





## Review article

# Which exercise is most beneficial for treating women with fibromyalgia? A systematic review and network meta-analysis



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## ABSTRACT

**Background:** Therapeutic exercise is the only intervention with strong evidence for fibromyalgia, yet the most effective modality remains uncertain.

**Objective:** To determine which modality of therapeutic exercise is the most effective in reducing the impact of fibromyalgia in women, as assessed by the Fibromyalgia Impact Questionnaire (FIQ/FIQR).

**Design:** Systematic review with a network meta-analysis of randomized controlled trials.

**Methods:** A comprehensive search was performed in MEDLINE, Cochrane Library, Scopus, Web of Science, and CINAHL from inception to March 2025. Eligible randomized controlled trials involved therapeutic exercise interventions reporting Fibromyalgia Impact Questionnaire outcomes. Data synthesis followed PRISMA-NMA guidelines, using a frequentist network meta-analysis to estimate effect sizes and clinically important differences in the short term ( $\leq 3$  months) and long term ( $> 3$  months). Certainty of evidence was assessed with CINeMA.

**Results:** Sixty-four studies were identified, of which 59 were included in the quantitative synthesis ( $n = 3256$ ). Fourteen modalities of therapeutic exercise and seven comparison interventions (comparators) were identified. In the short term, Pilates, Aquatic Exercise, and Resistance Exercise ranked highest. In the long term, Dance and Mixed Exercise ranked highest. Certainty of evidence was mostly low to moderate (CINeMA), mainly limited by imprecision and heterogeneity.

**Conclusions:** Pilates, Aquatic Exercise, and Resistance Exercise ranked highest in the short term, while Dance and Mixed Exercise ranked highest in the long term. However, findings should be interpreted with caution due to substantial heterogeneity and mostly low-to-moderate certainty of evidence.

## 1. Introduction

Fibromyalgia is a clinical syndrome characterized primarily by widespread chronic pain. In addition, people may experience a variety of other symptoms, including sleep disturbances, fatigue, psychological distress, irritable bowel syndrome, and tension or migraine headaches, among other possible symptoms (Andrade et al., 2020; Sarzi-Puttini et al., 2020). The prevalence, depending on the criteria used, varies between 1.2% and 5.4%. Moreover, the proportion of women affected

compared to men also varies depending on the criteria used, with the highest being 13.7 women for every man according to the ACR 1990 criteria (Jones et al., 2015).

Although these symptoms are relevant, it is also important to consider the health-related quality of life in fibromyalgia, which, compared to the general population, showed significant impairment in people with fibromyalgia. In particular, significant gender differences were observed within the fibromyalgia group, with women experiencing worse health outcomes related to role limitations due to physical

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function, bodily pain, and general health (Cabo-Meseguer et al., 2017; Wolfe et al., 2018). Therefore, fibromyalgia has a negative impact on the physical, psychological, and social dimensions related to quality of life. Furthermore, there are clinical and psychological variables that affect it (Campos et al., 2024).

For fibromyalgia, therapeutic exercise (TE) is the only intervention receiving a strong recommendation (Macfarlane et al., 2017). In this context, exercise is considered a cornerstone of non-pharmacological management. Previous studies have shown that different exercise modalities can improve health-related outcomes in adults with fibromyalgia, particularly when programs are individualized (Albuquerque et al., 2022; Couto et al., 2022). However, there is still no agreement regarding which specific exercise modality is the most effective (Bidonde et al., 2017; Kim et al., 2019). The available evidence reports heterogeneous and sometimes inconsistent effects across different exercise modalities, which limits the translation of these findings into clear clinical recommendations and highlights the need for comparative analyses to better understand differences in effectiveness between exercise approaches.

Several network meta-analyses (NMA) have evaluated interventions for fibromyalgia, including exercise-based approaches. However, most of these studies have focused primarily on pain intensity (Rodríguez-Domínguez et al., 2025), included mixed-sex populations (Wang et al., 2025), or grouped distinct exercise modalities into broad categories, potentially obscuring modality-specific effects. In addition, few studies have assessed the impact of fibromyalgia using the FIQ/FIQR, despite its multidimensional scope (Zhang et al., 2022). While our research group has previously conducted a NMA focusing on pain intensity in women with fibromyalgia (Rodríguez-Domínguez et al., 2025), the impact of fibromyalgia represents a broader and clinically complementary outcome that has not yet been addressed using a sex-specific comparative approach.

To date, we have not identified studies that compare all exercise modalities to improve the impact of fibromyalgia in women. Considering that this condition predominantly affects women and that treatment results are influenced by a variety of factors, such as gender, this study aimed to assess the effectiveness of different exercise modalities in reducing the impact of fibromyalgia (FIQ/FIQR total score) in women through a NMA of randomized clinical trials (RCTs).

## 2. Methods

### 2.1. Protocol and registration

This systematic review with NMA was conducted according to a predefined protocol and is reported in accordance with the PRISMA extension statement for Network Meta-Analyses (PRISMA-NMA) guidelines (Hutton et al., 2015). The protocol was registered in the PROSPERO database.

### 2.2. Data sources and searches

A search was conducted from inception to March 10, 2025, in the following databases: MEDLINE, Cochrane Library, Scopus, Web of Science (WoS), and the Cumulative Index to Nursing and Allied Health Literature (CINAHL). The search strategy combined controlled vocabulary (MeSH terms) and free-text keywords related to fibromyalgia (e.g., “Fibromyalgia”, “Fibrositis”), exercise interventions (e.g., “Exercise Therapy”, “Resistance Training”, “Aerobic Exercise”, “Pilates”, “Yoga”, “Aquatic Exercise”), and relevant outcomes (e.g., “Fibromyalgia Impact Questionnaire”, “Quality of life”, “Disease severity”). The complete search strings for each database are reported in Appendix 1.

In addition, a manual search was performed by screening the reference lists of relevant systematic reviews and meta-analyses identified during the database search to identify additional eligible studies.

### 2.3. Eligibility criteria and study selection

A systematic review of the literature was conducted to identify studies evaluating the effectiveness of TE on the impact of fibromyalgia in women. The inclusion criteria were established according to the PICOS framework.

1. Population: adult women diagnosed with fibromyalgia according to the criteria of the American College of Rheumatology (ACR, 1990/2010/2016).
2. Intervention: studies that included some form of TE as the only intervention in one of the groups.
3. Comparison: Any intervention compared with a TE modality.
4. Outcomes: studies that evaluated the impact of fibromyalgia using the Fibromyalgia Impact Questionnaire (FIQ) or its revised version (FIQR).
5. Studies: randomized clinical trials (RCTs).

Studies that incorporated men, combined TE with another intervention modality, or used the same exercise modality in both groups were excluded from the analysis.

The FIQ is a multidimensional instrument that assesses the impact of fibromyalgia across multiple domains, with higher scores indicating greater impact. A revised version (FIQR) has been developed, which demonstrates comparable psychometric properties while requiring less time to complete (Bennett et al., 2009a). Given the conceptual and measurement equivalence between the FIQ and FIQR, outcomes from both versions were considered comparable and included in the analyses.

Two reviewers independently screened titles/abstracts, then full texts; disagreements resolved by consensus/third reviewer. All records were imported into a reference management software (Mendeley), where duplicate records were initially identified and removed using the software's automatic detection function. All potential duplicates were subsequently verified manually by the reviewers before final removal. Before formal screening, an initial manual inspection was performed to remove records that were clearly irrelevant based on predefined inclusion and exclusion criteria. Title and abstract screening was then conducted independently by two reviewers, followed by independent full-text assessment of potentially eligible studies. In cases of disagreement, a third reviewer was consulted to reach a final decision.

### 2.4. Risk of bias assessment

The risk of bias was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool (Sterne et al., 2019), which was conducted by two independent researchers (M-CG, A-RR). In case of disagreement, another researcher (AJ-RD) was consulted. This tool covers five domains: the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported results. Each domain was rated as “low risk,” “some concerns,” or “high risk,” providing an overall risk of bias judgment for each included study.

### 2.5. Data extract

Data extraction from the selected studies was performed by two independent researchers (AJ-RD, M-RS). A third researcher (JJ-JR) was consulted in case of disagreement. The variability and point variability for the intervention groups (mean and standard deviation) were extracted for analysis. In the studies that provided different measures (such as median or interquartile range), an estimate was made to homogenize the data using the mean and standard deviation for statistical analysis (Hozo et al., 2005; Wan et al., 2014a).

The characteristics of the studies were organized into a standardized form that included: reference, sample (number of participants and intervention groups), diagnostic criteria and risk of bias scale score, summary of interventions, follow-up, and results obtained (APPENDIX

2).

## 2.6. Data synthesis and statistical analysis

A qualitative synthesis of the included studies and a quantitative synthesis (pairwise meta-analysis and NMA) were included. FIQ is presented as a continuous measure ranging from 0 to 10 or 0 to 100, with higher scores indicating greater impact of fibromyalgia. All extracted data were standardized from 0 to 100 for inclusion in the meta-analyses. Two temporal points were established: short-term ( $\leq 3$  months) and long-term ( $> 3$  months). If multiple measurements were present, those closest to three months were selected for the short-term study, while those closest to six months were selected for the long-term study. For multi-arm trials in which two intervention groups shared the same control group, the control group sample size was divided equally between comparisons to avoid double-counting participants (Higgins et al., 2019).

The implementation of pairwise meta-analyses was facilitated by the use of Review Manager software version 5.4. A fixed-effect model was used when homogeneity was observed between studies, and a random-effect model was used when heterogeneity was observed. Chi (Sarzi-Puttini et al., 2020) test values  $< 0.05$  and/or  $I^2$  coefficient values  $> 50\%$  were used as indicators of heterogeneity.

