What is known about fitness, physical activity, health-related quality of life and muscle-strengthening activities in adults with fibromyalgia? A scoping review

MOUNTER, Darcie <http://orcid.org/0009-0006-2024-8566>, ROGERSON, David <http://orcid.org/0000-0002-4799-9865>, DE VIVO, Marlize and THOMPSON, Steve <http://orcid.org/0000-0001-7674-3685>

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What is known about fitness, physical activity, health-related quality of life and muscle-strengthening activities in adults with Fibromyalgia? A scoping review.

Darcie Mounter[1], David Rogerson[1], Marlize De Vivo[2], Steve. W Thompson[1]

1. Sport and Physical Activity Research Centre, School of Sport and Physical Activity, Sheffield Hallam University, Sheffield, UK.
2. Advanced Wellbeing and Research Centre, Sheffield Hallam University, Sheffield, UK.

Corresponding Author: D.Mounter@shu.ac.uk

ABSTRACT

Objective To map the current evidence on components of fitness, physical activity and health-related quality of life, in addition to common fitness and health-related quality of life outcomes and assessment tools, explore existing evidence on the design and effects of muscle-strengthening activities on health-related quality of life, and map the research on the barriers and facilitators to engagement in physical activities, specifically muscle-strengthening activities, in adults living with fibromyalgia.

Design Scoping review of published articles.

Data sources Electronic databases (PubMed, SPORTDiscus, SCOPUS, CINAHL, Cochrane library, MedLine, Google Scholar), and reference searching were included from the earliest date to March 2025.

Eligibility criteria Studies were included if they assessed components of fitness, physical activity, health-related quality of life and/or muscle-strengthening activities in relation to fibromyalgia, and were published in English. Articles containing reviews, case reports, protocols, editorials or opinion pieces were excluded.

Results 79 articles were included in the scoping review. Compared to healthy controls, individuals with fibromyalgia have decreased muscle strength, cardiovascular fitness, agility, balance and flexibility, levels of physical activity, and health-related quality of life. The fibromyalgia impact questionnaire, 36-item short-form health survey, and visual analogue scale were predominant tools used to assess health-related quality of life, though methods varied considerably across studies. Muscle-strengthening activity intervention study designs were heterogeneous, although progressions during resistance-based strength exercise emerged as a promising modality to improve health-related quality of life. Currently, the barriers to, and facilitators of, muscle-strengthening activities are underexplored.

Conclusion This scoping review highlights substantial heterogeneity in health-related quality of life assessment tools and muscle-strengthening activity intervention design in adults with fibromyalgia. While muscle-strengthening activities appear beneficial, the absence of standardised protocols limits the comparability of studies. Moreover, further work is needed within qualitative research to understand the barriers to engagement in muscle-strengthening activities to further inform the development of tailored, patient-centred muscle-strengthening programmes.

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Strengths and limitations of this study

- The Joanna Briggs Institute framework for scoping reviews and the Preferred Reporting for Systematic Reviews and Meta-Analysis (PRISMA) extension for scoping reviews (PRISMA-ScR) were both followed.
- A broad search was conducted across 6 databases and google scholar without date restrictions, providing wide coverage of relevant literature.
- A limitation of this study is that the search was limited to studies published in English, and therefore other relevant articles may have been missed.

BACKGROUND

Fibromyalgia syndrome (FMS) is a multifactorial, complex condition with unknown aetiology [1]. In the UK alone, FMS impacts up to 2.9 million individuals [2] and has a disproportionate impact on women [3,4]. Common symptoms include widespread pain, fatigue [5], sleep disturbances [6], and psychological distress [7], and is associated with substantial functional impairment [8], placing a large economic burden to healthcare systems [9,10] and reducing health-related quality of life (HRQoL).

At present, there is no cure for FMS. Treatment predominantly focuses on symptom management and improving quality of life (QoL) [11] and physical activities (PA) are recommended for pain management [12] due to the low cost, convenience, and anti-inflammatory effects [13]. The role of PA in FMS shows a promising impact on physical health

[14], however, FMS symptoms may lead to a sedentary lifestyle [15], making PA both challenging and crucial for the management of symptoms.

Physical fitness, encompassing muscle strength, cardiovascular endurance, flexibility, agility, and balance, is fundamental to overall health [16]. Individuals with FMS consistently demonstrate lower levels of physical fitness than healthy populations, with reduced strength, impaired cardiovascular capacity, and poorer flexibility [17–19]. These deficits not only limit daily functioning but also exacerbate the cycle of inactivity and physical deconditioning [20]. Physical inactivity may worsen pain sensitivity and fatigue, whereas increased levels of PA have been associated with improved pain and HRQoL [21]. Despite the benefits of PA, many individuals with FMS remain inactive [22], and while impairments on physical fitness are well documented in single domains, no comprehensive synthesis exists to describe the evidence-base of fitness components in adults with FMS.

Muscle strength is an essential component of physical fitness [23] and is the ability to exert maximal force generated by a muscle or muscle group in response to an internal or external demand [24]. Strength is needed to accomplish activities of daily living and functional tasks [25] and has a direct influence on quality of life [19]. The value of strength-based activities, specifically muscle-strengthening activities (MSA), is now more recognised and is recommended as part of the UK PA guidelines to be completed on at least two days per week [26]. MSA are activities that develop or maintain strength in the major muscle groups, and can include activities such as heavy gardening, carrying heavy shopping, or resistance exercise [26]. As a broad category, MSA encompasses a variety of exercise modalities that differ in their structure and mechanisms, but share the aim of developing or maintaining strength and function. Examples include resistance training (RT) (defined as any exercise that requires the muscles to contract against an external resistance [27]), functional RT (movements designed to improve physical performance in real-world activities, often emphasising compound, multiplanar movements [28]), body-weight training, and holistic strengthening activities such as Tai Chi and Pilates.

MSA has been labelled a promising strategy [29] for the management of FMS due to the unique benefits of improved physical function, increased muscle strength [30], and reduced pain [31]. Some studies suggest MSA improves HRQoL [32] and slows down the cycle of deconditioning [33], however findings are controversial [34]. This inconsistency may arise from variation in protocol designs, particularly in how exercise dose parameters such as frequency, intensity, time and type are specified in interventions. This heterogeneity makes it difficult to directly compare outcomes, undermining the ability to draw firm and accurate conclusions about the effectiveness [35] of MSA interventions. While several MSA protocols exist, there is a need to synthesise the existing protocols to inform the development of future, effective approaches.

In addition to the heterogeneous nature of MSA interventions, engagement to PA and MSA's among individuals with FMS is often low, and sedentary behaviours are prevalent [36]. Moreover, lack of engagement to PA is commonly undermined by perceived barriers and facilitators, such as pain and motivation [37]. However, the literature surrounding the factors affecting MSA engagement is lacking, and existing insights are confined to small-scale qualitative studies investigating the barriers to PA [37,38]. Therefore, it is important to comprehensively map identified barriers and facilitators to engagement in PA, specifically MSA's, for the FMS population to develop successful interventions.

HRQoL is accepted as a multidimensional assessment of how a disease or treatment affects perceived overall function and wellbeing [39], and represents several domains including physical, psychological, and well-being aspects. Current evidence suggests individuals with FMS suffer with high levels of pain [40], depression [41], difficulty sleeping [42], and limitations in physical function [43], all of which contribute to reduced HRQoL. However, many HRQoL tools exist, ranging from generic QoL scales, such as the 36-item short-form health survey (SF-36), to FMS-specific tools, such as the fibromyalgia impact questionnaire (FIQ). These differences create considerable heterogeneity in the way that HRQoL is conceptualised [44]. Moreover, it is important to identify the available HRQoL measures and highlight which are most commonly used. Consistent use of these tools enables meaningful comparison between studies, supports the evaluation of interventions, and improves understanding of how FMS affects individuals.

Given these complexities, a comprehensive synthesis is needed to map what is currently known and where the key gaps lie within the evidence base. Scoping reviews are suited to this purpose, mapping the breadth of available evidence across multiple study designs [45]. Accordingly, the aim of this study was to map out the evidence base around fitness components, PA and HRQoL, whilst identifying MSA interventions previously implemented in the FMS population. The review addressed four main objectives: (1) to map the current evidence on components of fitness , PA levels and HRQoL in adults with FMS; (2) To map the existing literature on common HRQoL and fitness outcomes and assessment tools; (3) to explore existing evidence on the design, implementation and effects of MSA on HRQoL in adults with FMS; (4) to map the research on barriers of, and facilitators to, engagement in PA and MSA in adults with FMS. To address the aims and objectives, the research question for this scoping review was: What is known about fitness, PA, HRQoL and MSA in adults with FMS?

METHODS

This review focused on the scoping review framework outlined by the Joanna Briggs Institute (JBI)[46] for scoping reviews, and was conducted in accordance with the Preferred Reporting for Systematic reviews and Meta-Analysis (PRISMA) extension for scoping reviews (PRISMA-ScR)[47] guidelines (Supplementary information 1). The protocol of this review was specified in advance and registered in the Open Science Framework database [OSF, https://osf.io/djwbq].

Identification of Relevant Studies

Eligibility criteria were established through discussion with the research team and is depicted in Table 1. There were no time restrictions applied to searches.

Table 1 Eligibility criteria for selected studies

Inclusion Criteria	Exclusion Criteria
• Studies including adults with a mean age between 18- and 59-years old with a confirmed diagnosis of FMS. • Any study which assessed components of fitness or PA levels in FMS patients. • MSA interventions that evaluated the effects on HRQoL. Combined exercise interventions were eligible, providing sufficient details of MSA component were supplied. • Outcomes that measured HRQoL (including pain, physical function, fatigue, overall QoL, impact of FMS, sleep, depression and anxiety). • Full-text available	• Research including children, adolescents or elderly • Participants had comorbidities that may affect participation to exercise, such as presence of serious cardiovascular disease, pulmonary or endocrine, neurological or renal disease • Case reports, reviews, protocols, editorials or opinion pieces.

- Published in English language

FMS = fibromyalgia syndrome; HRQoL = health related quality of life; MSA = muscle-strengthening activities; PA = physical activity; QoL = quality of life.

Search Strategy and Databases

An initial search of PubMed and SPORTDiscus was conducted to identify relevant articles on the topic. Systematic searches were conducted from January to March 2025. Electronic databases (PubMed, SPORTDiscus, SCOPUS, CINAHL, MedLine, Google Scholar, Cochrane Library) and grey literature were searched from the earliest record to March 2025. For Google Scholar, the first 200 articles were selected. The search strategy (Supplementary information 2) was applied to identify articles containing 'titles', 'abstracts' and 'keywords' that included predefined search terms related to FMS, MSA, and HRQoL. Systematic reviews were identified, and their reference lists were manually searched for potentially eligible studies.

Selection of Sources

Search results were exported from databases and imported into a systematic review management tool (Covidence, Version 2025, Veritas Health Innovation, Melbourne, Australia). Duplicates were removed, and studies were entered into a two-stage screening process. The first author (DM) independently screened titles and abstracts, followed by full-text articles, against the predefined eligibility criteria. At both stages, calibration checks were completed on a sample (20%) by a co-author (ST). Discrepancies occurred during the screening process, particularly related to differing interpretations of the inclusion criteria. These were resolved through discussion (DM, ST) and with the research team (DM, ST, DR, MDV) until consensus was achieved.

