

Physical Therapy and Rehabilitation Interventions for Pain and Dysfunction in Rheumatoid Arthritis: A Systematic Review

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Abstract

Rheumatoid arthritis (RA) is a chronic inflammatory condition associated with pain, stiffness, impaired physical function, joint damage, and reduced quality of life. Rehabilitation forms an integral part of RA management, with treatment approaches directed toward maintaining mobility, physical capacity, hand function, and participation in daily activities. This systematic review synthesized evidence from randomized controlled trials evaluating contemporary rehabilitation approaches for adults with RA. Searches were conducted in PubMed/MEDLINE, PEDro, CINAHL, Scopus, and the Cochrane Library for trials published between January 2016 and June 2026. The date range was selected to focus the review on contemporary rehabilitation approaches and digital health interventions while maintaining coverage of recent clinical evidence. In total, 15 randomized controlled trials met the predefined eligibility criteria. Interventions included aquatic exercise, aerobic and resistance training, high-intensity interval training, individualized exercise programs, hand exercise, manual therapy, mobilization with movement, therapeutic hand massage, and selected digital health and self-management approaches, including telehealth, smartphone-based care, and digital education programs. Risk of bias was assessed using the Cochrane Risk of Bias 2 (RoB 2) framework. Findings varied according to the intervention, comparator, outcome, and assessment time point. Exercise-based approaches showed benefits in selected measures of physical capacity, fatigue, pain, and function, although effects were not consistently observed across all outcomes. Hand rehabilitation and manual therapy showed improvements in selected measures of hand function, strength, or pain, while some comparisons demonstrated no additional benefit. Digital and self-management approaches showed potential benefits for selected aspects of disease management, patient engagement, and quality of life. Because of substantial clinical and methodological heterogeneity across interventions, populations, comparators, outcomes, and follow-up periods, findings were synthesized using a structured narrative approach rather than quantitative meta-analysis. Overall, the findings indicate that contemporary physical therapy, rehabilitation, and selected digital or self-management approaches may provide potential benefits for selected outcomes in adults with RA. However, variation in intervention protocols, comparators, outcome measures, follow-up periods, and risk-of-bias judgments limits direct comparison across trials. Further well-designed randomized controlled trials with standardized outcome assessment and adequate follow-up are warranted.

Categories: Pain Management, Physical Medicine & Rehabilitation, Quality Improvement

Keywords: aquatic exercise, digital rehabilitation, exercise-based rehabilitation, high-intensity interval training (hiit), manual therapy

Introduction And Background

Rheumatoid arthritis (RA) is a chronic systemic inflammatory disease that primarily affects synovial joints and can cause persistent pain, joint stiffness, fatigue, muscle weakness, and progressive functional limitations [1-3]. These manifestations may interfere with mobility, hand function, activities of daily living, and participation in social and occupational activities, thereby adversely affecting patients' independence and health-related quality of life [2,4]. Although advances in disease-modifying antirheumatic drugs and other pharmacological treatments have improved the management of RA, patients may continue to experience pain, fatigue, reduced physical capacity, and functional disability [4,5]. Therefore, comprehensive RA management should address not only inflammatory disease activity but also the persistent symptoms and functional consequences that affect everyday life.

Physical therapy and rehabilitation are important components of multidisciplinary RA management. Exercise-based interventions, including aerobic, resistance, aquatic, and individually tailored exercise programs, aim to improve physical capacity, muscle strength, endurance, and functional performance. Hand rehabilitation may address limitations in hand function and difficulties with daily activities, while selected manual therapy techniques may be considered adjuncts to exercise when clinically appropriate [6]. However, the evidence and clinical recommendations are not equivalent across these approaches. Current physical

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therapy guidance emphasizes exercise, education, and self-management support, while recommending caution regarding passive interventions because of limitations in the available evidence and specific clinical contraindications [6]. Rehabilitation-related care may also incorporate digital health and self-management approaches, such as remote support, digital education, and technology-assisted monitoring, to facilitate patient engagement and continuity of care. These approaches address complementary but distinct needs: exercise and selected manual interventions primarily target physical impairments and functional limitations, whereas digital approaches may support education, self-management, and access to care. They should therefore be evaluated according to their specific aims rather than treated as interchangeable interventions.

Previous evidence syntheses have investigated selected aspects of non-pharmacological management in RA. For example, Brady et al. examined lifestyle physical activity and sedentary behavior interventions and reported effects across several outcomes, including physical activity, disease activity, functional ability, and fatigue, while effects were not demonstrated consistently across all assessed outcomes [7]. Clinical practice guidance has also outlined the role of physical therapists in assessing functional limitations and tailoring exercise, education, and self-management support to individual needs [6]. Nevertheless, evidence from different rehabilitation approaches remains distributed across interventions with different therapeutic aims, comparators, outcome measures, and follow-up periods. Findings from a review focused on lifestyle physical activity cannot, by themselves, establish the effectiveness of hand rehabilitation, manual therapy, or digital disease-management interventions. Similarly, improvement from baseline within an intervention group does not necessarily demonstrate a greater benefit than the comparator. These differences make it important to interpret findings according to the intervention delivered, the comparison made, the outcome assessed, and the time point at which it was measured. The major categories of rehabilitation-related interventions evaluated in RA include exercise-based rehabilitation, manual therapy, digital rehabilitation, and self-management interventions. These approaches encompass exercise programs, joint mobilization, therapeutic hand massage, digital health applications, telehealth, patient education, and home-based self-management strategies, as shown in Figure 1.

