International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
Canada
+15878858911
editorial-office@sciformat.ca

ARTICLE TITLE	BEHAVIORAL STRATEGIES TO INCREASE PHYSICAL ACTIVITY IN PATIENTS WITH RHEUMATOID ARTHRITIS: A NARRATIVE REVIEW
DOI	https://doi.org/10.31435/ijitss.2(50).2026.5431
RECEIVED	05 February 2026
ACCEPTED	03 June 2026
PUBLISHED	15 June 2026
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

BEHAVIORAL STRATEGIES TO INCREASE PHYSICAL ACTIVITY IN PATIENTS WITH RHEUMATOID ARTHRITIS: A NARRATIVE REVIEW

Paulina Krysa *(Corresponding Author, Email: paulinakrysaa@gmail.com)*
City Hospital of John Paul II in Rzeszów, Rzeszów, Poland
ORCID ID: 0009-0000-6633-3586

Agnieszka Szwed
MSWiA Hospital, Rzeszów, Poland
ORCID ID: 0009-0003-6395-5365

Katarzyna Anna Borzęcka
Medical Center in Łańcut Sp. z o.o., Łańcut, Poland
ORCID ID: 0009-0007-4084-4370

Ewa Maria Polewczak-Karp
Medical Center in Łańcut Sp. z o.o., Łańcut, Poland
ORCID ID: 0009-0006-6411-4826

Daria Aleksandra Warzocha-Żurek
Clinical Provincial Hospital in Rzeszow, Rzeszów, Poland
ORCID ID: 0009-0005-5756-2404

Krystian Andryszko
Clinical Regional Hospital of Saint Jadwiga The Queen in Rzeszów, Rzeszów, Poland
ORCID ID: 0009-0006-6170-5663

Aleksandra Sołtys
University of Rzeszow, Rzeszów, Poland
ORCID ID: 0009-0007-2557-2696

Marcelina Dymon
University of Rzeszow, Rzeszów, Poland
ORCID ID: 0009-0000-8008-7932

Katarzyna Wawrzonek
Clinical Provincial Hospital of Saint Jadwiga the Queen in Rzeszów, Rzeszów, Poland
ORCID ID: 0009-0007-6883-422X

Natalia Matylda Ziemba-Furgała
Ministry of Interior and Administration Hospital in Rzeszów, Rzeszów, Poland
ORCID ID: 0009-0009-5031-3930

ABSTRACT

Research objectives: The aim of this narrative review is to systematize knowledge about the theoretical basis and effectiveness of behavioral interventions aimed at increasing and maintaining long-term physical activity in patients with rheumatoid arthritis (RA).
Methods: A narrative review of the available literature was conducted, analyzing key models of behavior change, including the COM-B model, Self-Determination Theory, and Social-Cognitive Theory, and identifying the main barriers and facilitators to physical activity in this group of patients.
Key findings: The analysis revealed that traditional medical education is insufficient to induce lasting behavioral change. Low physical activity results from physical barriers:pain, chronic fatigue; psychological barriers: kinesiophobia, lack of motivation, depression; and logistical and systemic barriers. The most effective interventions are multi-component and focus on building self- efficacy and resilience. Positive results are achieved through the implementation of hybrid models, mHealth, motivational interviewing, and close interdisciplinary collaboration between physicians, nurses, and physiotherapists.
Conclusions: Individualized behavioral strategies are an essential component of comprehensive RA treatment. A holistic approach, incorporating social and psychological support, allows for the safe integration of exercise into the patient's daily life, preventing progressive disability and sarcopenia.

KEYWORDS

Rheumatoid Arthritis, Physical Activity, Behavior Change, Self-Efficacy, mHealth, Interdisciplinary Collaboration

CITATION

Paulina Krysa, Agnieszka Szwed, Katarzyna Anna Borzęcka, Ewa Maria Polewczak-Karp, Daria Aleksandra Warzocha-Żurek, Krystian Andryszko, Aleksandra Sołtys, Marcelina Dymon, Katarzyna Wawrzonek, Natalia Matylda Ziemba-Furgała. (2026) Behavioral Strategies to Increase Physical Activity in Patients with Rheumatoid Arthritis: A Narrative Review. *International Journal of Innovative Technologies in Social Science*. 2(50). doi: 10.31435/ijitss.2(50).2026.5431

Introduction

Rheumatoid arthritis (RA) is a chronic, systemic (Wu et al., 2022) an autoimmune inflammatory disease (Brown et al., 2024). Activated T and B lymphocytes, macrophages (Gravallese & Firestein, 2023), synovial fibroblasts (FLS), and osteoclasts (Yoshitomi, 2019), which produce proinflammatory cytokines such as TNF-alpha, IL-6, and IL-1 (Ding et al., 2023), are involved in its pathogenesis. Genetic and environmental factors also play a key role, including smoking (Hahn et al., 2023), higher BMI (Ohno et al., 2020), changes in the composition of the gut microbiota (Y. Chen et al., 2021), exposure to dust and pollutants (Gumtorntip et al., 2023), viral infections (Kudaeva et al., 2019), and vitamin D deficiency (Cutolo et al., 2023). Smoking may act synergistically with genetic predispositions, such as the presence of certain HLA-DRB1 alleles, which may significantly increase the risk of developing rheumatoid arthritis (Terao et al., 2014). Exposure to dust and air pollution may promote the development of a local inflammatory response within the mucous membranes, leading to protein modifications, including citrullination, which in turn facilitates the formation of autoantibodies (De Ocampo et al., n.d.).

Microbiome disturbances may also play a significant role. The presence of pathogenic bacteria in the oral cavity and gastrointestinal tract, in particular, can initiate processes leading to autoimmune reactions (Y. Chen et al., 2021). Additionally, the importance of viral infections has been implicated, as they may participate in mechanisms of molecular mimicry and the activation of genes associated with autoimmunity (Kudaeva et al., 2019). In summary, the pathogenesis of RA results from a complex interaction of genetic and environmental factors.

This disease ultimately leads to progressive damage to joint structures, reduced mobility (Ye et al., 2025), and a decreased quality of life (Song et al., 2024). Despite significant advances in pharmacotherapy, many patients still experience pain, morning stiffness, fatigue, and functional limitations that impede daily activities (Bergström et al., 2025). Pain and fatigue are strongly associated with depression, insomnia, and low physical activity (Goubran et al., 2025), not just with inflammation itself. Contemporary approaches to RA treatment

emphasize the need to combine pharmacological treatment with non-pharmacological interventions (Gioia et al., 2020), among which regular physical activity is key (Z. Li & Wang, 2023).

RA affects a significant percentage of the adult population and remains one of the leading causes of chronic musculoskeletal disability (Black et al., 2023). The disease's consequences also include decreased cardiorespiratory fitness, weakened muscle strength, and an increased risk of comorbidities (Figus et al., 2021). From a physical perspective, this often means gradual reduction in daily activities and avoidance of exercise.

Available data indicate that physical activity levels in patients with RA are typically lower than in the general population (El Sharkawy et al., 2025), and a significant proportion of patients do not meet the minimum recommendations for moderate-to-vigorous exercise. The available data emphasize that adherence is as important as the activity itself, as RA patients often struggle to consistently incorporate exercise into their lifestyles, preventing them from fully utilizing the therapeutic potential of regular exercise. Fear of disease exacerbation, the risk of joint damage, and a lack of knowledge about the disease and acceptable levels of physical activity constitute significant barriers limiting patients' physical activity. Adherence applies to both spontaneous activity and structured rehabilitation interventions. (Thomas et al., 2023).

Physical activity is an essential element of comprehensive therapeutic management of RA. Regular, appropriately tailored exercise can improve physical function, reduce pain and fatigue, and support disease control (Fu et al., 2025). Benefits are observed in both physical performance and fitness (Bilberg et al., 2024), as well as mental well-being, which translates into greater patient independence (Brady et al., 2023).

The importance of exercise is reflected in current recommendations from scientific societies, including the ACR (2022) (England et al., 2023)and EULAR (2021) guidelines (Gwinnutt et al., 2023), which emphasize the need to systematically incorporate exercise interventions into patient care. In clinical practice, physical activity can impact not only short-term symptom reduction but also long-term health outcomes, such as maintaining functional independence, limiting the progression of disability, and improving quality of life.(Brady et al., 2023) (Bilberg et al., 2024).

Despite well-documented health benefits, traditional educational approaches based solely on information have proven insufficient to permanently change patient behavior. Knowledge alone about the importance of physical activity rarely leads to regular participation, especially in conditions of chronic pain, fatigue, and episodic disease exacerbations (Metsios et al., 2023). Shang Xueying et al. demonstrated that kinesiophobia, or fear of movement, can occur in as many as 65–71% of RA patients and is associated with increased pain, impaired function, and decreased activity (Xueying et al., 2024).

As a result, increasing attention is being paid to interventions based on behavioral change theories that consider the patient's motivation, self-efficacy, goals, habits, and social context. Behavioral strategies enable individualized interventions and support long-term physical activity maintenance (Swärdh et al., 2021).

The aim of this narrative review is to synthesize the theoretical foundations and effectiveness of selected behavioral strategies for increasing physical activity in patients with rheumatoid arthritis, with a particular emphasis on their application in clinical practice.

Methodology

This article is based on a narrative synthesis of the scientific literature examining behavioral strategies for increasing physical activity in patients with rheumatoid arthritis, integrating psychological, clinical, and technological perspectives.

A targeted literature search was performed in PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar using keywords related to: rheumatoid arthritis, physical activity, behavior change, behavioral strategies, self-efficacy, motivational interviewing, mHealth, kinesiophobia, and self-management. Priority was given to literature published within the last 6–7 years, supplemented by seminal publications to provide a robust theoretical foundation.

Systematic and narrative literature reviews, randomized controlled trials, cohort studies, cross-sectional studies, and qualitative studies evaluating behavioral interventions, as well as barriers and facilitators to physical activity in RA, were included. Only peer-reviewed scientific articles were included. Additional sources were identified through hand searching of the bibliographies of key review articles.

Studies were selected for their relevance, methodological quality, and alignment with the review objectives. Data extraction focused on theoretical frameworks for behavior change (Social Cognitive Theory, Self-Determination Theory, COM-B model), specific behavioral interventions (motivational interviewing and self-regulation coaching), the role of digital technologies (wearables, telemedicine), and the reported impact on physical activity levels, clinical outcomes, and patient empowerment.

