Accepted Article

Journal of Frailty, Sarcopenia and Falls

Review Article

Group-based physical activity interventions for fibromyalgia: a systematic scoping review

Martin Pursley[1], Fiona Muirhead[1], Craig Donnachie[1], David Kennedy[1], Alexandra Mavroeidi[2]

[1]*Department of Physical Activity and Health, School of Psychological Sciences and Health, University of Strathclyde, Glasgow, Scotland, UK;*

[2]*Department for Occupational Therapy and Human Nutrition and Dietetics, School of Health and Life Sciences, Glasgow Caledonian University, Glasgow, Scotland, UK*

Abstract

Group-based physical activity interventions improve symptoms, quality of life and function, and are a cost-effective treatment approach for the management for Fibromyalgia Syndrome. Multiple forms of physical activity have been examined in the Fibromyalgia population; however, a comprehensive review of these approaches is lacking. This review aimed to map the current research and descriptively report on attrition data. A scoping review was undertaken searching Medline, CINAHL, SCOPUS, SPORTDiscus and Web-of-Science for studies meeting the following criteria: English language; peer-reviewed; published January 1, 2000 - February 23, 2023; adults (≥18 years) diagnosed with Fibromyalgia; group-based exercise or group-based physical activity. Study selection and data extraction were performed independently by two reviewers. Data were recorded into spreadsheets, then descriptively analysed and tabulated. 17 studies were included enrolling a total of 893 participants. Most examined multi-component intervention designs. Twelve included resistance exercise, ten included flexibility, eight included aerobic, six included hydrotherapy, four included balance training, three included "mindful movement" (e.g. Qi-Gong), one included Pilates, and one included exergames. Mean attrition was 21%. Current literature on group-based physical activity for Fibromyalgia examines mostly multi-component programmes delivered by multi-disciplinary teams in community settings, matching best-practice guidelines. Future studies should explore attrition further, examining influential variables.

Keywords: Chronic pain, Exercise, Fibromyalgia, Group-based physical activity, Physical activity

Introduction

Fibromyalgia Syndrome (FMS) is a condition characterised by persistent pain in multiple body areas and is often associated with fatigue, poor concentration (or 'brain fog'), irritable bowel syndrome, anxiety, depression and disrupted sleep[1]. FMS affects approximately 1 in 20 people worldwide and an estimated 2.5 million people in the UK[2]. The pathophysiology and diagnosis of FMS are subject to arduous debate, however, there is extensive evidence that changes in central pain processing, more so than damage or inflammation of peripheral structures, are important in the development and maintenance of persistent pain in patients with FMS[3]. These changes often manifest in allodynia and hyperalgesia which are changes to the responsiveness and sensitivity of the nervous system to various stimuli including pressure, vibration, temperature and medications[4]. The impact of FMS symptoms often leads to significant physical disability, high healthcare utilisation and poor quality of life (QoL)[5,6].

Traditionally, management of FMS has focused heavily on treating symptoms within a biomedical framework[7,8]. Pharmacological treatments are often used as first

The authors have no conflict of interest.

Corresponding author: *Martin Pursley, School of Psychological Sciences and Health (Physical Activity for Health), University of Strathclyde, Scotland, UK*

E-mail: *Martin.Pursley@strath.ac.uk*

Edited by: *Jagadish K. Chhetri*

Accepted *4 August 2025*

line management despite the recognition that opioids, gabapentinoids and NSAIDs should not be offered to manage FMS symptoms[9]. There have been calls for a shift in the way persistent pain conditions like FMS are managed, with the proposal of moving away from the 'we can fix and cure you' model towards a model more in-keeping with the supported self-management approaches used to treat other non-communicable diseases like Diabetes or Asthma[8]. Adopting a Biopsychosocial perspective to the management of FMS may result in a deeper understanding of the experience of living with FMS and contribute to the provision of effective, person-centred treatment approaches[10]. A Biopsychosocial approach systematically considers biological, psychological, and social factors and their complex interactions in understanding health, illness, and health care delivery[11]. Interventions incorporating both pharmacological and non-pharmacological treatments are therefore recommended[8,9], and current evidence suggests physical activity (PA) is the most effective non-pharmacological intervention, particularly aerobic exercise and exercise to increase muscle strength[7,8,12].

The Power of Group-Based PA

Physical activity (PA) is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure", whilst exercise is defined as "a subset of PA that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness"[13]. The World Health Organization recommends adults undertake a minimum of 150 minutes of moderate intensity PA, or 75 minutes of vigorous PA, per week, alongside two moderate-vigorous intensity muscle strengthening activities[14]. They also suggest all adults should aim to surpass these recommended levels to reduce the detrimental effects of sedentary behavior. PA interventions are a low-risk management option which have a positive effect on physical and psychological function, pain intensity, exercise tolerance, and quality of life in people with FMS[8,15].

However, engaging in PA interventions can be challenging for people with FMS. Comorbidity, depression, low pain self-efficacy (defined as "one's confidence regarding one's ability to function effectively while in pain"[16]), and higher pain intensities are recognised as consistent barriers to PA for this group[15]. Previous studies have highlighted the potential benefits of group-based interventions that incorporate PA in this population through shared experiences, peer support and pain validation[17,18].

Peer support is based on understanding another's situation through the shared experience of illness, and Sallinen et al[18] highlights the importance of feeling "part of a group" and "not being alone" in managing FMS. This delineates peer support from other forms of social support, such as support from family, friends or health professionals[19]. Pain validation, defined as the observer's intentional communication aimed at legitimizing the individual's pain experience, represents a critical—yet often insufficient—component of healthcare for individuals with persistent pain. Many patients report that clinical encounters are marked by a perceived lack of validation, manifesting as feelings of being unheard, dismissed, belittled, or ignored. This deficit may contribute to further psychological distress and impede effective pain management[6,20]. It may be the case that group-based interventions have the potential to ameliorate some of the barriers to engagement in PA in this population by providing the shared experience, peer support and pain validation that is not provided by other forms of PA.

Purpose

Currently, there are multiple systematic reviews and meta-analyses exploring PA interventions in people with FMS[25-28]. These demonstrate benefits including reduced pain and depression, and improved physical fitness, function, and quality of life, as a result of undertaking PA. However, there are no systematic or scoping reviews explicitly investigating group-based PA interventions in people with FMS. Therefore, mapping what is currently known about group-based PA interventions for people with FMS may be a useful step in increasing our understanding of how to design and deliver PA interventions. This study aimed to provide such a scoping review, addressing two specific research questions:

1. From the existing literature, what types of group-based PA interventions have been implemented in people with FMS?
2. What are the attrition rates in group-based PA interventions in published trials within this population?

Methods

Design/Search Methods

A scoping review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR)[29]. Arksey and O'Malley[30] explain that a scoping review allows the reader to gain insight into how a topic has been examined and reported upon and can highlight knowledge gaps for future evidence synthesis. The framework produced through their report has been employed to guide this study. Our study protocol was not registered as the paper was originally intended to be submitted in support of a Master of Research thesis without a plan to submit for publication.

Multiple electronic databases, chosen to reflect the multidisciplinarity of the review, including Medline (OVID), CINAHL, SCOPUS, SPORTDiscus, and Web of Science were searched. Medical Subject Heading (MeSH) keywords were combined with free-text keywords using Boolean operators (and/or/not). The search terms used in each database are outlined in Appendix.