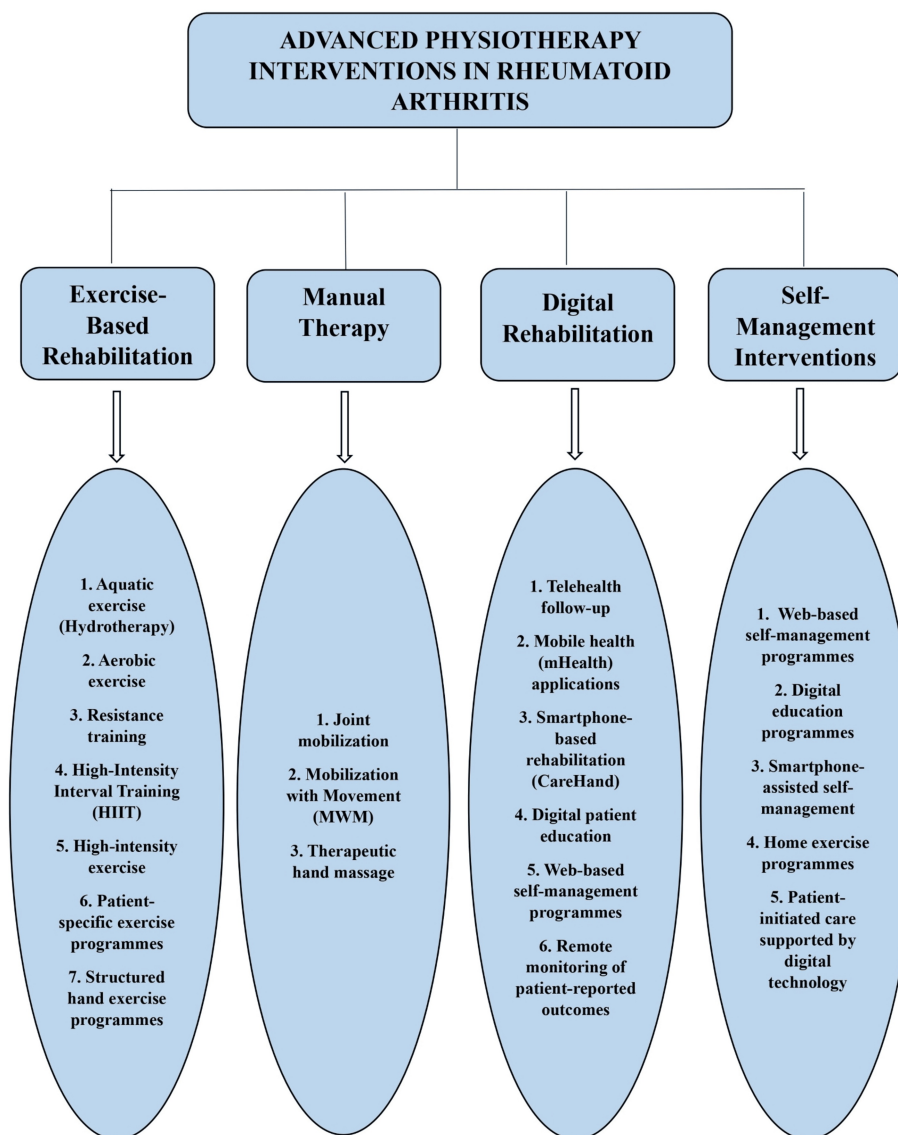


FIGURE 1: Advanced physiotherapy interventions in rheumatoid arthritis.

RA: rheumatoid arthritis; HIIT: high-intensity interval training; MWM: mobilization with movement; mHealth: mobile health; CareHand: smartphone-based hand rehabilitation application

Image created by Durga A. Jagdale, using Microsoft PowerPoint (Microsoft Corporation, Redmond, WA, USA).

A focused synthesis of contemporary randomized controlled trials (RCTs) is therefore needed to clarify the available evidence across relevant physical therapy and rehabilitation approaches, identify where comparative treatment effects remain uncertain, and support clinical decisions based on patients' predominant symptoms and functional goals. The present systematic review addresses this need by examining RCTs published between January 2016 and June 2026 that investigated physical therapy and rehabilitation interventions in adults with RA, including exercise-based rehabilitation, hand-focused interventions, manual therapy, and selected digital health and self-management approaches relevant to rehabilitation-related care. The review evaluates reported outcomes including pain, physical function, fatigue, hand function, physical performance, disease activity, and health-related quality of life, while considering the specific comparators and follow-up periods used in the included studies.

Review

Methodology

Study Design

This systematic review was conducted to evaluate the effectiveness of physical therapy and rehabilitation interventions for reducing pain and improving physical function and other patient-reported outcomes in adults with RA, by synthesizing evidence from RCTs. The review protocol was prospectively registered with the International Prospective Register of Systematic Reviews (PROSPERO) (registration number: CRD420261529966). To maintain high levels of clarity and scientific integrity, this systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework during the data collection and reporting phases [8].

Search Strategy

Electronic database searches were conducted in PubMed/MEDLINE via the NCBI interface, PEDro via the PEDro website, Scopus via the Elsevier platform, CINAHL via the EBSCOhost platform, and the Cochrane Library via its online database interface to identify RCTs published between January 2016 and June 2026. This publication period was selected to focus on contemporary evidence regarding physical therapy and rehabilitation approaches while maintaining coverage of recent clinical trials. The search strategy combined Medical Subject Headings (MeSH) and free-text keywords using Boolean operators (AND, OR). The search terms included “Rheumatoid Arthritis,” “Exercise Therapy,” “Physical Therapy,” “Physiotherapy,” “Rehabilitation,” “Aerobic Exercise,” “Resistance Training,” “High-Intensity Interval Training,” “Aquatic Exercise,” “Hand Exercise,” “Manual Therapy,” “Joint Mobilization,” “Telehealth,” “Digital Health,” “Mobile Application,” “Self-Management,” and “Randomized Controlled Trial.” Database-specific modifications were applied to optimize retrieval. The search was limited to English-language RCTs involving adults diagnosed with RA. The English-language restriction was applied because of the resources available for screening and full-text assessment and may have resulted in the exclusion of potentially relevant studies published in other languages.

Following concerns about search reproducibility and incomplete retrieval, the literature search should be reconstructed using documented, database-specific strategies. The revised search should record the platform, exact search date, complete search string, limits applied, and number of records retrieved from each database. The original date restriction should be reassessed against the review objective and registered protocol. If the search period is expanded, this change should be transparently reported as a protocol deviation, with its rationale documented.

The database-specific search strategies, search dates, and filters or limits applied. No additional searches of clinical trial registries, grey literature sources, or citation databases were performed. Reference-list screening and citation tracking were also not used as supplementary study identification methods. The review therefore relied on the electronic database searches reported in Table 1.