Results

1. Theoretical Foundations of Behavioral Strategies

Effectively increasing physical activity in patients with RA requires an approach that goes beyond general exercise recommendations (Iken et al., 2026; Larkin et al., 2024; Metsios et al., 2023; Thomsen et al., 2023). Behavioral interventions are most effective when they are grounded in theories that explain the mechanisms by which behavioral change is initiated and maintained. This theoretical framework helps identify determinants of activity, select appropriate intervention techniques, and design programs tailored to the clinical and psychosocial needs of patients (Larkin et al., 2024).

1.1. Theories of behavior change in the context of physical activity

Effective implementation of exercise interventions for patients with chronic conditions requires a solid theoretical framework. Well-established rational-cognitive theories play a role in physical activity promotion models. Among the most commonly used are Social Cognitive Theory (SCT), the Transtheoretical Model of Change (TTM), and the Theory of Reasoned Action (TRA), with its derivative, the Theory of Planned Behavior (Matting et al., 2025).

Each of these models emphasizes slightly different psychological mechanisms. Social Cognitive Theory assumes that learning new behaviors occurs through observing others and anticipating the positive outcomes of one's own actions. Its key pillar is self-efficacy, or the patient's belief that they possess sufficient competence to cope with movement challenges despite objective obstacles (Bandura, 1977). The Transtheoretical Model of Change, on the other hand, conceptualizes lifestyle modification as a process unfolding over time, dividing it into specific stages: from precontemplation, through contemplation and preparation, to the action and maintenance phase. Applying TTM allows therapists to tailor their arguments to the patient's current level of readiness (Prochaska & DiClemente, 1983; Prochaska & Velicer, 1997). The Theory of Conscious Action and the Theory of Planned Behavior, on the other hand, postulate that the primary driver of action is intention, which is influenced by personal attitudes toward exercise, subjective norms like pressure and support from the environment, and perceived control over behavior.(Ajzen, 1991; Fishbein, M., & Ajzen, I. (1975).) In the rheumatoid arthritis population, this last element is fundamental, as the unpredictable severity of pain symptoms often drastically weakens patients' confidence in maintaining a regular exercise routine (de Ridder et al., 2008). The importance of self-efficacy in the treatment process is confirmed by the European EULAR recommendations, which identify strengthening this competence in patients with arthritis as one of the priority areas of action in the area of disease self-management (Nikiphorou et al., 2021).

Theories based on a humanistic approach are less frequently used in physiotherapy practice compared to cognitive models. The most important of these is Self-Determination Theory (SDT), which emphasizes the quality of human motivation (Matting et al., 2025). According to its assumptions, for behavioral change to be lasting, an intervention must satisfy three basic psychological needs of the patient: autonomy: the feeling that activity is one's own choice and not a requirement imposed by a physician; competence: self-confidence; and relatedness: a sense of connection and support from a therapist or group (Deci & Ryan, 1987; Ryan & Deci, 2000). Strategies that support patient agency and promote autonomous motivation yield significantly better long-term results than interventions based on external pressure (Fenton et al., 2020).

Theoretical frameworks used in modern physical activity promotion programs increasingly include integrated behavioral models, such as the Behavior Change Wheel (BCW) along with the COM-B model and the Theoretical Domains Framework (TDF), which enable the systematic identification of behavioral barriers and the selection of appropriate techniques to support behavior change (Larkin et al., 2024; Matting et al., 2025). The COM-B model forms the core of this approach, organizing the factors determining a healthy lifestyle into three categories: Capability- both physical predispositions and psychological knowledge, Opportunity- environmental conditions and social support and Motivation- conscious goals and automatic habits. The BCW supports this model with specific intervention functions, such as education, persuasion, and modeling, facilitating the design of multicomponent therapies (Michie et al., 2011). The TDF, in turn, expands these concepts with 14 specific psychological domains, enabling researchers to precisely identify specific implementation barriers and facilitators in the target population (Cane et al., 2012).

These models have found widespread and practical application in RA research. A prime example of BCW's use is the PIPPRA study, in which physiotherapists conducted an individualized intervention supporting individuals with low activity levels. This program, fully based on behavioral techniques such as goal setting, action planning, and problem-solving, helped patients systematically incorporate movement into their daily routines (Larkin et al., 2024). Another example from the literature is the intervention described by

Salmon et al., targeted at RA patients experiencing severe fatigue. This program, based on the combined framework of BCW, COM-B, TDF, and Self-Determination Theory, aimed to develop patients' ability to self-manage fatigue through skillful modification of physical activity rather than complete cessation. (Salmon et al., 2019)This integrated approach demonstrates that simply providing medical information is far from sufficient unless it is accompanied by precise attention to the patient's self-regulatory abilities, motivation, and environmental conditions.

The Information-Motivation-Behavioral Skills (IMB) model complements these concepts. It posits that education alone is completely insufficient unless accompanied by adequate motivation and practical self-regulatory skills. Knowledge about the disease, social support, and stress-coping strategies influence daily health choices in RA patients indirectly, by building a strong sense of self-efficacy (J. Chen et al., 2025).

2. Key Barriers to Physical Activity in Patients with RA.

Although regular physical activity is a proven and key component of non-pharmacological treatment for rheumatoid arthritis (England et al., 2023; Gwinnutt et al., 2023), most patients spend time sedentary and do not meet global exercise recommendations (El Sharkawy et al., 2025). Understanding the multidimensional barriers patients face is essential for designing effective and personalized therapeutic interventions. Below is a comprehensive breakdown of the most common barriers to exercise in this group of patients.

2.1. Symptom and disease barriers

The first and most direct line of resistance to movement is the physical manifestations of the disease itself. Pain, swelling, and morning stiffness significantly impede functioning, so the overall level of symptoms experienced can become one of the main reasons for abandoning exercise (Brady et al., 2023; Lee et al., 2025; Metsios et al., 2023). As demonstrated by Metsios et al., pain and painful, swollen joints are among the significant factors preventing patients from being active (Metsios et al., 2023). Lee et al. also confirmed that the severity of disease symptoms t (Lee et al., 2025).

Another problem is fatigue, general exhaustion, and the associated decline in performance and health (Beider et al., 2024; Brady et al., 2023; Metsios et al., 2023). Research by Beider et al. demonstrated that severe fatigue occurs in over 64% of patients with rheumatic diseases, which directly and negatively correlates with their ability to exert themselves (Beider et al., 2024). These results are reflected in the data collected by Metsios et al., where fatigue was identified as the number one barrier (Metsios et al., 2023).

Moreover, objective clinical indicators have a real impact on patients' physical activity. High disease activity measured by, among others, DAS28 and RAPID3 scales and poorer physical function reduce the likelihood of meeting training recommendations (Brady et al., 2023; Lukovic et al., 2024). Lukovic et al. demonstrated that patients with the lowest levels of physical activity not only have less controlled inflammation but are also at significantly higher risk of developing sarcopenia. Loss of muscle mass combined with weakened body function creates a vicious cycle that further discourages patients from attempting to improve their performance (Lukovic et al., 2024).

2.2. Psychological barriers

Physical symptoms, however, are only part of the problem, as mental barriers can equally effectively paralyze RA patients. A significant obstacle is a complete lack of motivation to exercise. Research conducted by Lee et al. identified a lack of internal drive as the most common barrier overall, cited by nearly 47% of participants (Lee et al., 2025).

This motivation deficit, however, often has a deeper, anxiety-related root, known as kinesiophobia, an irrational fear of movement and potential injury (SH, 1990). Research by Lukovic et al. alarmingly indicates that kinesiophobia affects up to 65.2% of the RA population. (Lukovic et al., 2024). Patients are deeply convinced that any exercise will directly damage their joints, destroy cartilage, or trigger a painful exacerbation of the disease (Lukovic et al., 2024; İ. B. Öztürk et al., 2021). Thomsen et al. observed that this fear of joint degradation is a significant reason why patients refrain from engaging in physical activity (Thomsen et al., 2023).

Persistent pain restrictions also impact broader psychological states, provoking the development of depression, generalized anxiety, and pain catastrophizing, which are significant demotivators (Beider et al., 2024; Lukovic et al., 2024). Beider et al. demonstrated that depression and anxiety disorders are strongly and directly linked to physical inactivity. The same analysis demonstrated that patients with comorbid depression had significantly higher rates of extreme sedentary behavior than those without mood disorders (Beider et al., 2024). Lukovic et al. also confirmed that severe depressive symptoms, measured with the PHQ-9, were found in patients with the lowest levels of physical activity (Lukovic et al., 2024).

2.3. Environmental and organizational barriers

Even patients with good intentions and relatively low pain levels encounter challenges related to external and systemic factors. Weather conditions are a significant deterrent, often exacerbating the subjective experience of joint stiffness (Lee et al., 2025; New-Tolley et al., 2026). Furthermore, there is a lack of access to appropriate and safe exercise spaces (Marley et al., 2025; New-Tolley et al., 2026).

Costs, lack of free time for regular training and difficulties in commuting to rehabilitation facilities may also be a serious logistical limitation. (Bell et al., 2022; Ö. Öztürk et al., 2026)Iken et al. point out that financial uncertainty about what insurance actually covers effectively inhibits patients from engaging in long-term exercise therapy (Iken et al., 2026).

Finally, it's important to highlight errors and omissions at the healthcare organization level itself. Inconsistent, general, and often devoid of empathy, exercise recommendations provided in clinics leave patients feeling lost. Ester et al. defined this problem as information overload (Ester et al., 2025). During a short medical visit, patients are bombarded with information about blood tests and pharmacotherapy, leaving the topic of exercise marginalized, and the fatigued patient unable to absorb subsequent recommendations (Ester et al., 2025; Lehtomäki et al., 2025). Standardized and non-personalized physical activity advice is perceived by patients as insufficient because it fails to address their specific barriers, such as fear of joint damage, fatigue, or pain (Thomsen et al., 2023)**.** This problem is further exacerbated by unclear eligibility criteria for specialized physiotherapy programs and a shortage of appropriately trained therapists (Iken et al., 2026).

3. Factors that facilitate physical activity

In terms of individual factors, the foundation that helps RA patients engage in exercise is solid knowledge about how exercise positively impacts their overall health and improves their mood (Lee et al., 2025; Metsios et al., 2023). According to research by Metsios et al., awareness of the potential for improving overall fitness and physical performance is one of the strongest motivators for exercise (Metsios et al., 2023). Equally important is the patient's internal belief that they can exercise completely safely, which, combined with a high sense of self - efficacy, gives them confidence in their own ability to undertake and maintain exercise (Houge et al., 2024; Lee et al., 2025). Furthermore, individuals with objectively lower inflammatory activity, experiencing less pain and fatigue, and reporting a higher quality of life, are significantly more likely to regularly follow exercise recommendations (Andersson et al., 2025; Lukovic et al., 2024).

