Efficacy of different exercises in women with fibromyalgia syndrome: a randomised controlled trial

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Abstract

Objective

The objective of this study was to evaluate the impact of aerobic exercise, resistance exercise combined with aerobic exercise, and yoga exercises combined with aerobic exercise on pain and disease activity in patients with fibromyalgia syndrome (FM).

Methods

The study population comprised 60 individuals with FM who met the inclusion criteria. The participants were randomly assigned to one of three groups. The first group underwent aerobic exercise (n=20), the second group combined aerobic exercise with yoga (n=20), and the third group engaged in aerobic and resistance exercise (n=20). All exercise interventions were conducted for a total of 12 weeks. Disease activity was evaluated using the Fibromyalgia Impact Questionnaire (FIQ), while pain status was assessed with the Melzack-Melzack Pain Questionnaire (MMPQ). All assessments were conducted before and following the completion of the exercise program. The clinical trial number of this study is NCT06006494.

Results

The measurements of the aerobic exercise and yoga group were significantly lower than those of the aerobic and resistance exercise group. A statistically significant difference was observed between the groups in terms of post-treatment MMPQ scores. The measurements of the aerobic exercise and yoga group were significantly lower than those of the aerobic exercise only and aerobic and resistance exercise groups. No statistically significant difference was observed between the post-treatment MMPQ scores of the aerobic and aerobic resistance exercise groups.

Conclusion

The combination of aerobic exercise and yoga is more efficacious in the treatment of FM than aerobic exercise alone or a combination of resistance exercises and aerobic exercise.

Key words

aerobic exercise, fibromyalgia, resistance training, pain, yoga

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Introduction

Fibromyalgia syndrome (FM) is defined as a chronic rheumatological disease that causes sensory changes and musculoskeletal pain. It is more prevalent in the female population (1, 2). Regarding the underlying mechanism, one group of researchers posits that hyperexcitability of the central nervous system may be the cause. In contrast, others suggest that an imbalance of neurotransmitters may be the underlying factor (3). Although numerous symptoms are associated with FM, the primary symptoms have been identified as chronic pain, fatigue, and muscle weakness (4, 5).

The management of this syndrome entails the alleviation of symptoms across various domains, including neurological and rheumatological manifestations (6, 7). Advances in the comprehension of FM have resulted in the emergence of novel therapeutic avenues for patients. Further studies are ongoing to examine the efficacy of new drugs and non-pharmacological interventions. Nevertheless, no treatment has yet been identified that is suitable for all patients with FM or for all symptoms experienced by a single patient (8). The available clinical evidence indicates that a multifaceted treatment program is the most appropriate approach for fibromyalgia syndrome. In considering non-drug treatments for fibromyalgia, there is compelling evidence to support the efficacy of cardiovascular exercise, cognitive-behavioural therapy, patient education, and combined treatments. Additionally, there is moderate evidence to suggest the efficacy of treatments such as strength training, acupuncture, hypnotherapy, biofeedback, and balneotherapy (9).

It is frequently observed that patients with fibromyalgia exhibit impaired physical fitness. It is therefore recommended that physical fitness programs be incorporated into the treatment plan (8). In general, exercise is regarded as a transformative approach to the treatment of fibromyalgia, as well as a means of achieving holistic improvement in the health of individuals affected by this condition (10). The efficacy of exercise in the treatment of fibromyalgia is contingent upon the specific characteristics of the exercise program, including its content and intensity. The combination of submaximal aerobic exercise with strengthening and stretching components has been demonstrated to elicit favourable outcomes in the reduction of symptoms and hyperalgesic response (11, 12). In individuals with fibromyalgia, a minimum of moderate-intensity exercise is deemed sufficient to elicit clinical benefits, although low-intensity exercise also yields limited benefits. Given the low exercise tolerance observed in this cohort, the performance of high-intensity exercises is not a viable option (13). In designing an exercise program for patients, it is essential to consider the importance of initiating exercise at a low intensity, gradually increasing the level of exertion, maintaining the frequency of exercise, and reducing the intensity if the patient experiences adverse reactions. Additionally, incorporating a diverse range of exercise modalities into the program is crucial for ensuring patient safety and adherence (13, 14).