## 2.7. Planned methods of analysis

The frequentist inference frames the NMA carried out in this study (Hong et al., 2013; Shim et al., 2019), for which the 'netmeta' library from RStudio was used (Rücker and Schwarzer, 2015). Mean differences (MD) and its standard error for each pair of treatments compared in the sample were calculated from the mean and standard deviation reported by each study for those treatments (Wan et al., 2014b). A random-effects model was applied, assuming a distribution of true effect sizes across studies (Viechtbauer, 2007). This approach allows us to consider the heterogeneity of comparisons and more easily extrapolate the results to a larger population.

To evaluate the transitivity assumption, we examined statistical coherence (Higgins et al., 2003), which examines whether direct and indirect comparisons of whatever two treatments show statistically significant differences. Specifically, local coherence is studied using the 'Separating Indirect from Direct Evidence' (SIDE) method, while global coherence is evaluated using the  $I^2$  statistic.

Treatment ranking probabilities were estimated, and the surface under the cumulative ranking curve (SUCRA) was used to summarize the relative ranking of each intervention. SUCRA values range from 0% (least effective) to 100% (most effective). Sensitivity analyses were performed to examine the robustness of the findings.

## 2.8. Definition of intervention nodes

Intervention nodes for the NMA were defined a priori based on clinical and methodological considerations. Exercise interventions were grouped into nodes according to their primary training objective and core components, following established classifications of TE and the F.I. T.T principles (frequency, intensity, time, and type). Conversely, interventions with clearly different training objectives or exercise characteristics were classified into separate nodes. Studies that combined two or more distinct exercise modalities within the same intervention arm (e.g., aerobic plus resistance and/or flexibility training) were classified as "Mixed Exercise." All node definitions were established prior to data synthesis and are detailed in Appendix 3.

## 2.9. Certainty of the evidence

The certainty of the evidence for each network estimate was evaluated using the Confidence in Network Meta-analysis (CINeMA), which is

based on the GRADE approach (Papakonstantinou et al., 2020). Certainty ratings were evaluated across six domains: within-study bias, reporting bias, indirectness, imprecision, heterogeneity, and incoherence. Evidence was downgraded by one or more levels when serious or very serious concerns were identified in any of these domains, following CINeMA guidance. The overall certainty rating for each comparison was determined by the domain with the most serious limitation. A detailed description of the domains of the CINeMA framework is included in APPENDIX 4.

Potential publication bias was explored using visual inspection of funnel plots and statistically assessed using Begg's rank correlation test and Egger's regression test when sufficient studies were available. Funnel plots including fewer than 10 studies were considered exploratory only and were not used to infer publication bias.

## 2.10. Minimal clinically important difference (MCID)

The minimal clinically important difference (MCID) is defined as "the smallest difference in score in the domain of interest, which patients perceive as beneficial and which would mandate, in the absence of troublesome side effects and excessive cost, a change in the patient's management" (Jaeschke et al., 1989). According to Bennett et al. (2009) (Bennett et al., 2009b), a 14% change in the FIQ total score is clinically relevant. Therefore, this value was used as the reference measure to assess the MCID. The Usual Care group was used to evaluate the MCID.

## 3. Results

Fig. 1 describes the study selection process. Sixty-four articles were included in the qualitative synthesis (Acosta-Gallego et al., 2018; Alentorn-Geli et al., 2008; Alev et al., 2017; Altan et al., 2009; Andrade et al., 2019; Arakaki et al., 2021; Assumpção et al., 2017; Baptista et al., 2012; Brito et al., 2020; Carson et al., 2010; Carvalho et al., 2020; Collado-Mateo et al., 2017; Da Costa et al., 2005; de Medeiros et al., 2020; Duruturk et al., 2015; Ekici et al., 2016; Ernberg et al., 2018; Espí-López et al., 2016; Etnier et al., 2009; Evcik et al., 2008; Fernandes et al., 2016, 2024; Fonseca et al., 2021; García-Martínez et al., 2012; Garrido-Ardila et al., 2021; Gavi et al., 2014; Genc et al., 2015; Glasgow et al., 2017; Gomez-Hernandez et al., 2019; Gulsen et al., 2020; Hernando-Garajo et al., 2021; Ide et al., 2008; Izquierdo-Alventosa et al., 2020; Jablochkova et al., 2019; Jones et al., 2002; Kayo et al., 2011; King et al., 2002; Kingsley et al., 2005; Larsson et al., 2015; Latorre et al., 2015; Letieri et al., 2013; López-Rodríguez et al., 2013; López-Rodríguez M del et al., 2012; Munguía-Izquierdo and Legaz-Arrese, 2007; Olivares et al., 2011; Rivas et al., 2024; Rodríguez-Mansilla et al., 2021; Sañudo et al., 2010a,b, 2011, 2012; Sañudo Corrales et al., 2010; Sari et al., 2025; Sarmiento et al., 2020; Sevimli et al., 2015; Silva et al., 2019; Swar, 2020; Tomas-Carus et al., 2007, 2008; Valim et al., 2003; Villafaina et al., 2019) and 59 were included in the quantitative synthesis (APPENDIX 2).

### 3.1. Characteristics of the study and results of individual studies

The publication date of the included studies ranged from 2002 to 2025. Three of the included studies had two intervention groups with the same exercise modality but different dosage parameters (Schachter et al., 2003; Rooks et al., 2007; Atan and Karavelioğlu, 2020). However, they were included because they had another control group. Therefore, these trials contributed two comparisons each to the meta-analysis as six studies (two comparisons per study).

The total number of patients was 3591 (mean = 56 patients per study). However, 335 subjects were not included in the meta-analyses because they belonged to studies that did not report the quantitative outcome data required for pooling, leaving a total of 3256 subjects. All subjects were women with a mean age of  $49.58 \pm 5.41$ . The majority of subjects were from Spain and Brazil (1318 and 962, respectively). The

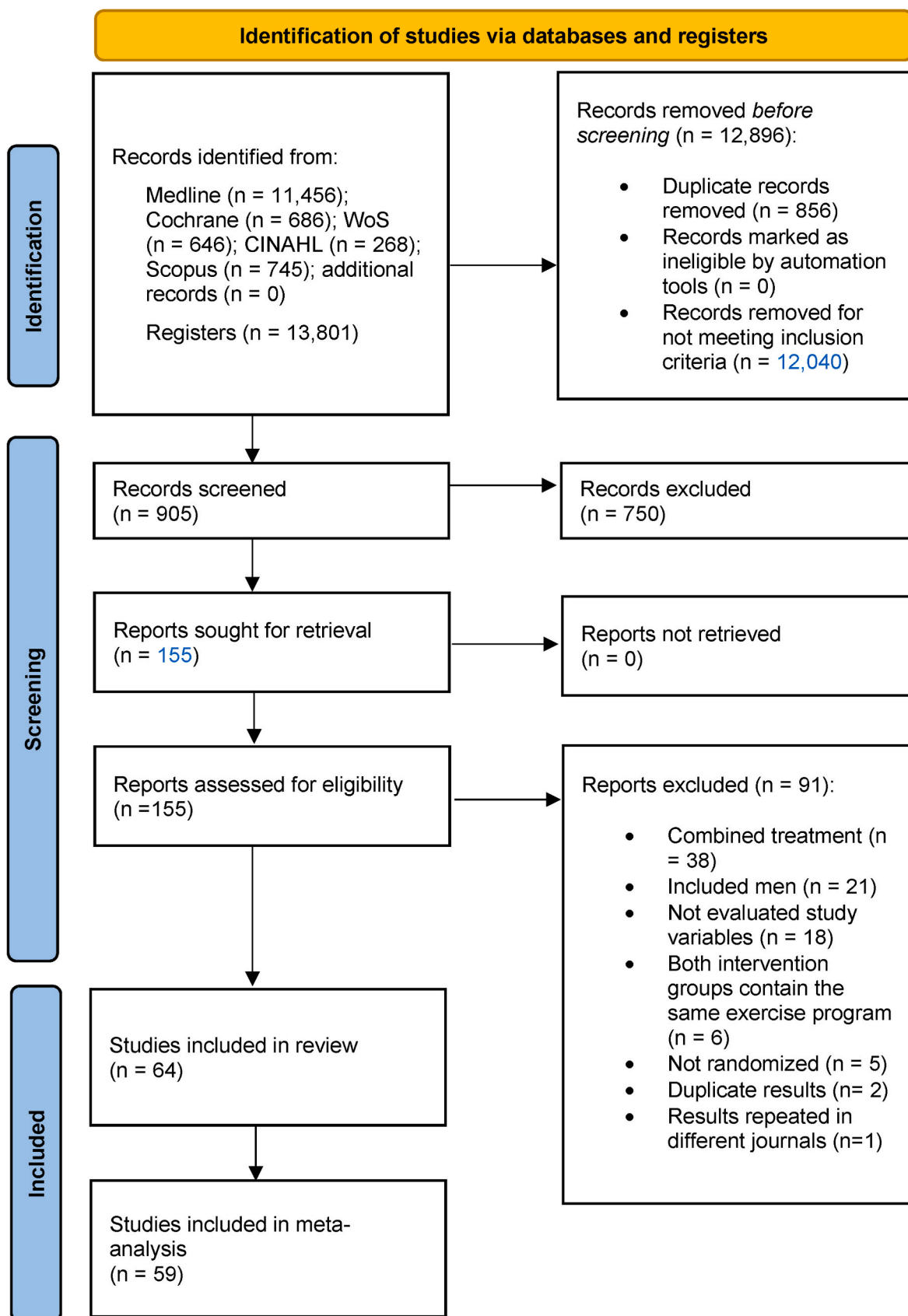


Fig. 1. PRISMA flowchart of study selection.

number of participants in each TE modality evaluated, as well as their nationality and diagnostic criteria, is detailed in APPENDIX 5.

3.1.1. Therapeutic exercise groups

APPENDIX 3 in Data S1 details the definitions of the different TE modalities identified for analysis. Fourteen TE modalities were identified, which were described in the qualitative synthesis based on the F.I.T.T parameters. (APPENDIX 2).