Data extraction

Data from selected studies were manually extracted using standardised forms from Covidence and collated in Microsoft Word (Version 16.89.1, Microsoft, Washington, USA) and Excel (Version 16.89.1, Microsoft, Washington, USA). Extracted data included: study details, participant characteristics, methods, interventions (if appropriate), outcomes, results and additional information (e.g., funding, registration, conflicts). Data charting was completed individually. MSA interventions were divided into the following categories:

- *Resistance-based strength exercise (RBSE):* Exercise that requires the muscle to contract against an external resistance [27], is commonly designed to improve muscular strength, endurance, power or hypertrophy, and includes interventions where resisted muscular contraction against external, elastic, machine-based, or bodyweight load represents the primary training stimulus.
- *Other strength exercise*: Modalities intended to improve strength, muscular function, or physical capacity through alternative exercise approaches, and are not primarily based on conventional resistance-loading paradigms. This includes:
  - *Functional resistance training:* Interventions which can emphasise multi-planar movement, reflect or mimic activities of daily living, and incorporate complex movement patterns and integrated movement to improve strength, power, mobility and/or endurance movements [28].
  - *Concurrent exercise*: Programmes which combine resistance exercise and aerobic exercise [27] and can occur on land (land-based concurrent exercise) or partly in water (aquatic concurrent exercise).
  - *Holistic muscle strengthening activities (HOL-MSA)*: Activities embedded in holistic philosophies of well-being, focusing on mind-body movements that combine strengthening exercises with balance, flexibility, breathing, and coordination (for example, Tai chi, Yoga or Pilates [48].

Data analysis

The data from the included studies were charted and synthesised using a descriptive and narrative approach, consistent with the objectives of a scoping review. Studies were grouped according to the objectives of the review, and data summaries were presented in figures and tables where appropriate.

Patient and Public Involvement

Patients and members of the public were not involved in the design, conduct, reporting or dissemination plans of this scoping review, which is based exclusively on publicly available, published literature.

RESULTS

Selection of sources of evidence.

The initial search generated 5,257 results, which were screened for eligibility. Search results and process can be seen in Figure 1. After screening, seventy-nine studies were included in this scoping review. Studies were categorised, according to the review's objectives, into the following: (A) fitness, PA and HRQoL; (B) outcomes and assessment tools; (C) MSA interventions; (D) barriers and facilitators to engagement in PA and MSA.

Synthesis of Results

A total of seventy-nine studies were included in this scoping review. An overview of study characteristics is available in Supplementary information 3. The geographical location and study designs of the final sample are presented in Table 2.

Studies were published between 1998 and 2025, and the greatest number of studies took place in Spain (31.7%), Brazil (21.5%), and USA (20.3%). Sample sizes ranged from 9 participants [49] to 91,453 participants [50]. Interestingly, 82.3% of studies used female-only participants, 1.3% used male-only, and 16.5% used both male and female participants.

Table 2 Geographical location and study design used in selected studies.

Characteristics	Value, *n* (%)
Geographical location	
Belgium	1 (1.3)
Brazil	17 (21.5)
Finland	1 (1.3)
North Korea	1 (1.3)
Netherlands	2 (2.5)
Spain	25 (31.6)
Sweden	4 (5.1)
Turkey	10 (12.7)
United Kingdom	1 (1.3)
United States of America	17 (21.5)
Study design	
Randomised controlled trial	29 (36.7)
Cross-sectional	27 (34.2)
Pre-post clinical trial	4 (5.1)
Quasi-Experimental	3 (3.8)
Controlled trial	3 (3.8)
Qualitative interview	2 (2.5)
Randomised trial	2 (2.5)
Prospective observational cohort	2 (2.5)
Prospective trial	2 (2.5)

Other*	5 (6.3)

*Other includes focus group, non-randomised trial, randomised equivalence trial, case control and a comparative association analysis

Fitness, Physical Activity, and Health-related Quality of Life.

Components of fitness

Twenty-eight studies assessed components of fitness in FMS patients [15,17–19,40,43,51–72]. An overview of fitness and HRQoL outcomes and assessment methods are available in Supplementary information 3.

Seventeen studies assessed muscle strength [57,59]. Of these, fifteen reported significantly lower muscle strength in individuals with FMS compared to healthy controls (HCs) [17–19,43,51,53,54,62,64,65,67–69,71,73], whereas two studies found no differences in ankle strength or elbow flexor strength, respectively [40,59]. Handgrip strength (HGS) was significantly lower in individuals with FMS in thirteen (86.6%) of fifteen studies [18,19,51,53–56,62,64,65,67,70,71], while two studies reported no significant differences to HCs [17,69].

Of the fourteen studies evaluating cardiorespiratory fitness (CRF), nine (64.3%) reported significantly poorer six-minute-walk test (6MWT) performance in FMS compared to HCs[15,17,18,53,54,58,60,62,66], while only one study found no significant difference[68]. Additional findings showed significantly lower VO_{2peak} [64], reduced two-minute walk test distance [19], and shorter treadmill time in a symptom-limited exercise test [51].

Results were mixed for flexibility in FMS patients; five studies (62.5%) reported significantly reduced flexibility [18,19,51,53,54], while three (37.5%) found no significant differences compared to HCs [40,68,71]. Balance was assessed in four studies; 50% reported significantly impaired balance in FMS [18,51] and 50% found no differences to HCs [40,68]. All five studies assessing agility found significantly poorer performance in FMS [15,18,40,53,54].

Physical activity

Levels of PA were assessed in fifteen studies. Interestingly, 57.1% of studies found that PA levels were significantly lower in FMS as compared to HC's [50,65,68,74], whereas 42.9% found no significant differences in levels of PA [40,59,60]. One study highlighted that most FMS participants were physically inactive[75], however, a similar study found daily moderate PA was significantly higher in FMS compared to HC's [71].

Health-related quality of life

Twenty-five unique measures were utilised to assess HRQoL across the seventy-nine studies (Fig. 2). The impact of FMS (n=49), pain (n=47) and overall QoL (n=27) were the most frequently assessed outcomes. Other outcomes include tender point (TP) count (n=27), depression (n=18), fatigue (n=16), PA levels (n=15), anxiety (n=14), and physical function (n= 4). Fifteen studies compared baseline HRQoL outcome levels in FMS to HCs. All studies assessing pain [17,40,59,65,67,68,74] identified significantly higher levels in FMS. TP[19,57], the impact of FMS[40,43,58], overall QoL [19,56,62,65,71], sleep [43], physical functioning [69], levels of depression [71,74], levels of anxiety [19,43,71,74], and fatigue [17,59,67] were all significantly poorer in FMS compared to HCs.

Associations between physical fitness and HRQoL

Pain

The included studies identified that the 6MWT was negatively associated with pain, as measured by the visual analogue scale (VAS) [17], and inversely correlated with TP count [61]. Pain intensity was identified to be moderately and significantly correlated with both time to get-up-and-go (TUG) and muscle strength [57]. Similarly, Costa et al. [15] found higher ratings of pain intensity were significantly associated with increased time to perform TUG and reduced distance walked in 6MWT. Sahin et al. [70]. also found muscle strength to be inversely associated with pain. Furthermore, Soriano-Maldonado et al. [72] reported a linear relationship between physical fitness and pain, where higher performance was associated with lower levels of pain. However, Carbonell-Baeza et al.[61] reported a weak correlation between functional capacity and pain.

FIQ and SF-36

Findings suggest HGS demonstrates a negative association with FIQ dimensions including pain, fatigue, stiffness and the total FIQ score [55]. However, Aparicio et al. [56] reported HGS was positively associated with FIQ domains pain, fatigue, morning tiredness and job difficulty. Aparicio et al. [18] and Aparicio et al. [54] found that most physical fitness tests were correlated with FIQ and revised FIQ (FIQr) scores. However, Ayan et al.[58] observed no associations between FIQ scores and 6MWT performance. Latorre-Roman et al. [66] and Larsson et al. [65] reported significant correlations between distance walked in the 6MWT and the SF-36 dimensions of physical function. Additionally, Larsson et al. [65] found muscle strength was significantly correlated with the physical function domain of the SF-36, which is supported by Sener et al. [71] who observed moderate positive correlations between all strength tests and overall SF-36 scores.

Psychological status

Cordoba-Torrecilla et al. [63] found performance on fitness tests was inversely associated with levels of anxiety. Sener et al. [71] reported moderate negative correlations between fitness tests and depression and anxiety, as measured by the Beck depression inventory (BDI) and Beck anxiety inventory (BAI), respectively.

Physical activity

Breda et al. [60] found a positive correlation between daily distance walked and total international physical activity questionnaire (IPAQ) scores. Additionally, Segura-Jiminez et al. [76] reported a positive correlation between sedentary time and FIQr pain. Alvarez et al. [77] found no significant associations between fatigue and PA levels, but fatigue was negatively and significantly associated with physical and mental health indicators. Additionally, a linear, dose-response relationship was found between levels of fitness and HRQoL [52].

3.4 Outcomes and Assessment Tools

Fitness

Physical fitness was assessed using a range of standardised tests, with eleven studies using the Senior Fitness Test Battery (SFT).

Seventeen studies assessed muscle strength using various tests, including the 30-second chair stand [40], one-repetition maximum (1RM) [73], HGS and maximal voluntary contraction of upper and lower limbs [57,59]. CRF and physical function were assessed using predominantly the 6MWT. Flexibility was most frequently assessed by the back scratch and sit-and-reach tests. Balance was assessed using various methods, including the blind-flamingo and modified Romberg's test. TUG and 8ft up and go were the modal assessment methods for agility.

Physical Activity

In the 15 studies which assessed physical activity levels in FMS patients, the assessment tools varied considerably. The IPAQ, physical activity assessment tool (PAAT) and leisure-time physical activity instrument (LTPAI) questionnaires were utilised, alongside the use of accelerometers and a metabolic halter.

Health-related Quality of Life Measures

Assessment tools (Fig. 2) were inconsistent. The FIQ (*n*=42), pain-VAS (*n*=33), and the SF-36 (*n*=26) were the modal HRQoL assessment tools. Other common tools include BDI (*n*=13); Pittsburgh Sleep Quality Index (*n*=9); BAI (*n*=4); and fatigue-VAS (*n*=5).

Muscle-strengthening activities.

A total of forty-four MSA interventions were included in this scoping review. These were categorised into (1) RBSE interventions (54.55%); and (2) other strength exercise interventions (45.45%). Supplementary information 4 details all MSA interventions.

Resistance-based strength exercise.

Twenty-four studies were categories as RBSE interventions [6,30–34,49,73,78–93]. The programme duration, session frequency, and session length varied considerably across the included studies. The mean programme duration was 11.46 ± 5.56 weeks, with a session frequency of 2.33 ± 0.48 times per week, prescribed for an average of 39.00 ± 9.12 minutes per session. The most frequent duration was 12 weeks [30,32,78,80,82,83,91], with a common frequency of two times per week [6,30,31,34,69,73,78–82,87–89,91,92]. The most frequent number of sets and repetitions were 3 sets of 12 repetitions (*n*=7) [32,49,78,84–87], with an intensity of 12th repetition maximum (*n*=3) [84–86] or individualised intensity (*n* = 3) [88–90], though twelve studies followed progressive principles and included different volumes [6,30,31,33,34,73,78–80,82,83,92]. Modalities included the use of free-weights, machines, and body-weight exercises. Sixteen out of twenty-four studies were supervised [6,30–32,34,49,81,83–85,87–91,93].