Database	Search date	Search strategy	Filters/Limits applied
PubMed/MEDLINE	July 15, 2026	("Rheumatoid Arthritis"[MeSH Terms] OR "rheumatoid arthritis"[Title/Abstract] OR RA[Title/Abstract]) AND ("Exercise Therapy"[MeSH Terms] OR "exercise therapy"[Title/Abstract] OR "physical therapy"[Title/Abstract] OR physiotherapy[Title/Abstract] OR rehabilitation[Title/Abstract] OR "aerobic exercise"[Title/Abstract] OR "resistance training"[Title/Abstract] OR "high-intensity interval training"[Title/Abstract] OR HIIT[Title/Abstract] OR "aquatic exercise"[Title/Abstract] OR "hand exercise"[Title/Abstract] OR "manual therapy"[Title/Abstract] OR "joint mobilization"[Title/Abstract] OR telehealth[Title/Abstract] OR "digital health"[Title/Abstract] OR "mobile application"[Title/Abstract] OR "self-management"[Title/Abstract]) AND (randomized controlled trial[Publication Type] OR randomized[Title/Abstract] OR randomised[Title/Abstract] OR RCT[Title/Abstract])	Publication date: January 2016–June 2026; Article type: Randomized Controlled Trial
PEDro	July 17, 2026	Rheumatoid arthritis AND (exercise therapy OR physiotherapy OR rehabilitation OR aerobic exercise OR resistance training OR HIIT OR aquatic exercise OR hand exercise OR manual therapy OR joint mobilization OR telehealth OR digital health OR self-management)	Publication period: January 2016–June 2026; Method: Clinical trial/randomized controlled trial
Scopus	July 18, 2026	TITLE-ABS-KEY("rheumatoid arthritis") AND TITLE-ABS-KEY("exercise therapy" OR "physical therapy" OR physiotherapy OR rehabilitation OR "aerobic exercise" OR "resistance training" OR "high-intensity interval training" OR HIIT OR "aquatic exercise" OR "hand exercise" OR "manual therapy" OR "joint mobilization" OR telehealth OR "digital health" OR "mobile application" OR "self-management") AND TITLE-ABS-KEY("randomized controlled trial" OR randomised OR randomized OR RCT)	Publication date: January 2016–June 2026; Document type: Article; Study design: Randomized controlled trials
CINAHL	July 20, 2026	MH "Rheumatoid Arthritis+" AND (MH "Exercise Therapy+" OR "physical therapy" OR physiotherapy OR rehabilitation OR "aerobic exercise" OR "resistance training" OR "high-intensity interval training" OR HIIT OR "aquatic exercise" OR "hand exercise" OR "manual therapy" OR "joint mobilization" OR telehealth OR "digital health" OR "self-management") AND (MH "Randomized Controlled Trials+" OR "randomized controlled trial" OR randomised OR randomized OR RCT)	Publication date: January 2016–June 2026; Publication type: Randomized controlled trial/clinical trial
Cochrane Library	July 21, 2026	("rheumatoid arthritis") AND ("exercise therapy" OR "physical therapy" OR physiotherapy OR rehabilitation OR "aerobic exercise" OR "resistance training" OR "high-intensity interval training" OR HIIT OR "aquatic exercise" OR "hand exercise" OR "manual therapy" OR "joint mobilization" OR telehealth OR "digital health" OR "self-management") AND ("randomized controlled trial" OR randomised OR randomized OR RCT)	Publication date: January 2016–June 2026; Study type: Randomized controlled trial

TABLE 1: Search strategy.

RA: rheumatoid arthritis; MEDLINE: Medical Literature Analysis and Retrieval System Online; PEDro: Physiotherapy Evidence Database; CINAHL: Cumulative Index to Nursing and Allied Health Literature; MeSH: Medical Subject Headings; HIIT: high-intensity interval training; RCT: randomized controlled trial; AND: Boolean operator used to combine search terms; OR: Boolean operator used to broaden the search by including alternative terms

Eligibility Criteria

Inclusion criteria: Studies were included if they were RCTs published in English and involved adult participants diagnosed with RA. Interventions of interest included physical therapy and rehabilitation approaches such as exercise-based interventions, aquatic exercise, hand rehabilitation, manual therapy, mobilization with movement (MWM), and therapeutic massage, as well as selected digital health and self-management approaches relevant to rehabilitation-related care, including telehealth-supported care, smartphone-based interventions, web-based self-management, and digital patient education. Only studies

involving human participants were included, as shown in Table 2.

Criteria	Inclusion criteria	Exclusion criteria
Participants	Adults diagnosed with RA	Healthy individuals or participants with other rheumatic or musculoskeletal disorders
Condition	RA, including generalized RA and hand involvement	Osteoarthritis, juvenile idiopathic arthritis, psoriatic arthritis, ankylosing spondylitis, or other inflammatory conditions
Intervention	Exercise-based rehabilitation, physiotherapy, aquatic exercise, aerobic or resistance training, HIIT, hand exercises, manual therapy, or physiotherapist-/rehabilitation-led telehealth, digital health, smartphone-based, or self-management interventions	Pharmacological treatment alone without a rehabilitation component
Comparator	Usual care, conventional therapy, no intervention, wait-list, attention control, or another eligible comparator	Studies without an appropriate comparator
Study design	RCTs	Observational studies, case reports, case series, reviews, systematic reviews, meta-analyses, editorials, conference abstracts, and study protocols
Language	English	Non-English publications
Outcomes	Pain, fatigue, physical function, hand function, grip strength, quality of life, disease activity, muscle strength, cardiovascular fitness, self-management, patient-reported outcomes, or functional performance	Studies without relevant clinical or functional outcome measures
Population type	Human participants	Animal or laboratory studies

TABLE 2: Eligibility criteria of the included studies.

RA: rheumatoid arthritis; HIIT: high-intensity interval training; RCT: randomized controlled trial

Exclusion criteria: Studies were excluded if they included healthy individuals or participants with musculoskeletal or rheumatic conditions other than RA, such as osteoarthritis, juvenile idiopathic arthritis, psoriatic arthritis, or ankylosing spondylitis. Studies evaluating pharmacological treatment alone without a rehabilitation component, as well as observational studies, case reports, case series, reviews, systematic reviews, meta-analyses, conference abstracts, editorials, and study protocols, were excluded. Non-English publications, studies without relevant clinical or functional outcome measures, and studies involving animal or laboratory research were also excluded, as shown in Table 2.