Yoga can be considered as a discipline that offers a multimodal treatment approach for fibromyalgia in both physical (exercise) and psychological (coping skills) dimensions, aiming at mind-body integrity (12, 15). The fundamental elements of yoga can be distilled into three core components: breathing techniques, postures, and meditation (16). In the practice of yoga, the slowing of the respiratory rate and subsequent reduction in heart rate result in the activation of the parasympathetic nervous system, which initiates the relaxation response (17). Asanas, another component of yoga, have been reported to reduce stress, improve mood, and raise cortisol levels (18). It has been demonstrated that elevated cortisol levels are associated with enhanced mental endurance, elevated self-esteem, and greater mental stability (19). A substantial body of evidence from scientific studies indicates that yoga can lead to notable improvements in various aspects of life for individuals with FM. These include reductions in pain, stiffness, and sleep disturbances, as

well as an improvement in psychological symptoms. Furthermore, yoga has been demonstrated to have beneficial effects in numerous domains, including flexibility, strength, balance, and overall quality of life (20). Yoga is widely practiced among FM patients and is beneficial by patients (21). In the context of primary care for fibromyalgia, yoga is regarded as a promising complementary treatment approach, offering a low-cost and highly adaptable solution (22).

A review of the literature revealed that a combination of aerobic and resistance exercise may be an efficacious approach for patients with FM (23). It is plausible that all forms of exercise may contribute to the alleviation of symptoms and the advancement of overall well-being in patients diagnosed with FM (10). Combined exercise programs have been demonstrated to be an effective approach for FM, with a strong evidence base. However, further investigation is required to ascertain the efficacy of different exercise types (9, 24). This study aimed to determine the effects of aerobic exercise, combined with either resistance training or yoga, on pain and disease activity in patients diagnosed with FM.

Materials and methods

Study design

This study is a prospective, randomized controlled study with a parallel group design conducted between September and December 2023. Ethical approval was obtained from Üsküdar University Non-Interventional Research Ethics Committee (61351342/May 2023). The study complies with the Declaration of Helsinki and all participants signed informed consent. The clinical number of the study is NCT06006494.

Sample size calculation

G*Power 3.1.9.4 software was used to determine the required number of participants (25). The total number of participants was planned to be 60, with a minimum of 20 participants in each group. In the power analysis, the alpha significance level was taken as 0.05, the confidence interval as 95%, the effect size value as 0.45, and the desired power value as ß=0.80. However, to account for potential drop-outs and to obtain more valid results, a total of 67 participants were included at baseline.

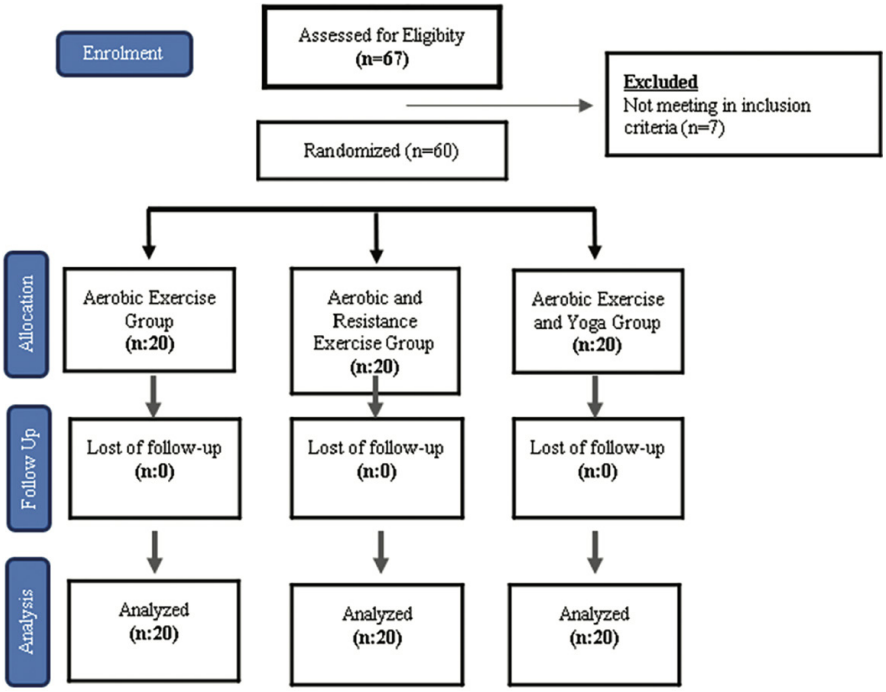

Fig. 1. CONSORT flow chart.