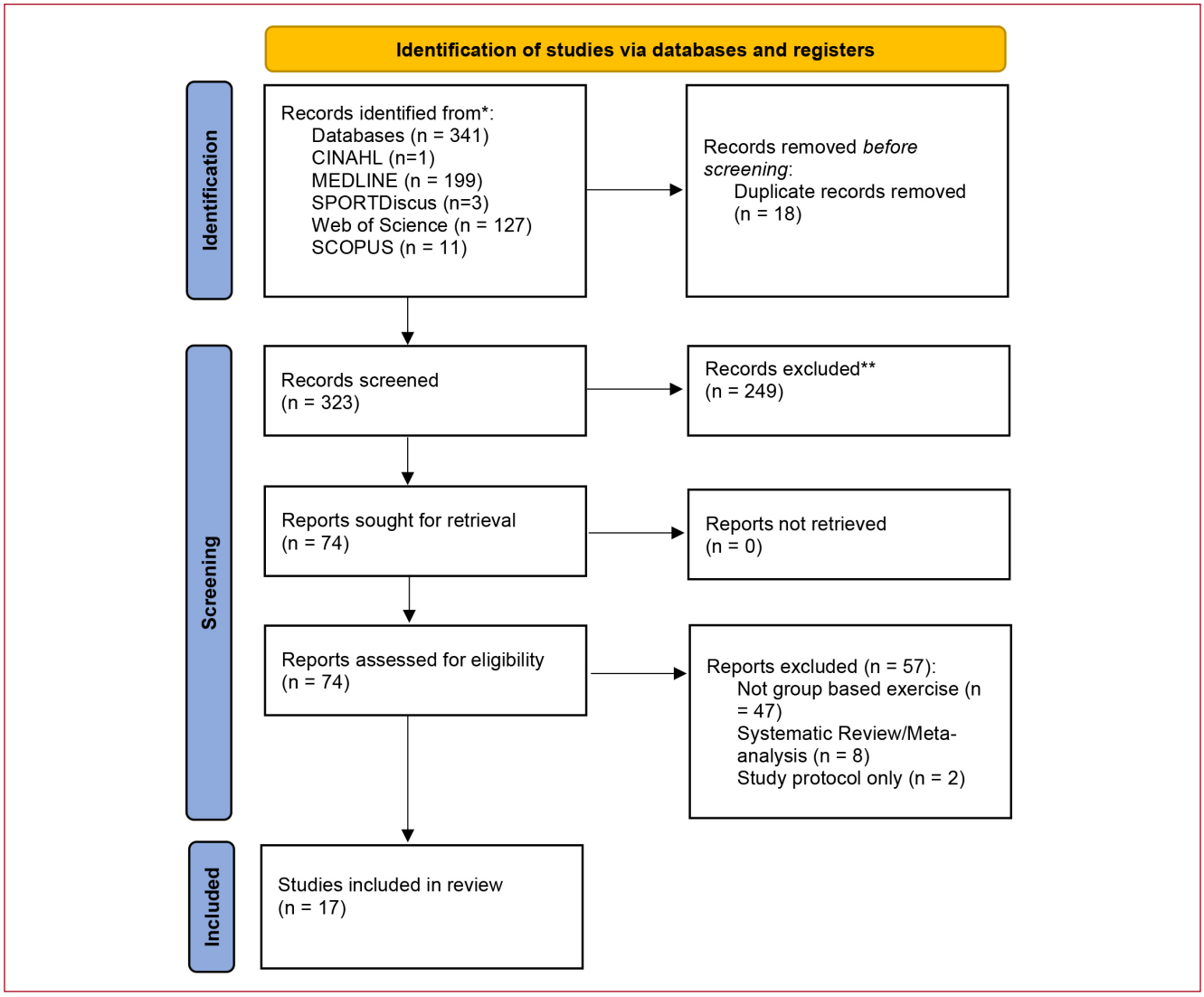

Figure 1. PRISMA flowchart.

Inclusion Criteria

Studies were eligible if they were: (1) published in English language in a peer-reviewed journal; (2) published 1st January, 2000 through 23rd February, 2023; (3) included adult participants (18 years or older) diagnosed with fibromyalgia; (4) investigating group-based exercise or group-based PA interventions/ programmes.

Types of Intervention

Any intervention that included PA or exercise in a group setting were included. It was agreed by the authors a priori that interventions involving movement-based exercise, such as mindful movement, tai-chi, qi-gong, etc., would be included alongside studies using traditional forms of exercise such as aerobic and resistance training, flexibility work, balance exercise and circuit-based activities.

Types of Study

Preliminary searches of existing literature found limited numbers (n = 4) of Randomised Controlled Trials (RCTs) of group-based PA interventions for people with FMS. Therefore, we decided to include all relevant study designs (eg, RCT, non-RCT, controlled before–after, survey, qualitative, mixed-methods) to draw from as wide an evidence base as possible.

Selection of Studies

Studies were selected through a multi-step screening strategy. Firstly, studies identified via the search strategy were imported to EndNote for deduplication. Secondly, studies that were deemed to be entirely non-relevant based on their title and abstract, that is, studies where there was no uncertainty about their lack of congruence with the inclusion criteria, were excluded by the author (MP). The same process was simultaneously undertaken by an independent researcher (DK). A consensus on the studies to be included for full text screening after this step was reached through discussion, and any disagreements were resolved by a third researcher (FM). Thirdly, the lead author undertook full text-screening of the remaining articles, whilst a sample of twenty per cent of these were reviewed, in full, independently by a second researcher (DK), as described by Petticrew and Roberts[31], to ensure that the eligibility criteria had been appropriately applied. Any study that did not meet the inclusion criteria was excluded and assigned a reason. Studies for which no clear consensus could be reached by the two reviewers were independently assessed by a third reviewer (FM), and any disagreements were resolved through discussion until final consensus was reached.

Data Analysis

Data were abstracted into spreadsheets by the lead author (MP) including: study background (name of the first author, year, and study location), sample characteristics (number of participants, age of participants, and number of males and females), design, recruitment method, intervention, follow up, and outcome measures assessed. Data were reviewed and confirmed by a second author (FM) and any discrepancies were discussed and, where necessary, resolved by a third person (CD). Data from included studies were synthesised and tabulated to allow descriptive reporting of the results. Complying with Joanna Briggs Institute (JBI) scoping review guidance[32], no attempt will be made to draw conclusions about the effectiveness of any intervention included in this review. This was due to the included studies not having undergone a process of critical appraisal or risk of bias appraisal and, also, not having undergone a process of pooling or aggregation that considers the combination of all study results (e.g., meta-analysis or meta-synthesis).

Results

Search Results

The search returned 341 records. After deduplication in EndNote, 323 records were screened by title and abstract by two reviewers (MP and DK), leaving 74 articles for full text screening. After full text screening against the inclusion/exclusion criteria, 21 papers were initially agreed for inclusion. Four studies were subsequently found to be inappropriate for the review and a final total of seventeen papers met the eligibility criteria and were included in the review. Two of the papers included were secondary analyses of an initial study published by the same authors; however, these assessed different outcomes from the same data pool and were therefore included in the review. Analyses were adjusted accounting for this and participant data were only included once in any calculations (e.g. study duration and attrition analyses). The screening process is documented in a PRISMA study flow diagram (Figure 1).

Excluded Studies

A total of (n = 57) studies were excluded from the review at full-text screening. Most exclusions were due to studies not exploring group-based PA, studies being systematic reviews, or studies not including the desired population (adults with FMS). Of the studies excluded under the subheading 'Systematic Review/Meta-analyses', most did explore some form of PA intervention but they were either not specifically group-based, or did not aim to identify or examine the broadest spectrum of group-based PA interventions, that is, they focussed on one particular modality of PA, rather than scoping all the available options. Six studies examined PA interventions (strength or aerobic or both (n=2); body awareness/ meditative movement (n=2); dance (n=1); complementary and alternative exercises (n=1)), and two studies examined non-PA interventions (any intervention n=1, psychological interventions only n=1).

Characteristics of Included Studies

Seventeen studies were included, five of which were RCTs[33-37], three were pilot RCTs[38-40], three were non-randomised controlled trials[41-43]. The remaining six studies comprised: two randomised, non-inferiority designed feasibility studies[44,45], one prospective observational cohort study[46], one prospective randomised parallel trial[47], one phenomenological qualitative report[48], and one quasi-experimental, explanatory, pre/post, mixed-methods pilot study[49].

