MLTJ
Muscles, Ligaments and Tendons Journal

REVIEW

EFFECTS OF RESISTANCE TRAINING IN RHEUMATOID ARTHRITIS: A SYSTEMATIC REVIEW WITH META-ANALYSIS

Flávia Heloísa da Silva, Gabriella Lopes Capellaro, Ana Caroline Barbosa Retameiro, Marcia Rosangela Buzanello Azevedo, Lucinéia de Fátima Chasko Ribeiro, Márcia Miranda Torrejais, Gladson Ricardo Flor Bertolini

Universidade Estadual do Oeste do Paraná, Cascavel, Brazil

Corresponding author's e-mail: gladsonricardo@gmail.com

Received: 17/04/2025
Accepted: 02/10/2025
Published: 27/08/2026

Conflict of interests: The Authors declare that there are no competing interests.
Fundings: Fundação Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).
Data availability: The data is in possession of the authors and can be presented if necessary.
Contributions: All authors were responsible for the conceptualization and research protocol; FHS, GLC, ACBR, MRBA and GRFB were responsible for the search strategy; FHS, GLC and ACBR were the reviewers of the study; LFCR, MMT and GRFB were responsible for technical supervision; MRBA was responsible for reviewing the systematic review; FHS wrote the manuscript; GLC, ACBR, MRBA, LFCR, MMT and GRFB were responsible for critically reviewing the manuscript.
This article is licensed under a CC Attribution-NonCommercial-NoDerivatives 4.0 License

LEVEL OF EVIDENCE: 1

ABSTRACT

Introduction: Rheumatoid arthritis (RA) is a systemic, chronic, autoimmune inflammatory condition that affects the joints, leading to deformities that limit mobility and impair physical function.

Aim: To systematically review the effectiveness of high-intensity resistance training in individuals with rheumatoid arthritis.

Materials and methods: The following indexed databases were searched: PubMed, Web of Science, Embase, Scopus, Latin American and Caribbean Health Sciences (LILACS), and Cochrane. Gray literature sources included Google Scholar, OpenGrey, and ProQuest. The risk of bias was assessed using the RoB 2 tool. The outcomes analyzed were functional capacity, quality of life, and pain intensity. Statistical analysis was conducted using RevMan 5.4.1.

Results: A total of 1,357 records were identified, with four studies meeting the inclusion criteria. The total sample comprised 150 participants. Subjective functional capacity showed improvement (MD = -0.26; 95% CI [-0.50, -0.02]; p = 0.03; I^2 = 0%), as did objective functional capacity (MD = 2.30; 95% CI [1.24, 3.35]; p <0.0001; I^2 = 10%), both favoring the intervention group. However, pain intensity did not differ significantly between groups, while quality of life showed a significant improvement in favor of the intervention.

Conclusion: High-intensity resistance exercise is effective in improving both subjective and objective functional capacity in individuals with rheumatoid arthritis. Additionally, it has a positive impact on quality of life. However, the effects on pain intensity were inconsistent. Functional capacity improvements may be attributed to gains in strength, stability, and motor control, which promote greater independence in daily activities, even when pain reduction is not substantial.

KEYWORDS

Rheumatoid arthritis, physical function, resistance training, pain measurement, quality of life

Publisher smc media srl

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic, progressive, autoimmune inflammatory disease that primarily affects the joints[1]. It impacts approximately 1% of the global population, is more prevalent in women, and its incidence increases around the age of 50[2]. As the prevalence of RA tends to rise due to population aging, it is likely to have a significant impact on healthcare costs and health systems with the ongoing inversion of the age pyramid[3].

Patients with RA often exhibit poor exercise tolerance[4], as the progression of the disease leads to edema, pain, stiffness, structural damage, and joint deformities that limit mobility, resulting in physical inactivity and compromised muscle condition[3]. Additionally, symptoms such as fatigue, muscle atrophy, altered body composition, reduced quality of life, cardiovascular complications, impaired immune and pulmonary function, osteoporosis, glucose intolerance, and increased mortality[1–3,5], are commonly associated with the disease and may further discourage individuals with RA from maintaining an active lifestyle.

Individuals with RA have, on average, a 15% reduction in lean body mass compared to healthy controls[5]. Despite the recommendation of regular resistance training (RT) as part of standard care for RA by both the American College of Rheumatology (ACR)[6] and the European League Against Rheumatism (EULAR), only 1–14% of patients consistently engage in strength training. Common barriers include difficulty remembering exercise techniques and fear of symptom exacerbation[2].

Although some authors consider strength training a safe intervention — capable of improving muscle strength, body composition, and functional capacity, as well as reducing pain and inflammatory markers[2], others regard the effectiveness of resistance training (RT) as controversial, with mixed results concerning its impact on RA-related disability[3]. This inconsistency may stem from limitations in participation due to joint degeneration, along with variations in access, cost, and exercise load. These factors contribute to uncertainty regarding the potential for joint damage or deformities, particularly at higher intensities[6]. Therefore, the objective of this systematic review was to evaluate the effectiveness of high-intensity resistance training in individuals with rheumatoid arthritis.

MATERIALS AND METHODS

Study design

This systematic review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) and registered in the Open Science Framework (OSF) under DOI: 10.17605/OSF.IO/GY97S.

Eligibility criteria

The research question guiding this study was formulated based on the PICOS acronym: P (population) - individuals with rheumatoid arthritis; I (intervention) - RT, above 70% of one-repetition maximum (1 RM); C (comparison) - no intervention, or exercises with insufficient range of motion to promote a hypertrophic response, or medication; O (outcome) - subjective and objective functional capacity, quality of life and pain intensity; S (study type) - randomized clinical trials.

The inclusion criteria comprised studies that met the following conditions: participants were women and men diagnosed with rheumatoid arthritis classified as functional class I or II, or described as clinically controlled, without joint deformities that would prevent participation in exercise programs; aged 18 years or older; on stable medication for at least three months; and engaged in resistance training (RT) at an intensity above 70%, as measured by a maximal or submaximal repetition test (1 RM to 3 RM). No restrictions were applied regarding language or publication date.