Effect of resistance-based strength exercise on components of fitness and health-related quality of life.

Reporting on adherence rates were poor, with only 37.5% of studies (n=9) including details on adherence, attendance or completion rates [30–33,78,80,81,91,92]. Adherence rates ranged from 82.8% [33] to 92% [81]. Completion rates ranged from 69% [80] to 100% in at least 90% of classes [92].

Improvements in fitness and HRQoL were seen across most studies after RBSE. Across all studies evaluating muscle strength (*n*=13) [30–32,34,73,78–81,87,88,91,92], flexibility (*n*=3) [87,91,92], balance (*n*=1) [89] and agility (*n*=1) [78], significant improvements were consistently observed following RBSE. Similarly, improvements in CRF were reported in five out of six studies [31,78,87,90,92], while one study found no significant changes [88].

Of the studies evaluating pain (*n*=16), 75% reported significant improvements in levels of pain following RBSE[31,32,78,79,83,85–87,90–93]. Two studies found improvements that were not significant [82,88], while two found no significant differences [34,89]. The number of TP (*n*=7) reduced significantly in 85.71% of studies [30,33,82,88,90,91], while one study found no significant differences post intervention [80]. Similarly, fatigue (*n*=5) [6,34,90–92] was improved in 80% of studies [6,34,90,91]. The impact of FMS was assessed in fifteen studies [30–33,78–82,84,87,89–91,93] with thirteen finding significant differences [30–33,79,81,82,84,87,89–91,93]. All studies assessing physical function (*n*=3) found no significant differences post-intervention [33,34,80]. Overall QoL was assessed in seven studies; all found significant differences in domains of the SF-36 [32,78,82,83,87,90,93]. 66.67% of studies assessing sleep (*n*=9) found significant improvements [6,79,85,90–92] after RBSE, two studies had improvements but weren't significant [84,86], and one found no significant difference [34]. Depression [6,34,83,84,87,90,91] and anxiety [6,81,84,87,90–92] were assessed in seven studies, respectively. 85.71% of studies found significant improvements in levels of depression [34,83,84,87,90,91], whilst 57.14% of studies evaluating anxiety found no significant differences following RBSE [6,81,90,92].

Other Strength Exercise

Functional resistance training

Two functional RT interventions were included (4.55%) [94,95]. One study was land-based [94] whilst one was implemented partly in water [95]. One study was purely strength-based exercises [94], whilst the other included aspects of strength and balance [95]. The mean programme duration was 16 ± 2.83 weeks, performed 2.5 ± 0.71 times per week for an average of 52.5 ± 10.61 minutes per session. Both studies included different volumes; one included two sets of 10 repetitions [94], whilst the other include 1-3 sets of 8-12 repetitions [95]. Both studies had self-administered intensities, with one using the ratings of perceived exertion (RPE) scale [94]. The equipment used were elastic bands and aquatic materials, and both studies did not report on whether the intervention was supervised. One study was not supervised [94] whilst the other was not mentioned [95].

Effect of functional resistance training on components of fitness and health-related quality of life

Both studies included adherence rates; Latorre-Roman et al. [95] reported 95% and Fernandes et al. [94] reported 95.2% adherence. Both studies assessing muscle strength, agility and balance found significant improvements following functional RT [94,95]. Flexibility was assessed in one study and was significantly improved [94], whilst CRF was not measured in either study.

Pain and impact of FMS were measured in both studies and significantly improved post-intervention. TP count [95][97] and overall QoL [94] significantly improved in respective studies. Fatigue, physical function, sleep, depression, and anxiety were not assessed in either study.

Concurrent Exercise Interventions

A total of 13 concurrent exercise interventions were included (29.55%). The mean programme duration was 14.92 ± 7.64 weeks, with a session frequency of 2.38 ± 0.65 times per week, prescribed for an average of 53.96 ± 8.95 minutes per session. Concurrent exercises were further categorised into land-based (*n*= 9) and aquatic (*n*=4).

Land-based Concurrent Exercises

Nine studies were categorised as land-based concurrent exercise [96–104]. Two studies combined strength and aerobic exercise [101,103], four studies combined aerobic, strength and flexibility [98–100,102]. Other studies combined aerobic, strength and coordination [96]; aerobic, strength, functional and proprioceptive exercise [97] and aerobic, strength, flexibility and balance [104]. Programme durations ranged from six to twenty-four weeks, with the latter being the most common. The most common frequency was twice per week, although two studies used three times per week [101,103] and one used once [97] per week. The intensity for aerobic exercise was most commonly 65-70%HR_{max} (n=3) [98–100], and intensities for strength varied considerably (Borg scale, %1RM, elastic bands). The strength exercise had loads of one set of eight repetitions [98,99], ten-to-fifteen repetitions [100] or two sets of ten-to-twelve repetitions [102]. Five studies [96,97,101,103,104] did not supply details of the strengthening load. Individual session length ranged from thirty to sixty minutes, with the latter being the most common [96,100–102,104]. Free-weights, dumbbells, elastic bands, treadmills, resistance machines and body weight were the modalities used in land-based concurrent exercise. Seven out of nine studies were supervised.

Aquatic Concurrent Exercise

Four studies were categorised as aquatic concurrent exercises [43,105–107] and occurred in a swimming pool. Interventions combined strength and aerobic exercise [43,107], flexibility and strengthening [105] and strength, aerobic and balance [106]. Programme durations ranged from eight to twenty-four weeks. All four studies utilised a frequency of three times per week. Aerobic exercise included an intensity of 50-80%HR_{max} [43] and 65-80%HR_{max} [107]. The RPE scale was commonly used [106,107] to identify strength intensity, although two did not report on this [43,105]. The number of sets and repetitions varied and typically included one set of ten-to-fifteen or twelve repetitions and progressing to two-to-three sets of eight-to-ten or sixteen repetitions [43,107]. Two studies did not report on the number of sets and repetitions [105,106] Session length ranged from forty-five to sixty minutes, with the latter being most common [95,105]. Two studies were supervised [105,106].

Effects of concurrent exercise on components of fitness and health-related quality of life.

Reporting on adherence rates were more consistent across concurrent exercise interventions. Eleven studies reported these values [43,96–99,101–104,106,107], and adherence rates ranged from 78% [102] to 100% [96]. Muscle strength (*n*=5) significantly improved in all studies [43,99,101,102,106]. Six studies assessed CRF, four found significant improvements after concurrent exercise fitness [96,97,101,102] and two found no significant pre-post differences [104,106]. Flexibility, balance and agility were not assessed in land-based concurrent exercise, but in aquatic concurrent exercise, one study found improvements in balance and agility [106] and two studies found significant improvements in flexibility [105,106] post-intervention.

Five studies assessed pain [96,102–105]; three studies found significant improvements following interventions [96,103,105]. All studies assessing TP count (*n*=5) [43,100,103,105,106], physical functioning (*n*=1) [96], fatigue (*n*=3) [100,102,107], and sleep (*n*=4) [43,100,103,107] found significant improvements following concurrent exercise. The impact of FMS was significantly improved in all studies (*n*=9) [43,95–102,105]. Overall QoL was only assessed in land-based concurrent exercise (*n*=5). Five studies found significant improvements post intervention in overall QoL [98–100,102,104], whilst one found no differences pre-post intervention [104]. Similarly, depression was evaluated in five land-based concurrent exercise interventions; four found significant post-intervention improvements [96,98,99,102] whilst one study found no significant differences [103]. Finally, anxiety was assessed in three studies; land-based (*n*=2) all significantly improved [96,102], however, aquatic (*n*=1) did not produce significant differences in levels of anxiety [43].

Holistic Muscle-Strengthening Activities.

A total of five studies (11.36%) were categorised as HOL-MSA; three tai-chi interventions [108–110] and two Pilates interventions [111,112]. All studies included a duration of twelve weeks, and the most common frequency was twice per week [108,109,112]. Individual session lengths ranged from fifty to ninety minutes, with sixty minutes being the most frequent [109,111]. All HOL-MSA interventions were supervised, and modalities included elastic bands and Pilates balls.

Effects of holistic muscle-strengthening activities on components of fitness and health-related quality of life.

All HOL-MSA studies reported on adherence rates, ranging from 72% [108] to 97.3% [110]. Muscle strength [110], agility [108] and balance [108] all significantly improved post-intervention. CRF was assessed in two studies [109,111] with one study finding significant improvements [109]. Flexibility was similar, with Wong et al. [110] finding significant improvements, whereas Jones et al. [108] found no significant changes post-intervention. TP count [111], overall QoL [109,112], fatigue [110] and depression [109] all significantly improved after HOL-MSA. The impact of FMS [108,109,111,112] (n=4) and pain [108–112] (n=5) both significantly improved in all studies. Sleep was assessed in four studies, with two studies finding significant improvements [108,109] and two finding no significant differences post-intervention [110,112].

Barriers and Facilitators to engagement in physical activity and resistance training.

Studies reporting on the barriers and facilitators to engagement in physical activities, including MSA's, were limited. It is important to note that the present review did not identify any study identifying barriers or facilitators specifically to MSA's in FMS, while only three qualitative studies [37,38,113] identified the barriers and facilitators to PA in FMS. Fear of worsening symptoms, a lack of self-efficacy or confidence, and poor time management were the most frequent barriers to general exercise and PA [37,38,113]. Additionally, social isolation, lack of motivation, and lack of accessible areas, safety concerns, and limited opportunities were noted barriers. Several facilitators were identified which could increase participation to PA; motivation was a large factor, in addition to having a positive impact on health and exposure to positive stimuli. Other facilitators include external support from peers and family, as well as social support and accessibility.

DISCUSSION

This review aimed to scope the existing literature on physical fitness, PA levels, and HRQoL in adults with FMS; in addition to commonly used assessment tools in FMS research; explore existing evidence on the design of MSA and its effects on HRQoL; and map out the barriers to, and facilitators of, PA and MSA's.

Fitness, Physical Activity and Health-related Quality of Life

The findings of this review highlight a consistent pattern of reduced physical fitness in individuals with FMS compared to HCs. Furthermore, across multiple domains, including muscle strength, cardiorespiratory fitness, flexibility, balance, and agility, individuals with FMS demonstrated significantly poorer performance in most studies.

Muscle strength, particularly HGS and lower limb function, was impaired in most studies [51,53,62,64]. Similarly, reduced performance on the 6MWT and other aerobic assessments points to diminished cardiovascular endurance [17,18,54,60,114]. Although most findings support the notion that individuals with FMS have significantly reduced physical fitness [19,54], some authors report no significant differences between FMS and HCs in some components of fitness [68,69]. These differences may be attributed to the fluctuant and heterogeneous nature of FMS symptomatology [115], and patients can differ greatly in terms of pain intensity and fatigue. It has been found that pain and fatigue are likely to negatively affect physical performance in women with FMS [63,72]. Interestingly, FMS is predominantly present in women [116,117], and it has been suggested that gender may influence symptom severity. Women may experience significantly greater levels of fatigue compared to men [116], which may explain the differing findings, whereby those who experience less pain or fatigue are likely to perform better on fitness tests. However, due to the low number of diagnosed men with FMS, research has mainly focused on women [118]. This is apparent in this review, whereby 82.3% of studies used only the female population. Thus, findings may not fully reflect the male population, and further work is needed to draw firm conclusions on gender differences in FMS to determine whether these outcomes are consistent across demographic categories. In addition, the geographical clustering of studies within three main regions (Spain, Brazil, USA) suggests additional research in underrepresented settings may help broaden global understanding of fitness, PA and HRQoL among individuals with FMS.