Participants in Included Studies

The studies recruited 893 suitable participants (Table 1a). Most of the participants were female (89% - 796 females/97 males). The mean age of participants ranged from 47 to 61. One study did not provide the mean age[49].

Interventions

Most studies examined multicomponent programmes incorporating more than one type of PA but the most common was resistance exercise (n = 12). Flexibility/ stretching exercise (n = 10) and aerobic exercise (n = 8) were the next most commonly included forms of PA. Six studies included a pool-based hydrotherapy component, four included some form of balance training, and three

Table 1. Characteristics of studies (Design and recruitment).

First Author/Year of Publication	Study Design	No of Participants	Gender	Mean Age	Recruitment Route	Duration of Study (weeks)	Duration of Follow Up (weeks)
Areso-Boveda (2022)[33]	RCT	64	All female	61	Referral from Primary Care	6	52
Beltran-Carrillo (2013)[48]	Qualitative (Observational/Interview/ Focus Group)	25	All female	55	Referral from Primary Care	36	No follow up
Carbonell-Baeza (2011)[41]	Non-randomised controlled trial	75	All female	51	Members of the Fibromyalgia Patients Association Granada, Spain, were contacted and offered to participate.	12	No follow up
Carbonell-Baeza (2011)[42]	Non-randomised controlled trial	75	All female	51	Members of the Fibromyalgia Patients Association Granada, Spain, were contacted and offered to participate.	12	No follow up
Ceballos-Laita (2020)[44]	Randomised, non-inferiority designed feasibility study including 2 intervention groups	32	All female	53	Participants referred from medical doctors and from the fibromyalgia association FIBROAS (Soria, Spain)	10	12
Ceballos-Laita (2021)[45]	Secondary analysis of a randomised, non-inferiority designed feasibility study including 2 intervention groups	32	All female	53	Participants referred from medical doctors and from the fibromyalgia association FIBROAS (Soria, Spain)	10	12
De Medeiros (2020)[34]	RCT (Single-blind)	42	All female	48	Recruited from waiting lists of 'Clinic Physiotherapy School' and 'Basic Health Units' of the city (location unclear)	12	No follow up
Ericsson (2016)[35]	RCT	34	All Male	49	Primary Care waiting lists	12	No follow up
Larsson (2015)[36]	RCT (assessor-blinded)	130	All Female	52	Newspaper advertisement in 3 cities (location unclear)	15	72
Latorre (2013)[43]	Non-randomised controlled study	85	All Female	52	Local fibromyalgia association (AFIXA, Jaen, Spain) meeting.	24	No follow up
Liu (2012)[38]	Pilot RCT (Single-blind)	14	All Female	56	Local neurology clinic and FM support group.	6	No follow up
Loftus (2022)[46]	Prospective observational cohort study	43	F38 M5	50	Physiotherapy waiting lists (patients referred from Rheumatology departments).	6	24
Martin (2012)[37]	RCT	153	F143 M10	50	Pain Management Service waiting list	6	48
Redondo (2004)[47]	Prospective randomised parallel trial	40	All Female	No record of mean age	Rheumatology waiting list following GP referral.	8	48

Table 1. *(Cont. from previous page).*

First Author/Year of Publication	Study Design	No of Participants	Gender	Mean Age	Recruitment Route	Duration of Study (weeks)	Duration of Follow Up (weeks)
Ricciardi (2020)[49]	Quasi-experimental, explanatory, pre/post, mixed-methods pilot study	27	All Female	51	Unclear	12	No follow up
Sarmento (2020)[39]	Pilot RCT (Double-blind: participants and assessors)	23	All Female	49	Participants identified using the 'Healthcare Enterprise Repository for Ontological Narration' (HERON) provided by the University of Kansas Medical Center.	10	No follow up
Vrouva (2022)[40]	Pilot RCT (Double-blind: participants and assessors)	106	F58 M48	47	Orthopaedic Clinic	3	12

included "mindful movement" type activities (like Qi-Gong or Tai Chi) focussing on proprioception and breath awareness. One study included mat Pilates[34], whilst another included exercise games (children's games or ball games) alongside flexibility and body-awareness activities to promote joint mobility and coordination[33].

Table 2 summarises the intervention contact time and the provider(s) delivering each intervention. Contact time ranged from three hours for a three-week strength and flexibility programme[40] to seventy-two hours for a twelve-week combined land-based and hydrotherapy strength/aerobic programme[43]. The mean contact time was 25.75 hours. Most interventions were delivered by healthcare professionals (Physiotherapists, Nurses, Doctors, Psychologists and Occupational Therapists) and many used a multidisciplinary team (MDT) approach (n = 10). Of the seven studies not delivered via MDT, three were led by physiotherapists and four by exercise professionals. These were the two professions most represented across the studies, with physiotherapists involved in twelve and exercise professionals involved in seven. There were no programmes delivered by volunteers, carers, or peer supporters.

The majority of studies described interventions delivered in multiple locations, with most of these carried out in community facilities (gyms, community centres or swimming pools) or healthcare centres, and many incorporated a home-based component, for example – participants were instructed to complete a Qi-Gong routine at home twice per week alongside their once weekly supervised session[39].

Several studies incorporated relaxation/mindfulness in the form of breathing/body awareness activities (n = 7) and many included an educational component focussed on pain management strategies and pain science (n = 6). Some studies included education based on psychological interventions including Cognitive Behavioural Therapy (CBT) and Acceptance and Commitment Therapy (ACT) (n = 6).

Control Groups

Control groups were varied across the studies (Table 1). Five studies defined the control group as 'treatment as usual' or 'standard care' which included mostly antidepressant medication, antiepileptics and opioid and non-opioid analgesics but no PA intervention or advice[33,37,41-43]. Three of the studies did not include a control group due to their design[46,48-49]. The remaining nine studies made direct comparisons between two interventions. Larsson[36] compared resistance exercise to relaxation therapy. Ceballos-Laita[44,45] compared a programme of circuit-based aerobic and resistance exercise with and without pain neuroscience education. De Medeiros[34] and Ericsson[35] used hydrotherapy as their comparator, measured against mat Pilates and resistance exercise respectively. Liu[38] and Sarmento[39] compared Qi-Gong to sham Qi-Gong (movements only without breathing/mindfulness component). Vrouva[40] compared circuit-based exercise with and without mindful breathing, and Redondo[47] compared hydrotherapy + land-based circuit exercise to CBT only.

Table 2. Characteristics of Studies (Intervention, control, outcome measures).

