexibility exercises, or general lifestyle movement – as an important part of managing rheumatoid arthritis. Regardless of study design, type of exercise, or population, there was a clear positive effect of exercise on disease activity, fatigue, pain, physical function, and health-related quality of life. Aerobic and resistance exercise had the most profound effect on inflammatory indices and cardiovascular fitness. In contrast, flexibility exercises helped improve joint range of motion and reduce symptoms, especially in more advanced patients. Lifestyle physical activity proved to be a viable and practical alternative, with clear benefits and high levels of adherence and safety. All forms of exercise were safe and did not increase disease flare-ups. These results support the inclusion of individualized and evidence-based physical activity as a regular component of RA management. Future studies are needed to better define exercise programs and their long-term effectiveness in the RA population.

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Authors' Contributions

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Methodology, [Julia Dzięcioł, Weronika Dmoch, Kinga Dzioba];

Formal analysis, [Julia Dzięcioł];

Investigation, [Julia Dzięcioł, Kinga Dzioba, Szymon Chmiela];

Writing – original draft, [Julia Dzięcioł];

Writing – review & editing, [Julia Dzięcioł, Weronika Dmoch, Kinga Dzioba, Gabriela Kamińska, Szymon Chmiela, Natalia Bołtralik, Julia Sawicka, Zuzanna Banaś, Paulina Kisielewska];

Supervision, [Julia Dzięcioł, Gabriela Kamińska].

Informed consent

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Ethical approval

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Conflict of interest

The authors declare that they have no conflicts of interest, competing financial interests or personal relationships that could have influenced the work reported in this paper.

Data and materials availability

All data associated with this study will be available based on the reasonable request to corresponding author.

REFERENCES

1. Athanasiou A, Papazachou O, Rovina N, Nanas S, Dimopoulos S, Kourek C. The effects of exercise training on functional capacity and quality of life in patients with rheumatoid arthritis: a systematic review. *J Cardiovasc Dev Dis* 2024;11(6):161. doi:10.3390/jcdd11060161.
2. Baillet A, Vaillant M, Guinot M, Juvin R, Gaudin P. Efficacy of resistance exercises in rheumatoid arthritis: meta-analysis of randomized controlled trials. *Rheumatology (Oxford)* 2012;51(3):519-527. doi:10.1093/rheumatology/ker330
3. Baxter SV, Hale LA, Stebbings S, Gray AR, Smith CM, Tretharne GJ. Walking is a feasible physical activity for people