The included studies used a range of approaches to define FMS, including the ACR 1990 [119], 2010 [120], or 2016 [121] criteria, the Yunus criteria [122], or did not explicitly report the diagnostic criteria used, producing large heterogeneity within the diagnosed population [123]. This variation is important as the ACR 1990 criteria emphasises widespread pain and tender point examination, but was criticised for failing to consider fatigue, sleep disturbances and cognitive symptoms [120]. Subsequently, the ACR 2010 and 2016 criteria incorporate these domains by combining the widespread pain index and symptom severity scale, and no longer requiring tender-point assessments. The ACR 1990 is considered a rigid criteria that only includes more severely affected patients, whilst the ACR 2010 can differentiate between patients according to the level of symptoms [120,124]. As a result, these differences should be considered when interpreting the generalisability of findings.

The findings of the present study align with previous evidence suggesting individuals with FMS suffer from muscle dysfunction and deconditioning [67,125,126] and is closely related to fatigue [127]. For example, Umay et al. [128] identified that decreased quadricep femoris muscle cross-sectional area was significantly correlated with increased fatigue severity in FMS patients and HCs. Muscle deconditioning may exacerbate the fatigue-pain feedback loop in FMS[114]. This can be understood through the deconditioning paradigm, which suggests that pain and reduced tolerance for physical activities can result from physical inactivity and the resulting physical deconditioning [17,129]. Supporting this, Segura-Jiminez et al. [76] reported a positive correlation between sedentary time and FIQr pain. Thus, in addition to muscle deconditioning being closely related to fatigue, it appears that increased sedentary time, a result of physical inactivity, elevates levels of pain.

Across the studies that compared FMS patients and HCs, all studies assessing pain, the impact of FMS, overall QoL, sleep, physical functioning, fatigue, anxiety and depression identified significantly poorer levels in FMS patients. Furthermore, the present review found individuals with FMS have poor HRQoL, which is supported by previous research within this field[130]. This may be attributed to FMS symptomatology, whereby symptoms negatively impact QoL [131] and HRQoL worsens over time [132]. For example, chronic pain significantly effects physical function and overall QoL [133]. These findings have been supported by Dailey et al. [134] and suggests higher levels of fitness result in lower levels of pain. However, while fitness may play a role in reducing the impact of symptoms, the consistent findings of poor HRQoL across studies suggests that improvements in fitness components alone may be insufficient to counteract the multifaceted symptom burden of FMS. In this context, these findings highlight the need for interventions that not only address physical fitness, but also the broader determinants of health that will increase HRQoL.

Outcomes and Assessment Tools

Physical fitness in individuals with FMS is typically assessed using a variety of objective, performance-based tests, including the 6MWT, HGS, 30s chair stand, 8ft up and go and chair-sit-and-reach test [135]. These fitness tests have been shown to reliably discriminate between FMS patients and healthy controls [54,56]. Moreover, many protocols are derived from the SFT, which incorporates six tests, including the 30s-chair stand, 30s-arm curl, 6MWT, chair-sit-and-reach, back scratch, and 8ft up and go [136]. Despite demonstrating good reliability and feasibility in FMS populations [137], only eleven of twenty-nine studies assessing physical fitness identified in the present review used the SFT. Other studies utilised alternate methods of assessing fitness, indicating substantial heterogeneity in fitness testing. For example, for strength alone, seventeen different methods were utilised. While some researchers rely on HGS [55,70], others employ 30s-chair stand tests [40,63], 1RM protocols [62,73] and isokinetic dynamometry [67,69]. Each of these approaches capture different aspects of muscular performance, increasing the difficulty in comparing the effectiveness of an intervention in relation to muscle strength changes over time and hinders cross-study comparability. Additionally, the traditional methods for assessing muscle strength used for the general population, such as 1RM protocols, may not capture the complexity of FMS and may not discriminate between FMS patients and healthy populations. Thus, simple reliable tools, such as HGS, 30s chair stand or the 6MWT, may be better suited in the evaluation of FMS patients [18].

Assessing FMS remains challenging due to the absence of definitive biomarkers [138], though various tools have been developed to evaluate symptom severity and HRQoL [139].The impact of FMS, pain, and overall QoL, frequently assessed through the FIQ, pain-VAS, and SF-36 (respectively), were the predominant HRQoL outcomes identified. These are widely used tools that understand health status [140] by assessing symptom severity, physical function, and QoL in FMS patients [139]. The pain-VAS, a validated and reliable measure for assessing pain intensity in FM patients [141], asks individuals to rate their pain on a single-item scale of 0 (no pain) to 10 (extreme pain) [142] over a specific time. Thus, the pain-VAS is prone to biasing factors [143], such as pain intensity at the time of recall [144]. Similarly, the FIQ, developed by Burckhardt et al. [145], evaluates clinical severity and the efficacy of interventions in FMS patients across three domains; physical function, overall impact of FMS, and symptom severity (e.g., pain, fatigue, and depression) using VAS scales [138]. However, despite the limitations to self-report measures, the VAS and FIQ are widely implemented in clinical and research settings [146] due to the reliability and validity in measuring physical function [147,148]. Additionally, the FIQ appears to be a sensitive measure of change related to symptoms and disability [149], allowing treatment evaluation and monitoring of disease progression. Nevertheless, despite the common use of these tools to measure domains of HRQoL, the present review identified twenty-five unique tools that were used to assess HRQoL across FMS research. However, recent developments by Coskun Benlidayi et al. [139] present a new QoL scale specific to FMS (FM-QoLS) which authors describe as valid and reliable, although this assessment tool was not implemented in the identified studies. It is apparent that there is a lack of a standardised tool to assess HRQoL which constructs considerable heterogeneity in the way that HRQoL is conceptualised [44], thus undermining the validity of FMS studies. Therefore, the validation of a tool that is suited to the symptomatology of FMS is needed to improve cross-study comparability.

Muscle-strengthening activities

This scoping review revealed substantial heterogeneity in MSA protocols regarding the design, delivery and implementation of MSA's, reflecting both the experimental nature of the current research in FMS, and the need for individualised approaches due to symptom variability [82,87,150]. Forty-four MSA interventions were included in this scoping review. When categorised, studies implemented RBSE (54.55%), and 45.55% implemented other strength exercises (4.55% functional RT, 29.55% concurrent exercise and 11.36% HOL-MSA). This suggests a lack of standardisation in how interventions are designed, delivered and implemented, suggesting that both FMS patients and practitioners do not understand which modality is the most effective. In support of this, protocols varied widely in terms of the intensity, duration, and progression strategies, thus increasing the difficulty of comparing outcomes across trials and determining the most effective protocol to improve HRQoL.

It is also important to note the use of inconsistent terminology in how strength-related terms are described. For example, several authors label interventions as 'muscle-strengthening exercises' [32,87,91], whilst others use 'strength training' [80,85,86] or 'resistance training' [78,81,83], suggesting a conceptual overlap in terminology used across literature. Previous research has highlighted inconsistent use of nomenclature for resistance exercises [151,152], with one study surveying professionals' views on resistance exercises, finding inconsistent use of terminologies in all examples [153]. Despite interventions often involving comparable exercise principles (e.g., progressive overload), the inconsistency may present challenges for evidence synthesis, interpretations, and cross-study comparisons. Greater consistency in terminology may help to facilitate comparisons between studies and strengthen the development of evidence-based exercise guidelines for FMS.

In individuals with FMS, it has been suggested that MSA's may reduce pain, fatigue, and levels of depression [13]. The present review found that RBSE and other strength exercise all improved domains of HRQoL. For example, RBSE reduced pain in 75% of studies, and functional RT and HOL-MSA improved pain in all included studies. However, the notable inconsistencies in the reporting of training intensities, progressions, and individualisation limits the comparability of the effects of MSA on HRQoL outcomes. Similarly to fitness, PA and HRQoL research, most

MSA interventions recruited only female participants, limiting the generalisability across genders. MSA has been recognised as beneficial for women, due to improvements in muscle strength and cardiometabolic health markers [154]. Women's physiological adaptations are largely mediated by the neuroendocrine system, resulting in altered fatiguability and recovery [155]. However, individualisation within programmes is imperative due to the physiological differences between sexes.

In addition, delivering a sufficient and progressive exercise stimulus is essential to sustain adaptations in strength. From the included studies categorised as RBSE interventions, twelve implemented volume-progressive strategies. These were associated with improvements in pain [90], fatigue [6] depression [91], and muscle strength [31]. Furthermore, progressions during strength exercise avoids plateaus, facilitates neuromuscular adaptations [156], and can be used safely in the treatment of FMS [34]. The findings of the present study suggest progressions in the load or intensity over the duration of RBSE interventions are beneficial for improving HRQoL, especially pain [78,90], impact of FMS [79,94], overall QoL [82,93] and sleep [91]. Reductions in pain after progressive RBSE are common within research on pain-related disorders, with several researchers concluding pain may be reduced and avoided by gradual introduction of heavier loads [157]. This is likely due to the consideration of participant limitations and individual differences [13], without exacerbating symptoms [101]. However, future systematic reviews and meta-analyses are needed to determine the most effective modality of MSA's in supporting the individual needs of FMS patients. It should also be noted that although many studies reported a positive impact of MSA's on HRQoL and components of fitness, several methodological limitations should be considered. Some studies included small sample sizes [31,79,84,86], and reporting of participant adherence was inconsistent. Out of forty-four MSA interventions, only 59.09% clearly reported adherence rates through attendance or completion rates. These limitations may reduce the generalisability and clinical applicability of the findings.

Barriers and Facilitators to Engagement in Physical Activity and Resistance Training

While the current review identified three qualitative studies exploring barriers in relation to PA, none specifically addressed the barriers to MSA. Across the three studies investigating the barriers to PA, fear of worsening symptoms, a lack of self-efficacy, and poor time management were the most frequent barriers. In support of this, Bidonde et al. [158] identified a fear of activity induced exacerbation was a barrier to PA, in addition to lacking motivation and support. Although these findings provide valuable insights into the challenges faced by individuals with FMS, the absence of research focusing specifically on MSA, despite the well-document benefits [6,30,31], limits the ability to draw meaningful conclusions regarding this modality. Therefore, it is likely that barriers unique to FMS remains unexplored, highlighting a significant gap in the literature.

Framing future work around theoretical frameworks, such as the Behaviour Change wheel, specifically the Capability-Opportunity-Motivation model for behaviour (COM-B) [159] may enable an exploration of the determinants of behaviour across capability, opportunity, and motivation constructs. Such insights would support the identification of the barriers to MSA, which will help to develop training programmes that encourage and motivate FMS patients specifically related to individual needs [160]. Thus, future research should be guided by theoretical frameworks, such as the COM-B, in order to systematically explore these constructs and better understand how they influence engagement with MSA's. This approach would help to design and promote effective interventions [161] using appropriate behaviour change techniques to identify what needs to change and providing specific targets for intervention development [162].