Study Selection and Data Extraction

Records identified through the reconstructed searches were deduplicated and screened against the predefined eligibility criteria. Full texts were assessed for all potentially eligible reports, and the reasons for exclusion were documented. The final PRISMA flow diagram reports the number of records identified, duplicates removed, records screened, reports sought, reports not retrieved, reports assessed for eligibility, reports excluded with reasons, and independent trials included.

A standardized data extraction form was used to verify each included report against its original publication. Extracted information included the study design, trial registration where available, sample size, participant characteristics, intervention and comparator details, intervention duration, follow-up periods, outcome measures, between-group effect estimates, measures of uncertainty, adverse events, and relevant risk-of-bias information.

Multiple publications arising from the same randomized trial were linked under a single trial identifier. A secondary analysis provided additional outcomes or follow-up data, but it was not counted as an independent randomized trial or as a separate participant sample. Data were assigned to the appropriate trial and outcome, with the source publication identified for each extracted result.

The extraction tables, narrative synthesis, and risk-of-bias assessments were checked against the original reports. Discrepancies were resolved by re-examining the source publication and documenting the

correction. The final number of independent trials and all reported outcome findings were updated only after this verification was complete.

Full-Text Retrieval

Reports identified as potentially eligible were subjected to additional full-text retrieval attempts where the initial search had been unsuccessful. Retrieval efforts included checking publisher websites, available institutional library resources, open-access repositories, and author publication pages. Where appropriate, corresponding authors were contacted to request access to the full text. The outcome of each retrieval attempt was documented, and reports that remained unavailable were recorded as not retrieved. Eligibility assessment was performed only for reports whose full texts could be obtained.

Quality Assessment

Risk of bias was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool for the relevant randomized trial results. The assessment considered the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Judgments were made with reference to the specific outcome, comparison, and time point evaluated rather than treating RoB 2 as a generic measure of overall study quality [9].

Data Synthesis

A quantitative meta-analysis was not performed because the included RCTs showed substantial clinical and methodological heterogeneity in participant characteristics, physical therapy interventions, intervention duration, outcome measures, and follow-up periods. Therefore, findings were synthesized narratively and organized according to intervention type and outcome domain. Reported changes in pain, physical function, hand function, fatigue, quality of life, disease activity, and other relevant outcomes were compared across studies based on the direction and statistical significance of treatment effects. Where reported, effect estimates, measures of variability, and p-values were considered in interpreting the findings. Due to the absence of quantitative pooling, assessment of statistical heterogeneity using I^2 or Cochran's Q , pooled effect estimates with 95% confidence intervals, sensitivity or subgroup meta-analyses, and formal publication bias testing were not applicable.

Results

Study Selection

A total of 205 records were identified through database searching. Before screening, 49 records were removed, comprising 31 duplicate records, 10 records marked as ineligible by automation tools, and eight records removed for other reasons. The remaining 156 records were screened based on their titles and abstracts, and 68 were excluded. Subsequently, 88 reports were sought for retrieval, of which 32 could not be retrieved despite the retrieval attempts undertaken. The remaining 56 reports were assessed for eligibility. Of these, 41 were excluded because of ineligible study design ($n = 19$), a population that did not meet the inclusion criteria ($n = 12$), or insufficient outcome data ($n = 10$). Finally, 15 RCTs were included in the systematic review. Figure 2 shows the PRISMA flowchart.

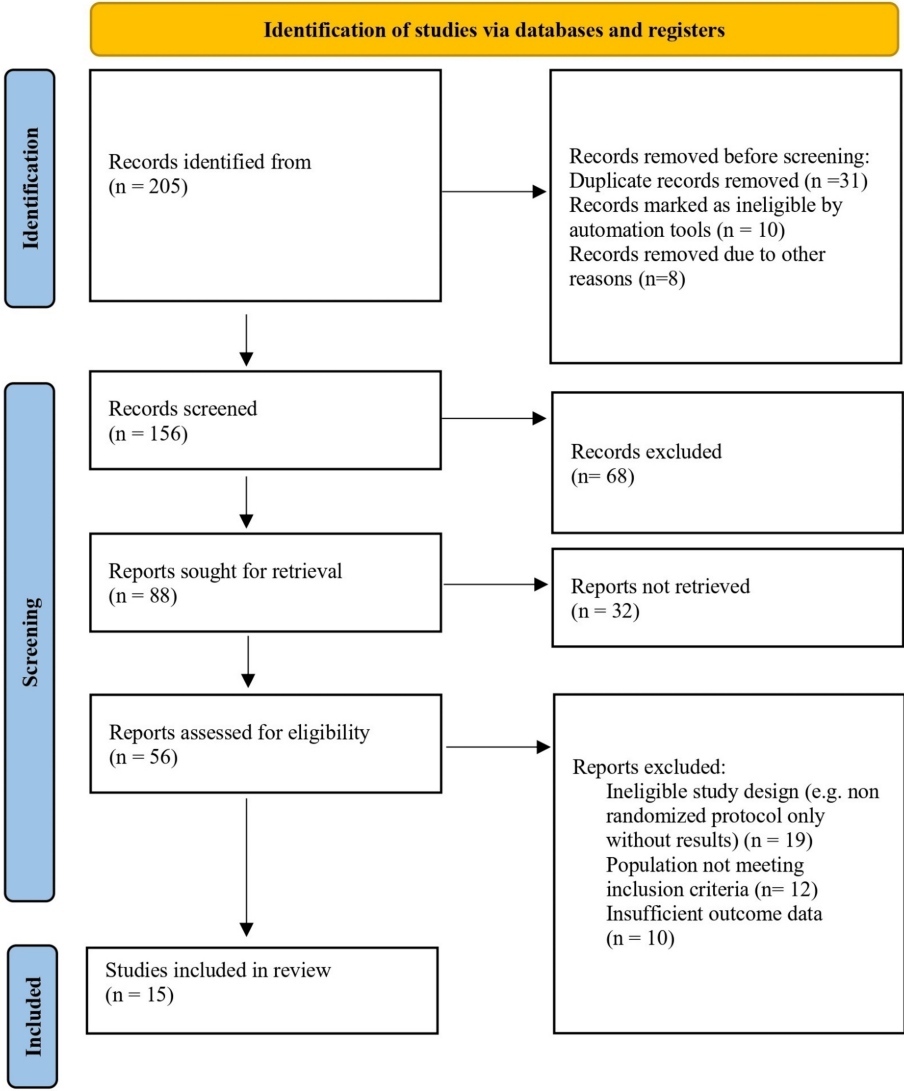


FIGURE 2: PRISMA flow diagram.