From a psychological perspective, Andersson et al. demonstrated that a powerful factor in motivating people to exercise, especially in people with significantly impaired physical function, is a sense of empowerment (Andersson et al., 2025). This includes the ability to set realistic goals, good body knowledge, and a genuine willingness to change habits (Anderson & Funnell, 2010; Bravo et al., 2015). Thomsen et al., on the other hand, demonstrate that patients are usually able to fully engage in physical activity only after undergoing the psychologically challenging process of accepting their illness (Thomsen et al., 2023). The process of mentally accepting the limitations resulting from RA and integrating physical activity with the patient's new identity promote the development of empowerment, which allows patients to autonomously and flexibly adapt the form of exercise to their current health capabilities.(Andersson et al., 2025; Houge et al., 2024; Thomsen et al., 2023).

In terms of professional support, patients report the need for clear and individualized recommendations from members of the medical team. Nurses are often the preferred source of support for everyday issues and a natural partner for lifestyle discussions, while physiotherapists are responsible for precisely tailoring exercises to the patient's clinical condition (Lehtomäki et al., 2025). It is also crucial that exercise programs be led by specialists and instructors with in-depth knowledge of the pathophysiology of RA, ensuring safety and protecting patients from the fear of triggering a painful flare (Iken et al., 2026; Lehtomäki et al., 2025; Thomas et al., 2023; Thomsen et al., 2023).

In the context of supervised support, increasing emphasis is being placed on programs utilizing proven psychological models such as SDT. This model assumes that human motivation is not uniform but forms a fluid continuum: from amotivation, through various forms of extrinsic motivation, such as exercising under peer pressure, medical orders, or guilt, to the highly desirable, autonomous motivation. In this latter, most effective form, the patient undertakes exercise voluntarily, deriving enjoyment from it and perceiving its deep alignment with their own values. Interventions based directly on behavior change techniques, researched by Larkin et al. in the PIPPRA project, focus on building lasting habits by developing self-control skills. In this model, the physiotherapist moves away from the role of a person merely dictating exercises and becomes a

facilitator, teaching the patient to collaboratively set goals, create contingency plans, address ongoing pain issues, and continuously monitor their own progress (Larkin et al., 2024).

Tools that can facilitate the implementation of the above models include mHealth technologies and tracking devices, such as discreet activity monitors, such as accelerometers that count steps. Because they do not negatively interfere with the patient's daily life, they can be an effective motivational tool based on immediate feedback (Bannell et al., 2024; Jacquemin et al., 2018; Larkin et al., 2024). Participation in group exercise sessions can also be helpful, as they provide peer support and can prevent social exclusion, beyond the purely physical aspect (Davoodifard et al., 2025; Swärdh et al., 2020; Thomas et al., 2023).

Unfortunately, in everyday clinical practice, patients regularly encounter inconsistent and superficial advice that lacks the necessary individualization. Ester et al. highlight the phenomenon of information overload. During a typically short medical visit, patients receive such an overwhelming dose of information about the disease itself, medications, and laboratory results that even broaching the topic of physical activity only induces defensive cognitive fatigue (Ester et al., 2025). For this reason, the researchers conclude that routinely handing out dry informational leaflets to patients, without providing support in implementing the recommendations, is an ineffective tool for achieving lasting changes in exercise habits (Ester et al., 2025; Hasanica et al., 2020).

4. The role of self-efficacy and motivation

Self-efficacy is one of the most important predictors of initiating and maintaining physical activity in RA. Patients who believe they can exercise despite symptoms and limitations are more likely to initiate activity, cope better with relapses, and are less likely to discontinue the program. As Hsiao et al. demonstrated, a deep belief in one's own ability to cope with the disease is a critical factor, allowing patients to overcome fear of pain and engage in regular physical activity (Hsiao et al., 2024). The importance of this phenomenon is explained by the IMB model, analyzed by Chen et al. In this model, self-efficacy is not just an isolated feature but serves as a central mediator. It is this self-efficacy that translates the patient's knowledge about the disease, stress coping strategies, and received social support into self-management behaviors, including engagement in physical activity (J. Chen et al., 2025). Additionally, Zhou et al. prove that a higher sense of self-efficacy, occurring in tandem with mental resilience, creates a specific buffering chain that protects the patient's overall quality of life (QoL) from the destructive impact of chronic fatigue (Zhou et al., 2024).

Equally important to the patient's sense of efficacy itself is the quality of their motivation, as described by SDT. Using this model, Kim et al. demonstrated that autonomous motivation, based on a deep, personal belief in the value of exercise, rather than external pressure from a doctor or guilt, directly determines the level of physical activity undertaken in women with RA. They also demonstrated that for patients to develop such autonomous motivation, it is necessary to satisfy their basic psychological needs and receive autonomy support from medical staff. These (Kim et al., 2023) conclusions align with the findings of Houge et al., who emphasize that internalization of goals protects patients from premature abandonment of exercise recommendations (Houge et al., 2024).

A key element of the change process is self-regulation skills: setting goals, monitoring progress, planning responses to barriers, and modifying the plan during disease flares. Developing these competencies can increase a patient's sense of control and support empowerment, which translates into more stable patterns of physical activity (J. Chen et al., 2025; Oh et al., 2024).

Building this understanding of agency and self-regulation skills requires modernly designed interventions that depart from traditional prescriptions. Contemporary research clearly promotes multi-component and digital solutions. Oh et al. demonstrated in their study that mHealth-based programs combining education with daily symptom monitoring via e-diaries and coaching support via telephone calls significantly increase self-efficacy in symptom control and reduce depression levels, which translates into a more active lifestyle (Oh et al., 2024). Similarly, Knudsen et al. demonstrated that structured, digital patient education is significantly more effective in building long-term self-efficacy than standard, one-time face-to-face counseling because it provides patients with the space and tools to self-manage their illness (Knudsen et al., 2024). It is in such models that patients more effectively practice behavior change techniques, such as goal setting and progress monitoring, described earlier in the PIPPRA project (Larkin et al., 2024).

5. The Complexity of Assessing Physical Behavior and Types of Motivation

When analyzing the effectiveness of behavioral interventions in patients with RA, particular attention should be paid to the way physical activity itself is defined and measured. Research indicates that patients often perceive their involvement in physical activity differently than objective medical guidelines indicate (Hamy et al., 2025; Houge et al., 2024; Steultjens et al., 2023; Yu et al., 2015). In a cross-sectional study by Houge et al., physical activity in RA patients was assessed using two different measures: meeting rigorous aerobic recommendations: a minimum of 150 minutes of moderate exercise or 75 minutes of vigorous exercise per week, and being in the so-called maintenance stage of the TTM. The results revealed significant cognitive dissonance in patients: as many as 58% of the study participants believed they were in a phase of sustained, regular physical activity, yet in this group, over half (55%) actually did not meet clinical recommendations regarding the minimum duration and intensity of aerobic training (Houge et al., 2024). This shows that behavioral interventions must precisely define movement goals, because the patient's subjective feeling of being active, through daily, short, low-intensity walks, does not always translate into achieving the amount of movement necessary to obtain full benefits.

Crucially from an SDT perspective, this phenomenon is strongly correlated with the quality of motivation, as measured by the Relative Autonomy Index (RAI). A high RAI, indicating deep, internalized, and intrinsic motivation to exercise, can be a strong and stable predictor of physical activity (Houge et al., 2024; Videm et al., 2022). From a clinical perspective, this means that an appropriately internally motivated patient does not completely abandon activity in the face of pain, but rather modifies its form (Houge et al., 2024; Knittle et al., 2016).

6. Psychosocial Mediators of Change: Resilience

A key element in the successful implementation of physical activity in patients with rheumatoid arthritis is an appropriate level of psychological resilience. When planning behavioral strategies, clinicians must be aware that the patient's baseline condition is often dominated by a disabling cluster of neuropsychological symptoms. Chronic fatigue, sleep disturbances, and depressive symptoms can create a vicious cycle that paralyzes physical activity initiatives (Berdal et al., 2024). This is supported by research by Hsiao et al., which shows that low self-efficacy can be correlated with perceived exhaustion and increased depression (Hsiao et al., 2024).

Psychological resilience proves to be a crucial buffer for breaking this negative pattern. As Zhou et al. demonstrate using a chain mediating model, although chronic fatigue in RA has a detrimental impact on physical and mental quality of life, a mechanism capable of neutralizing this process is the strong link between resilience and self-efficacy. Patients with high psychological resilience are able to adapt to pain stressors much more flexibly and positively. As a result, they are less likely to fall into the trap of learned helplessness and are able to maintain a sense of control over disease management (Zhou et al., 2024).

From an intervention design perspective, this leads to a fundamental conclusion: programs focused solely on promoting exercise in patients with RA may prove ineffective. For physical activity to be permanently ingrained, exercise interventions must be preceded by or closely integrated with psychological support. This holistic approach allows the patient to first rebuild their psychological resources, teaching them to flexibly cope with the unpredictability of the disease, which provides the foundation for sustained physical activity.

7. The Impact of Disease Duration on Patients' Physical Activity.

The impact of disease duration on the physical activity of patients with rheumatoid arthritis (RA) is a subject of complex debate in the literature, with quantitative data often contrasting with the neuropsychological perspective. Contemporary statistical analyses, based on large research samples and objective verification of exercise levels, suggest a lack of a simple, linear relationship between disease duration and behavioral barriers. Key evidence in this regard comes from a study of 350 patients, which demonstrated that RA duration is not a statistically significant predictor of kinesiophobia levels (Xueying et al., 2024). Yildirim also found no relationship between the duration of the disease and fear of movement, indicating that patients' subjective fears do not increase or decrease deterministically with the years since diagnosis (Yildirim, 2023). Furthermore, studies using accelerometry, such as the work of Haider et al., demonstrate that the actual number of steps taken is primarily determined by the current pain intensity and the degree of functional disability, measured by the HAQ index, and not by the duration of the disease (Haider et al., 2020).