Limitations

This scoping review is not without limitations. Firstly, the search was limited to studies published in English, therefore relevant articles in other languages may have been missed. Secondly, due to database restrictions, the search was limited to what was available to researchers. However, this study followed the JBI framework for scoping reviews, providing a rigorous and transparent method for mapping areas of FMS and the present review does provide an extensive summary of fitness, HRQoL and MSA interventions in relation to FMS.

Future research

Future research should improve the design and reporting of MSA interventions, and intervention design should also account for symptom variability and the likelihood of exercise related pain [12]. Greater consistency in describing and applying exercise dose parameters and condition-specific nuances would strengthen comparison across studies and, over time, enable more robust synthesis of findings. In addition, qualitative research is needed to better understand the barriers and facilitators associated with engaging in MSA's [158].

CONCLUSIONS

This review shows that research on fitness, PA, HRQoL and MSA's in FMS is highly variable, which limits the ability to compare findings across studies. MSA's appears to be promising in improving HRQoL, but inconsistent reporting of exercise dose parameters and intervention design reduces the clarity of current evidence. The absence of qualitative research also means there is limited insight into the factors that influence engagement. Greater consistency in measurement, intervention reporting, and qualitative understanding will support clearer and more coherent evidence in future research.

Statements

Author Contributorship

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by DM and ST. The first draft of the manuscript was written by DM and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Competing Interests

None declared.

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Data Availability Statement

All data extracted from included studies are provided within supplementary materials.

Ethical approval and Patient consent

Not applicable

List of Figures

ORCiD ID:

Darcie Mounter - https://orcid.org/0009-0006-2024-8566

David Rogerson - https://orcid.org/0000-0002-4799-9865

Marlize De Vivo - https://orcid.org/0000-0002-7873-5985

Steve. W Thompson - https://orcid.org/0000-0001-7674-3685

References

[1] Rodríguez-Andreu J, Ibáñez-Bosch R, Portero-Vázquez A, et al. Cognitive impairment in patients with Fibromyalgia syndrome as assessed by the Mini-Mental State Examination. BMC Musculoskelet Disord 2009;10:162. https://doi.org/10.1186/1471-2474-10-162.

[2] Fowler Davis S, Humphreys H, Maden-Wilkinson T, et al. Understanding the Needs and Priorities of People Living with Persistent Pain and Long-Term Musculoskeletal Conditions during the COVID-19 Pandemic—A Public Involvement Project. Healthcare 2022;10:1130. https://doi.org/10.3390/healthcare10061130.

[3] Marques AP, Santo A de S do E, Berssaneti AA, et al. Prevalence of fibromyalgia: literature review update. Revista Brasileira de Reumatologia (English Edition) 2017;57:356–63. https://doi.org/10.1016/j.rbre.2017.01.005.

[4] Queiroz LP. Worldwide Epidemiology of Fibromyalgia. Curr Pain Headache Rep 2013;17:356. https://doi.org/10.1007/s11916-013-0356-5.

[5] Häuser W, Eich W, Herrmann M, et al. Fibromyalgia Syndrome: Classification, diagnosis and treatment. Dtsch Arztebl Int 2009;106:383–91. https://doi.org/10.3238/arztebl.2009.0383.

[6] Ericsson A, Palstam A, Larsson A, et al. Resistance exercise improves physical fatigue in women with fibromyalgia: A randomized controlled trial. Arthritis Res Ther 2016;18:176. https://doi.org/10.1186/s13075-016-1073-3.

[7] Roizenblatt S, Neto N, Tufik S. Sleep disorders and fibromyalgia. Curr Pain Headache Rep 2011;15:347–57. https://doi.org/10.1007/s11916-011-0213-3.

[8] Quodling N, Hoffman N, Carrick F, et al. A Review of Movement and Functional Impairments in Fibromyalgia: Implications for Targeted Treatment. J Pain Res 2025;18:5587–97. https://doi.org/10.2147/JPR.S543775.

[9] Annemans L, Le Lay K, Taïeb C. Societal and Patient Burden of Fibromyalgia Syndrome. Pharmacoeconomics 2009;27:547–59. https://doi.org/10.2165/11313650-000000000-00000.

[10] D'Onghia M, Ciaffi J, Ruscitti P, et al. The economic burden of fibromyalgia: A systematic literature review. Semin Arthritis Rheum 2022;56:152060. https://doi.org/10.1016/j.semarthrit.2022.152060.

[11] Prabhakar A, Kaiser JM, Novitch MB, et al. The Role of Complementary and Alternative Medicine Treatments in Fibromyalgia: a Comprehensive Review. Curr Rheumatol Rep 2019;21:14. https://doi.org/10.1007/s11926-019-0814-0.

[12] Busch AJ, Webber SC, Brachaniec M, et al. Exercise Therapy for Fibromyalgia. Curr Pain Headache Rep 2011;15:358–67. https://doi.org/10.1007/s11916-011-0214-2.

[13] Chiapeta AV, Oliveira CEP de, Moraes AA de, et al. Effects of resistance training on pain, functionality and quality of life in women with fibromyalgia: A systematic review. J Bodyw Mov Ther 2024;40:761–8. https://doi.org/10.1016/j.jbmt.2024.05.014.

[14] Häuser W, Klose P, Langhorst J, et al. Efficacy of different types of aerobic exercise in fibromyalgia syndrome: a systematic review and meta-analysis of randomised controlled trials. Arthritis Res Ther 2010;12:R79. https://doi.org/10.1186/ar3002.

[15] Costa I da S, Gamundí A, Miranda JGV, et al. Altered functional performance in patients with fibromyalgia. Front Hum Neurosci 2017;11:14. https://doi.org/10.3389/fnhum.2017.00014.

[16] Sato T, Demura S, Murase T, et al. Contribution of Physical Fitness Component to Health Status in Middle-aged and Elderly Females. J Physiol Anthropol 2007;26:569–77. https://doi.org/10.2114/jpa2.26.569.

[17] Akyol Y, Ulus Y, Tander B, et al. Muscle Strength, Fatigue, Functional Capacity, and Proprioceptive Acuity in Patients With Fibromyalgia. Turk J Phys Med Rehabil 2013;59:292–8. https://doi.org/10.4274/tftr.22230.

[18] Aparicio VA, Carbonell-Baeza A, Ruiz JR, et al. Fitness testing as a discriminative tool for the diagnosis and monitoring of fibromyalgia. Scand J Med Sci Sports 2013;23:415–23. https://doi.org/10.1111/j.1600-0838.2011.01401.x.

[19] Sempere-rubio N, Aguilar-rodríguez M, Inglés M, et al. Physical condition factors that predict a better quality of life in women with fibromyalgia. Int J Environ Res Public Health 2019;16:3173. https://doi.org/10.3390/ijerph16173173.

[20] Di Carlo M, Bianchi B, Salaffi F, et al. Fibromyalgia: one year in review 2024. Clin Exp Rheumatol 2024;42:1141–9. https://doi.org/10.55563/clinexprheumatol/mbyi1n.

[21] Gavilán-Carrera B, Delgado-Fernández M, Álvarez-Gallardo IC, et al. Longitudinal association of sedentary time and physical activity with pain and quality of life in fibromyalgia. Scand J Med Sci Sports 2023;33:292–306. https://doi.org/10.1111/sms.14258.

[22] Vancampfort D, Van Damme T, McGrath RL, et al. Physical activity levels among people with fibromyalgia: A systematic review and meta-analysis. Musculoskeletal Care 2023;21:623–32. https://doi.org/10.1002/msc.1771.

[23] Currier BS, D'Souza AC, Singh MAF, et al. American College of Sports Medicine Position Stand. Resistance Training Prescription for Muscle Function, Hypertrophy, and Physical Performance in Healthy Adults: An Overview of Reviews. Med Sci Sports Exerc 2026;58:851–72. https://doi.org/10.1249/MSS.0000000000003897.

[24] Knuttgen HG, Kraemer WJ. Terminology and Measurement in Exercise Performance. J Strength Cond Res 1987;1:1–10. https://doi.org/10.1519/00124278-198702000-00001.

[25] Nelson NL. Muscle strengthening activities and fibromyalgia: A review of pain and strength outcomes. J Bodyw Mov Ther 2015;19:370–6. https://doi.org/10.1016/j.jbmt.2014.08.007.

[26] Department of Health and Social Care. UK Chief Medical Officers' physical activity guidelines. Https://WwwGovUk/Government/Publications/Physical-Activity-Guidelines-Uk-Chief-Medical-Officers-Report 2019.

[27] Lippincott, Williams, Wilkins. ACSM's guidelines for exercise testing and prescription. Wolters Kluwer/Lippincott Williams & Wilkins Health; 2013.

[28] McAvoy CR, Batrakoulis A, Camhi SM, et al. 2026 ACSM Worldwide Fitness Trends. ACSMs Health Fit J 2025;29:16–33. https://doi.org/10.1249/FIT.0000000000001110.

[29] Macfarlane GJ, Kronisch C, Dean LE, et al. EULAR revised recommendations for the management of fibromyalgia. Ann Rheum Dis 2017;76:318–28. https://doi.org/10.1136/annrheumdis-2016-209724.

[30] Kingsley JD, McMillan V, Figueroa A. The effects of 12 weeks of resistance exercise training on disease severity and autonomic modulation at rest and after acute leg resistance exercise in women with fibromyalgia. Arch Phys Med Rehabil 2010;91:1551–7. https://doi.org/10.1016/j.apmr.2010.07.003.

[31] Larsson A, Palstam A, Löfgren M, et al. Resistance exercise improves muscle strength, health status and pain intensity in fibromyalgia-a randomized controlled trial. Arthritis Res Ther 2015;17:161. https://doi.org/10.1186/s13075-015-0679-1.

[32] Arakaki J, Jennings F, Estrela G, et al. Strengthening exercises using swiss ball improve pain, health status, quality of life and muscle strength in patients with fibromyalgia: a randomized controlled trial. Reumatismo 2021;73:15–23. https://doi.org/10.4081/reumatismo.2021.1357.

[33] Panton LB, Figueroa A, Kingsley JD, et al. Effects of resistance training and chiropractic treatment in women with fibromyalgia. Journal of Alternative and Complementary Medicine 2009;15:321–8. https://doi.org/10.1089/acm.2008.0132.

[34] Häkkinen A, Häkkinen K, Hannonen P, et al. Strength training induced adaptations in neuromuscular function of premenopausal women with fibromyalgia: comparison with healthy women. Ann Rheum Dis 2001;60:21–6. https://doi.org/10.1136/ard.60.1.21.

[35] Gagnier JJ, Moher D, Boon H, et al. Investigating clinical heterogeneity in systematic reviews: a methodologic review of guidance in the literature. BMC Med Res Methodol 2012;12:111. https://doi.org/10.1186/1471-2288-12-111.

[36] Herrador-Colmenero M, Segura-Jiménez V, Álvarez-Gallardo IC, et al. Is active commuting associated with sedentary behaviour and physical activity in women with fibromyalgia? The al-Ándalus project. Disabil Rehabil 2022;44:4602–10. https://doi.org/10.1080/09638288.2021.1884758.

