Bachelor's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Neuromedicine and Movement Science

Siri-Elise Torvik Espenakk
Pernille Gimnes Karlsen
Hedwig Maria Samuelsson

The Effect of Physical Exercise on Pain and Symptoms amongst Women with Fibromyalgia

Bachelor's thesis in Human Movement Science
Supervisor: Paul Jarle Mork
May 2023

NTNU
Norwegian University of
Science and Technology

Siri-Elise Torvik Espenakk
Pernille Gimnes Karlsen
Hedwig Maria Samuelsson

The Effect of Physical Exercise on Pain and Symptoms amongst Women with Fibromyalgia

Bachelor's thesis in Human Movement Science
Supervisor: Paul Jarle Mork
May 2023

Norwegian University of Science and Technology
Faculty of Medicine and Health Sciences
Department of Neuromedicine and Movement Science

NTNU
Norwegian University of
Science and Technology

Abstract

Objective: The aim of this study was to investigate the effectiveness of physical exercise on symptoms and pain amongst women with fibromyalgia.

Design: Studies retrieved from PubMed were systematically reviewed. Randomized controlled trials involving women aged 18-79 years were included. The primary outcomes considered in this systematic review were symptoms and pain, and it was measured using FIQ-total, FIQ-pain and VAS.

Results: Eight studies were included. FIQ was the most used outcome. Physical exercise showed a positive effect on symptoms and pain for the intervention groups compared to the control groups. The effects were significant in six of the studies.

Conclusion: Physical exercise is more effective on pain and symptoms amongst females with fibromyalgia than usual care. However, more research is needed to determine which type of exercise and modality is the most effective.

Abstrakt

Objektiv: Målet med studien var å undersøke hva slags effektiv fysisk trening har på smerte og symptomer hos kvinnelige pasienter med fibromyalgi.

Design: Studiene hentet fra PubMed ble systematisk gjennomgått. Randomiserte kontrollerte studier med kvinnelige deltakere i alderen 18-79 år ble inkludert. Utfallsmålene som ble vurdert i dette systematiske litteratursøket var smerte, og ble målt med bruken av FIQ-total, FIQ-smerte og VAS.

Resultater: Åtte studier var inkludert. FIQ var det mest brukte utfallsmålet. Fysisk trening viste en positiv effekt på symptomer og smerte for intervensjonsgruppen sammenliknet med kontrollgruppen. Effektene var signifikante i seks av studiene.

Konklusjon: Fysisk trening er effektiv mot smerte og symptomer hos kvinner med fibromyalgi. Ytterligere, er mer forskning nødvendig for å konstatere hvilken type trening og modalitet som er mest effektiv.

Key words: Fibromyalgia • Exercise • Fatigue Syndrome • Aerobic Exercise • Pain • Training

1. Introduction

Fibromyalgia (FM) is a chronic pain syndrome defined by widespread muscle pain and multiple tender points. It is considered a disorder of pain regulation, as indicated by increased sensitivity to painful stimuli and lowered pain threshold (1). Furthermore, symptoms like fatigue, muscle stiffness, sleep disturbance, headache, pain catastrophizing, depression and cognitive difficulty are commonly present in patients with FM, as well as reduced levels of physical function and daily activities. Pain acceptance is lower and causes a negative cognition in relation to daily activities such as walking, lifting, and carrying objects (1).

FM has a prevalence of 1-3% in the general population, increasing with age, and has a greater prevalence amongst women (2). Women encompass 75-90% of the diagnosed (3). A FM diagnosis has classically been dependent on an evaluation of "tender points," or areas of tenderness around joints, who are assessed to determine whether the subject can be diagnosed (3). Women tend to report more tender points and more intense pain than men (3). Therefore, the greater prevalence in women have attributed to this criterion. These individuals are often sedentary, with functional capacity similar to elder individuals (4). Furthermore, the disorder has also been linked with a higher prevalence of overweight and obesity than in the general population.