First Author/ Year of Publication	Intervention	Control Conditions	Outcome Measures
Areso-Boveda (2022)[33]	Mindful movement exercise, exergames + education	Standard care	FIQ, PCS, HADS, BPI, HAQ.
Beltran-Carrillo (2013)[48]	Circuit -based aerobic/ resistance exercise	No control due to study design	N/A - Qualitative
Carbonell-Baeza (2011)[41]	Hydrotherapy + land-based circuit aerobic/resistance exercise + ACT education	Standard care	Mechanical pain sensitivity (Tender points according to 1990 ACR criteria), Body composition (BI and BMI), Physical fitness battery (30s STS, Hand grip dynamometry, CSRT, BST, BFT, 8 feet up and go test, 6MWT).
Carbonell-Baeza (2011)[42]	Hydrotherapy + land-based circuit aerobic/resistance exercise + ACT education	Standard care	Mechanical pain sensitivity (Tender points according to 1990 ACR criteria), Body composition (BI and BMI), Physical fitness battery (30s STS, Hand grip dynamometry, CSRT, BST, BFT, 8 feet up and go test, 6MWT).
Ceballos-Laita (2020)[44]	Circuit-based aerobic/ resistance exercise + pain neuroscience education	Circuit -based aerobic/ resistance exercise alone	Pain intensity (VAS), Mechanical pain sensitivity (Tender points according to 1990 ACR criteria), FIQ-R, HADS, HAQ.
Ceballos-Laita (2021)[45]	Circuit-based aerobic/ resistance exercise + pain neuroscience education	Circuit -based aerobic/ resistance exercise alone	General fatigue and sleep disturbance (VAS). Physical Function: 6MWT, TUG, 30s STS, 30s Arm Curl test, CSRT, BST. Strength: Hand-grip dynamometer.
De Medeiros (2020)[34]	Mat Pilates + Swiss ball relaxation	Aqua aerobics	Pain intensity (VAS), FIQ, PSQ, SF-36, FABQ-BR, PRCTS.
Ericsson (2016)[35]	Resistance exercise (free weights and machines)	Aqua aerobics	MFI-20, HADS, FIQ, Pain localisation (pain drawing 18 points), SF-36, Isometric shoulder abduction (dynamometer), Knee flexion/extension strength (pressure transducer), Hand grip strength (dynamometer).
Larsson (2015)[36]	Resistance exercise	Relaxation therapy	Isometric knee extension force (dynamometer) FIQ, Pain intensity (VAS), 6MWT, Isometric elbow flexion force (dynamometer), Bilateral grip strength, SF36, PDI, CPAQ, FABQ, PGIC.
Latorre (2013)[43]	Hydrotherapy + land-based circuit aerobic/resistance exercise	No intervention	Tender points, Pain intensity (VAS), Physical Function: 6MWT, TUG, 30s STS, 30s Arm Curl test, CSRT, BST, Hand-grip dynamometry, FIQ, SF-36, BMI.
Liu (2012)[38]	Qi-Gong	Sham Qi-Gong	SF-MPQ, MFI-20, PSQI, FIQ.
Loftus (2022)[46]	Circuit-based aerobic/ resistance exercise + pain neuroscience education/ self-management education	No control due to study design	6MWT and FIQR.
Martin (2012)[37]	CBT + Education on FMS + Stretching/warming up Exercise	Standard care	FIQR, Pain intensity (VAS), CAD-R.
Redondo (2004)[47]	Hydrotherapy + land-based circuit aerobic/resistance exercise	CBT	Tender points, FIQR, SF-36, BAI, BDI, PSEQ, CPCI, Aerobic exercise capacity (cycle ergometer using Bruce protocol), Physical activity of vertebral column and upper and lower limbs (Battery of tests: ROM, Pain on Movement Likert score + upper limb/lower limb muscular endurance battery).
Ricciardi (2020)[49]	Qi-Gong	No control due to study design	Blood outcome measure: histone acetylation activity. Clinical outcome measures: FIQ, FACIT-F, PSQI, MPES.
Sarmento (2020)[39]	Qi-Gong (including mindful breathing)	Qi-Gong (without mindful breathing)	SF-MPQ, Pain intensity (VAS), PPT, FIQR, PSQI, QOLS, HADS

Table 2. *(Cont. from previous page).*

First Author/ Year of Publication	Intervention	Control Conditions	Outcome Measures
Vrouva (2022)[40]	Circuit-based aerobic/ resistance exercise + mindful breathing at point of pain	Circuit-based aerobic/ resistance exercise without mindful breathing at point of pain	FiRST, BPI, PQAS

6MWT = 6-minute Walk Test, ACT = Acceptance and Commitment Therapy, BAI = Beck Anxiety Inventory, BDI = Beck Depression Inventory, BFT = Blind Flamingo Test, BI = Bioelectrical Impedance, BMI = Body Mass Index, BPI = Brief Pain Index, BST = Back Scratch Test, CAD-R = Coping with Chronic Pain Questionnaire, CBT = Cognitive Behavioural Therapy, CPAQ = Chronic Pain Acceptance Questionnaire, CPCI = Chronic Pain Coping Inventory, CSRT = Chair Sit and Reach Test, FABQ = Fear Avoidance Beliefs Questionnaire, FACIT-F = The Functional Assessment of Chronic Illness Therapy – Fatigue, FiRST = Fibromyalgia Rapid Screening Tool, FIQ = Fibromyalgia Impact Questionnaire, FIQ-R = Fibromyalgia Impact Questionnaire – Revised, FMS = Fibromyalgia Syndrome, HADS = Hospital Anxiety and Depression Scale, HAQ = Health Assessment Questionnaire, MFI-20 = Multidimensional Fatigue Inventory, MPES = Multidimensional Pain Evaluation Scale, PDI = Pain Disability Index, PCS = Pain Catastrophizing Scale, PQAS = Pain Quality Assessment Scale, PPGIC = Patient Global Impression of Change, PPT = Pressure Pain Threshold, PRCTS = Pain-related catastrophizing Thoughts Scale, PSQI = Pittsburgh Sleep Quality Index, QOLS = Quality of Life Scale, RCT = Randomised Controlled Trial, SF-36 = Short-Form 36 Quality of Life scale, SF-MPG = Short-form McGill Pain Questionnaire, TUG = Timed Up and Go, VAS = Visual Analogue Scale.

Table 3. Intervention provider and estimated contact time.

First Author/Year of Publication	Provider	Estimated Time (hours)	Comments
Areso-Boveda (2022)[33]	Physiotherapist, Nurse, Doctor	12	
Beltran-Carrillo (2013)[48]	Doctor, Exercise professional	63	
Carbonell-Baeza (2011)[41]	Physiotherapist, Exercise Professional, Psychologist	45	
Carbonell-Baeza (2011)[42]	Physiotherapist, Exercise Professional, Psychologist	45	
Ceballos-Laita (2020)[44]	Physiotherapist, Exercise Professional, Psychologist	Group 1: 30 Group 2: 36	Group 1 = exercise only Group 2 = exercise + pain neurophysiology education
Ceballos-Laita (2021)[45]	Physiotherapist, Exercise Professional, Psychologist	Group 1: 30 Group 2: 36	Group 1 = exercise only Group 2 = exercise + pain neurophysiology education
De Medeiros (2020)[34]	Physiotherapist, Researcher (Group 2 only)	20	Group 1 = mat Pilates Group 2 = aqua aerobics
Ericsson (2016)[35]	Physiotherapist	24	Group 1 =land-based resistance Group 2 = hydrotherapy
Larsson (2015)[36]	Physiotherapist	Unclear	Sessions twice weekly for 15 weeks, no duration of session given
Latorre (2013)[43]	Exercise professional	72	
Liu (2012)[38]	Exercise professional	8	
Loftus (2022)[46]	Physiotherapist, Nurse, Occupational Therapist	9	
Martin (2012)[37]	Physiotherapist, Doctor, Psychologist	21	
Redondo (2004)[47]	Physiotherapist, Psychologist	Group 1: 30 Group 2: 20	Group 1 = Land-based resistance and aerobic exercise + Hydrotherapy Group 2 = CBT

Table 3. *(Cont. from previous page).*

First Author/Year of Publication	Provider	Estimated Time (hours)	Comments
Ricciardi (2020)[49]	Exercise professional	16	
Sarmento (2020)[39]	Exercise professional	7.5	
Vrouva (2022)[40]	Exercise professional	3	

CBT = Cognitive Behavioural Therapy.

Outcome Measures

A total of forty-two outcome measures were used across the seventeen included studies (see Table 1). Twenty-two of these are pain-related outcome measures (general pain (n = 7), chronic pain (n = 6), Pain self-efficacy (n = 5), and fibromyalgia-specific (n = 4)). Eleven were physical health outcome measures (strength (n = 4), aerobic fitness (n = 2), flexibility (n = 2), body composition (n = 2), and balance (n = 1)). Other outcomes assessed included fatigue, sleep, quality of life, anxiety and depression. No direct measures of either self-reported or objectively assessed total or free-living PA were used across the studies.

Duration and Follow Up

The duration of intervention ranged from three to thirty-six weeks, with a mean of twelve weeks. Follow up times ranged from twelve to seventy-two weeks. The mean follow up time was eighteen weeks. Nine studies collected outcome measurement upon completion of the intervention and did not include any follow up assessment (Table 1).