[37] Larsson A, Feldthusen C, Mannerkorpi K. Factors promoting physical activity in women with fibromyalgia: A qualitative interview study. BMJ Open 2020;10:e031693. https://doi.org/10.1136/bmjopen-2019-031693.

[38] Sermenli N, Sarıtaş F, Tonga E. Perspectives on physical activity among women with fibromyalgia: a qualitative study. J Public Health (Bangkok) 2025:1–11. https://doi.org/10.1007/s10389-025-02450-z.

[39] Sitlinger A, Zafar SY. Health-Related Quality of Life. Surg Oncol Clin N Am 2018;27:675–84. https://doi.org/10.1016/j.soc.2018.05.008.

[40] Góes SM, Leite N, Shay BL, et al. Functional capacity, muscle strength and falls in women with fibromyalgia. Clinical Biomechanics 2012;27:578–83. https://doi.org/10.1016/j.clinbiomech.2011.12.009.

[41] Tander B, Cengiz K, Alayli G, et al. A comparative evaluation of health related quality of life and depression in patients with fibromyalgia syndrome and rheumatoid arthritis. Rheumatol Int 2008;28:859–65. https://doi.org/10.1007/s00296-008-0551-6.

[42] Wagner J-S, DiBonaventura MD, Chandran AB, et al. The association of sleep difficulties with health-related quality of life among patients with fibromyalgia. BMC Musculoskelet Disord 2012;13:199. https://doi.org/10.1186/1471-2474-13-199.

[43] Munguía-Izquierdo D, Legaz-Arrese A. Assessment of the Effects of Aquatic Therapy on Global Symptomatology in Patients With Fibromyalgia Syndrome: A Randomized Controlled Trial. Arch Phys Med Rehabil 2008;89:2250–7. https://doi.org/10.1016/j.apmr.2008.03.026.

[44] Costa DSJ, Mercieca-Bebber R, Rutherford C, et al. How is quality of life defined and assessed in published research? Quality of Life Research 2021;30:2109–21. https://doi.org/10.1007/s11136-021-02826-0.

[45] Mak S, Thomas A. An Introduction to Scoping Reviews. J Grad Med Educ 2022;14:561–4. https://doi.org/10.4300/JGME-D-22-00620.1.

[46] Peters MDJ, Godfrey C, McInerney P, et al. Best practice guidance and reporting items for the development of scoping review protocols. JBI Evid Synth 2022;20:953–68. https://doi.org/10.11124/JBIES-21-00242.

[47] Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med 2018;169:467–73. https://doi.org/10.7326/M18-0850.

[48] Liu CJ, Latham NK. Progressive resistance strength training for improving physical function in older adults. Cochrane Database of Systematic Reviews 2009;3. https://doi.org/10.1002/14651858.CD002759.pub2.

[49] Vergeer I, Johansson M, Cagas JY. Holistic movement practices – An emerging category of physical activity for exercise psychology. Psychol Sport Exerc 2021;53:101870. https://doi.org/10.1016/j.psychsport.2020.101870.

[50] Shakespear-Druery J, De Cocker K, Biddle SJH, et al. Muscle-Strengthening Exercise Questionnaire (MSEQ): An assessment of concurrent validity and test-retest reliability. BMJ Open Sport Exerc Med 2022;8:e001225. https://doi.org/10.1136/bmjsem-2021-001225.

[51] Andrade A, de Azevedo Klumb Steffens R, Sieczkowska S, et al. Acute effect of strength training on mood of patients with fibromyalgia syndrome. Reumatismo 2019;71:141–7. https://doi.org/10.4081/reumatismo.2019.1169.

[52] Joustra ML, Zijlema WL, Rosmalen JGM, et al. Physical activity and sleep in chronic fatigue syndrome and fibromyalgia syndrome: Associations with symptom severity in the general population cohort lifelines. Pain Res Manag 2018;2018:5801510. https://doi.org/10.1155/2018/5801510.

[53] Alkan PN, Daskapan A, Tuzun EH, et al. Health-related physical fitness in women with fibromyalgia syndrome or myofascial pain syndrome. J Musculoskelet Pain 2008;16:258–65. https://doi.org/10.1080/10582450802479644.

[54] Álvarez-Gallardo IC, Soriano-Maldonado A, Segura-Jiménez V, et al. High Levels of Physical Fitness Are Associated With Better Health-Related Quality of Life in Women With Fibromyalgia: The al-Ándalus Project. Phys Ther 2019;99:1481–94. https://doi.org/10.1093/ptj/pzz113.

[55] Álvarez-Gallardo IC, Carbonell-Baeza A, Segura-Jiménez V, et al. Physical fitness reference standards in fibromyalgia: The al-Ándalus project. Scand J Med Sci Sports 2017;27:1477–88. https://doi.org/10.1111/sms.12741.

[56] Aparicio VA, Álvarez-Gallardo IC, Segura-Jiménez V, et al. Fitness testing in the fibromyalgia diagnosis: the al-Ándalus project. Med Sci Sports Exerc 2015;47:451–9. https://doi.org/10.1249/MSS.0000000000000445.

[57] Aparicio V, Carbonell-Baeza A, Ortega F, et al. Handgrip strength in men with fibromyalgia. Clinical and Experimental Rheumatology-Incl Supplements 2010;28:S78–81.

[58] Aparicio VA, Ortega FB, Heredia JM, et al. Handgrip strength test as a complementary tool in the assessment of fibromyalgia severity in women. Arch Phys Med Rehabil 2011;92:83–8. https://doi.org/10.1016/j.apmr.2010.09.010.

[59] Assumpção A, Sauer J, Mango P, et al. Physical function interfering with pain and symptoms in fibromyalgia patients. Clin Exp Rheumatol 2010;28:S57–63.

[60] Ayán C, Martin V, Alonso-Cortés B, et al. Relationship between aerobic fitness and quality of life in female fibromyalgia patients. Clin Rehabil 2007;21:1109–13. https://doi.org/10.1177/0269215507077365.

[61] Berardi G, Eble C, Hunter SK, et al. Localized Pain and Fatigue During Recovery From Submaximal Resistance Exercise in People With Fibromyalgia. Phys Ther 2023;103:pzad033. https://doi.org/10.1093/ptj/pzad033.

[62] Breda CA, Rodacki A, Leite N, et al. Physical activity level and physical performance in the 6-minute walk test in women with fibromyalgia. Rev Bras Reumatol 2013;53:276–81. https://doi.org/10.1016/s2255-5021(13)70033-6.

[63] Carbonell-Baeza A, Aparicio VA, Sjöström M, et al. Pain and Functional Capacity in Female fibromyalgia patients. Pain Medicine 2011;12:1667–75. https://doi.org/10.1111/j.1526-4637.2011.01239.x.

[64] Cardoso F, Curtolo M, Natour J, et al. Assessment of quality of life, muscle strength and functional capacity in women with fibromyalgia. Rev Bras Reumatol 2011;51:338–50. https://doi.org/10.1590/s0482-50042011000400006.

[65] Córdoba-Torrecilla S, Aparicio VA, Soriano-Maldonado A, et al. Physical fitness is associated with anxiety levels in women with fibromyalgia: the al-Ándalus project. Quality of Life Research 2016;25:1053–8. https://doi.org/10.1007/s11136-015-1128-y.

[66] Gómez-Cabello A, Vicente-Rodríguez G, Navarro-Vera I, et al. Influences of physical fitness on bone mass in women with Fibromyalgia. Adapted Physical Activity Quarterly 2015;32:125–36. https://doi.org/10.1123/APAQ.2014-0193.

[67] Larsson A, Palstam A, Bjersing J, et al. Controlled, cross-sectional, multi-center study of physical capacity and associated factors in women with fibromyalgia. BMC Musculoskelet Disord 2018;19:121. https://doi.org/10.1186/s12891-018-2047-1.

[68] Latorre-Román P, Santos-Campos M, Heredia-Jimenez J, et al. Analysis of the performance of women with Fibromyalgia in the six-Minute Walk Test and its relation with health and quality of life. J Sports Med Phys Fitness 2014;54:5111–517.

[69] Maquet D, Croisier J-L, Renard C, et al. Muscle performance in patients with fibromyalgia. Joint Bone Spine 2002;69:293–9. https://doi.org/10.1016/s1297-319x(02)00373-1.

[70] Özköslü M, Tonga E, Daskapan A, et al. Differences in Physical Activity and Physical Fitness Level in Patients with Fibromyalgia Syndrome and Healthy Individuals. Clinical and Experimental Health Sciences 2017;7:94–9. https://doi.org/10.5152/clinexphealthsci.2017.224.

[71] Panton LB, Kingsley JD, Toole T, et al. A comparison of physical functional performance and strength in women with fibromyalgia, age- and weight-matched controls, and older women who are healthy. Phys Ther 2006;86:1479–88. https://doi.org/10.2522/ptj.20050320.

[72] Şahin G, Ulubaş B, Çalikoğlu M, et al. Handgrip Strength, Pulmonary Function Tests, and Pulmonary Muscle Strength in Fibromyalgia Syndrome: Is There Any Relationship? Key Points. South Med J 2004;97:25–9. https://doi.org/10.1097/01.smj.0000101146.95697.18.

[73] Sener U, Ucok K, Ulasli AM, et al. Evaluation of health-related physical fitness parameters and association analysis with depression, anxiety, and quality of life in patients with fibromyalgia. Int J Rheum Dis 2016;19:763–72. https://doi.org/10.1111/1756-185X.12237.

[74] Soriano-Maldonado A, Ruiz JR, Aparicio VA, et al. Association of physical fitness with pain in women with fibromyalgia: The al-Ándalus project. Arthritis Care Res (Hoboken) 2015;67:1561–70. https://doi.org/10.1002/acr.22610.

[75] Figueroa A, Kingsley JD, Mcmillan V, et al. Resistance exercise training improves heart rate variability in women with fibromyalgia. Clin Physiol Funct Imaging 2008;28:49–54. https://doi.org/10.1111/j.1475-097X.2007.00776.x.

[76] McLoughlin MJ, Colbert LH, Stegner AJ, et al. Are women with fibromyalgia less physically active than healthy women? Med Sci Sports Exerc 2011;43:905–12. https://doi.org/10.1249/MSS.0b013e3181fca1ea.

[77] Sieczkowska SM, Vilarino GT, de Souza LC, et al. Does physical exercise improve quality of life in patients with fibromyalgia? Ir J Med Sci 2020;189:341–7. https://doi.org/10.1007/s11845-019-02038-z.

[78] Segura-Jiménez V, Borges-Cosic M, Soriano-Maldonado A, et al. Association of sedentary time and physical activity with pain, fatigue, and impact of fibromyalgia: the al-Ándalus study. Scand J Med Sci Sports 2017;27:83–92. https://doi.org/10.1111/sms.12630.

[79] Alvarez MC, Albuquerque MLL, Neiva HP, et al. Exploring the Relationship between Fibromyalgia-Related Fatigue, Physical Activity, and Quality of Life. Int J Environ Res Public Health 2022;19:4870. https://doi.org/10.3390/ijerph19084870.

[80] Silva HJ de A, Assunção Júnior JC, de Oliveira FS, et al. Sophrology versus resistance training for treatment of women with fibromyalgia: A randomized controlled trial. J Bodyw Mov Ther 2019;23:382–9. https://doi.org/10.1016/j.jbmt.2018.02.005.