The most frequently analyzed TE modalities were Mixed Exercise (19 studies), Aquatic Exercise (17 studies), Aerobic Exercise and Flexibility Exercise (12 studies), and Resistance Exercise (11 studies). Several modalities (Core Stability, Functional Training, Balance Exercise, and Yoga) were evaluated in a single study (APPENDIX 5).

3.1.2. Comparison group (comparator intervention)

The interventions of the comparison group were classified into seven categories, which are defined in APPENDIX 3. Studies that included a placebo group were classified as "Placebo" and groups that included the following categories were designated as "Usual Care": "no intervention," "wait and see," and "treatment as usual".

3.1.3. Outcomes

The meta-analyses performed in this study evaluated the effectiveness of the different TE modalities in reducing the impact of fibromyalgia (FIQ/FIQR) in women. All analyses performed were divided as described above: short-term ( $\leq 3$  months) and long-term ( $> 3$  months).

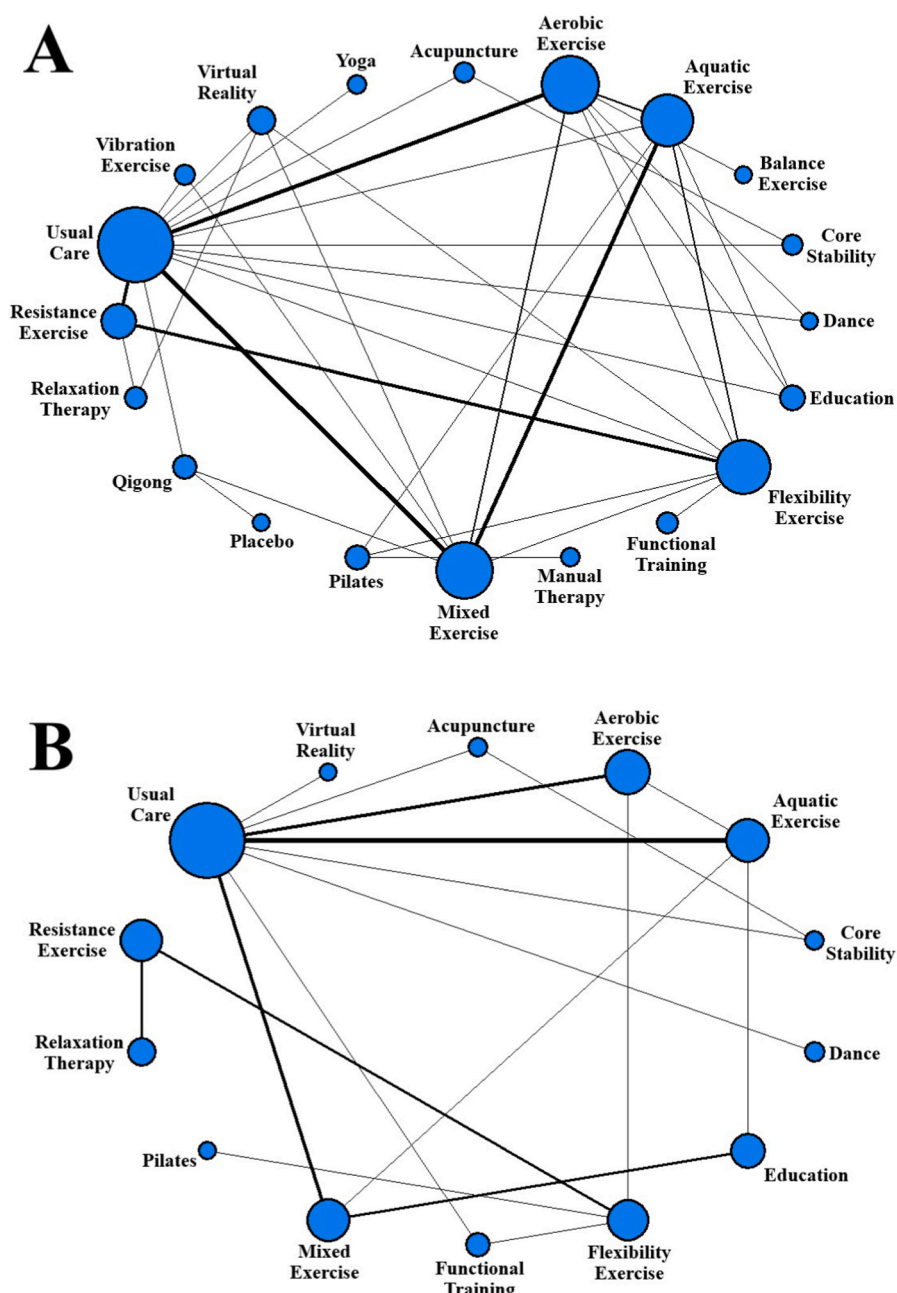


Fig. 2. Network plot of the results obtained. The size of the nodes represents the sample size within each treatment, while the width of the line represents the number of times both interventions have been compared. A. Short-term ( $\leq 3$  months): 39 trials, 196 comparisons, 2174 participants. B. Long-term ( $> 3$  months): 24 trials, 92 comparisons, 1599 participants.

### 3.2. Risk of bias assessment

Regarding the risk of bias analysis, none of the 64 trials were judged to be at high risk of selection bias. In contrast, 13 trials (20%) were judged to be at high risk of performance bias, and 12 trials (19%) were judged to be at high risk of detection bias. Five trials (8%) were judged to be at high risk of attrition bias, while only one trial (2%) was considered at high risk of reporting bias (APPENDIX 6).

### 3.3. Synthesis of results

The treatments and direct comparisons involved in the NMA are represented in a graph by nodes and edges, respectively. While the size of the nodes is proportional to the sample size for the corresponding treatment, the thickness of the edge refers to the number of direct comparisons collected between two treatments (Lin et al., 2017).

#### 3.3.1. Short-term results

In the short-term NMA (Fig. 2A), a total of 39 studies led to the analysis of 20 interventions. In fact, the NMA counted 41 studies, as two of them showed two comparisons with the same intervention group. Among them, there were 35 pairwise comparisons, six comparisons between three intervention groups. The size of the nodes shows that Usual Care had the largest sample size (n = 411), followed by Aerobic Exercise (n = 292), Flexibility Exercise (n = 267), Aquatic Exercise (n = 250) and Mixed Exercise (n = 283). The thickness of the edges determines that the comparison Aquatic Exercise versus Mixed Exercise and Mixed Exercise versus Usual Care are the most common, with 4 appearances each. Regarding certainty of evidence, most short-term network estimates were rated as having low to moderate certainty according to the CINeMA framework. Downgrading was mainly driven by concerns related to imprecision, due to wide confidence intervals and limited sample sizes in several comparisons, and by heterogeneity across

studies (Appendix 7). Risk of bias contributed to downgrading in some comparisons, whereas indirectness and incoherence were rarely judged as serious concerns. No important concerns regarding publication bias were identified (Appendix 8).

Regarding the assessment of local coherence, the SIDE method did not show statistically significant differences (1% significance level) between direct and indirect comparisons (APPENDIX 9). In the case of global coherence, a value of  $I^2 = 84%$  (78.1%, 88.4%) was obtained.

Fig. 3A shows the treatment ranking based on SUCRA values. SUCRA rankings should be interpreted cautiously given the uncertainty of several comparisons. Pilates ranked highest based on SUCRA values (SUCRA = 85.97%), followed by Aquatic Exercise (SUCRA = 80.75%) and Resistance Exercise (SUCRA = 76.43%).

Fig. 4 shows the relative effects estimated by the NMA between any pair of treatments. That is, the estimated differences between the effects of each pair of treatments and their respective 95% confidence intervals. The order in which the groups appear is established by the ranking (Fig. 3A). The last column shows the Usual Care and the remaining comparison groups. For a given cell, a negative difference indicates that the intervention group in its column is superior to the group in the corresponding row. A positive difference indicates the opposite behavior. Statistically significant differences were found in favor of Pilates, Aquatic Exercise and Resistance Exercise against Flexibility Exercise, Relaxation Therapy and Usual Care. Furthermore, Aerobic Exercise and Mixed Exercise also showed significant differences with Usual Care.

Specifically, the forest plot in Fig. 5A shows the estimated relative effect and its 95% confidence interval between each intervention group and Usual Care. The statistically significant differences mentioned above between Pilates, Aquatic Exercise, Resistance Exercise, Aerobic Exercise and Mixed Exercise, and Usual Care can be observed in this figure.