The exclusion criteria were:

1) Arthritic individuals at an advanced stage of the disease, with severe functional impairment;
2) Arthritic individuals with other autoimmune diseases, rheumatic diseases not associated with RA or serious comorbidities (e.g. cancer, kidney disease, liver disease, coronary artery disease, endocrine disorders, diabetics, any disease that promotes cachexia, fibromyalgia, joint deformities that would not allow them to perform the exercises, or patients who have undergone arthroplasty in any weight-bearing joint);
3) Therapies combined with other types of exercise;
4) Intervention time of less than two weeks;
5) Absence of a control group;
6) Study conducted with animals;
7) Hidden intensity or below 70% of 1 MR in all sets;
8) Incomplete articles, reviews, guides or manuals.

Sources of information

The indexed databases used were PubMed, Web of Science via Clarivate, Embase via Elsevier, Scopus, Latin American and Caribbean Health Sciences (LiLACS) via the Virtual Health Library (VHL) and Cochrane. The gray literature databases searched were Google Scholar, Open Grey and ProQuest. The search was conducted across all databases on September 4, 2024, and updated on February 27, 2025. The search was carried out on a single day to prevent new manuscripts from entering the databases and thus interfering with the total found.

Search strategy

Medical Subject Headings (MeSH) and Health Sciences Descriptors (DeCS) from the Virtual Health Library (VHL) website were used to define the search terms. The keywords used were “Arthritis, rheumatoid” and “Resistance Training” and their alternative terms with the Boolean operators AND and OR.

Selection of studies

EndNote Web and Rayyan QCRI (Qatar Computing

© 2026 The Author(s) - Doi: 10.32098/mltj_2026_7475

Eligible studies/ country	Study design	Sample size	Intervention protocol	Frequency/session duration / intervention duration	Time point	Outcomes/measurement instrument	Conclusion
Lemmey et al.[8] United Kingdom	Randomized controlled trial	N = 28 EG (n = 13) CG (n = 15) Age: EG (56 ± 8) CG (61 ± 11) Year after diagnosis: EG (6.2 ± 6.3) CG (10.4 ± 8.4) Sex: 23 F and 5 M	EG: PRT- warm-up (10 min. low-intensity range of movement) 1ª week: 1 set; 2ª week: 2 sets; 3ª – 24ª week: 3 sets. 15 repetitions/set at 60% of 1 RM in week 1-4; 12 repetitions/set at 70% of 1 RM in week 5-6; 8 repetitions/set at 80% of 1 RM in weeks 7–24, cool-down (10 min. low-intensity range of movement). CG: Low-intensity range of movement twice weekly at home.	Twice a week; Duration: 24 weeks	T0) Baseline T1) Immediately post-intervention	**Functional capacity:** • HAQ • 30-second arm curl • 30-second chair stand • 50-foot walk • Maximum knee extension strength.	24 weeks of PRT proved safe and effective in restoring lean mass and function in patients with RA.
Islam et al.[9] Pakistan	Randomized control interventional study	N = 30 EG (n = 15) CG (n = 15) Age: EG (20 to 55) CG (20 to 55) Year after diagnosis: Not mentioned Sex: Not mentioned	EG: Range of motion and isometric exercises for 4 weeks. After 4 weeks, patients were switched to progressive isotonic resistance exercises starting with 6 repetitions for 4 weeks, with 65% of 1RM, with progression of load, reaching 95-100% of 1RM after 12 weeks, with a rest interval of 3-5 min between each series. CG: (DMARDS) only.	1º moment - 6 times / week 2º moment - 3 times / week 1º moment – 30 min 2º moment - 40 min Duration: 12 weeks (1º moment – 4 wk 2º moment – 8 wk)	T0) Baseline T1) Immediately post-intervention	**Quality of life:** • SF-36 **Pain:** • Not mentioned	High-intensity exercise training was more effective in increasing aerobic capacity, muscle strength, joint mobility and physical function, without detrimental effect on disease activity, in patients with controlled RA.
Lourenzi et al.[11] Brazil	Randomized controlled clinical trial	N = 60 EG (n = 27) CG (n = 33) Age: EG (52.63 ± 7.10) CG (50.88 ± 8.57) Year after diagnosis: EG (11.3 ± 8.7) CG (9.1 ±5.8) Sex: 55 F and 5 M	EG: warm up (5 min.). Principal training: 2 sets of 8 repetitions, The first set with 50% and the second set with 70% of the 1 RM, with a rest interval of 2 min between each set. CG: conventional drug treatment.	Twice a week / 50-60 min; Duration: 12 weeks	T0) Baseline T1) 6 weeks T2) 12 weeks (post-intervention) T3) Follow-up: 24 weeks (12 weeks post-intervention)	**Functional capacity:** • HAQ • Grip strength • Muscle strength (1 repetition maximum) **Quality of life:** • SF-36 **Pain:** • NPRS (0 – 10 cm)	Improvement of physical function, in patients with rheumatoid arthritis, without adverse effects.
Rodrigues et al.[10] Brazil	Randomized controlled trial	N = 32 EG (n = 16) CG (n = 16) Age: EG (58.0 ± 6.6) CG (58.1 ± 5.9) Year after diagnosis EG (15.6 ± 10.39) CG (12.8 ± 7.4) Sex: 32 F	EG: HL-RT: First week 50% 1 RM, second week: 4 sets of 10 repetitions with 70% 1 RM, 5 sets starting from the fifth week. CG: usual activities of daily living.	Twice a week; Duration: 12 weeks	T0) Baseline T1) Immediately post-intervention	**Functional capacity:** • HAQ • TST • TUG • Maximum dynamic muscle strength of quadriceps extension **Quality of life:** • SF-36 **Pain:** • VAS	Improved muscle strength and function, with possible benefits in pain and quality of life in women with RA.