Despite the lack of statistical correlations across multiple studies, a deeper analysis of adaptive processes allows us to identify the early phase of RA as a period of particular psychological risk. The period of up to two years following diagnosis may be characterized by the lowest and most unstable levels of self-efficacy. During this phase, patients often struggle with unpredictable symptoms, which, combined with a lack of experience in disease management, can lead to paralysis of movement initiative and avoidance of physical activity as a defense strategy (Michaël et al., 2021). This phenomenon may evolve with the duration of the disease, as explained by the concept of response shift analyzed by Martinez-Calderon et al. This process involves the patient's internal redefinition of standards and values, which allows for the restoration of a sense of control over their own body. As a result, individuals with longer disease history, despite objectively progressing structural changes in joints, often demonstrate higher adaptive efficiency and greater determination to maintain physical activity than newly diagnosed patients. (Martinez-Calderon et al., 2020). Other studies show that the effects of exercise therapy may be diminished in patients with longer disease duration, highlighting the importance of early intervention (Liao et al., 2022). In summary, although disease duration does not constitute a direct, numerical barrier to exercise, the deficit in adaptive competence in the early stages of RA is a critical modifiable factor that requires targeted interventions to support the patient's sense of self-efficacy.

8. Preventing sarcopenia as a specific goal of behavioral interventions

Physical activity for patients with RA is crucial not only for reducing inflammation but, above all, for preventing sarcopenia (Kim et al., 2023; Liao et al., 2022; Nolla, 2024; Torii et al., 2023). Women with RA may be particularly vulnerable to this complication due to the coexistence of chronic inflammation, frequent use of glucocorticosteroids, and limited mobility resulting from pain (Nakayama et al., 2023).

The use of a model based on Self-Determination Theory allows us to identify the direct impact of psychological interventions on anthropometric and strength parameters in patients (Fenton et al., 2020; Kim et al., 2023; Yun et al., 2023). A study by Kim et al. conducted a path analysis of the influence of psychological factors on markers of sarcopenia, such as thigh circumference, as an indicator of muscle mass, and handgrip strength, as an indicator of muscle function. They demonstrated that physical activity, stimulated by autonomy support from medical staff and the satisfaction of the patient's basic psychological needs, directly translates into larger thigh circumference, acting as a protective factor against muscle atrophy. A surprising conclusion from these analyses, however, is that physical activity itself, even regular activity, did not directly affect handgrip strength; this parameter was determined primarily by objective disease activity, such as the DAS28 index, and the patients' age (Kim et al., 2023). This means that effective behavioral interventions to prevent sarcopenia must be two-pronged: on the one hand, they should build motivation and self-efficacy to increase overall movement volume, which protects muscle mass, and on the other hand, they must include strict pharmacological control of the inflammatory process, without which improvement may not be achieved.

9. Behavioral Strategies and Their Effectiveness

The practical application of behavior change models in the care of patients with RA involves interventions of varying intensity and delivery formats. Programs that combine motivational, self-regulatory, and social and professional support components can be very effective (England et al., 2023; Fenton et al., 2021; Lehtomäki et al., 2025; L. C. Li et al., 2025; Nikiphorou et al., 2021; Sekhon et al., 2021). This section discusses the most important behavioral strategies used to increase physical activity and their potential long-term impact.

9.1. Motivational Interviewing and Self-Regulation Coaching:

Motivational interviewing (MI) and self-regulation coaching are effective tools for supporting increased physical activity in patients with rheumatoid arthritis. As demonstrated in the literature, coaching programs, delivered through both face-to-face meetings and telephone or virtual sessions, significantly increase exercise levels and can contribute to pain reduction (Jung et al., 2024). A key mechanism for these changes is the promotion of autonomous motivation. Research based on SDT demonstrates that strengthening the intrinsic drive for movement can translate into more frequent moderate and vigorous activity and a significant improvement in patients' subjective vitality (Fenton et al., 2021).

Techniques used in MI and coaching can help patients resolve ambivalence, set realistic goals, and monitor progress, which is fundamental to building regularity (Berdal et al., 2024; Larkin et al., 2024). It's worth noting, however, that simply increasing exercise engagement doesn't always lead to immediate improvements in objective disease parameters or physical performance (Videm et al., 2022). Due to the

unpredictable and fluctuating course of RA, patients require long-term and flexible support to prevent relapses (Berdal et al., 2024). Implementing such programs in clinical practice requires appropriate training of medical personnel in behavior change techniques and rigorously individualized recommendations, which is crucial for optimizing therapeutic outcomes (Larkin et al., 2024; Nikiphorou et al., 2021).

9.2. Individually Tailored Behavioral Interventions.

The effectiveness of behavioral interventions in rheumatoid arthritis depends primarily on their strict personalization. The 2022 American College of Rheumatology guidelines indicate that exercise parameters must be individually tailored to the stage of the disease, functional capabilities, comorbidities, and patient preferences (England et al., 2023). Flexible adjustment of activity to changing abilities becomes feasible for patients only after psychological acceptance of the disease (Thomsen et al., 2023). Individualization allows for the safe implementation of exercise even in the most frail. Tailoring exercise intensity via the Borg scale allows elderly patients with physical deficits to exercise at home, providing a safe alternative to standardized activity schemes that may not be suitable for their needs (Onishi et al., 2023).

For patients with severe symptoms, immediately implementing full exercise recommendations doesn't have to be the starting point. Thomas et al. emphasize that for those not ready for structured exercise, a realistic initial strategy is simply systematically reducing the time spent sitting. Patients themselves confirm in interviews that incorporating low-intensity exercise into their daily routines is a highly beneficial form of activity (Thomas et al., 2023).

Interventions can take the form of home-based or center-based programs. Teuwen et al. demonstrated that long-term, personalized outpatient programs supervised by physical therapists are highly effective in improving functional abilities even in patients with very severe physical limitations (Teuwen et al., 2024). Behavioral support can be successfully implemented in a virtual or home-based model with high acceptance (Larkin et al., 2024). Regardless of the chosen model, due to the fluctuating course of RA, maintaining long-term results and preventing relapses may depend on providing the patient with extended, flexible support after the intensive phase of the program (Berdal et al., 2024).

9.3 Support from Health Professionals and the Use of Technology.

Healthcare professionals, particularly physiotherapists and nurses, play a key role in transforming general recommendations into individualized, safe, and feasible exercise programs for people with RA (Lehtomäki et al., 2025; Thomsen et al., 2023). As demonstrated by Larkin et al., structured counseling, regular progress monitoring, and interventions based on behavioral change theories help build a strong sense of empowerment in the patient, which may increase the chances of maintaining long-term physical activity (Larkin et al., 2024).

In turn, mHealth tools, including mobile apps, online platforms, and wearable devices, provide patients with mechanisms for self-monitoring, objective movement tracking, and personalized feedback (L. C. Li et al., 2025; Sekhon et al., 2021). Built-in features such as digital notifications, goal setting, and progress visualization can support exercise regularity (Sekhon et al., 2021). Importantly, Li et al. observed that these solutions yield optimal results when closely coupled with professional guidance, such as centralized physiotherapy support (L. C. Li et al., 2025).

Although digital interventions have great potential, their ultimate effectiveness is strongly dependent on a user-friendly interface, the level of patient engagement, and seamless integration with routine rheumatology care (Macbrayne et al., 2023). From an ethical and practical perspective, implemented technologies should not replace direct contact with a clinician; their primary role is to complement care and strengthen the trusting therapeutic relationship, not eliminate it (Leese et al., 2022).

9.4. Social and family support

Social support and family involvement are fundamental factors in the effectiveness of behavioral interventions and adaptation to a chronic disease such as rheumatoid arthritis (Azizoddin et al., 2024; Jung et al., 2024; Nebhinani et al., 2022; Nikiphorou et al., 2021). Practical help, empathy, and encouragement from loved ones directly increase a patient's self-efficacy and can protect them from negative emotions, which can facilitate coping with disease flare-ups, build motivation for exercise, and strengthen therapeutic adherence (Liang et al., 2025; Stoll et al., 2024; Thomas et al., 2023; Videm et al., 2022). Peer support is also considered crucial, especially in the form of organized group activities or programs run by patient organizations, where the exchange of experiences can reduce feelings of isolation (Larkin et al., 2024; Nikiphorou et al., 2021; Stoll

et al., 2024). Direct contact with individuals facing similar limitations, supported by patient-centered communication from therapists, can help normalize difficulties and build confidence in patients that long-term change in exercise habits is feasible (Fenton et al., 2021; Thomas et al., 2023; Thomsen et al., 2023). From a clinical practice perspective, this means that assessing the patient's psychosocial resources and actively involving their family network in the decision-making process should be an integral part of the planning, implementation, and evaluation of comprehensive care (Azizoddin et al., 2024; England et al., 2023; Liang et al., 2025; Teuwen et al., 2024).

10. Challenges in implementing digital technologies and mHealth

Modern rheumatology care is adopting digital solutions, such as mobile apps and wearable devices, to support patients with rheumatoid arthritis in changing their health habits (L. C. Li et al., 2025; Santosa et al., 2025). These technologies enable objective activity monitoring and provide personalized feedback, which can translate into measurable improvements in function and pain reduction (Sekhon et al., 2021). Furthermore, accelerometer data allows for precise assessment of exertion, verifying patients' subjective self-reports (Nowell et al., 2023).

Despite these benefits, the widespread implementation of digital tools faces multifaceted barriers. Patients often express concerns about technological overload, and complex interfaces discourage daily use (Macbrayne et al., 2023). The effectiveness of these solutions is also strongly influenced by patients' level of health and eHealth literacy, and the lack of appropriate cultural adaptation is a significant obstacle to their widespread acceptance (Alves et al., 2026; Knudsen et al., 2024). From a long-term perspective, maintaining adherence remains a significant challenge; studies based on real-world use of smartwatches show that after an initial period of enthusiasm, patient engagement can drastically decline over time (Nowell et al., 2023). Furthermore, technology implementation raises ethical challenges; these tools can raise concerns about losing direct contact with the clinician, therefore, their role should be to strengthen, not replace, a trusting therapeutic relationship (Leese et al., 2022). To prevent premature abandonment of technology, patients expect functions that go beyond simple step counters, indicating the need for integrated symptom monitoring, medication reminders, and the sharing of reports with their physician (Knitza et al., 2020). Therefore, app design must be based on proven behavior change techniques such as action planning and social support (Sekhon et al., 2021).