Amongst women diagnosed with FM, there is a high prevalence of comorbidities, which results in increased needs for appropriate medical management, which again results in higher healthcare resource utilization (5,6). There is a direct link between health care costs and severity of FM symptoms documented (1). Patients with FM often have a low working capacity and a low level of education, which could be due to higher levels of fatigue and limitations (3). This increases the unemployment amongst patients with FM, which has a negative effect both for the individual and society (2). Effective therapeutic and medical treatment is costly for the general society (1).

Many women diagnosed with FM report lack of physical exercise due to pain catastrophizing and anxiety (1). Pain catastrophizing is a psychosocial construct, which includes cognitive and emotional processing, and is associated with pain severity and disability. Thus, pain catastrophizing can have a negative impact on daily living amongst women with FM (1). Cognition and psychological aspects such as depression, anxiety, stress, and pain perception has also been

displayed as symptoms improving with the implementation of physical exercise. The main treatment of FM is based on pharmacological treatment with greater side effects and lower acceptance than non-pharmacological therapy like physical exercise (1). Physical exercise has been shown to be effective for improving health and quality of life (4). Physical exercise is defined as physical activity that is planned, structured, and repetitive for the purpose of conditioning any part of the body to develop or maintain physical fitness and overall health (7). Research provided by Busch et al. (8), recommend low to medium intensity activities such as walking and swimming. On a general basis, this population should start slowly and regulate the exercise level and intensity at a comfortable pace. Exercise has shown positive outcomes in both physical and psychological symptoms. Implementation of resistance training and aerobic exercises have a positive effect on the physical conditioning in neuromuscular-, cardiovascular-, and functional capacity (7). Physical exercise often provides beneficial effects on pain, cognitive distress, functional fitness and capacity, and other related symptoms (1). Therefore, this systematic review aims to investigate the effects of physical exercise on symptoms and pain amongst women with FM.

2. Methods

This systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines checklist. A systematic search was carried out by one author using the database: PubMed from 2008 until the 3rd of March 2023. The search strategy can be found in table 1. In addition to the keywords found in the table, filters such as randomized controlled trial, clinical trial and females were utilized, which resulted in 151 papers. The title and abstract of the papers were reviewed for relevance, those not relating to physical exercise as an intervention for pain as primary or secondary outcome amongst women with FM, were excluded. The remaining papers were read in full text and the following eligibility criteria were then applied.

We included papers who fulfilled the inclusion criteria: 1) Women between 18-79 years old with FM, 2) physical exercise as intervention, 3) American College of Rheumatology (ACR) classification for FM, 4) Fibromyalgia Impact Questionnaire (FIQ) or Visual Analogue Scale (VAS) as one of the outcome variables for pain. Exclusion criteria utilized to find relevant papers were 1) the intervention was less than 8 weeks, 2) other treatment methods were used in addition,

3) < 2 training sessions per week, 4) the study was written in other languages than English or Norwegian, 5) other study design than randomized clinical/controlled trial, 6) not free full text.

FIQ is a disease-specific self-reported 21 questionnaire designed to assess the disease effect over 10 dimensions ranging from 0 (no effect) to 10 (maximum effect) (9). VAS is a subjective measure, in which the VAS score is determined by measuring the distance from 0 cm to 10 cm, in which 0 = no pain, and 10 = the most intense pain imaginable.