Table 1. *Summary characteristics of the randomized clinical trials included in this review (n = 04). Data such as country of origin, sample characteristics, intervention and main results are presented. Abbreviations: RA, rheumatoid arthritis; PRT, progressive resistance training; CG, control group; EG, experimental group; HL-RT, high-load resistance training group; BFRT, blood-flow restriction training group; F, female; M, male; Sec, seconds; min, minutes; 1 RM, one-repetition maximum; ADL, activities of daily living; NPRS, Numeric Pain Rating Scale; VAS, visual analog pain scale; HAQ, Health Assessment Questionnaire; DMARD, disease modifying antirheumatic drugs; SF-36, 36-Item Short-Form Survey (questionnaire); TST, timed-stands test; TUG, timed-up-and-go test.*

Research Institute) software were used to collect the references and exclude duplicates.

The selection of records was conducted independently and blindly by two reviewers (R1 and R2), in two phases. In the first phase, titles and abstracts were screened according to the predetermined eligibility criteria. In the second phase, the full texts of records that passed the initial screening were assessed in detail. A third reviewer (R3) was involved in both phases to resolve any discrepancies between the primary reviewers before a final decision was made.

Individual assessment of the risk of bias in studies

The risk of bias was assessed using Cochrane's ROB 2 tool by two blind reviewers (R1 and R2). Any discrepancies were resolved by a third reviewer (R3). All selected studies were evaluated across five domains: deviations from planned interventions, missing data in the results, measurement of outcomes, selection of reported outcomes, and the overall risk of bias. Each domain was categorized as having low risk, some concerns, or high risk of bias.

Meta-analysis

Statistical analysis was performed using RevMan 5.4.1 (The Cochrane Collaboration, Software Update, Oxford, UK)[7]. Continuous results were expressed as standardized mean difference (with 95% confidence intervals (95% CI). A p-value of <0.05 was considered statistically significant. The Q^2 and I^2 statistical test values were calculated to test for heterogeneity between studies. An I^2 values of 0% to 40% might not be important; 30 to 60% may represent moderate heterogeneity; 50 to 90% may represent substantial heterogeneity; 75 to 100% may represent considerable heterogeneity[7]. A random effects model was adopted when statistically significant heterogeneity was identified. When necessary, transformations were used according to the Cochrane Handbook, Chapter 6[8].

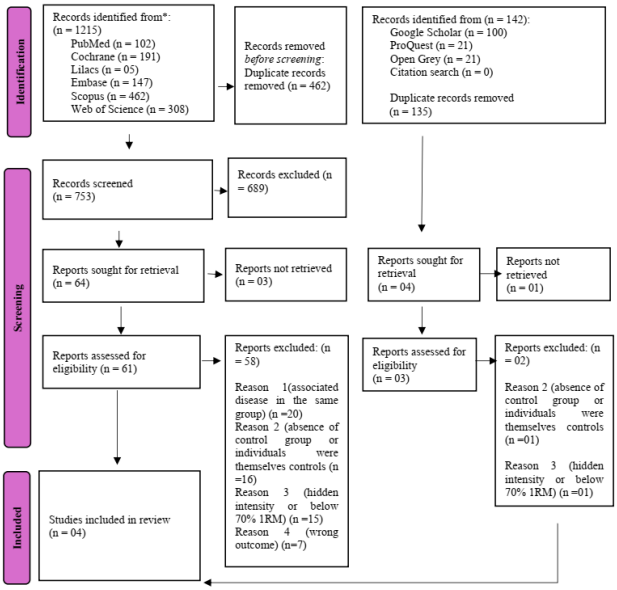


Figure 1. *PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources. After the various stages, four articles were included in the review.*

RESULTS

This systematic review included four studies assessing the effectiveness of high-intensity resistance training (RT) in rheumatoid arthritis. The outcomes evaluated were subjective and objective functional capacity, quality of life, and pain intensity. *Table 1* summarizes the key findings of the clinical trials included in this review.

Study selection

A total of 1,357 records were identified during the search, with 1,215 found in the main databases and 142 in gray literature. Of these, 597 duplicate records were excluded, leaving 757 studies for Phase 1 (title and abstract screening). A total of 58 studies proceeded to Phase 2 (full-text screening), resulting in 4 studies included in this review *(Fig. 1)*.

Individual study evaluation

Characterization of the sample

One study was conducted in the United Kingdom[5], one in Pakistan[9] and two in Brazil[10,11]. The total sample included 150 participants, comprising 110 women and 10 men. The study by Islam et al.[9] did not report gender distribution. Of these participants, 90 were under the age of 55, and 60 were above this age. The study by Lemmey et al.[5] included individuals with a lower average age at diagnosis, ranging from 6 to 10 years old, while the study by Rodrigues et al.[10] included participants with a higher average age at diagnosis, ranging from 13 to 16 years old. The study by Islam et al.[9] did not mention this factor.

Time points

Three randomized clinical trials included in this review assessed baseline and post-intervention outcomes[5,9,10]. The study by Lourenzi et al.[11] differed, as it evaluated baseline measures, reassessed at 50% of the intervention protocol, at the end of the intervention, and again at a follow-up 12 weeks later.

Primary outcome: functional capacity - subjective instrument

Subjective functional capacity, the primary outcome of this review, was assessed in three studies[5,10,11] using the Health Assessment Questionnaire (HAQ). The HAQ consists of 20 items that evaluate functional capacity through questions about daily life activities, divided into 8 components: dressing, getting up, eating, walking, personal hygiene, reaching objects, grasping objects, and other activities. Each item is scored from 0 to 3, where 0 indicates no difficulty, 1 indicates some difficulty, 2 indicates a lot of difficulty, and 3 indicates inability to

© 2026 The Author(s) - Doi: 10.32098/mltj_2026_7475

perform the activity. Therefore, higher scores reflect worse functional capacity, and the overall score is calculated as the average of the highest score for each component[12].