11. Telemedicine vs. face-to-face contact

The restrictions associated with the COVID-19 pandemic have significantly accelerated the development and validation of remote forms of care in rheumatology (Larkin et al., 2024; Stoll et al., 2024; Thomsen et al., 2023). Research shows that behavioral interventions delivered via telemedicine, including video sessions with a physiotherapist, mHealth programs, and automated messaging (chatbots), are a safe and highly acceptable alternative to traditional clinic visits (Bannell et al., 2024; Larkin et al., 2024; Prokofeva et al., 2024). Digital tools and remote monitoring save significant time and eliminate the need for burdensome travel, which is particularly helpful for those struggling with pain, fatigue, and limited mobility (Prokofeva et al., 2024; Rodríguez-Sánchez-Laulhé et al., 2020; Stoll et al., 2024). On the other hand, some patients emphasize that exclusive virtual contact is not optimal for everyone. The lack of direct supervision can hinder building a strong therapeutic relationship and reduce a sense of security, hence patients often prefer the physical presence of a specialist who understands the specifics of RA (Larkin et al., 2024; Thomas et al., 2023; Thomsen et al., 2023). These observations lead researchers to recommend flexible or hybrid models, in which key initial intervention steps, such as building trust, setting goals, and coaching, are conducted in-person, and subsequent motivational support is provided remotely, for example, through regular telephone consultations (Berdal et al., 2024; Fenton et al., 2021; Larkin et al., 2024). Implementing such solutions, while respecting individual patient preferences, is currently recognized as a highly effective element supporting self - management in inflammatory joint diseases (Jung et al., 2024; Nikiphorou et al., 2021).

12. The dynamics of collaboration between nurses and physiotherapists

The effectiveness of behavioral strategies depends on the consistency of the messages patients receive from various specialists within the multidisciplinary care team (Ester et al., 2025; Lehtomäki et al., 2025; Nikiphorou et al., 2021). Rheumatology nurses serve as key first-contact educators, with whom patients readily build a therapeutic alliance and who introduce the topic of physical activity into the broader context of overall disease management (Lehtomäki et al., 2025; Thomsen et al., 2023). Nurses' activities focus on building initial awareness and motivating patients to incorporate basic movement into their daily lifestyle and home routines

(Lehtomäki et al., 2025; Nikiphorou et al., 2021). Physiotherapists, in turn, take on a highly specialized role, designing individualized training programs that take into account the current inflammation status, appropriate exercise dose, and the patient's specific functional limitations (Ester et al., 2025; Larkin et al., 2024; Lehtomäki et al., 2025). However, communication barriers and a lack of accountability can be a significant problem in clinical practice; staff often report a lack of awareness of which movement issues have already been discussed with the patient by another team member (Ester et al., 2025; Lehtomäki et al., 2025). Therefore, improving information flow and clearly defining professional roles are indicated in the literature as crucial for improving the effectiveness and quality of behavioral interventions (Ester et al., 2025; Lehtomäki et al., 2025; Nikiphorou et al., 2021).

Discussion

Rheumatoid arthritis is associated with chronic pain and fatigue, which drastically reduce patients' physical activity levels. Evidence from the literature indicates that individualized behavioral strategies, anchored in models such as COM-B and SDT, are highly effective in building self-efficacy *and* overcoming psychological barriers, including kinesiophobia. The use of interdisciplinary support and digital tools (mHealth) facilitates the implementation of these interventions.

Despite promising results, significant gaps remain in research on behavioral interventions for RA. Significant heterogeneity across projects is evident in terms of duration, intensity, and outcome measurement methods, significantly limiting the ability to standardize care and directly compare outcomes. Furthermore, there is a lack of high-quality studies assessing long-term maintenance of exercise habits and verifying the phenomenon of decline in adherence to mobile technologies over time. Furthermore, the profiles of patients who benefit most from specific strategies have not been sufficiently identified.

These findings have fundamental implications for the field of rheumatology. They necessitate a shift from directive, standard counseling to early, holistic interdisciplinary support involving collaboration between physicians, nurses, and physiotherapists. Close integration of psychological care with targeted physical activity appears essential for lasting lifestyle modification, preventing progressive disability, and sarcopenia in patients with RA.

Conclusions

Behavioral strategies are an essential component of comprehensive rheumatoid arthritis management, addressing the complex challenges of maintaining physical activity in the face of chronic pain, fatigue, and psychological barriers such as kinesiophobia. Evidence gathered in this narrative review indicates that interventions based on behavior change theories, such as Social Cognitive Theory, Self-Determination Theory, and the COM-B model, consistently support the development of self-efficacy and autonomous motivation, which are critical determinants of long-term exercise adherence.

In various clinical contexts, strategies such as motivational interviewing, self-regulation coaching, and highly individualized exercise plans have been associated with greater engagement in physical activity and improved psychosocial outcomes. However, the existing evidence base remains heterogeneous, with significant variability in intervention duration, intensity, and methods of measuring physical activity.

Technological innovations, including mHealth apps and wearable devices, offer significant opportunities for improving self-monitoring, goal setting, and remote support. However, clinical and educational effectiveness appears to depend primarily on structured interdisciplinary collaboration involving nurses and physical therapists, social support, and high-quality personalized counseling, rather than solely on technology.

Future longitudinal and multicenter studies are essential to clarify the impact of new digital tools, optimize intervention designs, and identify patient profiles that benefit most from specific behavioral strategies. Overall, integrating personalized behavioral support into standard rheumatology practice is crucial to transforming short-term exercise recommendations into sustainable, lifelong health habits.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

REFERENCES

1. Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T
2. Alves, T. F., Horner, R., Montas, M. C., & Cozad, M. (2026). Usability and cultural relevance of an mHealth app for Hispanic/Latino individuals living with rheumatoid arthritis: Protocol for a mixed methods study. *JMIR Research Protocols, 15*(1), e88401. https://doi.org/10.2196/88401
3. Anderson, R. M., & Funnell, M. M. (2010). Patient empowerment: Myths and misconceptions. *Patient Education and Counseling, 79*(3), 277–282. https://doi.org/10.1016/j.pec.2009.07.025
4. Andersson, M. L. E., Wibring, K., Bergman, S., & Bremander, A. (2025). Empowerment as the key to health-enhancing physical activity in patients with rheumatoid arthritis and low physical function: A cross-sectional study. *Clinical Rheumatology, 45*(1), 503–513. https://doi.org/10.1007/s10067-025-07696-2
5. Azizoddin, D. R., Olmstead, R., Anderson, K. A., Hirz, A. E., Irwin, M. R., Gholizadeh, S., Weisman, M., Ishimori, M., Wallace, D., & Nicassio, P. (2024). Socioeconomic status, reserve capacity, and depressive symptoms predict pain in rheumatoid arthritis: An examination of the reserve capacity model. *BMC Rheumatology, 8*(1), 46. https://doi.org/10.1186/s41927-024-00416-4
6. Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191
7. Bannell, D. J., France-Ratcliffe, M., Hesketh, K. L., Cocks, M., Goodson, N., Taylor, C., Pecanha, T., Jones, H., Low, D. A., & Sprung, V. S. (2024). P114 Promoting physical activity using mobile health technology in people living with rheumatoid arthritis: MOTIVATE RA. *Rheumatology, 63*(Supplement_1). https://doi.org/10.1093/rheumatology/keae163.155
8. Beider, S., Stephan, M., Seeliger, T., Skripuletz, T., Witte, T., & Ernst, D. (2024). A comparative cross-sectional study of psychological distress, fatigue, and physical activity in patients with rheumatoid arthritis, systemic lupus erythematosus, and Sjögren's disease. *Frontiers in Medicine, 11*, 1507242. https://doi.org/10.3389/fmed.2024.1507242
9. Bell, K., Conde, M., Hendry, G., Rafferty, D., & Steultjens, M. (2022). Barriers and facilitators to physical activity in people with an inflammatory joint disease: A mixed methods study. *BMC Musculoskeletal Disorders, 23*(1). https://doi.org/10.1186/s12891-022-05847-z
10. Berdal, G., Kjeken, I., Linge, A. D., Aasvold, A. M., Tennebø, K., Eppeland, S. G., Hagland, A. S., Ohldieck-Fredheim, G., Valaas, H. L., Bø, I., Klokkeide, Å., Azimi, M., Dager, T. N., & Sand-Svartrud, A. L. (2024). Examining the building blocks of health behavior change in rheumatology rehabilitation: A theory-driven qualitative study. *Journal of Multidisciplinary Healthcare, 17*, 3649–3662. https://doi.org/10.2147/JMDH.S472713
11. Bergström, M., Larsson Ranada, Å., Sverker, A., Thyberg, I., & Björk, M. (2025). "As long as you learn to adapt": A longitudinal mixed-methods study exploring the first decade with rheumatoid arthritis. *BMC Rheumatology, 9*(1), 35. https://doi.org/10.1186/s41927-025-00485-z
12. Bilberg, A., Mannerkorpi, K., Borjesson, M., Svedlund, S., Sivertsson, J., Klingberg, E., & Bjersing, J. (2024). High-intensity interval training improves cardiovascular and physical health in patients with rheumatoid arthritis: A multicentre randomised controlled trial. *British Journal of Sports Medicine, 58*(23), e108369. https://doi.org/10.1136/bjsports-2024-108369
13. Black, R. J., Cross, M., Haile, L. M., Culbreth, G. T., Steinmetz, J. D., Hagins, H., Kopec, J. A., Brooks, P. M., Woolf, A. D., Ong, K. L., Kopansky-Giles, D. R., Dreinhoefer, K. E., Betteridge, N., Aali, A., Abbasifard, M., Abbasi-Kangevari, M., Abdurehman, A. M., Abedi, A., Abidi, H., … March, L. M. (2023). Global, regional, and national burden of rheumatoid arthritis, 1990–2020, and projections to 2050: A systematic analysis of the Global Burden of Disease Study 2021. *The Lancet Rheumatology, 5*(10), e594. https://doi.org/10.1016/S2665-9913(23)00211-4
14. Brady, S. M., Veldhuijzen van Zanten, J. J. C. S., Dinas, P. C., Nightingale, T. E., Metsios, G. S., Elmsmari, S. M. A., Duda, J. L., Kitas, G. D., & Fenton, S. A. M. (2023). Effects of lifestyle physical activity and sedentary behaviour interventions on disease activity and patient- and clinician-important health outcomes in rheumatoid arthritis: A systematic review with meta-analysis. *BMC Rheumatology, 7*(1). https://doi.org/10.1186/s41927-023-00352-9
15. Bravo, P., Edwards, A., Barr, P. J., Scholl, I., Elwyn, G., & McAllister, M. (2015). Conceptualising patient empowerment: A mixed methods study. *BMC Health Services Research, 15*(1), 252. https://doi.org/10.1186/s12913-015-0907-z
16. Brown, P., Pratt, A. G., & Hyrich, K. L. (2024). Therapeutic advances in rheumatoid arthritis. *BMJ, 384*. https://doi.org/10.1136/bmj-2022-070856
17. Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science, 7*(1). https://doi.org/10.1186/1748-5908-7-37
18. Chen, J., Song, Y., Chen, H., Tao, L., Wang, Y., Chen, Y., & Chen, H. (2025). The role of self-efficacy in self-management behaviours among patients with rheumatoid arthritis: A cross-sectional study based on the information–motivation–behavioural skills model. *Medicine, 104*(51), e46631. https://doi.org/10.1097/MD.0000000000046631