Table 1: Search strategy on PubMed

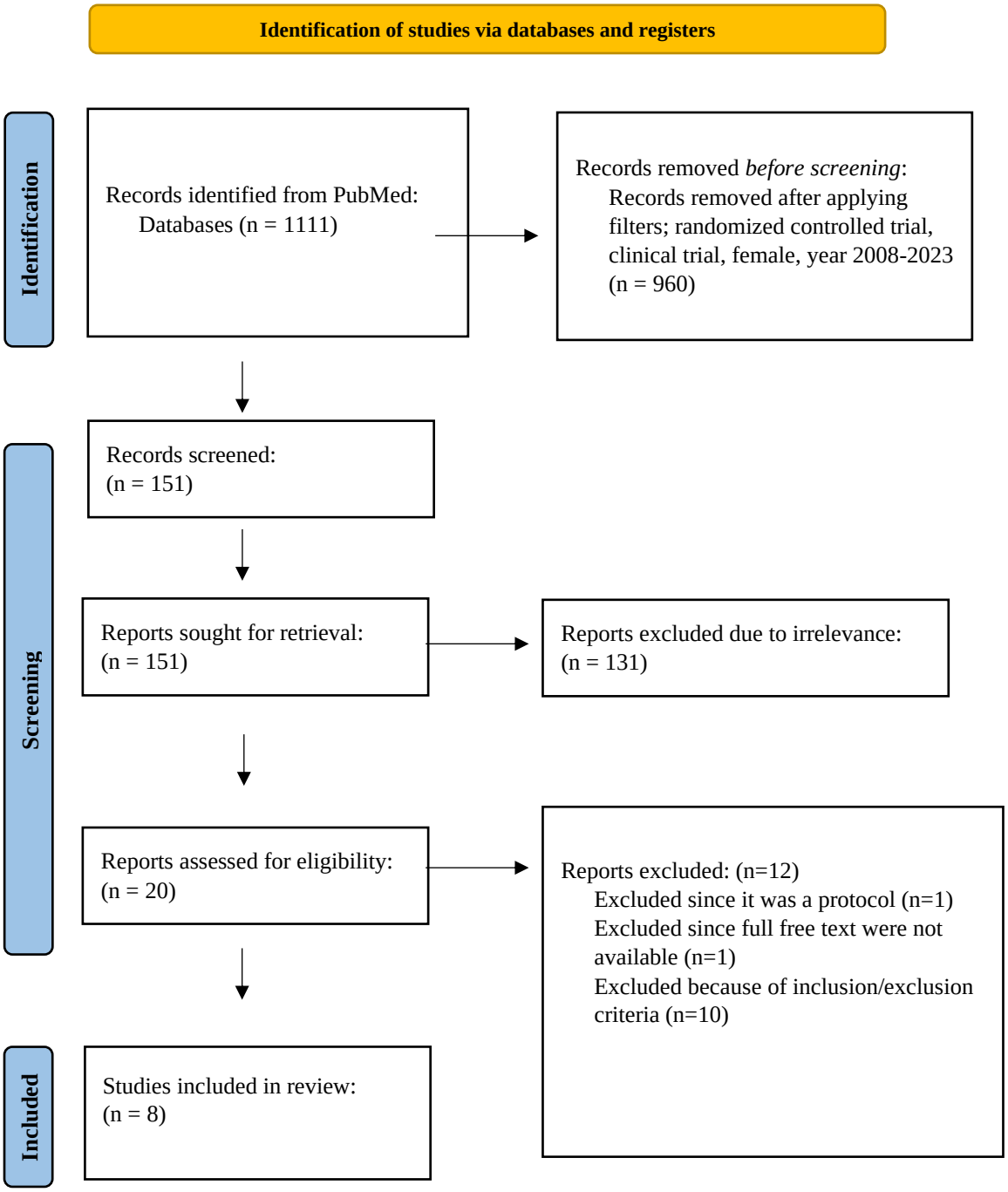
Search number	Search terms
Search #1	"fibromyalgia" (MeSH) OR "fatigue syndrome, chronic" (MeSH) OR "fibromyalgia" (all fields)
Search #2	"exercise" (MeSH) OR "physical exercise" (all fields) OR "physical activit*" (all fields) OR "aerobic exercise*" (all fields) OR "training" (all fields) OR "endurance training" (all fields) OR "strength training" (all fields) OR "resistance training" (all fields)
Search #3	"pain" (MeSH) OR "pain*" (all fields) OR "ache" (all fields)
Search #4	Search #1 AND search #2 AND search #3

MeSH: Medical subject headings

3. Results

Initial search yielded a total of 1,111 papers, of which 960 were excluded after applying filters. Screening of title and abstract resulted in exclusion of 131 of the 151 initial search results. After reading the full text of the remaining 20 articles, 12 were excluded, which makes the final papers included in the review eight. The procedure of screening and exclusion can be found in figure 1.