Randomisation and blinding

The trial was conducted according to the principles of a single-blind randomised controlled trial design. The evaluator was blinded to the study design. Participants were randomly allocated to the study groups using a simple randomised method. To ensure unbiased randomisation, the names of volunteers who met the inclusion criteria were listed on paper and placed in a container. An assessor sorted the papers into different groups using a random selection procedure. The 60 participants were divided into three groups: aerobic exercise, aerobic and resistance exercise, aerobic exercise and yoga groups. Each group had 20 participants.

Informed consent for the experiment was obtained from a total of 67 participants, whose eligibility was guided by an expert physician. Figure 1 shows the flow of participants throughout the study. The study included women, aged between 18 and 45 years, with a medical diagnosis of FM; those who met the 2016 ACR FM diagnostic criteria (26) Exclusion criteria were cognitive deficits that could affect the understanding of the assessment tools or questionnaires, uncontrolled systemic diseases such as diabetes mellitus and arterial hypertension, neurological and musculoskeletal disorders that could affect the assessment procedures such as stroke, major sensory changes, advanced joint diseases (arthroplasty or osteoarthritis), infectious diseases, receiving pharmacological treatment, and pregnancy.

Intervention and procedure

Participants were randomly assigned to three groups. The first group was an aerobic exercise group, the second group was an aerobic exercise and yoga group, and the third group was an aerobic and resistance exercise group. All three groups started the program with warm-up exercises and ended with cool-down exercises. The aerobic exercise was done 1 day a week, once a day for 30-40 minutes in the beginning, and after the first week, it was done 3 days a week, once a day for 30-40 minutes for a total of 12 weeks.

Sociodemographic information was obtained from participants who consented to participate in the study. Disease activity was assessed using the Fibromyalgia Impact Questionnaire

and pain status was assessed using the McGill Pain Questionnaire Fatigue. All assessments were made before and after the exercise program.

Treatment groups

Aerobic exercise group. All participants in the study were included in an aerobic exercise program that met the current guidelines for moderate-intensity exercise recommended for FM (27). Each aerobic exercise session consisted of an active warm-up with low-intensity exercise and dynamic stretching, aerobic exercise gradually increasing from low to moderate intensity, and a cool-down with low-intensity exercise and dynamic and static stretching. For exercise intensity, heart rate and perceived exertion rate were recorded during each session (28). Aerobic training was performed with a treadmill in the physiotherapy clinic. Participants completed a 10-minute warm-up, 20 minutes of aerobic exercise (50-60% of estimated maximum heart rate: perceived exertion ratio 11-13 (6 (no effort) to 20 (maximal effort)) and a 10-minute cool-down during the first week of the program. In subsequent weeks, the intensity was gradually increased according to the patient's tolerance (29). In weeks 10 to 12 of the program, participants engaged in 40 minutes of aerobic exercise at a level corresponding to 60-80% of their estimated maximum heart rate. The exercise program was individually tailored to each participant, and all sessions were conducted under the supervision and guidance of a physiotherapist.

Aerobic and resistance exercise group. Individuals allocated to the aerobic and resistance exercise groups were subjected to a 40-minute resistance exercise program two days per week, in addition to the program applied to the aerobic exercise group. This was conducted under the supervision of a physiotherapist.

The resistance exercise program commenced with a 10-minute warm-up period, followed by 50 minutes of resistance training exercises targeting the major muscle groups in the four extremities and the trunk. The resistance exercise program commenced at 40% of one repetition maximum (RM) and progressed to 80% of one repetition maximum for 12 weeks. The progression of loads was evaluated at three- to four-week intervals and subsequently adjusted on an individual basis (30).

Aerobic exercise and yoga group. Individualised yoga programs were provided to participants randomized to the aerobic exercise and yoga groups for an average of 40 minutes, two days per week, in addition to the program applied to the aerobic exercise group. These programs were supervised by a physiotherapist.