[81] Geel SE, Robergs RA. The effect of graded resistance exercise on fibromyalgia symptoms and muscle bioenergetics: A pilot study. Arthritis Care Res (Hoboken) 2002;47:82–6. https://doi.org/10.1002/art1.10240.

[82] Kingsley JD, Panton LB, Toole T, et al. The effects of a 12-week strength-training program on strength and functionality in women with fibromyalgia. Arch Phys Med Rehabil 2005;86:1713–21. https://doi.org/10.1016/j.apmr.2005.04.014.

[83] Glasgow A, Stone TM, Kingsley JD. Resistance Exercise Training on Disease Impact, Pain Catastrophizing and Autonomic Modulation in Women with Fibromyalgia. Int J Exerc Sci 2017;10:1184–95. https://doi.org/10.70252/lazd6794.

[84] Assumpção A, Matsutani LA, Yuan SL, et al. Muscle stretching exercises and resistance training in fibromyalgia: which is better? A three-arm randomized controlled trial. Eur J Phys Rehabil Med 2018;54:663–70. https://doi.org/10.23736/S1973.

[85] Kolak E, Ardıç F, Fındıkoğlu G. Effects of different types of exercises on pain, quality of life, depression, and body composition in women with fibromyalgia: A three-arm, parallel-group, randomized trial. Arch Rheumatol 2022;37:444–55. https://doi.org/10.46497/ArchRheumatol.2022.9190.

[86] Andrade A, Sieczkowska SM, Vilarino GT. Resistance Training Improves Quality of Life and Associated Factors in Patients With Fibromyalgia Syndrome. PM and R 2019;11:703–9. https://doi.org/10.1016/j.pmrj.2018.09.032.

[87] Andrade A, Vilarino GT, Bevilacqua GG. What Is the Effect of Strength Training on Pain and Sleep in Patients with Fibromyalgia? Am J Phys Med Rehabil 2017;96:889–93. https://doi.org/10.1097/PHM.0000000000000782.

[88] Andrade A, Steffens R de AK, Grisard F, et al. Strength training in patients with fibromyalgia: A feasibility study. Revista Brasileira de Medicina Do Esporte 2023;29:e176543. https://doi.org/10.1590/1517-869220232901176543.

[89] Gavi MBRO, Vassalo DV, Amaral FT, et al. Strengthening exercises improve symptoms and quality of life but do not change autonomic modulation in fibromyalgia: A randomized clinical trial. PLoS One 2014;9:e90767. https://doi.org/10.1371/journal.pone.0090767.

[90] Hooten WM, Qu W, Townsend CO, et al. Effects of strength vs aerobic exercise on pain severity in adults with fibromyalgia: A randomized equivalence trial. Pain 2012;153:915–23. https://doi.org/10.1016/j.pain.2012.01.020.

[91] Park HK, Song MK, Kim DJ, et al. Comparison of core muscle strengthening exercise and stretching exercise in middle-aged women with fibromyalgia A randomized, single-blind, controlled study. Medicine (United States) 2021;100:E27854. https://doi.org/10.1097/MD.0000000000027854.

[92] Bircan Ç, Karasel SA, Akgün B, et al. Effects of muscle strengthening versus aerobic exercise program in fibromyalgia. Rheumatol Int 2008;28:527–32. https://doi.org/10.1007/s00296-007-0484-5.

[93] Jones KD, Burckhardt C, Clark S, et al. A randomized controlled trial of muscle strengthening versus flexibility training in fibromyalgia. J Rheumatol 2002;29:1041–8. https://doi.org/10.6083/M4M043QK.

[94] Maestre-Cascales C, Castillo-Paredes A, Romero-Parra N, et al. Gradual Strength Training Improves Sleep Quality, Physical Function and Pain in Women with Fibromyalgia. Int J Environ Res Public Health 2022;19:15662. https://doi.org/10.3390/ijerph192315662.

[95] Kayo AH, Peccin MS, Sanches CM, et al. Effectiveness of physical activity in reducing pain in patients with fibromyalgia: A blinded randomized clinical trial. Rheumatol Int 2012;32:2285–92. https://doi.org/10.1007/s00296-011-1958-z.

[96] Fernandes G, Nery M, Meireles SM, et al. A functional exercise program improves pain and health related quality of life in patients with fibromyalgia: a randomized controlled trial. Advances in Rheumatology 2024;64:81. https://doi.org/10.1186/s42358-024-00422-7.

[97] Latorre Román PÁ, Santos E Campos MA, García-Pinillos F. Effects of functional training on pain, leg strength, and balance in women with fibromyalgia. Mod Rheumatol 2015;25:943–7. https://doi.org/10.3109/14397595.2015.1040614.

[98] Izquierdo-Alventosa R, Inglés M, Cortés-Amador S, et al. Low-intensity physical exercise improves pain catastrophizing and other psychological and physical aspects in women with fibromyalgia: A randomized controlled trial. Int J Environ Res Public Health 2020;17:3634. https://doi.org/10.3390/ijerph17103634.

[99] Loftus N, Dobbin N, Crampton JS. The effects of a group exercise and education programme on symptoms and physical fitness in patients with fibromyalgia: a prospective observational cohort study. Disabil Rehabil 2022;44:3860–7. https://doi.org/10.1080/09638288.2021.1891463.

[100] Sañudo CB, Galiano D, Carrasco L, et al. Effects of a prolonged exercise programe on key health outcomes in women with fibromyalgia : A randomized controlled trial. J Rehabil Med 2011;43:521–6. https://doi.org/10.2340/16501977-0814.

[101] Sanudo B, Galiano D, Carrasco L, et al. Aerobic exercise versus combined exercise therapy in women with fibromyalgia syndrome: A randomized controlled trial. Arch Phys Med Rehabil 2010;91:1838–43. https://doi.org/10.1016/j.apmr.2010.09.006.

[102] Toprak Celenay S, Anaforoglu Kulunkoglu B, Yasa ME, et al. A comparison of the effects of exercises plus connective tissue massage to exercises alone in women with fibromyalgia syndrome: a randomized controlled trial. Rheumatol Int 2017;37:1799–806. https://doi.org/10.1007/s00296-017-3805-3.

[103] Rooks DS, Silverman CB, Kantrowitz FG. The effects of progressive strength training and aerobic exercise on muscle strength and cardiovascular fitness in women with fibromyalgia: A pilot study. Arthritis Care Res (Hoboken) 2002;47:22–8. https://doi.org/10.1002/art1.10180.

[104] Rooks DS, Gautam S, Romeling M, et al. Group Exercise, Education, and Combination Self-management in Women With Fibromyalgia A Randomized Trial. Arch Intern Med 2007;167:2192–200. https://doi.org/10.1001/archinte.167.20.2192.

[105] Buckelew SP, Conway R, Parker J, et al. Biofeedback/relaxation training and exercise interventions for fibromyalgia: A prospective trial. Arthritis Rheum 1998;11:196–209. https://doi.org/10.1002/art.1790110307.

[106] Van Santen M, Bolwijn P, Verstappen F, et al. A Randomized Clinical Trial Comparing Fitness and Biofeedback Training versus Basic Treatment in Patients with Fibromyalgia. J Rheumatol 2002;29:575–81.

[107] Britto A, Rodrigues V, dos Santos AM, et al. Effects of water- and land-based exercises on quality of life and physical aspects in women with fibromyalgia: A randomized clinical trial. Musculoskeletal Care 2020;18:459–66. https://doi.org/10.1002/msc.1481.

[108] Carbonell-Baeza A, Aparicio VA, Ortega FB, et al. Does a 3-month multidisciplinary intervention improve pain, body composition and physical fi tness in women with fibromyalgia? Br J Sports Med 2010;45:1189–95. https://doi.org/10.1136/bjsm.2009.070896.

[109] Gavilán-Carrera B, Borges-Cosic M, Álvarez-Gallardo IC, et al. Effectiveness of Land- and Water-based Exercise on Fatigue and Sleep Quality in Women With Fibromyalgia: The al-Ándalus Quasi-Experimental Study. Arch Phys Med Rehabil 2023;104:1775–84. https://doi.org/10.1016/j.apmr.2023.04.028.

[110] Jones KD, Sherman CA, Mist SD, et al. A randomized controlled trial of 8-form Tai chi improves symptoms and functional mobility in fibromyalgia patients. Clin Rheumatol 2012;31:1205–14. https://doi.org/10.1007/s10067-012-1996-2.

[111] Wang C, Schmid CH, Rones R, et al. A Randomized Trial of Tai Chi for Fibromyalgia A BS TR AC T. N Engl J Med 2010;363:743–54. https://doi.org/10.1016/j.spinee.2010.11.012.

[112] Wong A, Figueroa A, Sanchez-Gonzalez MA, et al. Effectiveness of Tai Chi on cardiac autonomic function and symptomatology in women with fibromyalgia: A randomized controlled trial. J Aging Phys Act 2018;26:214–21. https://doi.org/10.1123/japa.2017-0038.

[113] Altan L, Korkmaz N, Bingol Ü, et al. Effect of Pilates Training on People With Fibromyalgia Syndrome: A Pilot Study. Arch Phys Med Rehabil 2009;90:1983–8. https://doi.org/10.1016/j.apmr.2009.06.021.

[114] De Medeiros SA, De Almeida Silva HJ, Do Nascimento RM, et al. Mat Pilates is as effective as aquatic aerobic exercise in treating women with fibromyalgia: A clinical, randomized and blind trial. Advances in Rheumatology 2020;60:21. https://doi.org/10.1186/s42358-020-0124-2.

[115] Sanz-Baños Y, Pastor MÁ, Velasco L, et al. To walk or not to walk: insights from a qualitative description study with women suffering from fibromyalgia. Rheumatol Int 2016;36:1135–43. https://doi.org/10.1007/s00296-016-3459-6.

[116] Rubio-Zarapuz A, Parraca JA, Tornero-Aguilera JF, et al. Unveiling the link: exploring muscle oxygen saturation in fibromyalgia and its implications for symptomatology and therapeutic strategies. Med Gas Res 2025;15:58–72. https://doi.org/10.4103/mgr.MEDGASRES-D-24-00013.

[117] Berwick R, Barker C, Goebel A. The diagnosis of fibromyalgia syndrome. Clinical Medicine, Journal of the Royal College of Physicians of London 2022;22:570–4. https://doi.org/10.7861/clinmed.2022-0402.

[118] Yunus MB. The role of gender in fibromyalgia syndrome. Curr Rheumatol Rep 2001;3:128–34. https://doi.org/10.1007/s11926-001-0008-3.

[119] Wolfe F, Walitt B, Perrot S, et al. Fibromyalgia diagnosis and biased assessment: Sex, prevalence and bias. PLoS One 2018;13:e0203755. https://doi.org/10.1371/journal.pone.0203755.

[120] Segura-Jiménez V, Estévez-López F, Soriano-Maldonado A, et al. Gender Differences in Symptoms, Health-Related Quality of Life, Sleep Quality, Mental Health, Cognitive Performance, Pain-Cognition, and Positive Health in Spanish Fibromyalgia Individuals: The Al-Ándalus Project. Pain Res Manag 2016;2016:1–14. https://doi.org/10.1155/2016/5135176.