Attendance and Attrition

621 (70.4%) of the 893 total participants recruited adhered until completion across both intervention and control groups according to the studies included (Table 3). Due to the heterogeneity of control conditions across studies, where an intervention and control group are present, and the control group consists of a "treatment as usual" approach or does not include any PA component, attrition was analysed for the intervention group only. Where studies compared two or more intervention types (e.g. Mat Pilates vs Aqua Aerobics), total attrition across groups has been reported as both sets of participants have undertaken group-based PA interventions. The attrition data from the two studies which were secondary data analyses have been included only once[42,45].

Attrition rates varied from 8%[50] to 52%[49] with a mean of 21%. Of these, one study reported attrition of >30%[49], six reported 20-30%[33,35-37,46-47], five reported 10-20%[38-39,41,43-44], and two reported <10%[34,48]. One study[40] did not report attrition rates or the number of participants at completion.

The lowest attrition rate (8%) was reported in the longest intervention which was thirty-six weeks in duration[48]. This study was the only one to incorporate qualitative interviews and focus groups to provide in-depth understanding and analysis of the perceived physical and psychosocial benefits of group-based exercise. The highest attrition rate (52%) was reported in a 12-week Qi-Gong intervention[49] (however, the other two studies investigating Qi-gong had significantly lower attrition rates [Sarmento[39] – 13% and Liu[38] – 14.3%]). This study was the only study to include blood sample analysis as part of outcome measurement which may have contributed to the significant attrition. Exercise Professionals were part of the intervention delivery team in six out of the seven studies that reported <20% attrition[38-39,41,43-44,48] and in only one of those reporting >20%[49], this appeared to be independent of the type of PA delivered.

The studies by Medeiros et al., Ceballos-Laita et al., Latorre et al., and Sarmento et al.[34,39,43,45] reported the highest levels of adherence. These interventions had heterogeneous design and PA types, they were delivered over a moderate duration, ranging from 10 to 24 weeks, and most included either multiple supervised sessions per week[34,43,45], or one supervised session per week[39] with instruction to practice daily at home supported by the inclusion of behaviour change compliance support tools, including activity diaries and home-based resources in the form of Qi-Gong videos. Latorre et al.[43] reported the highest total intervention exposure time across all studies (72 hours across 24 weeks). Sarmento et al.[39] reported lower supervised contact time (one weekly supervised session, totalling 7.5 hours across 10 weeks) than the other three, but the recommended self-directed activity was 6 sessions of 15-20 minutes of Qi-Gong, with one day off, per week. On average, this would equate to 27.5 hours

Table 4. Attrition rates of included studies.

First Author/Year of Publication	No of Participants Recruited (After inclusion/exclusion criteria applied)	No of Participants at Completion	Attrition Rate
Areso-Boveda (2022)[33]	64 (IG = 45; CG = 19)	53 (IG = 35; CG = 18)	IG = 22.3% CG = 5.3%
Beltran-Carrillo (2013)[48]	25	23	8%
Carbonell-Baeza (2011)[41]	75 (IG = 41; CG = 34)	65 (IG = 33; CG = 32)	IG = 19.5% CG = 5.9%
Carbonell-Baeza (2011) (symptomology)[42]	75 (IG = 41; CG = 34)	65 (IG = 33; CG = 32)	IG = 19.5% CG =5.9%
Ceballos-Laita (2020)[44]	32 (PNE + TE = 16; TE only = 16)	28 (PNE + TE = 15; TE only = 13)	PNE + TE = 6.25% TE only = 18.8% Total Attrition = 12.5%
Ceballos-Laita (2021)[45]	32 (PNE + TE = 16; TE only = 16)	28 (PNE + TE = 15; TE only = 13)	PNE + TE = 6.25% TE only = 18.8% Total Attrition = 12.5%
De Medeiros (2020)[34]	42 (MP =21; AAE = 21)	38 (MP = 18; AAE = 20)	MP = 14.3% AAE = 4.8% Total Attrition = 9.5%%
Ericsson (2016)[35]	34 (PE = 17; RE = 17)	26 (PE = 14; RE = 12)	PE = 17.6% RE = 29.4% Total Attrition =23.5 %
Larsson (2015)[36]	130 (RE = 67; RT = 63)	91 (RE = 48; RT = 43)	RE = 28.4% RT = 31.8% Total Attrition = 30%
Latorre (2013)[43]	85 (IG = 48; CG = 37)	75 (IG = 42; CG = 30)	IG = 12.5% CG = 18.9%
Liu (2012)[38]	14 (QE = 8; SQ = 6)	12 (QE = 6; SQ = 6)	QE = 25% SQ = 0% Total Attrition = 14.3%
Loftus (2022)[46]	43	32	26%
Martin (2012)[37]	153 (IG =82; CG = 71)	114 (IG =58; CG = 56)	IG = 29.3% CG = 21.1%
Redondo (2004)[47]	40 (EG = 19; CBT = 21)	31 (EG = 15; CBT = 16)	EG = 21.1% CBT = 23.8%
Ricciardi (2020)[49]	27	13	52%
Sarmento (2020)[39]	23 (QE = 11; SQ = 12)	20 (QE = 10; SQ = 10)	QE = 9.1% SQ = 16.7% Total Attrition = 13%
Vrouva (2022)[40]	106 (EG =53 ; EBG = 53)	Not reported	No attrition reported
Total	**893**	**621**	

AAE = Aqua Aerobic Exercise, CBT = Cognitive Behaviour Therapy, CG = Control Group, EBG = Exercise with Breathing Group, EG = Exercise Group, IG = Intervention Group, MP = Mat Pilates, PE = Pool Exercise, PNE = Pain Neuroscience Education, QE = Qi-Gong Exercise, RE = Resistance Exercise, RT = Relaxation Therapy, SQ = Sham Qi-Gong, TE = Therapeutic Exercise

in total exposure over the duration of the study. Of the four, two were delivered by physiotherapists[34,45] and two by exercise professionals[39,43].

Discussion

This scoping review provides the first comprehensive summary of group-based PA interventions for people diagnosed with fibromyalgia. Up to February 2023, a total of seventeen studies examining group-based PA in this population were identified. There was significant heterogeneity in intervention design, contact time, outcome measures assessed, study duration and follow up. However, there is a general trend towards multi-component interventions for people with FMS, incorporating a variety of PA approaches alongside patient education and in some cases, psychologically informed education (including ACT and CBT methods). These interventions are delivered by a variety of healthcare professionals: most commonly a combination of physiotherapists, exercise professionals, nurses, doctors and psychologists; and were often delivered in community settings. This represents a shift away from the historical approach in which people with FMS are treated within a biomedical framework under Rheumatology services. It appears to be in keeping with the new National Institute for Health and Care Excellence (NICE) guidelines on managing chronic pain which recommends a patient-centered approach, focusing on patients' priorities, abilities, and goals, and encouraging self-management and shared decision-making, best achieved in conjunction with community services[9].

Preceding studies have highlighted the challenges of participant retention in PA interventions for people with FMS, and the need to investigate the types of PA likely to yield the highest adherence rates[25,50-54]. The mean attrition rate across these studies was 21%. However, this should be interpreted with caution as half of the included studies reported attrition rates greater than the generally accepted 20%[55]. It is not clear from this review that group-based interventions ameliorate the previously reported high levels of attrition in PA interventions for people with FMS. Interestingly however, 86% (6/7) of the interventions reporting attrition <20% included an exercise professional in the delivery team whereas only 14% of those reporting >20% (1/7) included an exercise professional, independent of the type of PA in the intervention. This suggests that the inclusion of a trained exercise professional as part of the delivery team may improve attrition rates regardless of the type of PA delivered. It is possible that the personnel delivering the intervention play a significant role in whether participants maintain attendance to completion. This supports the findings of Bee et al.[56] which highlighted the importance of the participant-facilitator relationship. Their qualitative investigation into the management of chronic widespread pain stated that "dissatisfaction with the programme occurred when instructors disengaged or when they were perceived to lack the appropriate personal and medical knowledge to deliver a safe, personalised intervention". Future studies examining the impact of the personnel delivering PA interventions may be of value. Additionally, whilst analysis of the intervention characteristics of the four studies with the lowest levels of attrition in their intervention groups[34,39,43,45] did not highlight any clear and obvious causative attributes, it did suggest that greater adherence may be influenced by a combination of: moderate duration of intervention (10-24 weeks), higher total exposure to the intervention (more sessions per week, for more time – supervised or self-directed), and as above, the inclusion of an exercise professional or a physiotherapist in the delivery.