19. Chen, Y., Ma, C., Liu, L., He, J., Zhu, C., Zheng, F., Dai, W., Hong, X., Liu, D., Tang, D., & Dai, Y. (2021). Analysis of gut microbiota and metabolites in patients with rheumatoid arthritis and identification of potential biomarkers. *Aging, 13*(20), 23689–23701. https://doi.org/10.18632/aging.203641
20. Cutolo, M., Smith, V., Paolino, S., & Gotelli, E. (2023). Involvement of the secosteroid vitamin D in autoimmune rheumatic diseases and COVID-19. *Nature Reviews Rheumatology, 19*(5), 265–287. https://doi.org/10.1038/s41584-023-00944-2
21. Davoodifard, M., Abolfazl, S., V., & Saremi, Z. (2025). The impact of peer support groups on the psychological well-being of patients with rheumatoid arthritis: A randomized controlled trial. *Scientific Reports, 16*(1), 3621. https://doi.org/10.1038/s41598-025-33664-6
22. De Ocampo, C., Pollard, K. M., & Janssen, L. M. F. (n.d.). Modeling environmental inhalant exposure in rheumatoid arthritis. https://doi.org/10.1080/08958378.2025.2542555
23. de Ridder, D., Geenen, R., Kuijer, R., & van Middendorp, H. (2008). Psychological adjustment to chronic disease. *The Lancet, 372*(9634), 246–255. https://doi.org/10.1016/S0140-6736(08)61078-8
24. Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology, 53*(6), 1024–1037. https://doi.org/10.1037/0022-3514.53.6.1024
25. Ding, Q., Hu, W., Wang, R., Yang, Q., Zhu, M., Li, M., Cai, J., Rose, P., Mao, J., & Zhu, Y. Z. (2023). Signaling pathways in rheumatoid arthritis: Implications for targeted therapy. *Signal Transduction and Targeted Therapy, 8*(1), 68. https://doi.org/10.1038/s41392-023-01331-9
26. El Sharkawy, A. M., Elkholy, R. E., & Almokadem, H. A. (2025). Physical activity and nutritional profile assessment in elderly rheumatoid arthritis patients. *Egyptian Rheumatology and Rehabilitation, 52*(1), 23. https://doi.org/10.1186/s43166-025-00317-5
27. England, B. R., Smith, B. J., Baker, N. A., Barton, J. L., Oatis, C. A., Guyatt, G., Anandarajah, A., Carandang, K., Chan, K. K., Constien, D., Davidson, E., Dodge, C. V., Bemis-Dougherty, A., Everett, S., Fisher, N., Fraenkel, L., Goodman, S. M., Lewis, J., Menzies, V., … Treadwell, J. R. (2023). 2022 American College of Rheumatology guideline for exercise, rehabilitation, diet, and additional integrative interventions for rheumatoid arthritis. *Arthritis Care & Research, 75*(8), 1603–1615. https://doi.org/10.1002/acr.25117
28. Ester, M., Gillespie, D. C., Dhiman, K., Githumbi, R., Sipley, M., Adhikari, K., & Barber, C. (2025). Priority setting of healthcare provider barriers and facilitators to supporting patient physical activity in rheumatology: A nominal group technique study. *BMJ Open Sport & Exercise Medicine, 11*(4). https://doi.org/10.1136/bmjsem-2025-002669
29. Fenton, S. A. M., Duda, J. L., van Zanten, J. J. C. S. V., Metsios, G. S., & Kitas, G. D. (2020). Theory-informed interventions to promote physical activity and reduce sedentary behaviour in rheumatoid arthritis: A critical review of the literature. *Mediterranean Journal of Rheumatology, 31*(1), 19. https://doi.org/10.31138/MJR.31.1.19
30. Fenton, S. A. M., Veldhuijzen Van Zanten, J. J. C. S., Metsios, G. S., Rouse, P. C., Yu, C. A., Ntoumanis, N., Kitas, G. D., & Duda, J. L. (2021). Testing a self-determination theory-based process model of physical activity behavior change in rheumatoid arthritis: Results of a randomized controlled trial. *Translational Behavioral Medicine, 11*(2), 369–380. https://doi.org/10.1093/tbm/ibaa022
31. Figus, F. A., Piga, M., Azzolin, I., McConnell, R., & Iagnocco, A. (2021). Rheumatoid arthritis: Extra-articular manifestations and comorbidities. *Autoimmunity Reviews, 20*(4), 102776. https://doi.org/10.1016/j.autrev.2021.102776
32. Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Addison-Wesley.
33. Fu, X., Zhang, L., Wang, C., Yue, J., & Zhu, H. (2025). The effect of exercise therapy on pain, fatigue, bone function and inflammatory biomarkers individuals with rheumatoid arthritis and knee osteoarthritis: A meta-research review of randomized controlled trials. *Frontiers in Physiology, 16*, 1558214. https://doi.org/10.3389/fphys.2025.1558214
34. Gioia, C., Lucchino, B., Tarsitano, M. G., Iannuccelli, C., & Di Franco, M. (2020). Dietary habits and nutrition in rheumatoid arthritis: Can diet influence disease development and clinical manifestations? *Nutrients, 12*(5), 1456. https://doi.org/10.3390/nu12051456
35. Goubran, M., Van Allen, Z. M., Bilodeau, M., & Boisgontier, M. P. (2025). Depressive symptoms and physical activity mediate the adverse effect of pain on functional dependence in patients with arthritis: Evidence from the Canadian Longitudinal Study on Aging. *Physical Therapy, 105*(11), 120. https://doi.org/10.1093/ptj/pzaf120
36. Gravallese, E. M., & Firestein, G. S. (2023). Rheumatoid arthritis: Common origins, divergent mechanisms. *The New England Journal of Medicine, 388*(6), 529–542. https://doi.org/10.1056/nejmra2103726
37. Gumtorntip, W., Kasitanon, N., Louthrenoo, W., Chattipakorn, N., & Chattipakorn, S. C. (2023). Potential roles of air pollutants on the induction and aggravation of rheumatoid arthritis: From cell to bedside studies. *Environmental Pollution, 334*, 122181. https://doi.org/10.1016/j.envpol.2023.122181
38. Gwinnutt, J. M., Wieczorek, M., Balanescu, A., Bischoff-Ferrari, H. A., Boonen, A., Cavalli, G., de Souza, S., de Thurah, A., Dorner, T. E., Moe, R. H., Putrik, P., Rodríguez-Carrio, J., Silva-Fernández, L., Stamm, T., Walker-Bone, K., Welling, J., Zlatković-Švenda, M. I., Guillemin, F., & Verstappen, S. M. M. (2023). 2021 EULAR recommendations regarding lifestyle behaviours and work participation to prevent progression of rheumatic and musculoskeletal diseases. *Annals of the Rheumatic Diseases, 82*(1), 48–56. https://doi.org/10.1136/annrheumdis-2021-222020

39. Hahn, J., Malspeis, S., Choi, M. Y., Stevens, E., Karlson, E. W., Lu, B., Cui, J., Yoshida, K., Kubzansky, L., Sparks, J. A., & Costenbader, K. H. (2023). Association of healthy lifestyle behaviors and the risk of developing rheumatoid arthritis among women. *Arthritis Care & Research, 75*(2), 272–276. https://doi.org/10.1002/acr.24862
40. Haider, S., Sedlak, M., Kapan, A., Grabovac, I., Lamprecht, T., Erlacher, L., Quittan, M., Fenzl, K. H., & Dorner, T. E. (2020). Factors associated with objectively measured physical activity in patients with seropositive rheumatoid arthritis. *International Journal of Environmental Research and Public Health, 17*(23), 1–12. https://doi.org/10.3390/ijerph17239008
41. Hamy, V., Creagh, A., & Garcia-Gancedo, L. (2025). Assessment of physical activity patterns in patients with rheumatoid arthritis using the UK Biobank. *PLOS One, 20*(3), e0319908. https://doi.org/10.1371/journal.pone.0319908
42. Hasanica, N., Ramic-Catak, A., Mujezinovic, A., Begagic, S., Galijasevic, K., & Oruc, M. (2020). The effectiveness of leaflets and posters as a health education method. *Materia Socio-Medica, 32*(2), 135. https://doi.org/10.5455/msm.2020.32.135-139
43. Houge, I. S., Hoff, M., & Videm, V. (2024). Self-determined motivation and physical activity in patients with rheumatoid arthritis: A cross-sectional study. *Scandinavian Journal of Rheumatology, 53*(5), 307–315. https://doi.org/10.1080/03009742.2023.2300576
44. Hsiao, I. Y., Livneh, H., Chen, W. J., Lu, M. C., & Tsai, T. Y. (2024). An exploration of self-efficacy and its associated factors among rheumatoid arthritis patients in Taiwan. *Medicina, 60*(10), 1653. https://doi.org/10.3390/medicina60101653
45. Iken, A. R., Gademan, M. G. J., Vliet Vlieland, T. P. M., Nutma, A., Van Gaalen, F. A., Van Tubergen, A. M., Poolman, R. W., Van Bodegom-Vos, L., Van Der Laan, W. H., De Klerk, S., Peter, W. F. H., Pennings, P., & Rozema, C. (2026). Barriers and facilitators to implement longstanding exercise therapy for people with rheumatoid arthritis or axial spondyloarthritis. *Rheumatology Advances in Practice, 10*(1), 13. https://doi.org/10.1093/rap/rkag013
46. Jacquemin, C., Servy, H., Molto, A., Sellam, J., Foltz, V., Gandjbakhch, F., Hudry, C., Mitrovic, S., Fautrel, B., & Gossec, L. (2018). Physical activity assessment using an activity tracker in patients with rheumatoid arthritis and axial spondyloarthritis: Prospective observational study. *JMIR mHealth and uHealth, 6*(1). https://doi.org/10.2196/mhealth.7948
47. Jung, A., Geidl, W., Matting, L., Hoessel, L. M., Siemens, W., Sudeck, G., & Pfeifer, K. (2024). Efficacy of physical activity promoting interventions in physical therapy and exercise therapy for persons with noncommunicable diseases: An overview of systematic reviews. *Physical Therapy, 104*(7). https://doi.org/10.1093/ptj/pzae053
48. Kim, C. J., Yun, H. W., Kang, H. S., Jung, J. Y., & Schlenk, E. A. (2023). Predicting physical activity and sarcopenia-related health outcomes in women with rheumatoid arthritis: A test of the self-determination theory. *Nursing Open, 10*(9), 6369–6380. https://doi.org/10.1002/nop2.1885
49. Knittle, K., De Gucht, V., Hurkmans, E., Vlieland, T. V., & Maes, S. (2016). Explaining physical activity maintenance after a theory-based intervention among patients with rheumatoid arthritis: Process evaluation of a randomized controlled trial. *Arthritis Care & Research, 68*(2), 203–210. https://doi.org/10.1002/acr.22647
50. Knitza, J., Simon, D., Lambrecht, A., Raab, C., Tascilar, K., Hagen, M., Kleyer, A., Bayat, S., Derungs, A., Amft, O., Schett, G., & Hueber, A. J. (2020). Mobile health usage, preferences, barriers, and eHealth literacy in rheumatology: Patient survey study. *JMIR mHealth and uHealth, 8*(8), e19661. https://doi.org/10.2196/19661
51. Knudsen, L. R., Ndosi, M., Hauge, E. M., Lomborg, K., Dreyer, L., Aaboe, S., Kjær, M. B., Sørensen, L., Volsmann, L., Christensen, H. M., & De Thurah, A. (2024). Effectiveness of a novel digital patient education programme to support self-management of early rheumatoid arthritis: A randomized controlled trial. *Rheumatology, 63*(9), 2547–2556. https://doi.org/10.1093/rheumatology/keae177
52. Kudaeva, F. M., Speechley, M. R., & Pope, J. E. (2019). A systematic review of viral exposures as a risk for rheumatoid arthritis. *Seminars in Arthritis and Rheumatism, 48*(4), 587–596. https://doi.org/10.1016/j.semarthrit.2018.03.011
53. Larkin, L., McKenna, S., Pyne, T., Comerford, P., Moses, A., Folan, A., Gallagher, S., Glynn, L., Fraser, A., Esbensen, B. A., & Kennedy, N. (2024). Promoting physical activity in rheumatoid arthritis through a physiotherapist led behaviour change-based intervention (PIPPRA): A feasibility randomised trial. *Rheumatology International, 44*(5), 779–793. https://doi.org/10.1007/s00296-024-05544-1
54. Lee, A. Z. Y., Woon, T. H., Wang, C. T. M., Kwan, Y. H., & Fong, W. (2025). Facilitators and barriers to physical activity for patients with rheumatoid arthritis and axial spondyloarthritis. *International Journal of Rheumatic Diseases, 28*(2), e70109. https://doi.org/10.1111/1756-185X.70109
55. Leese, J., Zhu, S., Townsend, A. F., Backman, C. L., Nimmon, L., & Li, L. C. (2022). Ethical issues experienced by persons with rheumatoid arthritis in a wearable-enabled physical activity intervention study. *Health Expectations, 25*(4), 1418–1431. https://doi.org/10.1111/hex.13481
56. Lehtomäki, K., Ryhtä, I., Peltonen, J., & Stolt, M. (2025). Exploring the physical activity counselling for patients with rheumatoid arthritis: Perceptions of nurses and physiotherapists. *Musculoskeletal Care, 23*(1), e70053. https://doi.org/10.1002/msc.70053