Figure 1: PRISMA flowchart



3.1 Study characteristics

The eight studies included in the review recruited together 418 participants and the mean number of participants in each study was 52.25 (range 30-90). The baseline characteristics were recorded in table 2 and include the study design, number of participants, mean age, standard deviation (SD) and body mass index (BMI). Two of the studies were conducted in Brazil, four in Spain, one in South-Korea and one in Portugal.

Table 2: Baseline characteristics of the study population.

Source (Author, year)	**Study design**	**Groups and no. of participants (n)**	**Age Mean ± SD**	**BMI (kg/m^2) Mean ± SD**
Tomas-Carus et al. (2008)	RCT (2-arm)	Exercise group (n) = 15 Control group (n) = 15 Total (n) = 30	50.7 ± 10.6 50.9 ± 6.7	28.8 ± 4.5 26.6 ± 3.5
Sanudo et al. (2010)	RCT (3-arm)	Aerobic exercise (n) = 22 Combined group (n) = 21 Control group (n) = 21 Total (n) = 64	55.9 ± 1.6 55.9 ± 1.7 56.6 ± 1.9	29.6 ± 1.1 27.6 ± 1.1 29.7 ± 1.1
Kayo et al. (2012)	RCT (3-arm)	Walking programme (n) = 30 Muscle-strength (n) =30 Control group (n) = 30 Total (n) = 90	47.7 ± 5.3 46.7 ± 6.3 46.1 ± 6.4	26.3 ± 4.5 26.2 ± 4.8 26.7 ± 4.9
Román et al. (2015)	RCT (2-arm)	Exercise group (n) = 20 Control group (n) = 19 Total (n) = 36	51.70 ± 9.5 50.25 ± 8.83	26.20 ± 7.51 26.49 ± 4.08
Collado-Mateo et al. (2017)	RCT (2-arm)	Exercise group (n) = 42 Control group (n) = 41 Total (n) = 83	52.52 ± 9.73 52.47 ± 8.75	BMI not included.
Wong et al. (2018)	RCT (2-arm)	Exercise group (n) = 17 Control group (n) = 14 Total (n) = 31	51 ± 2 51 ± 2	23.1 ± 0.5 22.2 ± 0.6
Assumpção et al. (2018)	RCT (3-arm)	Stretch (n) = 14 Resistance (n) = 16 Control group (n) = 14 Total (n) = 44	47.9 ± 5.3 45.7 ± 7.7 46.9 ± 6.5	28.9 ± 4.2 28.1 ± 28.1 29.4 ± 4.8

RCT: Randomized-control trial, SD: Standard deviation, BMI: Body mass index.

3.2 Study interventions

The studies reviewed consisted of either three groups (two exercise groups and one control group) or two groups (intervention group and control group), and only included women. Three of the studies consisted of three groups, and five consisted of two groups. Eleven different interventions were examined across the studies, which involved various types of aerobic exercise, resistance training, and stretching. The control groups received no intervention or exercise other than continuance of usual care. The studies utilized different outcome measures. Six studies included different versions of FIQ, and five studies included VAS. All the results are represented in table 3, which can be found in appendix 1.

Tomas-Carus et al. (10) conducted a study with 30 women with FM to evaluate the effect of an 8-month exercise intervention on their physical and mental health, using FIQ-pain and FIQ-total. The participants were randomized into an exercise group and a control group. The exercise group underwent supervised training in a waist-high pool of water three times per week for an hour. The exercise sessions involved warmup, aerobic- and strength exercises, and a cool-down. The difference between the exercise group and the control group was 0.5 for FIQ-pain, and 1.1 for FIQ-total. As seen in table 3, improvements for FIQ-pain and FIQ-total between intervention and control were significant at the end of the intervention period at 32 weeks.