This scoping review suggests that, whilst the available literature on group-based PA appears to be in line with clinical guidelines for managing FMS, investigating the contextual factors that impact the acceptability of an intervention (for example, the delivery team) may prove useful. Intervention delivery approaches, contexts, and the characteristics of providers should be explored further and understanding these elements may be important in developing acceptable and sustainable future interventions. The Medical Research Council's (MRC) framework for developing complex interventions highlights that "complex intervention research goes beyond asking whether an intervention works in the sense of achieving its intended outcome – to asking a broader range of questions"[57]. Future intervention development should implement the use of similar frameworks to allow a more comprehensive understanding of how an intervention will interact with its context. The complex nature of PA interventions for FMS is demonstrated in the variety of PA types and outcome measures assessed. Given that the effectiveness of PA has been well established in managing FMS symptoms, it is important that future studies look beyond asking whether a particular type of PA works in terms of treatment effect and considers the broader questions as to how it works, how this impacts other systems within its context, and how valuable it is given its resource requirement. This approach may give clarity on why the personnel involved in delivery has an impact on attrition among other insights.

Given the complexity of FMS and the fact that presentations are often heterogeneous, it is challenging to agree on a suitable measure of success. Some people may see improvements in physical characteristics such as strength and aerobic fitness, whilst others may experience improvement in symptoms e.g. reduced pain, fatigue and anxiety[26-28]. Interestingly, however, no study included in this review examined measures of free-living PA associated with group-based interventions. It is recognised that people living with FMS have lower levels of habitual PA than healthy age- and gender-matched controls[15], and more than sixty per cent do not meet the World Health Organisation guidelines for PA[14]. Despite this, no study investigated

whether the delivery of group-based PA interventions led to an increase in habitual daily PA. This represents a gap in the current literature and future investigations into the long-term impact of group-based interventions on daily PA levels may prove useful.

Whilst this review has comprehensively identified and mapped the types of group-based PA interventions and descriptively reported on their attrition data, it is not without limitations. Firstly, the inclusion criteria stipulated English language papers only, potentially excluding high quality articles in different languages. Secondly, papers were only included if they were published after 1st January 2000, this was due two factors – the heterogeneity in language and diagnostic methods describing FMS prior to this date, and the time available and scope of the review, as it was undertaken as part of a Master of Research thesis. It is recognised that this may have led to the exclusion of potentially important early investigations in group-based PA. Third, in accordance with the PRISMA-ScR framework, a formal critical appraisal of study quality was not conducted, as this falls outside the primary objectives of a scoping review. The aim of this review was to map the extent, range, and nature of group-based PA interventions, rather than to evaluate the risk of bias or methodological quality in detail. Nonetheless, it is noteworthy that of the 17 studies included, only five were RCTs. The remainder of the studies were of varied design: pilot RCTs (n=3), non-randomised trials (n=3), randomised parallel feasibility studies (n=2), prospective observational studies (n=1), prospective randomised parallel trials (n=1), phenomenological qualitative reports (n=1), or pre-post quasi-experimental mixed-methods studies (n=1). Most of the studies included transparent reporting of recruitment processes, participant characteristics, and outcome measures which supports the strength of the evidence synthesised in this review and thus its relevance for informing future research and implementation efforts.

Conclusion

This scoping review has mapped the types of group-based PA interventions that have been implemented in the published literature for people with fibromyalgia and reported on their associated attrition data. Various forms of group-based PA have been explored, and most interventions include multiple components including strength, aerobic, flexibility and balance activities. These are often supported by psychologically informed patient education delivered by a multidisciplinary team in community settings in accordance with current best-practice guidelines. Some interventions also include mind-body exercise and hydrotherapy. The mean attrition rates in the included studies appear to be close to the generally accepted level of 20%, although half reported attrition greater than this figure, therefore it remains unclear if group-based approaches are superior to other forms of PA in reducing attrition. Further investigation into the factors that affect attrition rates in PA interventions for people with FMS is required and future studies using frameworks like the MRC framework for developing complex interventions that explore user acceptability for group-based PA interventions may prove fruitful in addressing the recognized challenges around attrition/adherence in the FMS population. Another area that may benefit from further investigation is the impact of group-based PA interventions on free-living daily PA in people with FMS.

Authors' Contributions:

MP completed the screening of studies for inclusion in this review, data extraction, and data analysis and wrote the manuscript. FM and DK contributed to the screening of studies. AM contributed to the data extraction. FM, CD and AM completed conflict resolution and contributed to the writing of the manuscript. All authors read and approved the final version of the manuscript.

Funding

This work was supported by University of Strathclyde MRes/MPhil Interdisciplinary Excellence Awards. Funding covered MRes student tuition fees only.

References

1. Gyorfi M, Rupp A, Abd-Elsayed A. Fibromyalgia Pathophysiology. Biomedicines. 2022;10(12):3070.
2. Doebl S, Hollick RJ, Beasley M, Choy E, Macfarlane GJ. Comparing the Impact of Symptoms and Health Care Experiences of People Who Have and Have Not Received a Diagnosis of Fibromyalgia: A Cross-Sectional Survey Within the PACFiND Study. Arthritis care & research (2010). 2022;74(11):1894-1902.
3. Cagnie B, Coppieters I, Denecker S, Six J, Danneels L, Meeus M. Central sensitization in fibromyalgia? A systematic review on structural and functional brain MRI. Semin Arthritis Rheum. 2014;44(1):68-75.
4. Nijs J, Meeus M, Van Oosterwijck J, et al. In the mind or in the brain? Scientific evidence for central sensitisation in chronic fatigue syndrome. Eur J Clin Invest. 2012;42(2):203-212.
5. Verbunt JA, Pernot DH, Smeets RJ. Disability and quality of life in patients with fibromyalgia. Health Qual Life Outcomes. 2008;6:8.
6. Werner A, Malterud K. It is hard work behaving as a credible patient: encounters between women with chronic pain and their doctors. Soc Sci Med. 2003;57(8):1409-1419.
7. Häuser W, Walitt B, Fitzcharles MA, Sommer C. Review of pharmacological therapies in fibromyalgia syndrome. Arthritis Res Ther. 2014;16(1):201-201.
8. Macfarlane GJ, Kronisch C, Dean LE, et al. EULAR revised recommendations for the management of fibromyalgia. Ann Rheum Dis. 2017;76(2):318-328.
9. National Institute for Health and Care Excellence (NICE). Chronic pain (primary and secondary) in over 16s: assessment of all chronic pain and management of chronic primary pain. National Institute for Health and Care Excellence (NICE). [April 7, 2021]. https://www.nice.org.uk/guidance/ng193/resources/chronic-pain-primary-and-secondary-in-over-16s-assessment-of-all-chronic-pain-and-management-of-chronic-primary-pain-pdf-6614208046842 1.