- with rheumatoid arthritis: a feasibility randomized controlled trial. *Musculoskeletal Care* 2016;14:47–56. doi:10.1002/msc.1112
4. Bilberg A, Ahlmén M, Mannerkorpi K. Moderately intensive exercise in a temperate pool for patients with rheumatoid arthritis: a randomized controlled study. *Rheumatol (Oxford)*. 2005;44(4):502–508. doi: 10.1093/rheumatology/keh528
5. Choy EH, Dures M. Fatigue in rheumatoid arthritis. *Rheumatology (Oxford)* 2019;58(Suppl 5):v1-v2. doi: 10.1093/rheumatology/kez314.
6. 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;8:CD008322. doi:10.1002/14651858.CD008322.pub2
7. de Jong Z, Munneke M, Kroon HM, Zwinderman AH, Kvien TK, Hazes JMW, Vliet Vlieland TPM. Long-term follow-up of a high-intensity exercise program in patients with rheumatoid arthritis. *Clin Rheumatol* 2009;28(6):663–671. doi:10.1007/s10067-009-1125-z.
8. Durcan L, Wilson F, Cunnane G. The effect of exercise on sleep and fatigue in rheumatoid arthritis: a randomized controlled study. *J Rheumatol* 2014;41(10):1966–1973. doi: 10.3899/jrheum.131282
9. Häkkinen A, Sokka T, Kotaniemi A, Hannonen P. A randomized two-year study of the effects of dynamic strength training on muscle strength, disease activity, functional capacity, and bone mineral density in early rheumatoid arthritis. *Arthritis Rheum* 2001;44(3):515–522. doi: 10.1002/1529-0131(200103)44:3<515::AID-ANR98>3.0.CO;2-5
10. Hootman JM, Helmick CG, Brady TJ. A public health approach to addressing arthritis in older adults: the most common cause of disability. *Am J Public Health* 2012; 102(3):426–433. doi:10.2105/AJPH.2011.300423
11. Iversen MD, Frits M, von Heideken J, Cui J, Weinblatt M, Shadick NA. Physical activity and correlates of physical activity participation over three years in adults with rheumatoid arthritis. *Arthritis Care Res (Hoboken)* 2017; 69(10):1535–1545. doi:10.1002/acr.23156
12. Katz P, Margaretten M, Gregorich S, Trupin L. Physical Activity to Reduce Fatigue in Rheumatoid Arthritis: A Randomized Controlled Trial. *Arthritis Care Res (Hoboken)* 2018;70(1):1–10. doi:10.1002/acr.23230
13. 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;61(12):1726–1734. doi:10.1002/art.24891.
14. 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;66(2):217–227. doi:10.1002/acr.22102
15. Metsios GS, Stavropoulos-Kalinoglou A, Veldhuijzen van Zanten JJ, Treharne GJ, Panoulas VF, Douglas KM, Koutedakis Y, Kitas GD. Rheumatoid arthritis, cardiovascular disease and physical exercise: a systematic review. *Rheumatology (Oxford)* 2008;47(3):239–48. doi:10.1093/rheumatology/kem260.
16. Neuberger GB, Aaronson LS, Gajewski B, Embretson SE, Cagle PE, Loudon JK, Miller PA. Predictors of exercise and effects of exercise on symptoms, function, aerobic fitness, and disease outcomes of rheumatoid arthritis. *Arthritis Rheum* 2007;57(6):943–952. doi:10.1002/art.22903
17. Smolen JS, Aletaha D, McInnes IB. Rheumatoid arthritis. *Lancet* 2016;388(10055):2023–38. doi: 10.1016/S0140-6736(16)30173-8
18. Sveaas SH, Smedslund G, Hagen KB, Dagfinrud H. Effect of cardiorespiratory and strength exercises on disease activity in patients with inflammatory rheumatic diseases: a systematic review and meta-analysis. *Br J Sports Med* 2017;51(14):1065–1072. doi:10.1136/bjsports-2016-097149.
19. van den Berg MH, de Boer IG, le Cessie S, Breedveld FC, Vliet Vlieland TP. Are patients with rheumatoid arthritis less physically active than the general population? *J Clin Rheumatol* 2007;13(4):181–186. doi:10.1097/RHU.0b013e318124a8c4
20. van den Ende CH, Breedveld FC, le Cessie S, Dijkmans BA, de Mug AW, Hazes JM. Effect of intensive exercise on patients with active rheumatoid arthritis: a randomised clinical trial. *Ann Rheum Dis* 2000;59(8):615–21. doi: 10.1136/ard.59.8.615.
21. Veldhuijzen van Zanten JJ, Rouse PC, Hale ED, Ntoumanis N, Metsios GS, Duda JL, Kitas GD. Perceived Barriers, Facilitators and Benefits for Regular Physical Activity and Exercise in Patients with Rheumatoid Arthritis: A Review of the Literature. *Sports Med* 2015;45(10):1401–12. doi:10.1007/s40279-015-0363-2.
22. Wang C, Roubenoff R, Lau J, Kalish R, Schmid CH, Tighiouart H, Rones R, Hibberd PL. Effect of Tai Chi in adults with rheumatoid arthritis. *Rheumatol (Oxford)* 2005;44(5):685–7. doi: 10.1093/rheumatology/keh572.