Sanudo et al. (11) studied the effects of supervised aerobic exercise and a combination of supervised aerobic, muscle strengthening, and flexibility exercises on important health outcomes in 64 women with FM. Participants were randomly assigned to one of three groups; supervised aerobic exercise, supervised combined exercise, or a control group. The exercise groups trained twice a week for 45-60 minutes per session over a 24-week period. The study evaluated FIQ-total before and after the 24 weeks of exercise. Both intervention groups had an 8.8-point reduction in FIQ-total scores, while the control group had no difference from baseline; meaning, there was an 8.8 FIQ-total score difference between the intervention group and the control group. There were no reported mean differences between the groups, therefore, no significant differences can be reported.

Kayo et al. (12) investigated the effectiveness of single modalities of physical exercise in reducing pain in 90 women with FM. The participants were randomized into one of three groups; muscle-

strengthening exercise, walking program or a control group. Exercises were performed three times a week for 60 min/session for 16 weeks. The intervention ended at week 16, with a follow-up period until week 28. Both VAS and FIQ-total were conducted in weeks 8, 16 and 28. As seen in table 3, there was a significant reduction in FIQ- and VAS-score for the intervention groups compared to the control group at week 16.

The study conducted by **Román et al.** (13) aimed to investigate the impact of a functional training program, which included in-water and on-land exercises on pain, strength, and balance in woman diagnosed with FM. A total of 36 women with FM were included in the study and were randomized into either an exercise group or a control group. The exercise sessions were performed for 60 minutes, three times per week, for 18 weeks. Of the three weekly sessions, two consisted of exercise in water and one exercise on land. Each session included a warm-up, muscular strengthening exercises, balance, and a cool-down. The assessment of pain was evaluated using the FIQ-total and VAS and was measured before and after the 18-week intervention period. There was 5.68 more reduction in FIQ-total, and 2.487 cm more reduction in VAS, in the exercise group compared to the control group. As seen in table 3, a significant reduction in VAS- and FIQ-score between the intervention group and the control group was found.

Collado-Mateo et al. (14) evaluated the effects of Virtual Reality exergame-based intervention on the effects of pain on 83 women with FM. The participants were randomized into either an exercise group or a control group. The exercise group underwent exercise sessions twice weekly, lasting 60min/session, for an 8-week period. The training program focused on postural control and coordination of the upper and lower limbs, aerobic conditioning, strength, and mobility. The assessment of symptoms and pain was evaluated using FIQ-total, FIQ-pain, and VAS. There was 2.07 points more reduction in the exercise group compared to the control group in FIQ-pain, and 8.25 points more reduction in FIQ-total. There was 0.65 cm reduction in VAS for the exercise group compared to the control group. As seen in table 3, there were significant differences between intervention and control groups for all outcome measures at 8 weeks.

The study conducted by **Wong et al.** (15) aimed to evaluate the effects of tai-chi training on symptoms in women with FM. A total of 31 women with FM were included in the study and were

randomized to either an exercise group or a control group. The exercise sessions were carried out three times weekly for a 12-week period. The assessment of pain was evaluated using VAS as an outcome. VAS was measured before and after the 12-week intervention period. The exercise group had 1.9 cm more reduction in VAS compared to the control group at week 12, and as seen in table 3, the difference is significant.

In the study by **Assumpção et al.** (16), the efficacy of stretching and strengthening exercises on symptom relief and quality of life in 44 women with FM was examined. The participants were randomly assigned into one of three groups; strengthening group, stretching group or control group. The sessions consisted of 40-minute workouts, twice weekly for a 12-week period. The strengthening group focused on progressive overload, while the stretching group performed active stretching and increased stretch intensity gradually to discomfort. Pain levels were assessed using the FIQ-pain, FIQ-total and VAS questionnaires, which the participants completed before and after the 12-week intervention period. Beneficial effects were reported within both intervention groups, but as seen in table 3, there were no significant differences between them and the control group.