The yoga program was equipped with a variety of supportive items, including a mat, blankets, eye pillows, and supports. The movements were performed in a fixed posture for a period of between 15 seconds and two minutes. The yoga poses were presented in a single sequence, with versions that could be performed in or out of a chair. Additionally, the sequence included meditation and breathing exercises, as well as yoga-based coping methods. The yoga sequence comprised a variety of elements, including preparatory exercises, self-massage, the mountain pose with sun arms, the table pose, the warrior 1 flow, the breath of joy, the downward-facing dog on the chair, the chair pose, the sphinx pose, the child's pose, the modified locust pose, the supine core strengthening pose, the supine thoracic twist flow, the supine pigeon pose, the bridge pose, the corpse pose and the knees to chest pose (31).

Outcome measures

In this study, disease activity was evaluated using the Fibromyalgia Impact Questionnaire, while pain status was assessed with the McGill Pain Questionnaire. Additionally, sociodemographic data, including age, height, body weight, and marital status, were recorded. All assessments were conducted before and after the completion of the exercise program.

Fibromyalgia Impact Questionnaire (FIQ). The FIQ, which has been validated and demonstrated reliability in Turkish for female individuals with FMS, consists of 10 items (32). The initial section comprises 11 Likert-type questions. The responses to these questions are graded on a scale of 0 to 3 and subsequently averaged. The second item inquires as to the number of days in the previous week during which the patient reported feeling well. To ensure consistency and comparability, the answer to this item is reverse scored, with a value of 7 assigned to 0 days and a value of 0 assigned to 7 days. The third item enquires as to the number of days in the previous seven-day period during which the patient was unable to work. The scores obtained from the first three items are then normalised. The score obtained from the initial item is multiplied by 3.3, while the scores derived from the subsequent two items are multiplied by 1.4. The remaining seven items were designed to assess the severity of symptoms, pain, fatigue, waking without rest, stiffness, anxiety, and depression, with respondents invited to indicate their level of discomfort on a 10-point Visual Analogue Scale. Responses to these questions are used to calculate a score on a scale of 0 to 100 (32). The mean score for a patient with fibromyalgia is 50, with a higher score indicating greater physical disability.

McGill Melzack Pain Questionnaire (MPQ). The MPQ, developed by Melzak and Targerson in 1975, is a comprehensive tool comprising four components designed to assess the pain experienced by the individual in question. The initial component of the assessment entails the identification of the specific locations on the body where the subject is experiencing pain. The second part of the assessment entails the selection of descriptive word groups that correspond to the pain being experienced. The third section of the assessment tool investigates the temporal characteristics of pain. The fourth component of the MPQ assesses the intensity of pain using a Likert-type scale (33). The scale comprises unambiguous questions that evaluate the intensity of pain as follows: severe, moderate, mild, and no pain (34). The scoring system ranges from 0 to 112. A higher score is

indicative of an increase in pain and associated parameters (35, 36).

Statistical analysis

Once the findings of the study had been collated, the SPSS 24.0 (Statistical Package for the Social Sciences) program was employed for the purpose of statistical analysis. In the process of evaluating the study data, quantitative variables were presented with mean, standard deviation, median, minimum, and maximum values, while qualitative variables were illustrated with descriptive statistical methods, such as frequency and percentage. The suitability of the data for normal distribution was evaluated using the Shapiro-Wilks test and box plot graphs. The Kruskal-Wallis test was employed for the evaluation of variables exhibiting non-normal distribution across three groups, while the Dunn test was utilized for post hoc assessments. Comparisons of postoperative scale scores according to preoperative groups were evaluated using the Wilcoxon signed-rank test. The Fisher-Freeman-Halton test was employed for the evaluation of qualitative measurements. The results were evaluated at the 95% confidence interval and with a significance level of $p<0.05$.

Results

The variables of age, height, body weight, and body mass index, as well as marital status, are presented in Table I for each group. No statistically significant differences were observed between the age, height, body weight, body mass index, and marital status variables of the 60 participants included in the study ($p>0.05$).