57. Li, L. C., Xie, H., Feehan, L. M., Shaw, C., Lu, N., Ramachandran, S., Wang, E., Therrien, S., Mucha, J., Hoens, A. M., English, K., Davidson, E., Liu-Ambrose, T., Backman, C. L., Esdaile, J. M., Miller, K. J., & Lacaille, D. (2025). Effect of digital monitoring and counselling on self-management ability in patients with rheumatoid arthritis: A randomised controlled trial. *Rheumatology, 64*(1), 310–320. https://doi.org/10.1093/rheumatology/kead709
58. Li, Z., & Wang, X. Q. (2023). Clinical effect and biological mechanism of exercise for rheumatoid arthritis: A mini review. *Frontiers in Immunology, 13*, 1089621. https://doi.org/10.3389/fimmu.2022.1089621
59. Liang, L., Zhang, X., Pan, Y., Huang, L., Jia, L., Xu, P., & Li, K. (2025). Exploring the factors related to medication adherence in patients with rheumatoid arthritis based on social cognitive theory: A path analysis. *Patient Preference and Adherence, 19*, 2565–2575. https://doi.org/10.2147/PPA.S529952
60. Liao, C. De, Chen, H. C., Huang, S. W., & Liou, T. H. (2022). Exercise therapy for sarcopenia in rheumatoid arthritis: A meta-analysis and meta-regression of randomized controlled trials. *Clinical Rehabilitation, 36*(2), 145–157. https://doi.org/10.1177/02692155211035539
61. Lukovic, S., Baralic, M., Tomonjic, N., Mihailovic, J., Neskovic, A., Sestakov, M. V., Pavlovic, I., Barac, B., Zivanovic Radnic, T., & Ostojic, P. (2024). Do patients with rheumatoid arthritis have an (in)adequate level of physical activity? A latent class analysis approach. *Life, 14*(12), 1600. https://doi.org/10.3390/life14121600
62. Macbrayne, A., Curzon, P., Soyel, H., Marsh, W., Fenton, N., Pitzalis, C., & Humby, F. (2023). Attitudes towards technology supported rheumatoid arthritis care: Investigating patient- and clinician-perceived opportunities and barriers. *Rheumatology Advances in Practice, 7*(3). https://doi.org/10.1093/rap/rkad089
63. Marley, J., McDonough, S. M., Tully, M. A., Atkins, L., Bunting, B., O'Hanlon, J., & Porter-Armstrong, A. (2025). Identifying behavioural determinants of physical activity in persistent musculoskeletal pain: A COM-B and TDF-guided qualitative study. *Disability and Rehabilitation*. https://doi.org/10.1080/09638288.2025.2587087
64. Martinez-Calderon, J., Meeus, M., Struyf, F., & Luque-Suarez, A. (2020). The role of self-efficacy in pain intensity, function, psychological factors, health behaviors, and quality of life in people with rheumatoid arthritis: A systematic review. *Physiotherapy Theory and Practice, 36*(1), 21–37. https://doi.org/10.1080/09593985.2018.1482512
65. Matting, L., Pfeifer, K., Sudeck, G., Jung, A., Langhirt, F., & Geidl, W. (2025). Physical activity promotion in physical therapy, exercise therapy and other movement-based therapies: A scoping review and content analysis of intervention studies and theoretical works. *International Journal of Behavioral Nutrition and Physical Activity, 22*(1), 72. https://doi.org/10.1186/s12966-025-01772-1
66. Metsios, G. S., Fenton, S. A. M., Tzika, K., Moe, R. H., Fragoulis, G. E., Vlieland, T. P. M. V., Nikiphorou, E., Van den Ende, C. H. M., Fatouros, I., van der Esch, M., Niedermann, K., Stavropoulos-Kalinoglou, A., van Zanten, J. J. C. S. V., Brodin, N., O'Brien, C. M., Koutedakis, Y., Kennedy, N., Swinnen, T. W., Bostrom, C., & Kitas, G. D. (2023). Barriers and facilitators for physical activity in rheumatic and musculoskeletal disease: A European-based survey. *Clinical Rheumatology, 42*(7), 1897–1902. https://doi.org/10.1007/s10067-023-06518-7
67. Michaël, D., Diederik, D. C., Sofia, P., Delphine, B., Johan, J., René, W., & Patrick, V. (2021). Treatment response and several patient-reported outcomes are early determinants of future self-efficacy in rheumatoid arthritis. *Arthritis Research & Therapy, 23*(1), 269. https://doi.org/10.1186/s13075-021-02651-3
68. Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science, 6*(1). https://doi.org/10.1186/1748-5908-6-42
69. Nakayama, M., Furuya, T., Inoue, E., Tanaka, E., Ikari, K., Yamanaka, H., & Harigai, M. (2023). Factors associated with sarcopenia in Japanese patients with rheumatoid arthritis: Results from the IORRA cohort study. *Clinical Rheumatology, 43*(1), 521–526. https://doi.org/10.1007/s10067-023-06779-2
70. Nebhinani, N., Mattoo, S. K., & Wanchu, A. (2022). Quality of life, social support, coping strategies, and psychiatric morbidity in patients with rheumatoid arthritis. *Journal of Neurosciences in Rural Practice, 13*(1), 119–122. https://doi.org/10.1055/s-0041-1742137
71. New-Tolley, J., Dyer, K. A., Lester, S., Stanhope, J., Burnet, S., Ting, K., Basnayake, S., Murthy, S., Hoon, E., Proudman, S., & Hill, C. L. (2026). Understanding physical activity participation in people living with rheumatoid arthritis. *Rheumatology Advances in Practice, 10*(1), 146. https://doi.org/10.1093/rap/rkaf146
72. Nikiphorou, E., Santos, E. J. F., Marques, A., Böhm, P., Bijlsma, J. W. J., Daien, C. I., Esbensen, B. A., Ferreira, R. J. O., Fragoulis, G. E., Holmes, P., McBain, H., Metsios, G. S., Moe, R. H., Stamm, T. A., de Thurah, A., Zabalan, C., Carmona, L., & Bosworth, A. (2021). 2021 EULAR recommendations for the implementation of self-management strategies in patients with inflammatory arthritis. *Annals of the Rheumatic Diseases, 80*(10), 1278–1285. https://doi.org/10.1136/ANNRHEUMDIS-2021-220249
73. Nolla, J. M. (2024). Sarcopenia, a hidden comorbidity of established rheumatoid arthritis. *Exploration of Musculoskeletal Diseases, 2*(4), 293–299. https://doi.org/10.37349/emd.2024.00057
74. Nowell, W. B., Curtis, J. R., Zhao, H., Xie, F., Stradford, L., Curtis, D., Gavigan, K., Boles, J., Clinton, C., Lipkovich, I., Venkatachalam, S., Calvin, A., & Hayes, V. S. (2023). Participant engagement and adherence to providing smartwatch and patient-reported outcome data: Digital tracking of rheumatoid arthritis longitudinally (DIGITAL) real-world study. *JMIR Human Factors, 10*(1), e44034. https://doi.org/10.2196/44034