Secondary outcomes: functional capacity - objective instruments

Objective functional capacity was assessed using various instruments across the studies. In the study by Lemmey et al.[5], the following tests were used: upper limb function (30-second arm curl test), lower limb function (30-second chair stand test), gait speed (50-foot walk test), and maximum isometric knee extension strength. In the 50-foot walk test, improvement is indicated by a reduction in the time required to complete the test. The 30-second arm curl test measures upper limb muscle strength and function by counting the number of biceps curls performed correctly in 30 seconds while holding a 2.27 kg dumbbell for women and 3.63 kg for men. The 30-second chair stand test evaluates lower limb strength and function by counting the number of repetitions the participant can perform in 30 seconds, from sitting to standing, with their arms crossed in front of their chest. The results of both tests are compared to a normative table that provides the ideal range of repetitions for each age group[13]. If the number of repetitions is above or below the norm, the result is considered above or below average for that age group.

Lourenzi et al.[11] used handgrip strength measured by a dynamometer, taking the average of three repetitions. Muscle strength was also assessed using the one-repetition maximum (1 RM) test, which determines the maximum load (kg) an individual can lift once with proper technique. The study mentions that exercises such as leg press, chest press, leg extension, seated rowing, leg curl, triceps extension, standing calf raises, and bicep curl were performed on a multi-stack machine, but does not report the isolated results for each group assessed.

Rodrigues et al.[10] used the Timed Up and Go (TUG) test and the Timed Stands Test (TST) to assess maximum dynamic quadriceps extension strength. In the TUG, participants are instructed to stand up from a chair, walk back and forth at a comfortable pace to a cone 3 meters away, and sit back down. The time taken to complete the task is recorded, with shorter times indicating better performance. The TST measures the number of repetitions performed in 30 seconds from sitting to standing without using the hands. Both tests assess dynamic balance and lower limb muscle strength[14], with a higher number of repetitions indicating a better result. The strength testing protocol followed a structured method to assess maximum muscle strength safely and accurately. Prior to the 1 RM test, participants performed a progressive warm-up with loads of 50% and 70% of their estimated 1 RM, followed by up to 5 attempts at 3-minute intervals to determine their maximum load. The tests were performed on the leg press and knee extension machines, with a focus on lower limb strength, particularly the quadriceps.

Quality of life - subjective instrument

Islam et al.[9], Lourenzi et al.[11] and Rodrigues et al.[10] used the Short Form Health Survey 36 (SF-36). The SF-36 consists of 36 questions, with higher scores indicating better quality of life, where 100 represents the maximum score[15].

Pain intensity - subjective instrument

Islam et al.[9] did not specify the instrument used to assess pain, while Lourenzi et al.[11] used the Numerical Pain Scale (NPS 0-10 cm), and Rodrigues et al.[10] used the Visual Analogue Scale (VAS 0-10). In both scales, 0 indicates no pain and 10 indicates intolerable pain.

Analysis of the risk of bias

As the studies assessed different outcomes, the risk of bias was evaluated separately for each reported outcome. Since there was no common outcome across all four studies included in this review, the risk of bias analysis

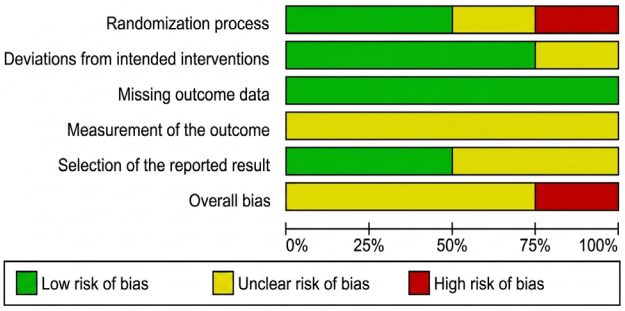


Figure 2. *Risk of bias graph: reviewers' judgements about each risk of bias item presented percentages across all included studies. The percentages are relative to the four studies included, indicating the variations within each item assessed as risk of bias.*

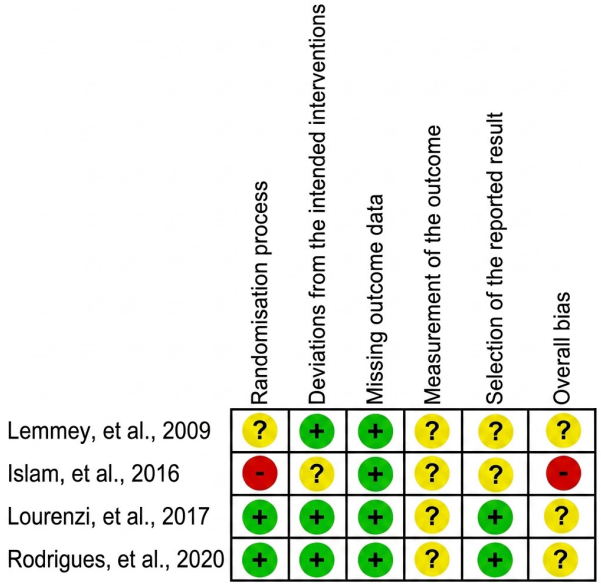


Figure 3. *Risk of bias summary: reviewers' judgements about each risk of bias item for each included study. The studies are presented individually in each row, with the item analyzed for risk of bias presented in each column.*

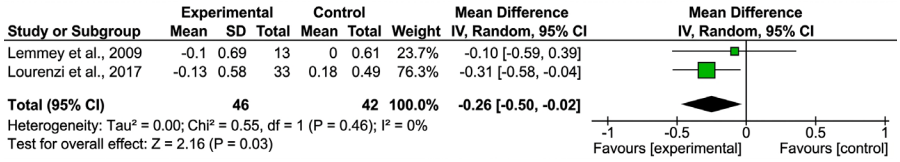


Figure 4. *Forest plot of the effect of high-load exercise vs. control on the outcome of subjective functional capacity. With the overall result favoring the experiment.*

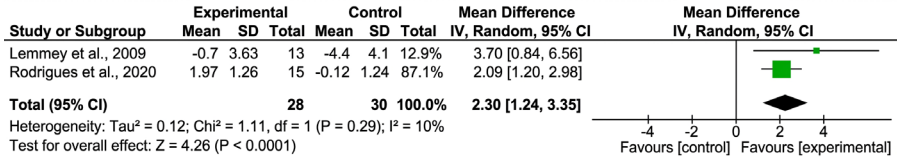


Figure 5. *Forest plot of high-load exercise vs. control for the outcome of objective functional capacity. With the overall result favoring the experiment.*

was conducted focusing on self-reported, e.g., subjective, outcomes. Subjective functional capacity was analyzed in the studies by Lemmey et al.[5], Lourenzi et al.[11], and Rodrigues et al.[10], while quality of life was assessed in the study by Islam et al.[9].