FIQ did not show a significant difference between the groups before treatment ($p=0.468$; $p>0.05$). Post-treatment FIQ scores were found to be statistically significant within ($p<0.05$) and between the groups ($p=0.002$; $p<0.01$). The analysis of the significance revealed that the measurements of the aerobic exercise and yoga group were found to be significantly lower than those of the aerobic and resistance exercise group ($p=0.002$; $p<0.01$). No significant difference was found between the other groups ($p>0.05$) (Table II).

Table I. Socio-demographic information of the participants.

Variables		Aerobic exercise group (n:20)	Aerobic and resistance exercise group (n:20)	Aerobic exercise and Yoga group (n:20)	p^a
		X±SD	X±SD	X±SD	
Age (years)		25.4±1.7	25.1±3.6	24±2.9	***0.253***
Height (cm)		165.2±3.1	162.4±3.6	166.8±6.2	***0.360***
Weight (kg)		63.4±3.8	62.2±7.9	64.2±5.2	***0.771***
BMI (kg/m²)		23.2±0.9	23.5±2.1	23.1±1.4	***0.968***
		n(%)	n(%)	n(%)	
Marital status	Married	12(60)	12(60)	16(80)	
	Single	8(40)	8(40)	2(20)	

*$p<0.05$.
a: Kruskal Wallis Test; X: mean; SD: standard deviation; n: number of individuals; cm: centimetre; kg: kilogram; m: meter; %: percentage; BMI: body mass index.

Table II. Results of Fibromyalgia Impact Questionnaire, McGill Melzack Pain Questionnaire.

Variables		Aerobic exercise group (n:20)	Aerobic and resistance exercise group (n:20)	Aerobic exercise and Yoga group (n:20)	
		X±SD (Min-Max)	X±SD (Min-Max)	X±SD (Min-Max)	p^b
FIQ	BI	55.3±9.4 (44.5-66.2)	60.7±1.5 (58.3-61.9)	63.9±6.8 (57.7-71.8)	***0.468***
	AI	27.9±2.3 (24.1-30)	44.5±2.7 (42.1-47.9)	17.4±6.1 (10.8-26.4)	***0.002****
	p^c	***0.042****	***0.034****	***0.043****	
	AI-BI	27.47±8.15	16.17±2.40	46.44±4.30	
MMPQ	BI	75.8±1.6 (74-78)	72.6±7.1 (61-78)	71.0±7.9 (57-76)	***0.408***
	AI	54.4±2.7 (52-59)	61.6±6.1 (53-69)	34.8±3.1 (30-38)	***0.004****
	p^c	***0.042****	***0.042****	***0.041****	
	AI-BI	21.40±1.52	11.00±6.08	36.20±5.16	

**$p<0.01$; b: Kruskal Wallis test, *$p<0.05$; X: Mean, c: Wilcoxon Signed Rank test.
SD: standard deviation; n: number of people; Min: minimum; Max: maximum; BI: before intervention; AI: after intervention; FIQ: Fibromyalgia Impact Questionnaire, MMPQ: McGill Melzack Pain Questionnaire.

MMPQ pre-treatment measurements did not show significant difference between the groups ($p=0.408$; $p>0.05$). Post-treatment MMPQ scores were statistically significant between the groups ($p=0.004$; $p<0.01$). The results demonstrated that the measurements of aerobic exercise and yoga groups were significantly lower than those of the aerobic exercise-only group ($p=0.040$; $p=0.001$). However, no significant difference was observed between the post-treatment MMPQ scores of the aerobic and aerobic and resistance exercise groups ($p>0.05$) (Table II).

Discussion

The objective of this study was to evaluate the impact of aerobic exercise, combined with or without resistance training, and yoga, in conjunction with or in addition to aerobic exercise, on pain and disease activity in individuals diagnosed with FM. The findings indicated that all three treatment groups demonstrated a reduction in pain and disease activity scores following the intervention. Furthermore, a comparison between the three groups revealed that the scores of the aerobic exercise and yoga group exhibited a more pronounced improvement compared to the

aerobic exercise only and aerobic and resistance exercise groups.