Regarding the pairwise meta-analyses, in the short-term a meta-analysis was performed for each TE modality (14 meta-analyses). Five

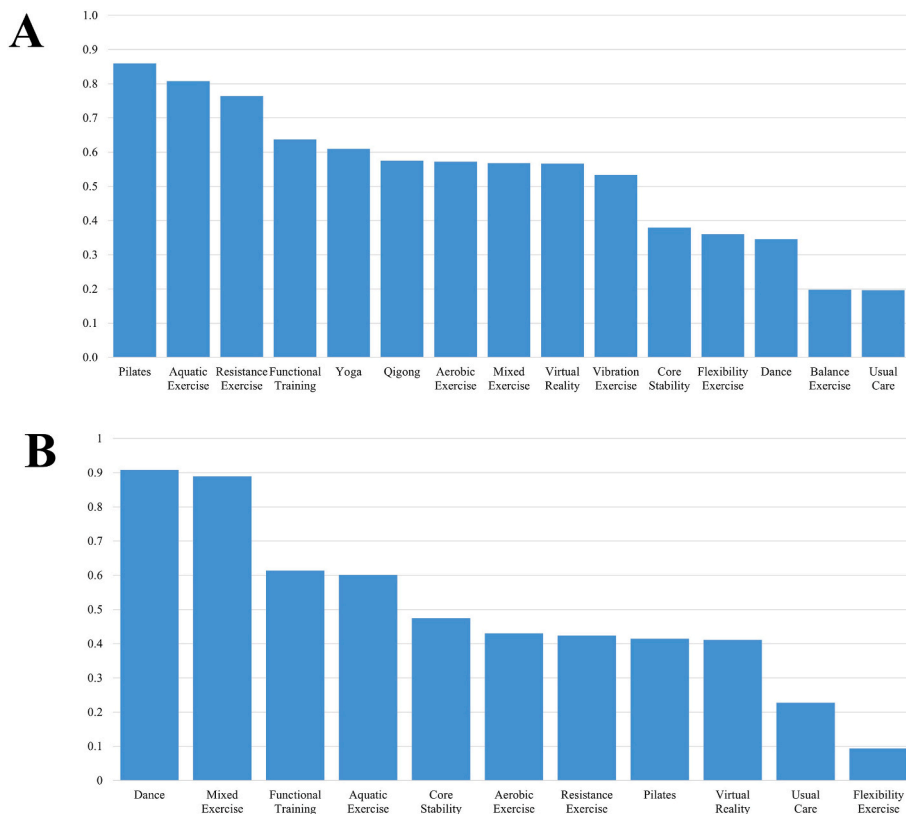


Fig. 3. Treatment rankings and surface under the cumulative ranking curve (SUCRA) for the impact of fibromyalgia (FIQ/FIQR total score). A: Short-term ( $\leq 3$  months); B: Long-term ( $> 3$  months).



= 345), followed by Aerobic Exercise (n = 180), Aquatic Exercise (n = 169), Mixed Exercise (n = 166), Resistance Exercise (n = 159) and Flexibility Exercise (n = 154). The thickness of the edges shows that the comparison between Aquatic Exercise and Usual Care is the most repeated with 4 appearances, followed by Aerobic Exercise and Mixed Exercise versus Usual Care with 3 appearances each. Regarding certainty of evidence, most comparisons were rated as having moderate certainty of evidence, with one comparison (Mixed Exercise versus Usual Care) achieving high certainty according to the CINeMA assessment. Downgrading of certainty was primarily driven by imprecision and heterogeneity, while risk of bias contributed in a smaller number of comparisons. Indirectness and incoherence were generally not considered serious concerns (Appendix 7). No relevant publication bias was detected (Appendix 8).

Regarding local coherence, the SIDE method did not show statistically significant differences between direct and indirect comparisons of treatments (APPENDIX 9). On the other hand, a value of  $I^2 = 61.2\%$  (31.9%, 77.9%) was obtained.

Fig. 3B presents the treatment ranking based on SUCRA values. Dance ranked highest (SUCRA = 90.79%), followed by Mixed Exercise (SUCRA = 88.97%) and Functional Training (SUCRA = 61.41%).

Fig. 6 is built the same way as in the short-term case. The relative effects and their 95% confidence intervals establish statistically significant differences between Dance, Mixed Exercise, Functional Training and Aquatic Exercise, versus Flexibility Exercise, unfavorable to the latter. Statistically significant differences can also be observed between Dance and Mixed Exercise, against Aerobic Exercise, in favor of the first two treatments; or between Mixed Exercise versus Aquatic Exercise, in favor of the first one.

Taking the Usual Care as a reference group, Fig. 5B shows the effect size of each treatment group. As in Fig. 6, Dance, Mixed Exercise and Aquatic Exercise arises as favorable interventions (statistically significant) compared to Usual Care.

Regarding the pairwise meta-analyses, in the long-term 10 pairwise meta-analyses were performed. Three meta-analyses showed statistically significant results in favor of the intervention group: Dance therapy (MD = -19.20; 95% CI -26.36 to -12.04), Functional Training (MD = -11.58; 95% CI -17.77 to -5.39) and Mixed Exercise (MD = -8.91; 95% CI -16.53 to -1.29). Flexibility Exercise showed statistically significant in favor of the comparison group (MD = 9.78; 95% CI 5.52 to 14.04) (APPENDIX 10 and 11).

### 3.4. Minimal clinically important difference (MCID)

To evaluate the MCID, the comparison of each TE modality with the Usual Care was taken as a reference. In the short term, four modalities obtained the MCID (Pilates, Aquatic Exercise, Resistance Exercise, and Functional Training). However, one of them (Functional Training) was not statistically significant (Fig. 5A). Although the point estimates for these modalities exceeded the MCID, the 95% confidence intervals crossed this threshold in several cases, indicating that a clinically meaningful benefit is plausible but remains uncertain. In the long term, only Dance and Mixed Exercise obtained the MCID (Fig. 5B), with similar patterns of uncertainty observed when confidence intervals were considered. Figs. 4 and 6 (short and long-term, respectively) show the results obtained for each comparison analyzed in the NMA, observing that some TE modalities also exceeded the MCID when compared with other exercise modalities.

## 4. Discussion

To date, this is the first NMA to directly and indirectly compare all TE modalities used to reduce the impact of fibromyalgia, as assessed by the FIQ, in women. Our results are presented in Figs. 4 and 6 in a very pragmatic way, according to the SUCRA ranking results. This allows us to establish a comparative ranking of evidence-based efficacy, which can serve as a useful support for clinical decision-making. The classification obtained, both for the short and long term, suggests that the exercise modalities ranking highest vary over time. This finding could help optimize the TE prescription for this population.

In the short term ( $\leq 3$  months), with moderate certainty of evidence, our analysis ranked the Pilates method highest for reducing the impact of fibromyalgia in women, closely followed by Aquatic Exercise and Resistance Exercise. However, the value of these three modalities lies not only in their comparative effects over interventions such as Flexibility, Relaxation, and Usual Care. Several estimates exceeded the MCID; however, confidence intervals crossed this threshold in some comparisons, indicating that clinically meaningful benefit is plausible but remains uncertain. This finding is not isolated. In fact, it is in consistent with a recent NMA (Rodríguez-Domínguez et al., 2025), which also pointed to Aquatic Exercise, Pilates, and Resistance Exercise among the highest-ranked modalities to relieve pain, in the short term, in women with fibromyalgia. Taken together, these findings suggest that these

Dance																			
-2.51 (-16.46, 11.44)	Mixed Exercise																		
-10.49 (-27.26, 6.28)	-7.99 (-20.99, 5.01)	Functional Training																	
-10.75 (-24.29, 2.78)	-8.25 (-15.66, -0.84)	-0.26 (-12.67, 12.15)	Aquatic Exercise																
-13.70 (-31.50, 4.10)	-11.19 (-25.55, 3.16)	-3.21 (-20.32, 13.90)	-2.95 (-16.90, 11.01)	Core Stability															
-14.78 (-28.70, -0.86)	-12.27 (-21.16, -3.39)	-4.29 (-16.14, 7.56)	-4.03 (-11.60, 3.55)	-1.08 (-15.41, 13.25)	Aerobic Exercise														
-15.82 (-35.53, 3.90)	-13.31 (-29.90, 3.28)	-5.32 (-20.09, 9.44)	-5.06 (-21.10, 10.97)	-2.12 (-22.12, 17.89)	-1.04 (-15.95, 13.87)	Resistance Exercise													
-15.97 (-39.73, 7.79)	-13.47 (-34.71, 7.77)	-5.48 (-25.33, 14.36)	-5.22 (-26.02, 15.58)	-2.27 (-26.28, 21.73)	-1.20 (-21.15, 18.76)	-0.16 (-19.46, 19.14)	Pilates												
-15.45 (-34.36, 3.46)	-12.94 (-28.65, 2.76)	-4.96 (-23.21, 13.30)	-4.70 (-20.03, 10.64)	-1.75 (-20.96, 17.46)	-0.67 (-16.35, 15.01)	0.37 (-20.63, 21.36)	0.52 (-24.31, 25.36)	Virtual Reality											
-24.27 (-41.32, -7.23)	-21.77 (-35.07, -8.47)	-13.78 (-24.72, -2.84)	-13.52 (-26.12, -0.92)	-10.57 (-27.95, 6.80)	-9.50 (-20.63, 1.64)	-8.46 (-18.38, 1.46)	-8.30 (-24.86, 8.26)	-8.82 (-27.33, 9.68)	Flexibility Exercise										
-19.20 (-31.56, -6.84)	-16.69 (-23.17, -10.22)	-8.71 (-20.04, 2.63)	-8.45 (-13.98, -2.92)	-5.50 (-18.32, 7.32)	-4.42 (-10.83, 1.99)	-3.38 (-18.75, 11.98)	-3.23 (-23.52, 17.07)	-3.75 (-18.06, 10.56)	-5.07 (-6.66, 16.81)	Usual Care									
-21.23 (-42.80, 0.34)	-18.73 (-37.48, 0.03)	-10.74 (-27.90, 6.43)	-10.48 (-28.74, 7.79)	-7.53 (-29.37, 14.31)	-6.45 (-23.74, 10.83)	-5.42 (-14.17, 3.33)	-5.26 (-26.45, 15.93)	-5.78 (-28.53, 16.96)	3.04 (-10.18, 16.27)	Relaxation Therapy									
-13.82 (-31.44, 3.80)	-11.31 (-25.45, 2.82)	-3.33 (-20.25, 13.60)	-3.07 (-16.80, 10.66)	-0.12 (-13.07, 12.83)	0.96 (-13.15, 15.07)	2.00 (-17.85, 21.85)	2.15 (-21.71, 26.02)	1.63 (-17.41, 20.67)	10.45 (-6.74, 27.65)	Acupuncture									
-4.46 (-19.58, 10.67)	-1.95 (-9.20, 30)	6.04 (-8.18, 20.25)	6.30 (-2.47, 15.07)	9.24 (-6.26, 24.75)	10.32 (-0.17, 20.82)	11.36 (-6.18, 28.90)	11.52 (-10.46, 33.50)	10.99 (-5.76, 27.75)	19.82 (5.36, 34.28)	Education									
Statistically significant and clinically important difference favouring column treatment		Clinically important difference favouring column treatment		Statistically significant difference favouring column treatment		No difference		Statistically significant and clinically important difference favouring row treatment											

Fig. 6. League table of network meta-analysis long-term outcomes for all comparisons between exercise and non-exercise interventions. Effects are expressed as the mean difference (95% CI) between interventions.

modalities may contribute to improvements across multiple domains of fibromyalgia impact. The fact that the same exercise modalities were associated with improvements in both pain and the impact of fibromyalgia in the short term supports their clinical relevance as therapeutic options, while acknowledging the uncertainty due to heterogeneity and limited certainty of evidence.