75. Oh, H., Suh, C. H., Kim, J. W., & Boo, S. (2024). mHealth-based self-management program for patients with rheumatoid arthritis: A pilot randomized controlled study. *Nursing & Health Sciences, 26*(4), e13187. https://doi.org/10.1111/nhs.13187
76. Ohno, T., Aune, D., & Heath, A. K. (2020). Adiposity and the risk of rheumatoid arthritis: A systematic review and meta-analysis of cohort studies. *Scientific Reports, 10*(1), 16006. https://doi.org/10.1038/s41598-020-71676-6
77. Onishi, A., Torii, M., Hidaka, Y., Uozumi, R., Oshima, Y., Tanaka, H., Onizawa, H., Fujii, T., Murata, K., Murakami, K., Tanaka, M., Matsuda, S., Morinobu, A., Arai, H., & Hashimoto, M. (2023). Efficacy of personalized exercise program on physical function in elderly patients with rheumatoid arthritis at high risk for sarcopenia: Study protocol for a randomized controlled trial. *BMC Musculoskeletal Disorders, 24*(1), 280. https://doi.org/10.1186/s12891-023-06185-4
78. Öztürk, İ. B., Garip, Y., Sivas, F., Özden, M. P., & Bodur, H. (2021). Kinesiophobia in rheumatoid arthritis patients: Relationship with quadriceps muscle strength, fear of falling, functional status, disease activity, and quality of life. *Archives of Rheumatology, 36*(3), 427. https://doi.org/10.46497/ArchRheumatol.2021.8535
79. Öztürk, Ö., Ueckert, D., van Bodegom-Vos, L., van Weely, S., Feyzioğlu, Ö., Niedermann, K., Rausch Osthoff, A.-K., & Davergne, T. (2026). Exploration of country-specific barriers and facilitators for the implementation of physical activity according to the EULAR physical activity recommendations for people with rheumatic musculoskeletal diseases in four different European countries: The CO…. *Clinical Rheumatology, 45*(4), 2209–2218. https://doi.org/10.1007/s10067-026-07984-5
80. Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*(3), 390–395. https://doi.org/10.1037//0022-006x.51.3.390
81. Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion, 12*(1), 38–48. https://doi.org/10.4278/0890-1171-12.1.38
82. Prokofeva, Y. A., Belenkov, Y. N., Kozhevnikova, M. V., Zheleznykh, E. A., Alborova, Z. V., & Menshikova, I. V. (2024). Remote monitoring of patients with rheumatoid arthritis using a personal messenger. *Digital Diagnostics, 5*(4), 740–751. https://doi.org/10.17816/DD634074
83. Rodríguez-Sánchez-Laulhé, P., Luque-Romero, L. G., Blanquero, J., Suero-Pineda, A., Biscarri-Carbonero, Á., Barrero-Garciá, F. J., & Heredia-Rizo, A. M. (2020). A mobile app using therapeutic exercise and education for self-management in patients with hand rheumatoid arthritis: A randomized controlled trial protocol. *Trials, 21*(1), 777. https://doi.org/10.1186/s13063-020-04713-4
84. Ryan, R. M., & Deci, E. L. (2000). The darker and brighter sides of human existence: Basic psychological needs as a unifying concept. *Psychological Inquiry, 11*(4), 319–338. https://doi.org/10.1207/s15327965pli1104_03
85. Salmon, V. E., Hewlett, S., Walsh, N. E., Kirwan, J. R., Morris, M., Urban, M., & Cramp, F. (2019). Developing a group intervention to manage fatigue in rheumatoid arthritis through modifying physical activity. *BMC Musculoskeletal Disorders, 20*(1), 194. https://doi.org/10.1186/s12891-019-2558-4
86. Santosa, A., Li, J. W., & Tan, T. C. (2025). Digital health for equitable rheumatic care: Integrating real-world experiences to guide policy pathways. *Healthcare, 13*(4), 438. https://doi.org/10.3390/healthcare13040438
87. Sekhon, M., White, C., Godfrey, E., Amirova, A., Revenäs, Å., King, S., Pedro, J., Quailey, J., & Bearne, L. (2021). Effectiveness of web-based and mobile health interventions designed to enhance adherence to physical activity for people with inflammatory arthritis: A systematic review. *Rheumatology Advances in Practice, 5*(1), rkab016. https://doi.org/10.1093/rap/rkab016
88. Kori, S. H. (1990). Kinesiophobia: A new view of chronic pain behavior. *Pain Management, 3*, 35–43. https://cir.nii.ac.jp/crid/1572824501081889280
89. Song, Y., Chen, Y., Wen, L., He, B., Ding, Y., Liu, M., Tang, F., Wang, L., Wu, J., Deng, X., Xing, L., & Zhao, W. (2024). Health-related quality of life profiles in patients with rheumatoid arthritis: A latent profile analysis. *Frontiers in Public Health, 12*. https://doi.org/10.3389/fpubh.2024.1478376
90. Steultjens, M., Bell, K., & Hendry, G. (2023). The challenges of measuring physical activity and sedentary behaviour in people with rheumatoid arthritis. *Rheumatology Advances in Practice, 7*(1), rkac101. https://doi.org/10.1093/rap/rkac101
91. Stoll, N., Dey, M., Norton, S., Adas, M., Bosworth, A., Buch, M. H., Cope, A., Lempp, H., Galloway, J., & Nikiphorou, E. (2024). Understanding the psychosocial determinants of effective disease management in rheumatoid arthritis to prevent persistently active disease: A qualitative study. *RMD Open, 10*(2). https://doi.org/10.1136/rmdopen-2024-004104
92. Swärdh, E., Nordgren, B., Opava, C. H., & Demmelmaier, I. (2020). "A necessary investment in future health": Perceptions of physical activity maintenance among people with rheumatoid arthritis. *Physical Therapy, 100*(12), 2144. https://doi.org/10.1093/ptj/pzaa176
93. Swärdh, E., Opava, C., & Brodin, N. (2021). Physical activity in patients with rheumatoid arthritis: An agile lifelong behaviour. *RMD Open, 7*(2). https://doi.org/10.1136/rmdopen-2021-001635
94. Terao, C., Ohmura, K., Ikari, K., Kawaguchi, T., Takahashi, M., Setoh, K., Nakayama, T., Kosugi, S., Sekine, A., Tabara, Y., Taniguchi, A., Momohara, S., Yamanaka, H., Yamada, R., Matsuda, F., & Mimori, T. (2014). Effects of smoking and shared epitope on the production of anti-citrullinated peptide antibody in a Japanese adult population. *Arthritis Care & Research, 66*(12), 1818–1827. https://doi.org/10.1002/acr.22385

95. Teuwen, M. M. H., van Weely, S. F. E., Vliet Vlieland, T. P. M., van Wissen, M. A. T., Peter, W. F., den Broeder, A. A., van Schaardenburg, D., van den Hout, W. B., Van den Ende, C. H. M., & Gademan, M. G. J. (2024). Effectiveness of longstanding exercise therapy compared with usual care for people with rheumatoid arthritis and severe functional limitations: A randomised controlled trial. *Annals of the Rheumatic Diseases, 83*(4), 437–445. https://doi.org/10.1136/ard-2023-224912
96. Thomas, R., Berry, A., Swales, C., & Cramp, F. (2023). Strategies to enhance physical activity in people with rheumatoid arthritis: A Delphi survey. *Musculoskeletal Care*. https://doi.org/10.1002/msc.1745
97. Thomsen, T., Aadahl, M., Hetland, M. L., & Esbensen, B. A. (2023). Physical activity guidance in the rheumatology clinic: What matters for patients with rheumatoid arthritis? A qualitative study. *Rheumatology International, 44*(1), 181–189. https://doi.org/10.1007/s00296-023-05466-4
98. Torii, M., Itaya, T., Minamino, H., Katsushima, M., Fujita, Y., Tanaka, H., Oshima, Y., Watanabe, R., Ito, H., Arai, H., & Hashimoto, M. (2023). Management of sarcopenia in patients with rheumatoid arthritis. *Modern Rheumatology, 33*(3), 435–440. https://doi.org/10.1093/mr/roac095
99. Videm, V., Hoff, M., & Liff, M. H. (2022). Use of the Behavioral Regulation in Exercise Questionnaire-2 to assess motivation for physical activity in persons with rheumatoid arthritis: An observational study. *Rheumatology International, 42*(11), 2039. https://doi.org/10.1007/s00296-021-05079-9
100. Wu, D., Luo, Y., Li, T., Zhao, X., Lv, T., Fang, G., Ou, P., Li, H., Luo, X., Huang, A., & Pang, Y. (2022). Systemic complications of rheumatoid arthritis: Focus on pathogenesis and treatment. *Frontiers in Immunology, 13*, 1051082. https://doi.org/10.3389/fimmu.2022.1051082
101. Xueying, S., Yanli, Y., Wei, X., Lingling, Z., & Lili, L. (2024). Influence of kinesiophobia on activity, function, and anxiety levels in patients with rheumatoid arthritis. *Frontiers in Medicine, 11*, 1514088. https://doi.org/10.3389/fmed.2024.1514088
102. Ye, X., Ren, D., Chen, Q., Shen, J., Wang, B., Wu, S., & Zhang, H. (2025). Resolution of inflammation during rheumatoid arthritis. *Frontiers in Cell and Developmental Biology, 13*, 1556359. https://doi.org/10.3389/fcell.2025.1556359
103. Yildirim, N. (2023). Comparison of kinesiophobia in patients with rheumatoid arthritis and systemic lupus erythematosus. *European Review for Medical and Pharmacological Sciences, 27*(23), 11508–11516. https://doi.org/10.26355/eurrev_202312_34589
104. Yoshitomi, H. (2019). Regulation of immune responses and chronic inflammation by fibroblast-like synoviocytes. *Frontiers in Immunology, 10*, 1395. https://doi.org/10.3389/fimmu.2019.01395
105. Yu, C. A., Rouse, P. C., Veldhuijzen Van Zanten, J. J. C. S., Ntoumanis, N., Kitas, G. D., Duda, J. L., & Metsios, G. S. (2015). Subjective and objective levels of physical activity and their association with cardiorespiratory fitness in rheumatoid arthritis patients. *Arthritis Research & Therapy, 17*(1). https://doi.org/10.1186/s13075-015-0584-7
106. Yun, H. W., Kim, C. J., Ahn, J. A., & Schlenk, E. A. (2023). Effects of a self-determination theory-based physical activity programme for postmenopausal women with rheumatoid arthritis: A randomized controlled trial. *International Journal of Nursing Practice, 29*(6), e13199. https://doi.org/10.1111/ijn.13199
107. Zhou, J., Fan, X., Gan, Y., Luo, Z., Qi, H., & Cao, Y. (2024). Effect of fatigue on quality of life in patients with rheumatoid arthritis: The chain mediating role of resilience and self-efficacy. *Advances in Rheumatology, 64*(1), 66. https://doi.org/10.1186/s42358-024-00410-x