Previous studies have revealed several advantages of exercise therapy for patients with FM (37, 38). Such benefits include enhanced cardiovascular fitness, augmented muscle strength, improved flexibility, and superior overall physical functioning (39). It is widely acknowledged that aerobic exercises play an integral role in maintaining optimal cardiovascular health. Similarly, resistance training has been demonstrated to enhance muscle strength and flexibility, while improving range of movement (40, 41). These developments collectively facilitate more efficacious FM management, aligning with the recommendations set forth by the American College of Sports Medicine (ACSM) (42). The efficacy of exercise therapy in the treatment of FM has been extensively investigated and endorsed due to its convenient administration, low cost, and long-term efficacy (43). Nevertheless, the level of exertion can influence the efficacy of treatment and the optimal methodology for exercise remains undetermined (44).

It can be posited that exercise plays a role in the comprehensive treatment of FM. Moreover, there is currently no cur for FM; rather, the objective of treatment is to provide long-term relief of symptoms (42). It can be reasonably deduced that patients with FM will require long-term treatment. Among the numerous treatment options available, exercise is notable for its lack of adverse effects and its capacity to enhance patients' physical fitness while providing more enduring symptom alleviation. Pain is the primary symptom of FM and is identified as the main diagnostic criterion. The prevailing view attributes the pain associated with FM primarily to the central nervous system (44). It has been demonstrated that exercise can exert a central analgesic effect, thereby providing relief from chronic pain (45). The findings of our study indicate that post-treatment pain reduction was observed in all exercise groups. It is hypothesised that this improvement in pain reduction can be attributed to movement-based interventions that increase muscle strength and decrease muscle loss and regular participation in exercise in all groups. The acquisition of strength represents an efficacious strategy for the management of pain in patients with FM (46). Moreover, exercise has been demonstrated to stimulate the production of endogenous opioids and β-endorphins, which have been shown to activate decreased nociceptive inhibitory mechanisms, thereby resulting in hypoalgesia (47).

A comprehensive indicator such as the FIQ encompasses a range of secondary symptoms, including physical function, occupational status, depression, anxiety, stiffness, fatigue, pain, and happiness (48). The results of our study demonstrated a statistically significant improvement in the FIQ, which assesses secondary symptoms, following treatment in all exercise groups. Each type of exercise exerts a therapeutic effect on FM. Our findings are consistent with those of previous meta-analyses of randomised controlled trials, including those that have analysed a large number of studies and demonstrated the efficacy of aerobic exercise (44). The findings of our study corroborate the notion that various forms of exercise, including aerobic, combined aerobic and resistance, and yoga programs incorporating both aerobic and flexibility components, can exert beneficial therapeutic effects on the disease activity associated with FM.

Trials investigating the effects of exercise and body awareness therapies (flexibility exercises, tai chi, yoga, Pilates) in people with FM have generally been conducted in female populations. The proportion of female participants in these studies varies from 73% to 100% (49). However, the total duration of treatment varied from 1 to 32 weeks and the frequency of treatment was reported as a minimum of one day per week and a maximum of three days per week (49). The range of treatment duration varied from 1 week (50) to 32 weeks, with the minimum and maximum treatment frequency being one day per week and three days per week, respectively (49). The sample of the present study consisted entirely of female participants and the duration and frequency of the yoga exercise program was similar to previous studies in the literature. Bravo *et al*. found positive results in the treatment of FM symptoms with exercise and body awareness therapies, finding significant improvements in pain levels immediately after testing and functional limitation on the FIQ score six weeks after treatment (51). Exercises based on movement and body awareness have been reported to have a moderate to high effect size in reducing pain (52). Meditative movement therapy had a positive effect on sleep disturbance, fatigue, depression and health-related quality of life, and these effects were maintained for 4.5 months (53). There was a significant improvement in pain, quality of life and physical condition with stretching (54). In our study, the aerobic exercise + yoga group was superior to the aerobic exercise + resistance exercise group in reducing disease activity and superior to both groups in reducing pain. This may be explained by both the proven effectiveness of aerobic exercise in patients with this diagnosis and the relaxation response produced by the movement and body awareness, flexibility and meditation components of yoga in people with FM.

When analysing the trials conducted in people with FM, the frequency and duration of aerobic exercise varied between 3-5 sessions per week and 6-24 weeks (49). Exercise interventions have been reported to have positive effects on pain, multidimensional function, and self-reported physical function (55).