Similarly, another NMA (Zhang et al., 2022) found that mind-body exercises were the most effective in improving quality of life in a mixed population of patients with fibromyalgia. However, these authors grouped several modalities (such as Pilates, Yoga, and Tai Chi) into this category, which does not allow us to conclude exactly which modality is most effective. By focusing exclusively on women and breaking down this category into specific modalities, such as Pilates, our study provides a more granular comparison and may help inform modality selection for this predominantly affected population. Furthermore, instead of using the FIQ, (a condition-specific measure of fibromyalgia impact), to assess quality of life, these authors used the SF-36. In any case, our results are consistent with those of the aforementioned authors in that they both emphasize the need to develop individualized exercise plans according to symptomatology and personal characteristics.

For the long term (>3 months), our NMA suggested differences in the highest-ranked interventions. Dance was positioned in first place with moderate certainty of evidence, followed by Mixed Exercise with high certainty of evidence. It is important to note that Mixed Exercise was the only intervention that obtained high certainty of evidence in the long term, supporting greater confidence in this estimate. Both modalities achieved MCID; however, in some comparisons the confidence intervals crossed this threshold, indicating that clinically meaningful benefit is plausible but remains uncertain. These two approaches were associated with greater improvements compared to Aerobic Exercise and Usual Care, among others. This result partially coincides with the recent NMA (Rodríguez-Domínguez et al., 2025), which also ranked Dance as one of the highest-ranked long-term interventions for pain. The fact that Dance, an activity that is both pleasant and social, is ranked first may have implications for long-term adherence and the adoption of healthy lifestyle habits. These are variables that we were unable to analyze in our study. Therefore, future studies should measure adherence to treatment and how women with fibromyalgia integrate treatment into their lifestyles as a healthy and pleasurable habit.

Regarding the finding on the efficacy of Mixed Exercise, which is defined as a combination of Aerobic, Resistance, and/or Flexibility Exercise, it seems to coincide with the results of another NMA (Nüesch et al., 2013), which found that combined therapy, a combination of exercise and cognitive behavior therapy, is the most promising non-pharmacological option. Although these approaches are not directly comparable, these findings support the idea that interventions integrating multiple components may be beneficial for the long-term management of fibromyalgia.

Therefore, it should be taken into account that although widespread chronic pain is the main symptom of this condition, its complexity and variety of associated symptoms mean that these patients require treatments that effectively address the different dimensions of health, using individualized and flexible approaches. Thus, the available studies seem to agree that active, multicomponent, and varied interventions that are tailored to the clinical characteristics of the patients may be more beneficial than passive and/or unimodal coping strategies and that no single treatment is likely to be the most effective in reducing the impact of fibromyalgia in all patients over time.

#### 4.1. Implications for clinical practice

The objective of this study was not only to explore which types of exercise are associated with greater reductions in the impact of fibromyalgia, but also to inform clinical decision-making regarding the selection of exercise modalities based on available evidence and patient-centered considerations. Importantly, differences observed between

short- and long-term outcomes reflect follow-up duration rather than a staged or sequential treatment approach.

Based on the current data, certain exercise modalities ranked higher at shorter follow-up durations (e.g., Pilates, Aquatic Exercise, and Resistance Exercise), whereas others ranked higher at longer follow-up durations (e.g., Dance and Mixed Exercise). However, these findings should not be interpreted as evidence supporting a therapeutic sequence, as interventions were evaluated independently and not as part of a progressive treatment strategy. Instead, these findings suggest that exercise choice may be best guided by what is realistic and acceptable for each patient, their preferences, and the time frame in which benefits are expected.

Therefore, clinicians should consider a grading, dynamic, and time sensitive treatment system and abandon generic recommendations to exercise. Maintaining the patient's commitment over time is as important as the intensity or type of exercise.

Finally, it seems essential to abandon the idea of a single prescription. Offering different effective options-and letting the patient herself, with the guidance of the professional, make the choice-not only respects her autonomy but is probably the best way to achieve good adherence. In light of this, clinicians are encouraged to adopt a model of shared decision-making, enabling patients to integrate treatment as a pleasant habit in their lifestyle.

#### 4.2. Limitations

This study has several limitations. The main one is the risk of bias inherent in clinical exercise trials, where blinding of participants and therapists is virtually impossible. Furthermore, the assessment of the certainty of evidence using CINeMA rated many of the comparisons as “low” or “moderate” quality, indicating the need for more high-quality research.

Remarkable heterogeneity was detected in the analysis, possibly due to the variability in exercise protocols (dose, frequency, intensity) between the included studies. Although we have classified the exercise modalities, there is internal diversity in how each was applied. There are also some interventions with a small number of studies, that is, Dance and Pilates had only two and three studies, respectively, so more research is needed to evaluate the effectiveness of these TE modalities. In this context, SUCRA-based rankings should be interpreted cautiously, as ranking probabilities may be unstable in sparse networks and when uncertainty is high (wide confidence intervals and low-to-moderate certainty of evidence). Therefore, our interpretation prioritizes effect estimates (MD and 95% CI) and CINeMA ratings rather than ranking alone. This uncertainty at the level of clinically meaningful change further supports the need for cautious interpretation of treatment effects. Furthermore, the generalization of our findings is limited to women with fibromyalgia and cannot be extrapolated to men. Restricting inclusion to women-only trials reduced the number of available studies per exercise modality and limits generalizability; however, this approach was chosen to preserve clinical homogeneity and to directly address a sex-specific research question. Another limitation, shared with other studies in the field, is the use of different ACR diagnostic criteria (1990, 2010, 2016) in the included studies, which could introduce selection biases. Importantly, several of the top-ranked interventions were supported by a small number of studies. In sparse networks, treatment rankings may be particularly sensitive to imprecision and indirect evidence, and therefore should not be interpreted as definitive evidence of superiority.

#### 4.3. Future research

To strengthen the evidence, future large-scale RCTs of high methodological quality are needed, especially for the top-ranked TE modalities. Trials with direct (head-to-head) comparisons between, for example, Pilates, Aquatic Exercise, and Resistance Exercise in the short

term, as well as between Dance and Mixed Exercise in the long term are needed, as our NMA relied heavily on indirect comparisons. Future studies should focus on determining the optimal parameters of the F.I.T. T principles for each exercise modality, as well as the analysis of adherence and the integration of TE as a lifestyle habit, with the aim of improving clinical practice. Finally, future studies should unify the diagnostic criteria for FM to improve the homogeneity of the samples in such investigations.

## 5. Conclusions

Our findings show, with low-to-moderate certainty of evidence, that Pilates, Aquatic Exercise and Resistance Exercise ranked highest in the short term for reducing the impact of fibromyalgia in women. In the long term, the most favorable interventions were Dance, with a moderate certainty of evidence, and Mixed Exercise, which ranked highest and showed the highest certainty of evidence across long-term comparisons. These results can guide the professional on which interventions to prioritize according to the therapeutic moment, favoring shared decision-making with the patient, and facilitating their incorporation into clinical practice. However, findings should be interpreted with caution due to substantial heterogeneity and predominantly indirect evidence, and more high-quality studies are needed to support and extend these conclusions.

## CRedit authorship contribution statement

**Álvaro-José Rodríguez-Domínguez:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **José-Jesús Jiménez-Rejano:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Melania Cardellat-González:** Writing – review & editing, Writing – original draft, Validation, Investigation, Data curation. **Abel Rosales-Tristancho:** Writing – review & editing, Writing – original draft, Validation, Formal analysis, Data curation. **Andrés Arana-Rodríguez:** Writing – review & editing, Writing – original draft, Validation, Formal analysis, Data curation. **Manuel Rebollo-Salas:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization.

## Trial registration number

This study was registered in the PROSPERO database (CRD420251007660).

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## Declaration of competing interest

None.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.msksp.2026.103515>.

## References

Acosta-Gallego, A., Ruiz-Montero, P.J., Castillo-Rodríguez, A., 2018. Land- and pool-based intervention in female fibromyalgia patients: a randomized-controlled trial. *Turk J Phys Med Rehabil* 64 (4), 337–343.

Albuquerque, M.L.L., Monteiro, D., Marinho, D.A., Vilarino, G.T., Andrade, A., Neiva, H.P., 2022. Effects of different protocols of physical exercise on fibromyalgia syndrome treatment: systematic review and meta-analysis of randomized controlled trials.

Rheumatol. Int. 42 (11), 1893–1908, 2022 May 23 [cited 2026 Jan 8];42(11). <https://link.springer.com/article/10.1007/s00296-022-05140-1>.

Alentorn-Geli, E., Padilla, J., Moras, G., Haro, C.L., Fernández-Solà, J., 2008. Six weeks of whole-body vibration exercise improves pain and fatigue in women with fibromyalgia. *J. Alternative Compl. Med.* 14 (8), 975–981 [cited 2021 Nov 20]. <http://www.liebertpub.com/doi/10.1089/acm.2008.0050>.

Alev, A., Mihriban, A., Bilge, E., Ayça, E., Merve, K., Şeyma, C., et al., 2017. Effects of whole body vibration therapy in pain, function and depression of the patients with fibromyalgia. *Complement Ther Clin Pract* 28, 200–203.