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Study Characteristics

The present systematic review included 15 RCTs published between 2016 and 2026, evaluating the effectiveness of exercise-based, manual therapy, and digital health interventions for individuals with RA. The interventions included aquatic exercise, aerobic and resistance training, high-intensity interval training (HIIT), high-intensity exercise, individualized exercise programs, hand exercises, hand massage, joint mobilization, MWM, telehealth follow-up, smartphone application-based rehabilitation, and digital self-management programs. The included studies reported improvements in pain, fatigue, hand function, grip strength, muscle strength, physical function, quality of life, disease activity, cardiovascular fitness, self-management, and patient engagement. Overall, the findings suggest that structured exercise and rehabilitation programs, along with digital health interventions, are effective in improving clinical and functional outcomes in patients with RA. The characteristics of the included studies are summarized in Table 3.

Authors/Year	Study design	Sample size	Population	Intervention (including follow-up)	Outcomes	Key results
			Women	Aquatic exercise		DAS28-ESR decreased in the WB group from 3.8 ± 1.2 at baseline to 3.1 ± 1.0 at 16 weeks; mHAQ

Siqueira et al. (2017) [10]	Randomized controlled trial	73	with RA (generalized RA)	program, 2 sessions/week for 16 weeks; follow-up: 16 weeks	Pain, function, quality of life, physical fitness	decreased from 0.7 ± 0.5 to 0.4 ± 0.4 . The trial reported improvements in disease activity and functional ability with exercise, particularly in the WB group
Williamson et al. (2017) [11]	Randomized controlled trial	490	Adults with RA affecting the hands	Structured hand exercise program plus home exercises; extended follow-up (~26 months)	Hand function, grip strength, disability	At extended follow-up, there was no between-group difference in change in hand function: MD 1.52 (95% CI = -1.71 to 4.76). Exercise participants remained improved from baseline ($p = 0.0014$), whereas usual care did not ($p = 0.1122$), but the between-group effect had diminished
De Thurah et al. (2018) [12]	Randomized controlled trial	294	Adults with RA (generalized RA)	Telehealth-supported rheumatology follow-up with nurse- or rheumatologist-led monitoring follow-up for 52 weeks; follow-up: 52 weeks	Disease activity (DAS28), patient satisfaction, healthcare utilization	In ITT analysis, the DAS28 mean difference versus control was -0.10 (90% CI = -0.30 to 0.13) for rheumatologist-led telehealth and -0.19 (90% CI = -0.41 to 0.02) for nurse-led telehealth. Nurse-led telehealth involved 1.72 ± 1.03 visits/year versus 4.15 ± 1.0 in controls
Lange et al. (2019) [13]	Randomized controlled trial	74	Older adults with RA (generalized RA)	Supervised aerobic and resistance exercise, 3 sessions/week for 20 weeks; follow-up: 20 weeks	Physical function, muscle strength, aerobic capacity	No significant between-group difference was found for the primary HAQ-DI outcome at 20 weeks. Aerobic capacity and 3 of 4 additional performance-based measures improved in the exercise group. At 12 months, no significant between-group difference in HAQ-DI change remained
Levitsky et al. (2019) [14]	Randomized crossover trial	12	Adults with RA affecting the hands	Manual joint mobilization of the hands; randomized crossover design; post-intervention assessment at 2 months	Pain, hand mobility, joint function	Hand pain and inflammatory/ultrasound measures improved over follow-up. MCP joint space increased from approximately 1.1 to 1.4 mm, corresponding to a median 21.2% increase. However, improvements were also observed in control hands, limiting interpretation of treatment-specific effects. No adverse events were reported
Zuidema et al. (2019) [15]	Randomized controlled trial	46	Adults with RA (generalized RA)	Web-based self-management enhancing program; follow-up at 6 and 12 months	Self-management behavior, self-efficacy, health status, pain, fatigue, quality of life	Most between-group comparisons were not statistically significant and effect sizes were small. The RAND-36 vitality outcome showed a difference of 5.41 (95% CI = 0.16–10.65; $p = 0.04$) at 6 months; no consistent benefit across outcomes was demonstrated
Ellegaard et al. (2019) [16]	Randomized controlled trial	55	Women with RA affecting the hands	Hand exercise program addressing range of motion and muscle strength; assessment after 8 weeks	ADL motor ability, hand function, pain, grip strength	ADL motor ability improved within both groups, but there was no between-group difference: MD 0.04 logits (95% CI = -0.16 to 0.25; $p = 0.88$). Clinically relevant improvement occurred in 46.4% versus 44.4% of participants, respectively
Azeez et al. (2020) [17]	Randomized controlled trial	66	Adults with RA (generalized RA)	Individualized exercise program for 12 weeks; follow-up: 12 weeks	Pain, fatigue, physical function	Peak VO_2 increased from 23.2 to 27.6 mL/kg/min in the intervention group ($p = 0.002$), while DAS28 showed no significant between-group difference. HAQ improved from 0.50 to 0.25 ($p = 0.05$), but the between-group difference was not significant. GFI decreased from 13.2 to 10.9 ($p = 0.047$), with a significant between-group difference reported for GFI
Lee et al. (2021) [18]	Randomized controlled trial	191	Adults with RA (generalized RA)	Mobile application for symptom monitoring over 12 months; follow-up: 12 months	Patient-reported outcomes, disease activity	At 6 months, median TSQM was 83.3 in both groups, median PEPPI was 50 in both groups, and median CDAI was 8 versus 10. No statistically significant between-group differences were detected for TSQM, PEPPI, or CDAI
				Smartphone-assisted patient-		Change in DAS28-ESR was noninferior: between-