The most frequently analysed combined exercise modalities were aerobic and resistance training, as reported by Andrade et al. The findings indicated that moderate to high-intensity aerobic exercise twice a week increased heart rate and reduced autonomic dysfunction. Conversely, resistance training was associated with an increase in muscle strength as well as a reduction in symptoms of anxiety and depression. However, the results did not demonstrate a reduction in autonomic dysfunction in the short or long term (56). This conclusion is supported by

the analysis of Cerrillo Urbina *et al*., who found that exercise programs have a positive effect on FMS symptoms in perimenopausal women (57). The results of the meta-analysis indicated that combined exercise and aquatic exercise programs had a moderate and small effect on global functional well-being respectively. It can be posited that short-term interventions may prove efficacious in the alleviation of symptoms experienced by perimenopausal women with fibromyalgia. Bidonde *et al*. conducted a comparative analysis of combined exercise interventions with a non-exercise control group and other exercise interventions. The findings indicated that combined exercise resulted in improved outcomes, reduced pain, fatigue, stiffness, and enhanced physical function when compared to the control group (58). In the design of the present study, combined exercises were evaluated as a comparison group against aerobic exercise. The findings demonstrated that the effectiveness of yoga exercises combined with aerobic exercise was superior. These findings corroborate the efficacy of a combined exercise program for FM and may indicate that a diverse exercise program could be a valuable addition to the management of syndromes with disparate symptoms.

A recent review of the literature revealed evidence of a positive effect of physiotherapy treatment on the signs and symptoms of FM, including pain, impaired physical capacity, and poor quality of life (49). The most extensively examined and utilised active intervention is movement and body awareness therapy, which has been demonstrated to result in notable reductions in pain intensity and functional limitations as reflected in the FIQ score over the medium to long term (51, 59). Furthermore, aerobic exercise was observed to exert a moderate influence on the long-term enhancement of multidimensional pain and physical functionality (55). In comparison to pharmacological treatments, active therapies are a more cost-effective option and are straightforward to integrate into routine clinical practice (51). Moreover, the low incidence of adverse effects associated with these therapeutic modalities renders them a relatively low-risk option for the management of FM (52). The combination of exercises was found to have a beneficial effect on several health-related outcomes, including symptoms, physical function, pain, fatigue, and quality of life (49).

A high level of adherence to an exercise program has been linked to enhanced physical health outcomes, thereby underscoring the significance of adhering to structured exercise guidelines (60). The classification system provides a framework for the assessment of the efficacy of exercise programs that are designed to align with the specific capabilities and constraints of the individual (60). In order to gain a more comprehensive understanding of the role of exercise therapy in the management of FM, it is essential to consider the therapeutic benefits of different exercise modalities in accordance with the guidelines set forth by the American College of Sports Medicine (ACSM) (60). It is proposed that adherence to these guidelines will optimise the various effects of aerobic, resistance, and flexibility exercises, thereby facilitating comprehensive improvements in health, pain relief, sleep, and fatigue management (60). It was emphasised that future treatment of patients with FM should include movement-based interventions in conjunction with other therapeutic modalities in order to optimise the management of FM and improve patients' mental health (60). In this context, our study is distinctive in that it compares the efficacy of combined exercise treatments.

It should be noted that the present study is not without limitations. The first limitation pertains to the outcome measures, which were limited to self-reported scales. The direct effects of exercise programs were not evaluated within the scope of this study. A second limitation is the absence of follow-up findings after the conclusion of the exercise programs. Consequently, the duration of the positive effects of the exercises remains unreported. It would be beneficial to ascertain the duration for which the positive effects of exercise programs are maintained. Thirdly, other sociodemographic information (including education, employment status, marital status, race/ethnicity, as well as clinical conditions such as year since diagnosis, medications, and other medical histories) was not collected in this study. Furthermore, post-exercise follow-up is recommended for future studies. In the majority of studies, various combined treatment programs were excluded to maintain the integrity of the exercise therapy (44). To the best of our knowledge, this is the first study to investigate the efficacy of aerobic exercise in conjunction with resistance training and aerobic exercise in conjunction with a yoga program on pain and disease activity in individuals with FM. It is crucial to gain insight into the impact of diverse exercise modalities and combinations on FM, as this will facilitate the diversification of treatment approaches and the individualisation of treatments. The findings of our study may contribute to the development of more effective and holistic approaches to FM.

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