Altan, L., Korkmaz, N., Bingol, Ü., Gunay, B., 2009. Effect of pilates training on people with fibromyalgia syndrome: a pilot study. *Arch. Phys. Med. Rehabil.* 90 (12) [cited 2021 Nov 20]. <https://linkinghub.elsevier.com/retrieve/pii/S000399930900687X>.

Andrade, C.P., Zamuner, A.R., Forti, M., Tamburisi, N.Y., Silva, E., 2019. Effects of aquatic training and detraining on women with fibromyalgia: controlled randomized clinical trial. *Eur. J. Phys. Rehabil. Med.* 55 (1), 79–88.

Andrade, A., Dominski, F.H., Sieczkowska, S.M., 2020. What we already know about the effects of exercise in patients with fibromyalgia: an umbrella review. *Semin. Arthritis Rheum.* 50 (6), 1465–1480 [cited 2022 Jan 22]. <https://linkinghub.elsevier.com/retrieve/pii/S0049017220300226>.

Arakaki, J.S., Jennings, F., Estrela, G.Q., Cruz Martinelli, V.D.G., Natour, J., 2021. Strengthening exercises using swiss ball improve pain, health status, quality of life and muscle strength in patients with fibromyalgia: a randomized controlled trial. *Reumatismo* 73 (1), 15–23 [cited 2021 Nov 20]. <http://www.ncbi.nlm.nih.gov/pubmed/33874643>.

Assumpção, A., Matsutani, L.A., Yuan, S.L., Santo, A.S., Sauer, J., Mango, P., et al., 2017. Muscle stretching exercises and resistance training in fibromyalgia: which is better? A three-arm randomized controlled trial. *Eur. J. Phys. Rehabil. Med.* 54 (5), 663–670.

Atan, T., Karaveliöglu, Y., 2020. Effectiveness of high-intensity interval training vs moderate-intensity continuous training in patients with fibromyalgia: a pilot randomized controlled trial. *Arch. Phys. Med. Rehabil.* 101 (11) [cited 2021 Nov 20]. <https://linkinghub.elsevier.com/retrieve/pii/S0003999320303828>.

Baptista, A.S., Villela, A.L., Jones, A., Natour, J., 2012. Effectiveness of dance in patients with fibromyalgia: a randomized, single-blind, controlled study. *Clin. Exp. Rheumatol.* 30 (6 Suppl. 74), 18–23. <http://www.ncbi.nlm.nih.gov/pubmed/23020850>.

Bennett, R.M., Friend, R., Jones, K.D., Ward, R., Han, B.K., Ross, R.L., 2009a. The Revised Fibromyalgia Impact Questionnaire (FIQR): validation and psychometric properties. *Arthritis Res. Ther.* 11 (4) [cited 2025 May 14]. <https://arthritis-research.biomedcentral.com/articles/10.1186/ar2783>.

Bennett, R.M., Bushmakina, A.G., Cappelleri, J.C., Zlateva, G., Sadosky, A.B., 2009b. Minimal clinically important difference in the fibromyalgia impact questionnaire. *J. Rheumatol.* 36 (6), 1304–1311.

Bidonde, J., Busch, A.J., Schachter, C.L., Overend, T.J., Kim, S.Y., Góes, S.M., et al., 2017. Aerobic exercise training for adults with fibromyalgia. *Cochrane Database Syst. Rev.* 2017 (6). <https://doi.org/10.1002/14651858.CD012700>.

Britto, A., Rodrigues, V., dos Santos, A.M., Rizzini, M., Britto, P., Britto, L., et al., 2020. Effects of water- and land-based exercises on quality of life and physical aspects in women with fibromyalgia: a randomized clinical trial. *Muscoskel. Care* 18 (4), 459–466 [cited 2021 Nov 20]. <https://onlinelibrary.wiley.com/doi/10.1002/msc.1481>.

Cabo-Meseguer, A., Cerdá-Olmedo, G., Trillo-Mata, J.L., 2017. Fibromialgia: prevalencia, perfiles epidemiológicos y costes económicos. *Med. Clin.* 149 (10), 441–448 [cited 2022 Jun 18]. <https://linkinghub.elsevier.com/retrieve/pii/S0025775317304773>.

Campos, R.P., Vázquez, I., Vilhena, E., 2024. Psychological factors and health-related quality of life in fibromyalgia patients. *Health Psychol. Rep.* 12 (4), 352 [cited 2025 May 14]. <https://hpr.termia.pl/Psychological-factors-and-health-related-quality-of-life-in-fibromyalgia-patients,187335,0,2.html>.

Carson, J.W., Carson, K.M., Jones, K.D., Bennett, R.M., Wright, C.L., Mist, S.D., 2010. A pilot randomized controlled trial of the Yoga of Awareness program in the management of fibromyalgia. *Pain* 151 (2), 530–539. <https://journals.lww.com/00006396-201011000-00038>.

Carvalho, M.S. de, Carvalho, L.C., Menezes, F. da S., Frazin, A., Gomes, E. da C., Iunes, D. H., 2020. Effects of exergames in women with fibromyalgia: a randomized controlled Study. *Games Health J* 9 (5), 358–367 [cited 2021 Nov 20]. <https://www.liebertpub.com/doi/10.1089/g4h.2019.0108>.

Collado-Mateo, D., Domínguez-Muñoz, F.J., Adsuar, J.C., García-Gordillo, M.A., Gusi, N., 2017. Effects of exergames on quality of life, pain, and disease effect in women with fibromyalgia: a randomized controlled trial. *Arch. Phys. Med. Rehabil.* 98 (9), 1725–1731.

Couto, N., Monteiro, D., Cid, L., Bento, T., 2022. Effect of different types of exercise in adult subjects with fibromyalgia: a systematic review and meta-analysis of randomised clinical trials. *Sci. Rep.* 12 (1), 10391 [cited 2025 May 14]. <https://pmc.ncbi.nlm.nih.gov/articles/PMC9209512/>.

Da Costa, D., Abrahamowicz, M., Lowenstein, I., Bernatsky, S., Dritsa, M., Fitzcharles, M. A., et al., 2005. A randomized clinical trial of an individualized home-based exercise programme for women with fibromyalgia. *Rheumatology* 44 (11), 1422–1427.

de Medeiros, S.A., de Almeida Silva, H.J., do Nascimento, R.M., da Silva Maia, J.B., de Almeida Lins, C.A., de Souza, M.C., 2020. Mat Pilates is as effective as aquatic aerobic exercise in treating women with fibromyalgia: a clinical, randomized and blind trial. *Advances in Rheumatology* 60 (1), 21. <https://advancesinrheumatology.biomedcentral.com/articles/10.1186/s42358-020-0124-2>.

Duruturk, N., Tuzun, E.H., Culhaoglu, B., 2015. Is balance exercise training as effective as aerobic exercise training in fibromyalgia syndrome? *Rheumatol. Int.* 35 (5), 845–854 [cited 2021 Nov 20]. <http://link.springer.com/10.1007/s00296-014-3159-z>.

Ekici, G., Unal, E., Akbayrak, T., Vardar-Yagli, N., Yakut, Y., Karabulut, E., 2016. Effects of active/passive interventions on pain, anxiety, and quality of life in women with fibromyalgia: randomized controlled trial. *Women Health* 57 (1), 88–107.

Ernberg, M., Christidis, N., Ghafouri, B., Bileviciute-Ljungar, I., Löfgren, M., Bjersing, J., et al., 2018. Plasma cytokine levels in fibromyalgia and their response to 15 weeks of progressive resistance exercise or relaxation therapy. *Mediators Inflamm* 2018.

Espi-López, G.V., Inglés, M., Ruescas-Nicolau, M.A., Moreno-Segura, N., 2016. Effect of low-impact aerobic exercise combined with music therapy on patients with fibromyalgia. A pilot study. *Compl. Ther. Med.* 28, 1–7.

Ennier, J.L., Karper, W.B., Gapin, J.I., Barella, L.A., Yu, K.C., Murphy, K.J., 2009. Exercise, fibromyalgia, and fibrofog: a pilot study. *J. Phys. Activ. Health* 6 (2), 239–246.

Evcik, D., Yigit, I., Pusak, H., Kavuncu, V., 2008. Effectiveness of aquatic therapy in the treatment of fibromyalgia syndrome: a randomized controlled open study. *Rheumatol. Int.* 28 (9), 885–890.

Fernandes, G., Jennings, F., Nery Cabral, M.V., Pirozzi Buosi, A.L., Natour, J., 2016. Swimming improves pain and functional capacity of patients with fibromyalgia: a randomized controlled trial. *Arch. Phys. Med. Rehabil.* 97 (8), 1269–1275.

Fernandes, G., Nery, M., Meireles, S.M., Santos, R., Natour, J., Jennings, F., 2024. A functional exercise program improves pain and health related quality of life in patients with fibromyalgia: a randomized controlled trial. *Advances in Rheumatology* 64 (1), 81. <https://advancesinrheumatology.biomedcentral.com/articles/10.1186/s42358-024-00422-7>.

Fonseca, A.C.S., Faria, P.C., Alcántara, M.A., Pinto, W.D., De Carvalho, L.G., Lopes, F.G., et al., 2021. Effects of aquatic physiotherapy or health education program in women with fibromyalgia: a randomized clinical trial. *Physiother. Theory Pract.* 37 (5), 620–632. <https://www.tandfonline.com/doi/full/10.1080/09593985.2019.1639229>.

García-Martínez, A.M., De Paz, J.A., Márquez, S., 2012. Effects of an exercise programme on self-esteem, self-concept and quality of life in women with fibromyalgia: a randomized controlled trial. *Rheumatol. Int.* 32 (7), 1869–1876.