Figure 2 presents the assessment of the risk of bias in the included studies, expressed as a percentage for each domain analyzed. All studies (100%) showed a low risk of bias in domain 3, concerning missing outcome data. The next domain, deviations from the intended interventions, revealed that 75% of studies had a low risk, while 25% showed some concerns. In the domain of selection of reported results, 50% of the studies had a low risk, and 50% showed some concerns. For the outcome measurement, 100% of the studies demonstrated some concerns. Finally, regarding the randomization process, 50% of the studies had a low risk, 25% showed some concern, and 25% exhibited a high risk of bias. The overall risk of bias assessment indicated that 75% of the studies had some concerns, while 25% had a high risk of bias.

Figure 3 presents a summary of the risk of bias, showing the reviewers' judgment on each risk of bias item for each included study. In domain 1, "randomization process," the studies by Lourenzi et al.[11] and Rodrigues et al.[10] were classified as having a low risk of bias, indicating appropriate allocation of participants into the groups and maintenance of allocation concealment. The study by Lemmey et al.[5] raised some concerns, as it did not provide information regarding the confidentiality of the allocation. The study by Islam et al.[9] was classified as having a high risk of bias in this domain.

In domain 2 "deviations from the intended interventions", the studies by Lemmey et al.[5], Lourenzi et al.[11] and Rodrigues et al.[10], were considered to have a low risk of bias, indicating that the interventions were conducted as planned. However, the study by Islam et al.[9], raised some concerns regarding this criterion.

In domain 3, "missing outcome data," all the studies were classified as having a low risk of bias, indicating that there was significant data loss that compromised the analysis. In domain 4, "measurement of outcomes," all the studies analyzed[5,9–11] raised some concerns. This was due to the fact that the risk of bias assessment was based on self-reported outcomes, where the study participants themselves acted as the evaluators, potentially compromising the objectivity of the results.

In domain 5, "selection of reported results," the studies by Lourenzi et al.[11] and Rodrigues et al.[10] were considered to have a low risk of bias, indicating that the outcomes were reported in a manner consistent with the original plan. On the other hand, the studies by Lemmey et al.[5] and Islam et al.[9] raised some concerns due to the lack of prior registration of the studies.

Finally, the evaluation of the "general risk of bias" indicated that the studies by Lourenzi et al.[11], Rodrigues et al.[10] and Lemmey et al.[5] raised some concerns, while the study by Islam et al.[9] was classified as having a high risk of bias.

Results of outcomes

The outcomes analyzed included subjective (HAQ) and objective functional capacity (TSU, TUG, 30-second arm curl, 30-second chair stand, 50-foot walk, maximum isometric knee extension strength, handgrip strength, muscle strength, and maximum dynamic quadriceps extension strength), pain intensity (NPS and VAS), and quality of life (SF-36).

The subjective and objective functional capacity outcomes were meta-analyzed, while pain intensity and quality of life were presented descriptively.

Meta-analysis: outcome - subjective functional capacity

The functional capacity outcome, measured by the HAQ, was assessed through physical performance tests or specific questionnaires for rheumatoid arthritis. The mean difference (MD) found was -0.26 (95% CI: -0.50 to -0.02), favoring the intervention group (high-load exercise) over the control group. The absence of heterogeneity between the studies (I^2 = 0%) suggests consistency in the findings. The pooled effect estimate revealed statistical significance (p = 0.03), indicating that high-load exercise may have a beneficial effect on functional capacity compared to the control group *(Fig. 4)*.

Outcome - objective functional capacity

In the objective functional capacity outcome, measured by standardized scales used in the included studies (objective measures), the mean difference (MD) found was 2.30 (95%

CI: 1.24 to 3.35), favoring the intervention group over the control group. The low heterogeneity between the studies (I^2 = 10%) suggests consistency in the findings. The pooled effect estimate revealed statistical significance (p <0.0001), indicating that high-load exercise may have a beneficial effect on objective functional capacity compared to the control group *(Fig. 5)*.

Outcome - pain intensity

A significant reduction in pain was found in the study by Islam et al.[9], where 100% of participants had moderate to severe pain at baseline. After 12 weeks of resistance training (RT), 7.7% of the control group still experienced severe pain, while the remaining participants in this group reported a reduction to mild or moderate pain. In the intervention group, no participant had severe pain, and more than 57% reported mild pain after 12 weeks of exercise. Pain interference in activities of daily living improved in both groups, with extreme interference scores ranging from 46.7% to 60% in the control group, compared to 15.4% and 0% in the control and intervention groups, respectively, after the intervention.

In the study by Lourenzi et al.[11], pain intensity showed no statistical difference between the groups throughout the experiment when evaluated using the numerical scale (p = 0.895). However, in the intra-group evaluation, both groups showed a significant reduction (p = 0.039). On the other hand, the SF-36 questionnaire in the pain domain revealed a significant reduction in the intervention group compared to the control group (p = 0.027). Rodrigues et al.[10] found no statistical difference in the VAS scale between the groups.

Outcome - quality of life

Islam et al.[9], Lourenzi et al.[11] and Rodrigues et al.[10] used the SF-36 questionnaire to assess participants' quality of life. This questionnaire covers eight domains, and the studies analyzed showed significant improvements in some of these domains, particularly in the groups that participated in physical exercise programs.