Seppen et al. (2022) [19]	Randomized controlled trial	103	Adults with RA affecting the hands	initiated care in patients with RA and low disease activity for 3 months and the follow-up to 12 months	Disease activity, healthcare utilization, patient-reported outcomes	group difference -0.04 (95% CI = -0.39 to 0.30). Rheumatologist consultations were lower with app-supported care: 1.7 ± 1.8 versus 2.8 ± 1.4 visits/year; visit rate ratio 0.62 (95% CI = 0.47 – 0.81 ; $p < 0.001$).
Knudsen et al. (2024) [20]	Randomized controlled trial	202	Patients with early RA (generalized RA)	Digital education and self-management program for 12 months; follow-up: 12 months	Self-management, knowledge, patient activation	The mean between-group difference in self-efficacy was -4.34 on the RASE scale (95% CI = -8.17 to -0.51 ; $p = 0.026$), favoring the digital intervention. RA knowledge, health literacy, and QoL showed no important between-group differences, while outpatient contacts were fewer in the digital group
Bilberg et al. (2024) [21]	Randomized controlled trial	100	Adults with RA (generalized RA)	Supervised HIIT, 3 sessions/week for 12 weeks; follow-up: 12 weeks	Cardiorespiratory fitness, cardiovascular health, physical function	VO ₂ max improved by 3.71 mL/kg/min (95% CI = 2.16 – 5.25 ; $p < 0.0001$). Other between-group differences included O ₂ -pulse 1.38 (95% CI = 0.85 – 1.91), sit-to-stand 5.0 (95% CI = 3.35 – 6.72), and grip strength 28.5 (95% CI = 3.80 – 52.8). No significant differences were found for pain -4.0 (95% CI = -13.07 to 5.06) or DAS28 -0.25 (95% CI = -0.60 to 0.10)
Teuwen et al. (2024) [22]	Randomized controlled trial	217	Adults with RA and severe functional limitations	Longstanding (>52 weeks) supervised exercise therapy with individualized goal-setting, active exercises, education, and physical-activity self-management; follow-up: 52 weeks	Patient-Specific Complaints (PSC), HAQ-DI, RAQoL, 6MWT, PROMIS PF-10, SF-36	At 52 weeks, PSC1 improved more with exercise: MD -1.7 (95% CI = -2.4 to -1.0). Other between-group differences were PSC2 -1.8 (95% CI = -2.4 to -1.1), PSC3 -1.7 (95% CI = -2.4 to -1.0), PROMIS PF-10 $+3.09$ (95% CI = 1.80 – 4.38), HAQ-DI -0.17 (95% CI = -0.29 to -0.06), RAQoL -2.03 (95% CI = -3.39 to -0.69), SF-36 PCS $+3.83$ (95% CI = 1.49 – 6.17), and 6MWT $+56$ m (95% CI = 38 – 75). SF-36 MCS was not significantly different. One mild transient adverse event was reported
Özçelep et al. (2025) [23]	Randomized controlled clinical trial	72	Adults with RA affecting peripheral joints	Mobilization with Movement (MWM) for 6 weeks; follow-up: 6 weeks	Pain, ultrasound findings, inflammation, joint mobility	MWM produced greater improvements in joint distance, effusion, and inflammation. Joint space increased by 0.3 mm at the wrist and 0.2 mm at MCP/PIP joints; PIP effusion decreased by 0.04 mm ² . Inflammation decreased by 50.59% at the wrist and 53.33% at the PIP joint
Khojakulova et al. (2026) [24]	Randomized controlled trial	30	Adults with RA affecting the hands	Structured therapeutic hand massage for 2 weeks; follow-up: 2 weeks	Grip strength, hand function, pain	Grip strength increased from median 55 to 65 kg ($p = 0.008$), and pinch strength from 15 to 16 kg ($p = 0.023$) within the intervention group. DHI ($p = 0.005$) and PGA ($p = 0.001$) improved; PGA was lower than control at follow-up (4 (2–5) vs 5 (3–6), $p < 0.001$). No significant effect was observed on pressure pain threshold or tactile sensory threshold. No adverse events or withdrawals were reported

TABLE 3: Overview of the 15 articles selected for this study.

RA: rheumatoid arthritis; RCT: randomized controlled trial; DAS28: Disease Activity Score-28; ESR: erythrocyte sedimentation rate; WB: water-based; mHAQ: Modified Health Assessment Questionnaire; CI: confidence interval; MD: mean difference; ADL: activities of daily living; GFI: Groningen Frailty Indicator; VO₂max: maximal oxygen uptake; TSQM: Treatment Satisfaction Questionnaire for Medication; PEPP: Perceived Efficacy in Patient-Physician Interactions; CDAI: Clinical Disease Activity Index; HRQoL: health-related quality of life; HIIT: high-intensity interval training; PSC: patient-specific complaints; HAQ-DI: Health Assessment Questionnaire–Disability Index; RAQoL: Rheumatoid Arthritis Quality of Life; 6MWT: Six-Minute Walk Test; PROMIS PF-10: Patient-Reported Outcomes Measurement Information System Physical Function-10; SF-36: 36-Item Short Form Health Survey; MWM: mobilization with movement; DHI: Duruöz Hand Index; PGA: patient global assessment; PIP: proximal interphalangeal; MCP: metacarpophalangeal

Risk of Bias Assessment

Risk of bias was assessed using the RoB 2 tool for the relevant randomized trial results. The assessment followed the five RoB 2 domains: bias arising from the randomization process; bias due to deviations from intended interventions; bias due to missing outcome data; bias in measurement of the outcome; and bias in



selection of the reported result. Among the 15 assessed trial results, four were judged to have a low risk of bias, 11 had some concerns, and none was judged to have a high risk of bias. Judgments were made for the specific outcome, intervention comparison, and time point relevant to each assessed trial result rather than assigning a single overall methodological quality rating to each study. The signaling questions and supporting information were considered for each domain, and judgments were classified as low risk of bias, some concerns, or high risk of bias according to the RoB 2 framework.