Garrido-Ardila, E.M., González-López-arza, M.V., Jiménez-Palomares, M., García-Nogales, A., Rodríguez-Mansilla, J., 2021. Effects of physiotherapy vs. acupuncture in quality of life, pain, stiffness, difficulty to work and depression of women with fibromyalgia: a randomized controlled trial. *J. Clin. Med.* 10 (17).

Gavi, M.B.R.O., Vassallo, D.V., Amaral, F.T., Macedo, D.C.F., Gava, P.L., Dantas, E.M., et al., 2021. Strengthening exercises improve symptoms and quality of life but do not change autonomic modulation in fibromyalgia. *A Randomized Clinical Trial*. Cordero MD, editor. *PLoS One* 9 (3), e90767 [cited 2021 Nov 20]. <https://dx.plos.org/10.1371/journal.pone.0090767>.

Genc, A., Tur, B.S., Aytur, Y.K., Oztuna, D., Erdogan, M.F., 2015. Does aerobic exercise affect the hypothalamic-pituitary-adrenal hormonal response in patients with fibromyalgia syndrome? *J. Phys. Ther. Sci.* 27 (7), 2225–2231.

Glasgow, A., Stone, T.M., Kingsley, J.D., 2017. Resistance exercise training on disease impact, pain catastrophizing and autonomic modulation in women with fibromyalgia. *Int J Exerc Sci* 10 (8), 1184–1195. <https://digitalcommons.wku.edu/ijes/vol10/iss8/9/>.

Gomez-Hernandez, M., Gallego-Izquierdo, T., Martínez-Merino, P., Pecos-Martin, D., Ferragut-Garcías, A., Hita-Contreras, F., et al., 2019. Benefits of adding stretching to a moderate-intensity aerobic exercise programme in women with fibromyalgia: a randomized controlled trial. *Clin. Rehabil.* 34 (2), 242–251.

Gulsen, C., Soke, F., Eldemir, K., Apaydin, Y., Ozkul, C., Guclu-Gunduz, A., et al., 2020. Effect of fully immersive virtual reality treatment combined with exercise in fibromyalgia patients: a randomized controlled trial. *Assist. Technol.* 34 (3), 256–263.

Hernando-Garjio, I., Ceballos-Laita, L., Mingo-Gomez, M., Medrano-de-la-Fuente, R., Estébanez-de-Miguel, E., Martínez-Perez, M., et al., 2021. Immediate effects of a telerehabilitation program based on aerobic exercise in women with fibromyalgia. *Int J Environ Res Public Health* 18 (4).

Higgins, J., Thompson, S., Deeks, J., Altman, D., 2003. Measuring inconsistency in meta-analyses. *BMJ* 327 (7414), 557–560.

Higgins, J.P.T., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M.J., et al., 2019. *Cochrane handbook for systematic reviews of interventions*. *Cochrane Handbook for Systematic Reviews of Interventions* 1–694. <https://onlinelibrary.wiley.com/doi/book/10.1002/9781119536604>.

Hong, H., Carlin, B.P., Shamlivan, T.A., Wyman, J.F., Ramakrishnan, R., Sainfort, F., et al., 2013. Comparing Bayesian and frequentist approaches for multiple outcome mixed treatment comparisons. *Med. Decis. Mak.* 33 (5), 702–714.

Hozo, S.P., Djulbegovic, B., Hozo, I., 2005. Estimating the mean and variance from the median, range, and the size of a sample. *BMC Med. Res. Methodol.* 5 (1), 13.

Hutton, B., Salanti, G., Caldwell, D.M., Chaimani, A., Schmid, C.H., Cameron, C., et al., 2015. The PRISMA extension statement for reporting of systematic reviews incorporating network meta-analyses of health care interventions: checklist and explanations. *Ann. Intern. Med.* 162 (11), 777–784.

Ide, M., Laurindo, I., Rodrigues-Junior, A., Tanaka, C., 2008. Effect of aquatic respiratory exercise-based program in patients with fibromyalgia. *Int J Rheum Dis* 11 (2), 131–140. <https://onlinelibrary.wiley.com/doi/10.1111/j.1756-185X.2008.00348.x>.

Izquierdo-Alventosa, R., Inglés, M., Cortés-Adador, S., Gimeno-Mallench, L., Chirivella-Garrido, J., Kropotov, J., et al., 2020. 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* 17 (10) [cited 2021 Nov 20]. <https://pubmed.ncbi.nlm.nih.gov/32455853/>.

Jablochikova, A., Bäckryd, E., Kosek, E., Mannerkorpi, K., Ernberg, M., Gerdle, B., et al., 2019. Unaltered low nerve growth factor and high brain-derived neurotrophic factor levels in plasma from patients with fibromyalgia after a 15-week progressive resistance exercise. *J. Rehabil. Med.* 51 (10), 779–787.

Jaeschke, R., Singer, J., Guyatt, G.H., 1989. Measurement of health status. *Control. Clin. Trials* 10 (4), 407–415. <https://linkinghub.elsevier.com/retrieve/pii/0197245689900056>.

Jones, K.D., Burckhardt, C.S., Clark, S.R., Bennett, R.M., Potempa, K.M., 2002. A randomized controlled trial of muscle strengthening versus flexibility training in fibromyalgia. *J. Rheumatol.* 29 (5), 1041–1048. <http://www.ncbi.nlm.nih.gov/pubmed/12022321>.

Jones, G.T., Atzeni, F., Beasley, M., Fließ, E., Sarzi-Puttini, P., Macfarlane, G.J., 2015. The prevalence of fibromyalgia in the general population: a comparison of the American College of Rheumatology 1990, 2010, and modified 2010 classification criteria. *Arthritis Rheumatol.* 67 (2), 568–575.

Kayo, A.H., Peccin, M.S., Sanches, C.M., Trevisani, V.F.M., 2011. Effectiveness of physical activity in reducing pain in patients with fibromyalgia: a blinded randomized clinical trial. *Rheumatol. Int.* 32 (8), 2285–2292.

Kim, S.Y., Busch, A.J., Overend, T.J., Schachter, C.L., van der Spuy, I., Boden, C., et al., 2019. Flexibility exercise training for adults with fibromyalgia. *Cochrane Database Syst. Rev.* (9) 2019 Sep 2 [cited 2022 Jun 17] <http://www.ncbi.nlm.nih.gov/pubmed/31476271>.

King, S.J., Wessel, J., Bhambhani, Y., Sholter, D., Maksymowich, W., Kswjbydsym, W., et al., 2002. The effects of exercise and education, individually or combined, in women with fibromyalgia. *J. Rheumatol.* 29 (12), 2620–2627, 2002 Dec;29(12): 2620–7.

Kingsley, J.D., Panton, L.B., Toole, T., Sirthienthad, P., Mathis, R., McMillan, V., 2005. The effects of a 12-week strength-training program on strength and functionality in women with fibromyalgia. *Arch. Phys. Med. Rehabil.* 86 (9), 1713–1721.

Larsson, A., Palstam, A., Löfgren, M., Ernberg, M., Bjersing, J., Bileviciute-Ljungar, I., et al., 2015. Resistance exercise improves muscle strength, health status and pain intensity in fibromyalgia—a randomized controlled trial. *Arthritis Res. Ther.* 17 (1).

Latorre, Román PÁ., Santos, E., Campos, M.A., García-Pinillos, F., 2015. Effects of functional training on pain, leg strength, and balance in women with fibromyalgia. *Mod. Rheumatol.* 25 (6), 943–947.

Letieri, R.V., Furtado, G.E., Letieri, M., Góes, S.M., Borba Pinheiro, C.J., Veronez, S.O., et al., 2013. Pain, quality of life, self perception of health and depression in patients with fibromyalgia, submitted to hydrocortisone therapy. *Rev. Bras. Reumatol.* 53 (6), 494–500.

Lin, L., Zhang, J., Hodges, J.S., Chu, H., 2017. Performing arm-based network meta-analysis in R with the pnetmeta package. *J Stat Softw* 80 (5) [cited 2022 Jun 12]. <http://www.jstatsoft.org/v80/i05/>.

López-Rodríguez, M.M., Fernández-Martínez, M., Matarán-Peñarrocha, G.A., Rodríguez-Ferrer, M.E., Granados Gámez, G., Aguilar Ferrández, E., et al., 2013. Effectiveness of aquatic biodance on sleep quality, anxiety and other symptoms in patients with fibromyalgia. *Med. Clin.* 141 (11), 471–478.

López-Rodríguez M del, M., Castro-Sánchez, A.M., Fernández-Martínez, M., Matarán-Peñarrocha, G.A., Rodríguez-Ferrer, M.E., 2012. Comparison between aquatic-biodanza and stretching for improving quality of life and pain in patients with fibromyalgia. *Aten Primaria* 44 (11), 641–649.

Macfarlane, G.J., Kronisch, C., Dean, L.E., Atzeni, F., Häuser, W., Fluß, E., et al., 2017. EULAR revised recommendations for the management of fibromyalgia. *Ann. Rheum. Dis.* 76 (2), 318–328 [cited 2022 Jan 22]. <https://linkinghub.elsevier.com/retrieve/pii/S0003496724028577>.

Munguia-Izquierdo, D., Legaz-Arrese, A., 2007. Exercise in warm water decreases pain and improves cognitive function in middle-aged women with fibromyalgia. *Clin. Exp. Rheumatol.* 25 (6), 823–830. <http://www.ncbi.nlm.nih.gov/pubmed/18173915>.

Nüesch, E., Häuser, W., Bernardy, K., Barth, J., Jüni, P., 2013. Comparative efficacy of pharmacological and non-pharmacological interventions in fibromyalgia syndrome: network meta-analysis. *Ann. Rheum. Dis.* 72 (6), 955–962 [cited 2025 Jun 17]. <https://www.sciencedirect.com/science/article/abs/pii/S0003496724214849>.