In the study by Islam et al.[9] there was an improvement in the perception of general health after the intervention. Initially, 86.7% of participants reported poor health at baseline. However, after the intervention, this rate dropped to 28% in the intervention group, while it remained at 77% in the control group. Furthermore, when analyzing the health rating, it was observed that 85.7% of participants in the exercise group reported feeling better after the intervention, while 14.3% remained unchanged. In the control group, 61.3% reported improvement, 23% saw no change, and 15.4% reported worsening after 12 weeks. Another aspect assessed was the interference of physical or emotional problems with social activities. At the start of the study, the predominant responses were: moderately (66.7% in the experimental group and 46.7% in the control group) and severely (33.3% and 46.7%, respectively). After the intervention, the majority of participants in the intervention group reported that the problems interfered slightly (85.7%), followed by moderately (7.14%) and not at all (7.14%). In the control group, participants responded: slightly (61.53%), moderately (15.4%), and severely (23%), suggesting a less positive impact in the absence of the intervention. In the study by Lourenzi et al.[11], the results indicated a statistically significant difference in two domains for the intervention group: functional capacity (p = 0.022) and pain (p = 0.027), showing an improvement in health-related quality of life for patients who participated in the progressive resistance training program.

Similarly, Rodrigues et al.[10] found a significant improvement in the "physical function" domain (p = 0.016) in the intervention group, while no significant changes were observed in the control group across any of the SF-36 domains.

DISCUSSION

The aim of this systematic review was to synthesize the evidence on the efficacy of high-intensity resistance training (RT) in the treatment of controlled rheumatoid arthritis (RA), focusing on three main outcomes: subjective and objective functional capacity, quality of life, and pain intensity. Four clinical trials that met the eligibility criteria were included. The meta-analysis performed suggests that high-intensity RT can provide significant benefits, leading to improvements in functional capacity compared to no exercise. Additionally, a positive response was observed in the quality of life outcome in favor of the intervention group. However, the results regarding pain intensity were conflicting, with no significant reduction observed compared to the control group.

The studies analyzed demonstrated that resistance training (RT) has a positive influence on both subjective and objective functional capacity. Objective functional capacity was assessed using physical tests that measure mobility, balance, and muscle strength. In the Rodrigues et al.[10] study, the Timed-Up-and-Go (TUG) and Timed-Stands Test (TST) showed improvements in mobility and dynamic balance, evidenced by reduced TUG times and an increased number of repetitions in the TST, indicating progress in the functional capacity of the lower limbs[14]. In addition to these objective assessments, subjective functional capacity was evaluated using the SF-36 questionnaire, which revealed improvements in health perception and daily activity performance, as reported in the studies by Islam et al.[9] and Lourenzi et al.[11].

These results can be explained by the fact that, in addition to muscle strengthening, resistance training (RT) promotes positive adaptations in connective tissue, the primary component of ligaments and tendons, as well as in hyaline cartilage, which covers the joints. RT also increases bone density and improves bone strength. Strengthening these structures provides greater joint protection and stability, improves mobility, and reduces overload on compromised joints, enabling patients to carry out daily activities more

efficiently and with a lower risk of injury[16–18]. Furthermore, RT enhances motor coordination, balance, proprioception, and other skills[19], allowing for more efficient movement. Another important factor is neuromuscular adaptation, which improves muscle fiber recruitment, increases central nervous system activation, enhances the contraction inhibition process, reduces neural inhibitory processes, decreases fatigue, and increases tolerance to effort[18,20,21], all of which contribute to increased functional capacity.

Reduced levels of physical activity in individuals with RA contribute to sarcopenia, exacerbating the muscle mass loss and impairing both physical function and functional capacity[22]. In addition, systemic inflammation, mediated by cytokines such as TNF-α, IL-1β, and IL-6, accelerates muscle catabolism, worsening sarcopenia and negatively impacting functional capacity and quality of life[23].

Although drug treatments effectively control inflammation and reduce pain, they do not directly impact muscle strength and, in some cases, may even accelerate muscle mass loss, as seen with the use of glucocorticoids[24,25]. RT stands as the primary strategy for combating sarcopenia and preserving functionality, with evidence supporting its benefits even in patients who are less responsive to conventional treatment[26].

The review by Santos et al.[27] which included 10 studies, showed that low-intensity RT with restricted blood flow increased strength and muscle mass, improving functionality in women with RA and osteoarthritis. In contrast, Wen and Chai[28], who analyzed 17 studies evaluating different intensities of RT, observed improvements in physical function and reductions in disease activity, but no significant changes in pain perception. These findings suggest that the relationship between RT and pain reduction may be influenced by factors such as exercise intensity, duration, and progression. These variables influence muscle adaptation and can significantly impact pain reduction by altering its perception. The release of neurotransmitters such as β-endorphin, for example, can vary depending on the exercise protocol. Longer duration exercises (with lower resistance) and longer intervals between sets tend to induce the most significant release of this neurotransmitter. High-speed training also generates an endogenous opioid response to physical activity, which is associated with pain relief and enhanced well-being[29–31].

However, consistent with the findings of Wen and Chai[28], who observed an improvement in functionality, the studies in this review did not show a significant reduction in pain. This can be explained by psychophysiological or motor planning mechanisms[32], often associated with kinesiophobia, a condition common in individuals with chronic pain[33], and frequently seen in patients with moderate to severe RA[34]. Kinesiophobic factors — such as fear of symptom exacerbation, pain, early fatigue, and a lack of proper professional guidance — negatively affect exercise adherence[35]. Intensity and frequency of exercise are critical variables for achieving the medium and long-term benefits of resistance training on pain, which, in turn, impacts patients' activities of daily living and overall quality of life.