Accessed May 16, 2023.
10. Adams LM, Turk DC. Central sensitization and the biopsychosocial approach to understanding pain. Journal of applied biobehavioral research. 2018;23(2):e12125-n/a.
11. Engel GL. The Need for a New Medical Model: A Challenge for Biomedicine. Psychodyn Psychiatry. 2012;40(3):377-396.
12. Ferro Moura Franco K, Lenoir D, Santos Franco YR, Jandre Reis FJ, Nunes Cabral CM, Meeus M. Prescription of exercises for the treatment of chronic pain along the continuum of nociplastic pain: A systematic review with meta-analysis. Eur J Pain. 2021;25(1):51-70.
13. Caspersen CJ, Powell KE, Christenson GM. Physical Activity, Exercise, and Physical Fitness: Definitions and Distinctions for Health-Related Research. Public Health Rep. 1985;100(2):126-131.
14. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. Dec 2020;54(24):1451-1462.
15. Vancampfort D, McGrath RL, Hemmings L, Gillis V, Bernar K, Van Damme T. Physical activity correlates in people with fibromyalgia: a systematic review. Disabil Rehabil. 2023;45(25):4165-4174.
16. Nicholas MK. The pain self-efficacy questionnaire: Taking pain into account. European Journal of Pain. 2006;11(2):153.
17. Mannerkorpi K, Gard G. Physiotherapy group treatment for patients with fibromyalgia-an embodied learning process. Disabil Rehabil. 2003;25(24):1372-1380.
18. Sallinen M, Kukkurainen ML, Peltokallio L. Finally heard, believed and accepted – Peer support in the narratives of women with fibromyalgia. Patient Educ Couns. 2011;85(2):e126-e130.
19. Reig-Garcia G, Bosch-Farré C, Suñer-Soler R, et al. The impact of a peer social support network from the perspective of women with fibromyalgia: A qualitative study. Int J Environ Res Public Health. 2021;18(23):12801.
20. Lewis JS, Stokes EK, Gojanovic B, et al. Reframing how we care for people with persistent non-traumatic musculoskeletal pain. Suggestions for the rehabilitation community. Physiotherapy. 2021;112:143-149.
21. D'Onghia M, Ciaffi J, Ruscitti P, et al. The economic burden of fibromyalgia: A systematic literature review. Seminars in arthritis and rheumatism. 2022;56:152060-152060.
22. Barbosa EC, Wylde V, Thorn J, et al. Cost-Effectiveness of Group-Based Outpatient Physical Therapy After Total Knee Replacement: Results From the Economic Evaluation Alongside the ARENA Multicenter Randomized Controlled Trial. Arthritis Care Res (Hoboken). 2022;74(12):1970-1977.
23. Alhambra-Borrás T, Durá-Ferrandis E, Ferrando-García M. Effectiveness and estimation of cost-effectiveness of a group-based multicomponent physical exercise programme on risk of falling and frailty in community-dwelling older adults. Int J Environ Res Public Health. 2019;16(12):2086.
24. Richardson G, Hawkins N, McCarthy CJ, et al. Cost-effectiveness of a supplementary class-based exercise program in the treatment of knee osteoarthritis. International Journal of Technology Assessment in Health Care. 2006;22(1):84-9.
25. Busch AJ, Webber SC, Brachaniec M, et al. Exercise Therapy for Fibromyalgia. Current Pain and Headache Reports. 2011;15(5):358-367.
26. Estévez-López F, Maestre-Cascales C, Russell D, et al. Effectiveness of Exercise on Fatigue and Sleep Quality in Fibromyalgia: A Systematic Review and Meta-analysis of Randomized Trials. Arch Phys Med Rehabil. 2021;102(4):752-761.
27. Geneen LJ, Martin DJ, Adams N, et al. Effects of education to facilitate knowledge about chronic pain for adults: A systematic review with meta-analysis. Syst Rev. 2015;4(1):132-132.
28. Vasileios P, Styliani P, Nifon G, Pavlos S, Aris F, Ioannis P. Managing fibromyalgia with complementary and alternative medical exercise: a systematic review and meta-analysis of clinical trials. Rheumatology International. 2022;42(11):1909-1923.
29. McGowan J, Straus S, Moher D, et al. Reporting scoping reviews—PRISMA ScR extension. J Clin Epidemiol. 2020;123:177-179.
30. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International journal of social research methodology. 2005;8(1):19-32.
31. Petticrew M, Roberts, H. Systematic reviews in the social sciences: a practical guide. 1st ed. Blackwell Publishing; 2006.
32. Pollock, D, Peters, MDJ, Khalil, H, Mclnerney, P, Alexander, L, Tricco, AC, et al. Recommendations for the extraction, analysis, and presentation of results in scoping reviews. JBI evidence synthesis. 2023;21(3):520–532.
33. Areso-Boveda PB, Mambrillas-Varela J, Garcia-Gomez B, et al. Effectiveness of a group intervention using pain neuroscience education and exercise in women with fibromyalgia: a pragmatic controlled study in primary care. Article. Bmc Musculoskeletal Disorders. Apr 2022;23(1):323.
34. De Medeiros SA, De Almeida Silva HJ, Do Nascimento RM, Da Silva Maia JB, De Almeida Lins CA, De Souza MC. Mat Pilates is as effective as aquatic aerobic exercise in treating women with fibromyalgia: a clinical, randomized and blind trial. Randomized Controlled Trial. Research Support, Non-U.S. Gov't. Advances in Rheumatology. 04 06 2020;60(1):21.
35. Ericsson A, Bremell T, Cider A, Mannerkorpi K. Effects of exercise on fatigue and physical capacity in men with chronic widespread pain - a pilot study. BMC Sports Science, Medicine and Rehabilitation. 2016;8(1):29.
36. 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(1):161-161.
37. Martin J, Torre F, Padierna A, et al. Six-and 12-month follow-up of an interdisciplinary fibromyalgia treatment programme: results of a randomised trial. Article. Clinical and Experimental Rheumatology. Nov-Dec 2012;30(6):S103-S111.
38. Liu W, Zahner L, Cornell M, et al. Benefit of Qigong Exercise in Patients With Fibromyalgia: A Pilot Study. Article. International Journal of Neuroscience. Nov 2012;122(11):657-664.
39. Sarmento CVM, Moon S, Pfeifer T, et al. The therapeutic efficacy of Qigong exercise on the main symptoms of fibromyalgia: A pilot randomized clinical trial. Integrative Medicine Research. Dec 2020;9(4):100416.
40. Vrouva S, Sopidou V, Koutsioumpa E, et al. Can Exercise Affect the Pain Characteristics in Patients with Fibromyalgia? A Randomized Controlled Trial. Healthcare. Nov 30 2022;10(12):30.
41. Carbonell-Baeza A, Aparicio VA, Chillon P, Femia P, Delgado-Fernandez M, Ruiz JR. Effectiveness of multidisciplinary therapy on symptomatology and quality of life in women with fibromyalgia. Clinical Trial Comparative Study. Research Support, Non-U.S. Gov't. Clinical & Experimental Rheumatology. Nov-Dec 2011;29(6 Suppl 69):S97-103.
42. Carbonell-Baeza A, Aparicio VA, Ortega FB, et al. Does a 3-month multidisciplinary intervention improve pain, body composition and physical fitness in women with fibromyalgia? Controlled Clinical Trial. Research Support, Non-U.S. Gov't. British Journal of Sports Medicine. Dec 2011;45(15):1189-95.
43. Latorre PA, Santos MA, Heredia-Jimenez JM, et al. Effect of a 24-