For non-pharmacological interventions, the absence of participant or therapist blinding was not considered sufficient, by itself, to determine the overall risk of bias. Instead, potential bias related to deviations from intended interventions was considered in relation to the trial design, adherence to the assigned intervention, availability and use of outcome data, and whether analyses were consistent with the intended effect of assignment. Particular attention was also given to missing outcome data, the method of outcome measurement, including the potential influence of self-reported outcomes, and the possibility of selective reporting. The detailed domain-level judgments and supporting assessments for all 15 relevant trial results are presented in Table 4.

First author (year)	Outcome/Result assessed	Comparison	Time point	D1	D2	D3	D4	D5	Overall RoB
Siqueira et al. (2017) [10]	DAS28-ESR/mHAQ	Aquatic exercise vs control	16 weeks	Low Risk	Some concerns	Low risk	Low risk	Some concerns	Some concerns
Williamson et al. (2017) [11]	Hand function	Hand exercise + home exercises vs usual care	~26 months	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
De Thurah et al. (2018) [12]	DAS28	Telehealth-supported follow-up vs usual care	52 weeks	Low risk	Some concerns	Low risk	Low risk	Low risk	Some concerns
Lange et al. (2019) [13]	HAQ-DI	Supervised aerobic/resistance exercise vs control	20 weeks	Low risk	Some concerns	Low risk	Low risk	Some concerns	Some concerns
Levitsky et al. (2019) [14]	Hand pain	Manual joint mobilization vs control	2 months	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Zuidema et al. (2019) [15]	RAND-36 vitality	Web-based self-management vs control	6 months	Low risk	Some concerns	Some concerns	Low risk	Some concerns	Some concerns
Ellegaard et al. (2019) [16]	ADL motor ability	Hand exercise vs control	8 weeks	Low risk	Some concerns	Low risk	Low risk	Some concerns	Some concerns
Azeez et al. (2020) [17]	Peak VO ₂	Individualized exercise vs control	12 weeks	Low risk	Some concerns	Low risk	Low risk	Low risk	Some concerns
Lee et al. (2021) [18]	CDAI	Mobile application vs control	6 months	Low risk	Some concerns	Low risk	Low risk	Low risk	Some concerns
Seppen et al. (2022) [19]	DAS28-ESR	Smartphone-assisted care vs usual care	12 months	Low risk	Some concerns	Low risk	Low risk	Low risk	Some concerns
Knudsen et al. (2024) [20]	Self-efficacy (RASE)	Digital education/self-management vs control	12 months	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Bilberg et al. (2024) [21]	VO ₂ max	HIIT vs control	12 weeks	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Teuwen et al. (2024) [22]	Patient-Specific Complaints (PSC1)	Supervised exercise therapy vs control	52 weeks	Low risk	Some concerns	Low risk	Low risk	Low risk	Some concerns
Özçelep et al. (2025) [23]	Joint mobility/Joint distance	MWM vs control	6 weeks	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Khojakulova et al. (2026) [24]	Grip strength	Therapeutic hand massage vs control	2 weeks	Some concerns	Some concerns	Low risk	Low risk	Some concerns	Some concerns

TABLE 4: Risk of bias assessment of randomized controlled trials using Cochrane Collaboration's Risk of Bias 2 (RoB 2) tool.

DAS28: Disease Activity Score-28; ESR: erythrocyte sedimentation rate; mHAQ: Modified Health Assessment Questionnaire; HAQ-DI: Health Assessment Questionnaire–Disability Index; ADL: activities of daily living; VO₂max: maximal oxygen uptake; CDAI: Clinical Disease Activity Index

Discussion

This systematic review included 15 RCTs evaluating physical therapy and rehabilitation interventions, together with selected digital health and self-management approaches, in individuals with RA [10-24]. The interventions were broadly categorized into exercise-based rehabilitation, hand rehabilitation, manual therapy, and digital health and self-management approaches. The findings varied according to intervention type, outcome domain, comparator, and follow-up period, indicating that the effects of rehabilitation should be interpreted according to specific intervention-outcome combinations rather than as a uniform effect across all domains of RA-related disability.

Exercise-Based Rehabilitation

Exercise-based rehabilitation demonstrated the broadest range of evidence among the included interventions. Siqueira et al. [10] reported improvements in disease activity and functional ability following

a 16-week aquatic exercise programme in women with RA. Lange et al. [13] found that supervised aerobic and resistance exercise improved aerobic capacity and several performance-based measures in older adults with RA, although the primary Health Assessment Questionnaire-Disability Index (HAQ-DI) outcome did not differ significantly between groups. Azeez et al. [17] reported improvements in peak oxygen uptake and fatigue-related outcomes following an individualized exercise programme, while between-group differences in Disease Activity Score-28 (DAS28) and HAQ were not significant. These findings suggest that exercise may be particularly beneficial for physical capacity and selected functional outcomes, although improvements are not necessarily consistent across disease activity and global disability measures.

More recent evidence further supports appropriately supervised exercise for specific functional problems. Bilberg et al. [21] reported significant improvements in VO_{2max} , O_2 -pulse, sit-to-stand performance, and grip strength following HIIT, whereas pain and DAS28 did not show significant between-group differences. Importantly, Teuwen et al. [22] reported that more than 52 weeks of supervised, individualized exercise produced greater improvements in patient-specific complaints, physical function, HAQ-DI, Rheumatoid Arthritis Quality of Life (RAQoL), 36-Item Short Form Health Survey (SF-36) physical health, and six-minute walking distance than usual care, although SF-36 mental health did not differ significantly. Thus, exercise appears useful across selected physical and functional domains, but the optimal exercise modality, intensity, and duration should be individualized according to disease status, functional limitations, baseline fitness, and tolerance.

Hand Rehabilitation

Hand rehabilitation was evaluated primarily in patients with hand involvement. Williamson et al. [11] reported that structured hand exercise remained associated with improvement from baseline at extended follow-up; however, there was no significant between-group difference in change in hand function at approximately 26 months. Similarly, Ellegaard et al. [16] found improvement in activities-of-daily-living motor ability within both groups, but no significant between-group difference following an eight-week hand exercise programme. These findings suggest that hand exercise may contribute to maintaining or improving selected hand-related outcomes, but the evidence does not demonstrate a consistent additional treatment effect across all measures of hand function.