Hernando-Garijo et al. (17) investigated the immediate impact of a telerehabilitation program on pain in a group of 34 women with FM. The participants were randomly assigned to either an exercise group or a control group. The exercise program consisted of 55-minute sessions, twice a week for 15 weeks. The exercise group performed a selection of aerobic exercises guided by video, and the sessions consisted of low-impact rhythmic movements. Pain levels were evaluated using the FIQ-R and VAS questionnaires, which the participants completed before and after the 15-week intervention period. There was 6.98 points more reduction in the exercise group compared to the control group in FIQ-R, and 1.33 cm more reduction in VAS for the exercise group compared to the control group. As seen in table 3, the VAS score showed significant differences. However, there were no significant differences in FIQ-R scores between the intervention group and control group.

4. Discussion

The eight included studies were used to investigate the effects of physical exercise on pain and symptoms amongst women with FM. According to our research, exercise has a positive effect on pain and symptoms amongst women with FM. However, Assumpção et al. (16) and Sanudo et al.

(11) were the only studies who did not have any significant improvement on pain and symptoms between intervention groups and control group after the exercise interventions. Sanudo et al. (11) reported results within the groups but did not compare the results to the control group, therefore it is difficult to determine the effect of the intervention. Assumpção et al. (16) did not show any significant differences in the Analysis of variance test (ANOVA) and therefore did not perform a post-hoc test for FIQ-pain, FIQ-total and VAS. This makes it difficult to determine the effect between the intervention groups and the control group on symptoms and pain.

For our study selection, there are three different types of FIQ: FIQ, FIQ-R and the Spanish version of FIQ. FIQ is one of the most frequently used tools for evaluating FM (9). We decided to use the three versions due to its comparability and only consisting of some modifications from the original version. The revised FIQ (FIQ-R) was used in the study by Hernando-Garijo et al. (17). It has the same scoring measurements as the original FIQ but have modified some of the questions to make it more specific and focuses more on the domain of function. The two versions are correlated, and the results can therefore be compared to each other (9). Tomas-Carus et al. (10) used a Spanish version of FIQ which is a translated version of the FIQ-R. It is a valid and reliable method for assessing FM in Spanish speaking patients and is comparable with other results using the original FIQ.

The biggest significant reduction in FIQ-total between the intervention- and the control group, was found in the study by Kayo et al. (12). There was a significant difference in FIQ-total score between the muscle-strengthening group and the control group, and between the walking programme group and the control group. Furthermore, the biggest effect was found in the walking programme group. Walking is considered as one of the easiest and least harmful exercise forms for improving the cardiovascular system and energy levels due to the release of hormones and weight loss. It is cost-effective in view of the fact that equipment usage is minimal and easily accessible (18). The exercise intensity can easily be advanced for individual physical fitness level. Therefore, it is a versatile exercise option for women with FM who may have varying levels of physical capacity. In resemblance to other studies in this systematic review, Kayo et al. (12) chose muscle strengthening as one of their interventions. Muscle strengthening exercises increases muscle

strength, reduces depression, and increases quality of life (16). Thus, implementing muscle strengthening exercises in combatting the symptoms of fibromyalgia could be useful.

The biggest reduction in VAS were found in the study by Román et al. (13). This study consisted of functional training on land and in-water. This type of training included movement-based exercises which could be beneficial because of its low impact on weight-bearing joints. The sessions focused on exercises based on daily movements such as sit-to-stand, carrying objects, climbing stairs, and picking up things. The intervention could be useful for women with FM as it could increase motivation and ability to complete sessions. Exercises related to daily movements could be less intimidating and might reduce the negative cognition of physical exercise (1).