Oliveiras, P.R., Gusi, N., Parraca, J.A., Adsuar, J.C., Del Pozo-Cruz, B., 2011. Tilting Whole Body Vibration improves quality of life in women with fibromyalgia: a randomized controlled trial. *J Altern Complement Med* 17 (8), 723–728.

Papakonstantinou, T., Nikolakopoulou, A., Higgins, J.P.T., Egger, M., Salanti, G., 2020. CINEMA: software for semiautomated assessment of the confidence in the results of network meta-analysis. *Campbell Systematic Reviews* 16 (1), e1080.

Rivas, Neira S., Pasqual Marques, A., Fernández Cervantes, R., Seoane Pillado, M.T., Vivas Costa, J., 2024. Efficacy of aquatic vs land-based therapy for pain management in women with fibromyalgia: a randomised controlled trial. *Physiotherapy* 123, 91–101.

Rodríguez-Domínguez, Á.J., Rebollo-Salas, M., Chillón-Martínez, R., Rosales-Tristancho, A., Villa-del-Pino, I., Jiménez-Rejano, J.J., 2025. The most effective therapeutic exercises for pain intensity in women with fibromyalgia: a systematic review and network meta-analysis. *Braz. J. Phys. Ther.* 29 (4), 101226 [cited 2025 May 14]. <https://www.sciencedirect.com/science/article/pii/S1413355525000553>.

Rodríguez-Mansilla, J., Mejías-Gil, A., Garrido-Ardila, E.M., Jiménez-Palomares, M., Montanero-Fernández, J., González-López-arza, M.V., et al., 2021. Effects of non-pharmacological treatment on pain, flexibility, balance and quality of life in women with fibromyalgia: a randomised clinical trial. *J. Clin. Med.* 10 (17).

Rooks, D.S., Gautam, S., Romeling, M., Cross, M.L., Stratigakis, D., Evans, B., et al., 2007. Group exercise, education, and combination self-management in women with fibromyalgia: a randomized trial. *Arch. Intern. Med.* 167 (20), 2192–2200 [cited 2021 Nov 20]. <http://archinte.jamanetwork.com/article.aspx?doi=10.1001/archinte.167.20.2192>.

Rücker, G., Schwarzer, G., 2015. Ranking treatments in frequentist network meta-analysis works without resampling methods. *BMC Med. Res. Methodol.* 15 (1), 58. <http://www.ncbi.nlm.nih.gov/pubmed/26227148>.

- Sañudo Corrales, B., Galiano Orea, D., Carrasco Páez, L., Saxton, J., de Hoyo Lora, M., 2010. Respuesta autónoma e influencia sobre la calidad de vida de mujeres con fibromialgia tras una intervención de ejercicio físico a largo plazo. *Rehabilitación* 44 (3), 244–249. <https://linkinghub.elsevier.com/retrieve/pii/S004871201000054X>.
- Sañudo, B., Galiano, D.D., Carrasco, L., Blagojevic, M., de Hoyo, M.M.M., Saxton, J., et al., 2010a. Aerobic exercise versus combined exercise therapy in women with fibromyalgia syndrome: a randomized controlled trial. *Arch. Phys. Med. Rehabil.* 91 (12), 1838–1843.
- Sañudo, B., de Hoyo, M., Carrasco, L., McVeigh, J.G., Corral, J., Cabeza, R., et al., 2010b. The effect of 6-week exercise programme and whole body vibration on strength and quality of life in women with fibromyalgia: a randomised study. *Clin. Exp. Rheumatol.* 28 (6 Suppl. 63), S40–S45. <http://www.ncbi.nlm.nih.gov/pubmed/21122265>.
- Sañudo, B., Galiano, D., Carrasco, L., de Hoyo, M., McVeigh, J., 2011. Effects of a prolonged exercise program on key health outcomes in women with fibromyalgia: a randomized controlled trial. *J. Rehabil. Med.* 43 (6), 521–526. <https://medicaljournalsweden.se/jrm/article/view/16229>.
- Sañudo, B., Carrasco, L., De Hoyo, M., McVeigh, J.G., et al., 2012. Effects of exercise training and detraining in patients with fibromyalgia syndrome A 3-Yr longitudinal Study. *Am. J. Phys. Med. Rehabil.* 91 (7), 561–569.
- Sari, F., Sudan Aran, A., Alp, G., 2025. The psychological and physiological effects of a virtual reality-based treatment program in female patients with fibromyalgia syndrome: a randomized controlled trial. *Assist. Technol.* 37 (3), 220–228.
- Sarmento, C.V., Moon, S., Pfeifer, T., Smirnova, I.V., Colgrove, Y., Lai, S.M., et al., 2020. The therapeutic efficacy of Qigong exercise on the main symptoms of fibromyalgia: a pilot randomized clinical trial. *Integr Med Res* 9 (4).
- Sarzi-Puttini, P., Giorgi, V., Marotto, D., Atzeni, F., 2020. Fibromyalgia: an update on clinical characteristics, aetiopathogenesis and treatment. *Nat. Rev. Rheumatol.* 16 (11), 645–660. <https://www.nature.com/articles/s41584-020-00506-w>.
- Schachter, C.L., Busch, A.J., Peloso, P.M., Sheppard, M.S., 2003. Effects of short versus long bouts of aerobic exercise in sedentary women with fibromyalgia: a randomized controlled trial. *Phys. Ther.* 83 (4), 340–358. <https://academic.oup.com/ptj/article/83/4/340/2857523>.
- Sevimli, D., Kozanoglu, E., Guzel, R., Doganay, A., 2015. The effects of aquatic, isometric strength-stretching and aerobic exercise on physical and psychological parameters of female patients with fibromyalgia syndrome. *J. Phys. Ther. Sci.* 27 (6), 1781–1786. [https://www.jstage.jst.go.jp/article/jpts/27/6/27\\_jpts-2014-826/article](https://www.jstage.jst.go.jp/article/jpts/27/6/27_jpts-2014-826/article).
- Shim, S.R., Kim, S.J., Lee, J., Rücker, G., 2019. Network meta-analysis: application and practice using R software. *Epidemiol. Health.* 41, e2019013. <http://e-epih.org/journal/view.php?doi=10.4178/epih.e2019013>.
- Silva, H.J. de A., Assunção Júnior, J.C., de Oliveira, F.S., Oliveira, J.M. de P., Figueiredo, Dantas G., 2019. Sophrology versus resistance training for treatment of women with fibromyalgia: a randomized controlled trial. *J. Bodyw. Mov. Ther.* 23 (2), 382–389.
- Sterne, J.A.C., Savović, J., Page, M.J., Elbers, R.G., Blencowe, N.S., Boutron, I., et al., 2019. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 366, 14898. <https://www.bmj.com/content/366/bmj.14898>.
- Swar, W.K., 2020. Effect of underwater exercises on treating postmenopausal fibromyalgia symptoms. *European Journal of Molecular & Clinical Medicine* 661–672 [cited 2026 Jan 10];07(09). <https://www.ejmcm.com/archives/volume-7/issue-9/10398>.
- Tomas-Carus, P., Häkkinen, A., Gusi, N., Leal, A., Häkkinen, K., Ortega-Alonso, A., 2007. Aquatic training and detraining on fitness and quality of life in fibromyalgia. *Med. Sci. Sports Exerc.* 39 (7), 1044–1050.
- Tomas-Carus, P., Gusi, N., Häkkinen, A., Häkkinen, K., Leal, A., Ortega-Alonso, A., 2008. Eight months of physical training in warm water improves physical and mental health in women with fibromyalgia: a randomized controlled trial. *J. Rehabil. Med.* 40 (4), 248–252.
- Valim, V., Oliveira, L., Suda, A., Silva, L., de Assis, M., Barros Neto, T., et al., 2003. Aerobic fitness effects in fibromyalgia. *J. Rheumatol.* 30 (5), 1060–1069. <http://www.ncbi.nlm.nih.gov/pubmed/12734907>.
- Viechtbauer, W., 2007. Accounting for heterogeneity via random-effects models and moderator analyses in meta-analysis. *J. Psychol.* 215 (2), 104–121.
- Villafaina, S., Collado-Mateo, D., Domínguez-Muñoz, F., Fuentes-García, J.P., Gusi, N., 2019. Benefits of 24-Week exergame intervention on health-related quality of life and pain in women with fibromyalgia: a Single-Blind, randomized controlled trial. *Games Health J* 8 (6), 380–386.
- Wan, X., Wang, W., Liu, J., Tong, T., 2014a. Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. *BMC Med. Res. Methodol.* 14 (1), 135.
- Wan, X., Wang, W., Liu, J., Tong, T., 2014b. Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. *BMC Med. Res. Methodol.* 14 (1), 135. <https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/1471-2288-14-135>.
- Wang, C., Sun, J., Liang, Z., Cai, Y., Zhang, M., Tian, S., et al., 2025. Comparative effectiveness of exercise modalities for fibromyalgia: a systematic review and bayesian network meta-analysis. *Eur. J. Pain* 29 (9), e70109. <https://doi.org/10.1002/ejp.70109> [cited 2026 Jan 8].
- Wolfe, F., Walitt, B., Perrot, S., Rasker, J.J., Häuser, W., 2018. Fibromyalgia diagnosis and biased assessment: sex, prevalence and bias. *PLoS One* 13 (9), e0203755. <http://www.ncbi.nlm.nih.gov/pubmed/30212526>.
- Zhang, K.D., Wang, L.Y., Zhang, Z.H., Zhang, D.X., Lin, X.W., Meng, T., et al., 2022. Effect of exercise interventions on health-related quality of life in patients with fibromyalgia syndrome: a systematic review and network meta-analysis. *J. Pain Res.* 15, 3639–3656 [cited 2025 Jun 17]. <https://www.dovepress.com/effect-of-exercise-interventions-on-health-related-quality-of-life-in-peer-reviewed-fulltext-article-JPR>.