Khojakulova et al. [24] provided recent evidence for structured therapeutic hand massage, reporting improvements in grip strength, pinch strength, hand function, and patient global assessment after two weeks, although pressure pain threshold and tactile sensory threshold did not significantly improve. Collectively, the findings from Williamson et al. [11], Ellegaard et al. [16], and Khojakulova et al. [24] indicate that hand rehabilitation may be relevant for selected impairments such as weakness and reduced hand function. However, improvement in impairment-level outcomes should not automatically be interpreted as improvement in complex activities of daily living. Hand rehabilitation should therefore be individualized according to the patient's specific self-care, occupational, and functional limitations.

Manual Therapy

Manual therapy interventions included hand joint mobilization and MWM, while therapeutic hand massage was examined in a separate trial. Levitsky et al. [14] conducted a within-participant crossover study involving 12 participants with RA, with the final assessment at two months. The findings should be interpreted in the context of this small sample and crossover design, with attention to the comparison between intervention and control conditions. Özçelep et al. [23] investigated MWM and reported changes in selected joint-related outcomes. Khojakulova et al. [24] evaluated therapeutic hand massage in 30 women over a two-week intervention period. These studies investigated different interventions and outcomes and should not be treated as interchangeable evidence for a single manual therapy effect. Their findings should be interpreted according to the outcome-specific between-group comparisons, study design, and duration of follow-up.

Digital Health and Self-Management Approaches

Digital health and self-management approaches included telehealth follow-up, web-based self-management, mobile symptom monitoring, smartphone-assisted care, and digital patient education [13,16,19-21]. De Thurah et al. [12] found that telehealth-supported follow-up maintained disease activity outcomes while nurse-led care was associated with fewer rheumatologist visits. Zuidema et al. [15] reported that most outcomes of a web-based self-management programme did not differ significantly between groups, although a significant improvement was observed for RAND-36 vitality at six months. Lee et al. [18] found no significant between-group differences in treatment satisfaction, perceived efficacy in patient-physician interactions, or clinical disease activity with mobile application-based symptom monitoring.

Seppen et al. [19] reported that smartphone-assisted patient-initiated care was noninferior to usual care for change in DAS28-erythrocyte sedimentation rate (ESR) and was associated with fewer rheumatologist consultations. Knudsen et al. [20] found a significant improvement in self-efficacy with digital education and self-management, although knowledge, health literacy, and quality of life did not show important

between-group differences. Therefore, digital interventions appear to have potential primarily for monitoring, communication, education, healthcare utilization, and self-management rather than as direct substitutes for physiotherapist-delivered rehabilitation. Their clinical use should be considered complementary to individualized physical therapy and rehabilitation.

Overall Interpretation

Overall, the included trials indicate that rehabilitation effects in RA are intervention- and outcome-specific. Selected exercise-based interventions were associated with improvements in physical capacity, muscle strength, fatigue, walking ability, functional performance, and selected quality-of-life outcomes, although effects varied across outcomes and studies. Hand rehabilitation and manual therapy showed benefits for selected hand-related or localized outcomes, including hand function, grip strength, localized pain, and joint mobility. Digital and self-management approaches primarily demonstrated effects on disease monitoring, patient education, self-management, patient-healthcare communication, and healthcare utilization. However, several trials reported limited or null between-group effects for specific outcomes, and differences in participant characteristics, intervention protocols, dosage, comparators, outcome measures, and follow-up periods limit direct comparison across studies. Overall, these findings support an individualized rehabilitation approach based on the patient's predominant impairments, functional limitations, clinical needs, and treatment goals rather than a uniform intervention strategy.

Clinical Implications

For physiotherapists, the evidence supports selecting interventions according to the patient's predominant impairments and functional goals. Aerobic, resistance, aquatic, and appropriately supervised higher-intensity exercise can be incorporated to address reduced physical capacity, strength, endurance, fatigue, and functional performance. Hand-specific exercise and rehabilitation are appropriate when hand weakness or functional limitation interferes with daily activities. Manual therapy may be considered when localized pain or mobility restriction is present. Digital health approaches can complement these interventions by facilitating symptom monitoring, education, self-management, and communication between clinical visits. Their use may be particularly valuable for supporting continued engagement with rehabilitation, although digital delivery should remain integrated with appropriate clinical assessment.

Limitations

The findings are limited by heterogeneity across the 15 included trials in participant characteristics, interventions, outcome measures, and follow-up periods, preventing firm conclusions about the superiority of any single rehabilitation approach. Within-group improvements should be distinguished from between-group treatment effects to avoid implying superiority without consistent comparative evidence. The RoB 2 assessment identified four results with low risk of bias and 11 with some concerns, with none judged to have high risk. The English-language restriction and absence of supplementary citation, registry, and grey literature searches may have resulted in missed evidence. Additionally, 32 of the 88 reports sought for retrieval remained unavailable, introducing the possibility of availability bias. Future trials should use adequate sample sizes, standardized outcome measures, reproducible intervention protocols, transparent reporting of between-group effects, and longer follow-up to establish the sustained benefits of rehabilitation in RA.

Conclusions

Physical therapy and rehabilitation interventions may provide benefits across selected clinical and functional outcomes in adults with RA, but the effects vary according to intervention type, outcome, comparator, and follow-up duration. Exercise-based interventions showed the broadest evidence for improvements in physical capacity, strength, fatigue, walking ability, and selected quality-of-life outcomes, whereas hand rehabilitation and manual therapy were more specifically associated with selected hand-related and localized musculoskeletal outcomes. Digital and self-management approaches primarily demonstrated potential for supporting monitoring, education, communication, self-management, and healthcare utilization. Because the included trials were heterogeneous and several reported limited or null between-group effects, the findings do not support a uniform conclusion that all rehabilitation approaches improve all outcomes. Rehabilitation should therefore be individualized according to disease status, functional limitations, comorbidities, treatment tolerance, and patient goals. Further adequately powered RCTs using standardized, clinically meaningful outcomes and longer follow-up are needed to clarify the durability and comparative effectiveness of specific rehabilitation approaches in RA.

Additional Information

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All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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