As for quality of life, significant improvements were observed in participants who underwent RT. In the study by Islam et al.[9] there was an improvement in the perception of general health, with a reduction from 86.7% to 28% in the number of participants reporting poor health in the intervention group, while this rate remained high (77%) in the control group. Regarding the interference of physical and emotional problems in social activities, participants in the exercise group reported less impact after the intervention, with an increase in responses indicating slight interference (85.7%) and a decrease in those indicating severe interference (7.14%). In the control group, although some improvements were noted, 23% of participants still reported severe interference. Similar results were found by Lourenzi et al.[11], who identified statistically significant improvements in the functional capacity and pain domains in the intervention group. Rodrigues et al.[10] also found a significant improvement in the physical function domain for the intervention group, while no relevant changes were observed in any of the SF-36 domains for the control group. These findings reinforce the notion that RT not only improves physical functionality but also positively impacts quality of life, health perception, the ability to perform daily activities, mental health, mood, and psychosocial interaction. Thus, the improvements in functionality can be attributed to muscle strengthening, enhanced motor control, and psychological adaptation, all of which contribute to greater independence and efficiency in carrying out daily tasks[36]. Despite this, the American College of Rheumatology's recommendation for RT remains conditional due to the scarcity of studies with high methodological rigor[6]. Therefore, more high-quality studies are needed to establish clear guidelines on the intensity, volume, and frequency of RT for patients with RA, as well as individualized strategies for periods of disease exacerbation. This need for more robust evidence is a significant limitation of this review, which included only four studies. While this limits the strength of the findings, it is worth noting that meta-analyses can be conducted with as few as two clinically similar studies[8].

Overall, the findings of this review suggest that high-intensity RT can be an effective strategy for improving both subjective and objective functional capacity, as well as quality of life in patients with rheumatoid arthritis. These results highlight the importance of incorporating RT into the management of RA, demonstrating that consistent exercise can help reduce functional limitations and contribute to better disease control.

CONCLUSION

High-intensity resistance training (RT) is effective in improving both subjective and objective functional

capacity in individuals with rheumatoid arthritis, as evidenced by statistically significant results in these outcomes. Additionally, a positive impact on quality of life was observed in the exercise group. However, the results regarding pain intensity were conflicting. These findings suggest that high-intensity RT may be a beneficial intervention for improving functionality and quality of life in patients with rheumatoid arthritis. It is important to interpret these results with caution, as the small number of studies included in this review limits the strength of the conclusions.