[121] Wolfe F, Smythe H, Yunus M, et al. The American College of Rheumatology 1990 criteria for the classification of Fibromyalgia. Arthritis & Rheumatism: Official Journal of the American College of Rheumatology 1990;33:160–72. https://doi.org/10.1002/art.1780330203.

[122] Wolfe F, Clauw DJ, Fitzcharles MA, et al. The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. Arthritis Care Res (Hoboken) 2010;62:600–10. https://doi.org/10.1002/acr.20140.

[123] Wolfe F, Clauw DJ, Fitzcharles M-A, et al. 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. Semin Arthritis Rheum 2016;46:319–29. https://doi.org/10.1016/j.semarthrit.2016.08.012.

[124] Yunus M, Masi A, Calabro J, et al. Primary fibromyalgia (fibrositis): clinical study of 50 patients with matched normal controls. Semin Arthritis Rheum 1981;11:151–71. https://doi.org/10.1016/0049-0172(81)90096-2.

[125] Kumbhare D, Ahmed S, Watter S. A narrative review on the difficulties associated with fibromyalgia diagnosis. Ther Adv Musculoskelet Dis 2018;10:13–26. https://doi.org/10.1177/1759720X17740076.

[126] Galvez-Sánchez CM, Reyes del Paso GA. Diagnostic Criteria for Fibromyalgia: Critical Review and Future Perspectives. J Clin Med 2020;9:1219. https://doi.org/10.3390/jcm9041219.

[127] Henriksen M, Lund H, Christensen R, et al. Relationships between the fibromyalgia impact questionnaire, tender point count, and muscle strength in female patients with fibromyalgia: A cohort study. Arthritis Care Res (Hoboken) 2009;61:732–9. https://doi.org/10.1002/art.24512.

[128] Gerdle B, Dahlqvist Leinhard O, Lund E, et al. Fibromyalgia: Associations Between Fat Infiltration, Physical Capacity, and Clinical Variables. J Pain Res 2022;Volume 15:2517–35. https://doi.org/10.2147/JPR.S376590.

[129] Soriano-Maldonado A, Ruiz JR, Aparicio VA, et al. Association of Physical Fitness With Pain in Women With Fibromyalgia: The al-Ándalus Project. Arthritis Care Res (Hoboken) 2015;67:1561–70. https://doi.org/10.1002/acr.22610.

[130] Umay E, Gundogdu I, Ozturk EA. What happens to muscles in fibromyalgia syndrome. Irish Journal of Medical Science 2020;189:749–56. https://doi.org/10.1007/s11845-019-02138-w.

[131] Verbunt JA, Smeets RJ, Wittink HM. Cause or effect? Deconditioning and chronic low back pain. Pain 2010;149:428–30. https://doi.org/10.1016/j.pain.2010.01.020.

[132] Fernandez-Feijoo F, Samartin-Veiga N, Carrillo-de-la-Peña MT. Quality of life in patients with fibromyalgia: Contributions of disease symptoms, lifestyle and multi-medication. Front Psychol 2022;13:924405. https://doi.org/10.3389/fpsyg.2022.924405.

[133] Wang Y, Liu P, Li Z, et al. Quality of life, pain, depression, fatigue and sleep in patients with remission or mild fibromyalgia: a comparison with remission or low disease activity rheumatoid arthritis and healthy controls. BMC Musculoskelet Disord 2025;26:67. https://doi.org/10.1186/s12891-025-08323-6.

[134] Bennett RM, Schein J, Kosinski MR, et al. Impact of fibromyalgia pain on health-related quality of life before and after treatment with tramadol/acetaminophen. Arthritis Rheum 2005;53:519–27. https://doi.org/10.1002/art.21319.

[135] Leon-Llamas JL, Villafaina S, Murillo-Garcia A, et al. Strength Assessment Under Dual Task Conditions in Women with Fibromyalgia: A Test–Retest Reliability Study. Int J Environ Res Public Health 2019;16:4971. https://doi.org/10.3390/ijerph16244971.

[136] Dailey DL, Frey Law LA, Vance CGT, et al. Perceived function and physical performance are associated with pain and fatigue in women with fibromyalgia. Arthritis Res Ther 2016;18:68. https://doi.org/10.1186/s13075-016-0954-9.

[137] dos Santos MR, Moro CMC, Vosgerau DSR. Protocolo para avaliação física em portadores de síndrome de fibromialgia. Rev Bras Reumatol 2014;54:117–23. https://doi.org/10.1016/j.rbr.2014.03.006.

[138] Rikli RE, Jones CJ. Development and Validation of Criterion-Referenced Clinically Relevant Fitness Standards for Maintaining Physical Independence in Later Years. Gerontologist 2013;53:255–67. https://doi.org/10.1093/geront/gns071.

[139] Carbonell-Baeza A, Álvarez-Gallardo I, Segura-Jiménez V, et al. Reliability and Feasibility of Physical Fitness Tests in Female Fibromyalgia Patients. Int J Sports Med 2014;36:157–62. https://doi.org/10.1055/s-0034-1390497.

[140] Williams DA, Arnold LM. Measures of fibromyalgia: Fibromyalgia Impact Questionnaire (FIQ), Brief Pain Inventory (BPI), Multidimensional Fatigue Inventory (MFI-20), Medical Outcomes Study (MOS) Sleep Scale, and Multiple Ability Self-Report Questionnaire (MASQ). Arthritis Care Res (Hoboken) 2011;63:S86. https://doi.org/10.1002/acr.20531.

[141] Coskun Benlidayi I, Ornek C, Sariyildiz A, et al. Development of a fibromyalgia-specific quality of life instrument: the Fibromyalgia Quality of Life Scale (FM-QoLS). Rheumatol Int 2025;45:142. https://doi.org/10.1007/s00296-025-05895-3.

[142] Testa MA, Simonson DC. Assessment of Quality-of-Life Outcomes. New England Journal of Medicine 1996;334:835–40. https://doi.org/10.1056/NEJM199603283341306.

[143] Cetingok S, Seker O, Cetingok H. The relationship between fibromyalgia and depression, anxiety, anxiety sensitivity, fear avoidance beliefs, and quality of life in female patients. Medicine 2022;101:e30868. https://doi.org/10.1097/MD.0000000000030868.

[144] Myles PS, Troedel S, Boquest M, et al. The Pain Visual Analog Scale: Is It Linear or Nonlinear? Anesth Analg 1999;89:1517. https://doi.org/10.1097/00000539-199912000-00038.

[145] Langley GB, Sheppeard H. The visual analogue scale: Its use in pain measurement. Rheumatol Int 1985;5:145–8. https://doi.org/10.1007/BF00541514.

[146] Williams D, Gendreau M, Hufford M, et al. Pain assessment in patients with fibromyalgia syndrome: a consideration of methods for clinical trials. . Clin J Pain 2004;20:348–56. https://doi.org/10.1097/00002508-200409000-00010.

[147] Burckhardt C, Clark S, Bennett R. The fibromyalgia impact questionnaire: development and validation. J Rheumatol 1991;18:728–33.

[148] Collado-Mateo D, Chen G, Garcia-Gordillo MA, et al. Fibromyalgia and quality of life: mapping the revised fibromyalgia impact questionnaire to the preference-based instruments. Health Qual Life Outcomes 2017;15:114. https://doi.org/10.1186/s12955-017-0690-0.

[149] Sarmer S, Ergin S, Yavuzer G. The validity and reliability of the Turkish version of the Fibromyalgia Impact Questionnaire. Rheumatol Int 2000;20:9–12. https://doi.org/10.1007/s002960000077.

[150] Rivera J, Gonzalez T. The Fibromyalgia Impact Questionnaire: a validated Spanish version to assess the health status in women with fibromyalgia. . Clin Exp Rheumatol 2004;22:554–60.

[151] Salaffi F, Sarzi-Puttini P, Girolimetti R, et al. Health-related quality of life in fibromyalgia patients: a comparison with rheumatoid arthritis patients and the general population using the SF-36 health survey. Clin Exp Rheumatol 2009;27:S67.

[152] Valkeinen H, Alén M, Häkkinen A, et al. Effects of Concurrent Strength and Endurance Training on Physical Fitness and Symptoms in Postmenopausal Women With Fibromyalgia: A Randomized Controlled Trial. Arch Phys Med Rehabil 2008;89:1660–6. https://doi.org/10.1016/j.apmr.2008.01.022.

[153] Nuzzo JL, Nosaka K. Eccentric Muscle Actions Add Complexity to an Already Inconsistent Resistance Exercise Nomenclature. Sports Med Open 2023;9:118. https://doi.org/10.1186/s40798-023-00667-4.

[154] Nuzzo JL. Words and Patterns That Comprise Resistance Training Exercise Names. J Strength Cond Res 2017;31:826–30. https://doi.org/10.1519/JSC.0000000000000965.

[155] Jackson MC, Brown LE, Coburn JW, et al. Towards Standardization of the Nomenclature of Resistance Training Exercises. J Strength Cond Res 2013;27:1441–9. https://doi.org/10.1519/JSC.0b013e318289168d.

[156] Fyfe JJ, Hamilton DL, Daly RM. Minimal-Dose Resistance Training for Improving Muscle Mass, Strength, and Function: A Narrative Review of Current Evidence and Practical Considerations. Sports Medicine 2022;52:463–79. https://doi.org/10.1007/s40279-021-01605-8.

[157] Kraemer WJ, Fragala MS, Ratamess NA. Evolution of resistance training in women: History and mechanisms for health and performance. Sports Medicine and Health Science 2025;7:351–65. https://doi.org/10.1016/j.smhs.2025.01.005.

[158] Plotkin D, Coleman M, Van Every D, et al. Progressive overload without progressing load? The effects of load or repetition progression on muscular adaptations. PeerJ 2022;10:e14142. https://doi.org/10.7717/peerj.14142.

[159] Kristensen J, Franklyn-Miller A. Resistance training in musculoskeletal rehabilitation: a systematic review. Br J Sports Med 2012;46:719–26. https://doi.org/10.1136/bjsm.2010.079376.

[160] Bidonde J, Boden C, Foulds H, et al. Physical Activity and Exercise Training for Adults with Fibromyalgia. Fibromyalgia Syndrome, vol. 2021, Hoboken, New Jersey, USA: Springer, Cham; 2021, p. 59–72. https://doi.org/10.1007/978-3-030-78638-0_6.

[161] Michie S, Atkins L, West R. The behaviour change wheel: A guide to designing interventions. London: Silverback Publishing; 2014, p. 1003–10.

[162] Martín-Borràs C, González Serra G, Carrasco-Querol N, et al. Effectiveness of a brief multicomponent intervention to improve physical activity level and functional capacity in fibromyalgia and chronic fatigue syndrome (Synchronize+). Front Physiol 2024;15:1441076. https://doi.org/10.3389/fphys.2024.1441076.

[163] Vancampfort D, McGrath RL, Hemmings L, et al. Physical activity correlates in people with fibromyalgia: a systematic review. Disabil Rehabil 2023;45:4165–74. https://doi.org/10.1080/09638288.2022.2146911.

[164] West R, Michie S. A Brief Introduction to the COM-B Model of Behaviour and the PRIME Theory of Motivation [v1]. Qeios 2020. https://doi.org/10.32388/WW04E6.2.