week physical training programme (in water and on land) on pain, functional capacity, body composition and quality of life in women with fibromyalgia. Controlled Clinical Trial. Clinical & Experimental Rheumatology. Nov-Dec 2013;31(6 Suppl 79):S72-80.
44. Ceballos-Laita L, Mingo-Gomez MT, Estebanez-de-Miguel E, et al. Does the Addition of Pain Neurophysiology Education to a Therapeutic Exercise Program Improve Physical Function in Women with Fibromyalgia Syndrome? Secondary Analysis of a Randomized Controlled Trial. Journal of Clinical Medicine. Jun 07 2021;10(11):07.
45. Ceballos-Laita L, Mingo-Gomez MT, Navas-Camara F, et al. Therapeutic Exercise and Pain Neurophysiology Education in Female Patients with Fibromyalgia Syndrome: A Feasibility Study. Journal of Clinical Medicine. 2020;9(11):05.
46. 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(15):3860-3867.
47. Redondo JR, Justo CM, Moraleda FV, et al. Long-term efficacy of therapy in patients with fibromyalgia: A physical exercise-based program and a cognitive-behavioral approach. Article. Arthritis & Rheumatism-Arthritis Care & Research. Apr 2004;51(2):184-192.
48. Beltran-Carrillo VJ, Tortosa-Martinez J, Jennings G, Sanchez ES. Contributions of a group-based exercise program for coping with fibromyalgia: a qualitative study giving voice to female patients. Women & Health. 2013;53(6):612-29.
49. Ricciardi GB, Dorneles G, Pochmann D, Peres A, Elsner VR. Effects of Qigong practice in quality of life, fatigue, sleep, pain and epigenetic biomarkers in adult women with fibromyalgia. Article. Comparative Exercise Physiology. 2020;16(4):285-292.
50. Sosa-Reina MD, Nunez-Nagy S, Gallego-Izquierdo T, Pecos-Martín D, Monserrat J, Álvarez-Mon M. Effectiveness of Therapeutic Exercise in Fibromyalgia Syndrome: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. Biomed Res Int. 2017;2017:2356346.
51. Jones KD, Adams D, Winters-Stone K, Burckhardt CS. A comprehensive review of 46 exercise treatment studies in fibromyalgia (1988-2005). Health Qual Life Outcomes. 2006;4(1):67-67.
52. Kingsley JDP, McMillan VMD, Figueroa AMDP. 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(10):1551-1557.
53. 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(11):1479-1488.
54. 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(3):e90767-e90767.
55. Fergusson D, Aaron SD, Guyatt G, Hébert P. Post-randomisation exclusions: the intention to treat principle and excluding patients from analysis. BMJ. Sep 21 2002;325(7365):652-4.
56. Bee P, McBeth J, MacFarlane GJ, Lovell K. Managing chronic widespread pain in primary care: a qualitative study of patient perspectives and implications for treatment delivery. BMC Musculoskeletal Disorders. 2016;17(1):354.
57. Skivington K, Matthews L, Simpson S, et al. A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. BMJ (Online). 2021;374

Appendix: Systematic Review Search Strategies.

MEDLINE (OVID)
Chronic Pain Terms
S1 - "Chronic Pain" or "Persistent Pain" or "Long Term Pain" (62,755)
Widespread Pain Terms
S2 - "Fibromyalgia" or "Fibromyalgia syndrome" or "FMS" or "Widespread Pain" or "multiple joint pain" or "generalised pain" or "generalized pain" or "whole body pain" or "diffuse pain" (7,269)
S3 – S1 AND S2 (1,790)
Group Interventions
S4 - "Group Exercise" or "Therapeutic Exercise" or "Resistance Training" or "Aerobic Exercises" or "Upper Extremity Exercises" or "Lower Extremity Exercises" or "Breathing Exercises" or "Back Exercises" or "Arm Exercises" or "Anaerobic Exercises" or "Exercise" or "Recovery, Exercise" or "Tai Chi" or "Qi-Gong" or "Group-based" or "Group based" or "Group intervention*" (441,263)
S5 – S3 AND S4 (202)
CINAHL - Search Strategy
Chronic Pain Terms – searched by title and abstract
S1 - "Chronic Pain" or "Persistent Pain" or "Long Term Pain" or "Long-Term Pain" (5,731)
Widespread Pain Terms - searched by title and abstract
S2 - "Fibromyalgia" or "Fibromyalgia syndrome" or "FMS" or "Widespread Pain" or "multi-joint pain" or "multiple joint pain" or "multiple-joint pain" or "generalised pain" or "generalized pain" or "whole body pain" or "whole-body pain" or "diffuse pain" (3,323)
S3 – S1 AND S2 (42)
Group Interventions
S4 - "Group Exercise" or "Therapeutic Exercise" or "Resistance Training" or "Aerobic Exercises" or "Upper Extremity Exercises" or "Lower Extremity Exercises" or "Breathing Exercises" or "Back Exercises" or "Arm Exercises" or "Anaerobic Exercises" or "Exercise" or "Recovery, Exercise" or "Tai Chi" or "Qi-Gong" or "Group-based" or "Group based" or "Group intervention*" (205,895)
S5 – S3 AND S4 (1)
SCOPUS
Limited to keywords - "human". Excluding keywords - "non-human" and "cancer pain"
Chronic Pain Terms – searched by title and abstract
S1 - "Chronic Pain" or "Persistent Pain" or "Long Term Pain" or "Long-Term Pain" (8866)
Widespread Pain Terms - searched by title and abstract
S2 - "Fibromyalgia" or "Fibromyalgia syndrome" or "FMS" or "Widespread Pain" or "multi-joint pain" or "multiple joint pain" or "multiple-joint pain" or "generalised pain" or "generalized pain" or "whole body pain" or "whole-body pain" or "diffuse pain" (7,269)
S3 – S1 AND S2 (65)
Group Interventions
S4 - "Group Exercise" or "Therapeutic Exercise" or "Resistance Training" or "Aerobic Exercises" or "Upper Extremity Exercises" or "Lower Extremity Exercises" or "Breathing Exercises" or "Back Exercises" or "Arm Exercises" or "Anaerobic Exercises" or "Exercise" or "Recovery, Exercise" or "Tai Chi" or "Qi-Gong" or "Group-based" or "Group based" or "Group intervention*" (463,778)
S5 – S3 AND S4 (8)
SPORTDiscus
Chronic Pain Terms – searched by title and abstract
S1 - "Chronic Pain" or "Persistent Pain" or "Long Term Pain" or "Long-Term Pain" (1,097)
Widespread Pain Terms - searched by title and abstract
S2 - "Fibromyalgia" or "Fibromyalgia syndrome" or "FMS" or "Widespread Pain" or "multi-joint pain" or "multiple joint pain" or "multiple-joint pain" or "generalised pain" or "generalized pain" or "whole body pain" or "whole-body pain" or "diffuse pain" (837)
S3 – S1 AND S2 (9)

Appendix: *(Cont. from previous page).*

Group Interventions
S4 - "Group Exercise" or "Therapeutic Exercise" or "Resistance Training" or "Aerobic Exercises" or "Upper Extremity Exercises" or "Lower Extremity Exercises" or "Breathing Exercises" or "Back Exercises" or "Arm Exercises" or "Anaerobic Exercises" or "Exercise" or "Recovery, Exercise" or "Tai Chi" or "Qi-Gong" or "Group-based" or "Group based" or "Group intervention*" (239,516)
S5 – S3 AND S4 (1)
Web of Science
Excluding category - "oncology"
Chronic Pain Terms – searched by title and abstract
S1 - "Chronic Pain" or "Persistent Pain" or "Long Term Pain" or "Long-Term Pain" (47,443)
Widespread Pain Terms - searched by title and abstract
S2 - "Fibromyalgia" or "Fibromyalgia syndrome" or "FMS" or "Widespread Pain" or "multi-joint pain" or "multiple joint pain" or "multiple-joint pain" or "generalised pain" or "generalized pain" or "whole body pain" or "whole-body pain" or "diffuse pain" (26,148)
S3 – S1 AND S2 (2,193)
Group Interventions
S4 - "Group Exercise" or "Therapeutic Exercise" or "Resistance Training" or "Aerobic Exercises" or "Upper Extremity Exercises" or "Lower Extremity Exercises" or "Breathing Exercises" or "Back Exercises" or "Arm Exercises" or "Anaerobic Exercises" or "Exercise" or "Recovery, Exercise" or "Tai Chi" or "Qi-Gong" or "Group-based" or "Group based" or "Group intervention*" (506,105)
S5 – S3 AND S4 (184)