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. Wu ML, Ma JK, Tsui K, Hoens AM, Li LC. Tailoring strength training prescriptions for people with rheumatoid arthritis: a scoping review. Am J Lifestyle Med. 2024;18(2):200-215. doi: 10.1177/15598276221125415.
3. Baillet A, Vaillant M, Guinot M, Juvin R, Gaudin P. Efficacy of resistance exercises in rheumatoid arthritis: Meta-analysis of randomized controlled trials. Rheumatology. 2012;51(3):519–27. doi: 10.1093/rheumatology/ker330.
4. Li Z, Wang XQ. Clinical effect and biological mechanism of exercise for rheumatoid arthritis: A mini review. Front Immunol. 2023;13:1089621. doi: 10.3389/fimmu.2022.1089621.
5. 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 Care Res (Hoboken). 2009 Dec 15;61(12):1726–34. doi: 10.1002/art.24891.
6. England BR, Smith BJ, Baker NA, Barton JL, Oatis CA, Guyatt G, et al. 2022 American College of Rheumatology Guideline for exercise, rehabilitation, diet, and additional integrative interventions for rheumatoid arthritis. Arthritis Care Res (Hoboken). 2023;75(8):1603–15. doi: 10.1002/acr.25117.
7. Higgins JPT, Altman DG, Gotzsche PC, Juni P, Moher D, Oxman AD, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ. 2011;343(2):d5928–d5928. doi: 10.1136/bmj.d5928.
8. Higgins JPT, Li T, Deeks JJ. Chapter 6: Choosing effect measures and computing estimates of effect. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, et al., editors. Cochrane Handbook for Systematic Reviews of Interventions version 64. version 6.4. 2023.
9. Islam A, Rasul A, Afzal F, Qamar MM, Ahmed I. Strengthening exercises play a vital role in improving the quality of life in patients of rheumatoid arthritis. Int J Med Appl Health. 2016;4(2):54–60.
10. Rodrigues R, Ferraz RB, Kurimori CO, Guedes LK, Lima FR, de Sá-Pinto AL, et al. Low-load resistance training with blood-flow restriction in relation to muscle function, mass, and functionality in women with rheumatoid arthritis. Arthritis Care Res (Hoboken). 2020;72(6):787–97. doi: 10.1002/acr.23911.
11. Lourenzi FM, Jones A, Pereira DF, Santos JHCA Dos, Furtado RNV, Natour J. Effectiveness of an overall progressive resistance strength program for improving the functional capacity of patients with rheumatoid arthritis: A randomized controlled trial. Clin Rehabil. 2017;31(11):1482–91. doi: 10.1177/0269215517698732.
12. Maska L, Anderson J, Michaud K. Measures of functional status and quality of life in rheumatoid arthritis: Health Assessment Questionnaire Disability Index (HAQ), Modified Health Assessment Questionnaire (MHAQ), Multidimensional Health Assessment Questionnaire (MDHAQ), Health Assessment Questionnaire II (HAQ-II), Improved Health Assessment Questionnaire (Improved HAQ), and Rheumatoid Arthritis Quality of Life (RAQoL). Arthritis Care Res (Hoboken). 2011;63(SUPPL. 11):S4–13. doi: 10.1002/acr.20620.
13. Jones CJ, Rikli RE. Measuring functional fitness of older adults. The Journal on Active Aging. 2002;2(2):24–30.
14. Sancar B, Doğan A, Taş S. Timed Up-and-Go Test and Sit-to-Stand Test in community-dwelling older person: Inter and intraobserver reliability among Turkish nurses. Int J Older People Nurs. 2024;19(5):e12649. doi: 10.1111/opn.12649.
15. Laguardia J, Campos MR, Travassos C, Najar AL, Anjos LA dos, Vasconcellos MM. Brazilian normative data for the Short Form 36 questionnaire, version 2. Rev Bras Epidemiol. 2013;16(4):889–97. doi: 10.1590/S1415-790X2013000400009
16. Kristensen J, Franklyn-Miller A. Resistance training in musculoskeletal rehabilitation: a systematic review. Br J Sports Med. 2012;46(10):719–26. doi: 10.1136/bjsm.2010.079376.
17. Tyler J, Dr. Panayotis Thanos. Raising the bar for public health: Resistance training and health benefits. International Journal of Strength and Conditioning. 2023;3(1):1–8. doi: 10.47206/ijsc.v3i1.195.
18. Pal CP, Agarwal V, Srivastav R, Gupta M, Singh S. Physiological adaptations of skeletal muscle and bone to resistance training and Its applications in orthopedics. Journal of Bone and Joint Diseases. 2023 Jan;38(1):3–10. doi: 10.4103/jbjd.jbjd_9_23.
19. Thompson WR. Worldwide survey of fitness trends for 2013 learning objectives. ACSMs Health Fit J. 2012;16(6):8–17. doi: 10.1249/01.FIT.0000422568.47859.35
20. Del Vecchio A, Casolo A, Negro F, Scorcelletti M, Bazzucchi I, Enoka R, et al. The increase in muscle force after 4 weeks of strength training is mediated by adaptations in motor unit recruitment and rate coding. Journal of Physiology. 2019;597(7):1873–87. doi: 10.1113/JP277250.
21. Sale DG. Neural adaptation to resistance training. Med Sci Sports Exerc. 20(5):S135–45. doi: 10.1249/00005768-198810001-00009.
22. Tierney M, Fraser A, Kennedy N. Physical activity in rheumatoid arthritis: A systematic review. J Phys Act Health. 2012;9(7):1036–48. doi: 10.1123/jpah.9.7.1036.
23. Webster JM, Kempen LJAP, Hardy RS, Langen RCJ. Inflammation and skeletal muscle wasting during cachexia. Front Physiol. 2020;11:597675. doi: 10.3389/fphys.2020.597675.
24. Hein TR, Peterson L, Bartikoski BJ, Portes J, Espírito Santo RC, Xavier RM. The effect of disease-modifying anti-rheumatic drugs on skeletal muscle mass in rheumatoid arthritis patients: a systematic review with meta-analysis. Arthritis Res Ther. 2022;24(1):171. doi: 10.1186/s13075-022-02858-y.
25. Lemmey AB, Wilkinson TJ, Clayton RJ, Sheikh F, Whale J, Jones HSJ, et al. Tight control of disease activity fails to improve body composition or physical function in rheumatoid arthritis patients. Rheumatology (United Kingdom). 2016;55(10):1736–45. doi: 10.1093/rheumatology/kew243.
26. Churchward-Venne TA, Tieland M, Verdijk LB, Leenders M, Dirks ML, de Groot LCPGM, et al. There are no nonresponders to resistance-type exercise training inolder men and women. J Am Med Dir Assoc. 2015;16(5):400–11. doi: 10.1016/j.jamda.2015.01.071.
27. dos Santos LP, do Espírito Santo RC, Ramis TR, Portes JKS, da Silva Chakr RM, Xavier RM. The effects of resistance training with blood flow restriction on muscle strength, muscle hypertrophy and functionality in patients with osteoarthritis and rheumatoid arthritis: A systematic review with meta-analysis. PLoS One. 2021;55:1736–45. doi: 10.1371/journal.pone.0259574.
28. Wen Z, Chai Y. Effectiveness of resistance exercises in the treatment of rheumatoid arthritis: A meta-Analysis. Medicine (United States). 2021;100(13):E25019. doi: 10.1097/MD.0000000000025019.
29. Hughes XL, Stephen X, Patterson D. The effect of blood flow restriction exercise on exercise-induced hypoalgesia and endogenous opioid and endocannabinoid mechanisms of pain modulation. J Appl Physiol. 2020;128(4):914–24. doi: 10.1152/japplphysiol.00768.2019.
30. Elliot DL, Goldberg L, Watts WJ, Orwoll E. Resistance exercise and plasma beta-endorphin/beta-lipotrophin immunoreactivity. Life Sci. 1984;34:515–8. doi: 10.1016/0024-3205(84)90483-1.
31. Su CF, Chang YY, Pai HH, Liu IM, Lo CY, Cheng JT. Mediation of β-endorphin in exercise-induced improvement in insulin resistance in obese Zucker rats. Diabetes Metab Res Rev. 2005 Mar;21(2):175–82. doi: 10.1002/dmrr.496.
32. Gosling AP. Physical therapy action mechanisms and effects on pain management. Revista Dor. 2013;13(1):65–70. doi: 10.1590/S1806-00132012000100012.
33. Öztürk İB, Garip Y, Sivas F, Özden MP, Bodur H. Kinesiophobia in rheumatoid arthritis patients: Relationship with quadriceps muscle strength, fear of falling, functional status, disease activity, and quality of life. Arch Rheumatol. 2021;36(3):427–34. doi: 10.46497/ArchRheumatol.2021.8535.
34. Lukovic S, Baralic M, Tomonjic N, Mihailovic J, Neskovic A, Sestakov MV, et al. Do patients with rheumatoid arthritis have an (jn)adequate level of physical activity? A latent class analysis approach. Life. 2024;14(12):1600. doi: 10.3390/life14121600.
35. Thoma LM, Li LC, White DK, Oatis C. Physical therapists play a key role in the comprehensive management of rheumatoid arthritis. Arthritis Care Res (Hoboken). 2023;75(8):1625–8. doi: 10.1002/acr.25123.
36. Fraga RD. Os benefícios do treinamento resistido em idosos. Brazilian Journal of Health Review. 2025;8(1):e76463. doi: 10.34119/bjhrv8n1-027.