The studies conducted by Hernando-Garijo et al (17) and Collado-Mateo et al. (14) conducted home-based exercise programs, respectively tele-rehabilitation, and Virtual Reality. This type of exercise is comprehensive due to exercise anxiety which is common within this patient group (1). Virtual-Reality based training is new in the field of exercising and yet to be tested and modulated. The use of Virtual Reality is more costly than the other studies in this review, however, conducting a home-based study makes it more doable, and lowers the use of resources. Collado-Mateo et al. (14), had the biggest significant reduction for FIQ-pain between the intervention group and the control group. Considering the enjoyableness that exergame based training could provide, the participant might enjoy the lightness of the game compared to traditional exercise programs. In both studies, a significant difference in VAS-score was found, yet they showed the least significant improvement in effectiveness compared to the control groups. Some limitations of the studies could be that the participants did not push themselves hard enough to meet the expectations. Since the program was performed unsupervised and with lack of feedback from professionals, some participants may have performed the exercises wrong or used the wrong technique. This could be considered a limitation seeing the training benefit might not be optimal.

The ACR-classifications have been changed throughout the years. ACR first published criteria for FM diagnosis in 1990. This preliminary classification of diagnosis criteria consisted of a tender point examination performed by a physician, to determine if the patient met the requirements (19). The ACR published a revised version in 2010, and a modified version in 2011. The 2010 version

contained intermitted updates, and in contrast to the 1990 criteria, this version did not require a specific physical examination. In 2010/2011 the ACR decided, based on research, that the FM diagnosis criteria should depend on the number of reported painful body regions and severity of symptoms (5). In 2016, yet another revised version was published. This version combined the ACR 2010 "physician" based criteria with the 2011 modified "patient" criteria into a single set of criteria that can be used by physicians or patients (20). Considering the changes in the FM diagnosis criteria, the results in our findings may have limitations as the articles utilize different forms of ACR-classifications. One limitation of utilizing different classifications could be under- or overrepresentation in the study population. It may affect the consistency and comparability of research results across different studies. It could lead to variations in the characteristics of the study population and affect the validity of the results. For further research, one should be mindful of the version of the ACR criteria and consider potential limitations and implications.

5. Conclusions

To conclude this systematic review, exercise is beneficial for women with FM. Our findings revealed that physical exercise, regardless of its form, is an effective intervention for reducing pain and symptoms, compared to the control groups with usual care. Thus, healthcare professionals should consider prescribing exercise as a key component of treatment, with the aim of reducing symptoms and pain. Further research is needed to identify optimal exercise modalities, frequency, intensity, and implementation strategies that can maximize the benefits of exercise for this population.

References

1. Izquierdo-Alventosa R, Inglés M, Cortés-Amador S, Gimeno-Mallench L, Chirivella-Garrido J, Kropotov J, et al. Low-Intensity Physical Exercise Improves Pain Catastrophizing and Other Psychological and Physical Aspects in Women with Fibromyalgia: A Randomized Controlled Trial. Int J Environ Res Public Health. 2020 Jan;17(10):3634.

2. Ericsson A, Palstam A, Larsson A, Löfgren M, Bileviciute-Ljungar I, Bjersing J, et al. Resistance exercise improves physical fatigue in women with fibromyalgia: a randomized controlled trial. Arthritis Res Ther. 2016 Jul 30;18(1):176.

3. Arout CA, Sofuoglu M, Bastian LA, Rosenheck RA. Gender Differences in the Prevalence of Fibromyalgia and in Concomitant Medical and Psychiatric Disorders: A National Veterans Health Administration Study. J Womens Health. 2018 Aug 1;27(8):1035–44.

4. Latorre PÁ, Santos MA, Heredia-Jiménez JM, Delgado-Fernández M, Soto VM, Mañas A, et al. Effect of a 24-week physical training programme (in water and on land) on pain, functional capacity, body composition and quality of life in women with fibromyalgia. Clin Exp Rheumatol. 2013;31(6 Suppl 79): S72-80.

5. Wolfe F, Michaud K, Li T, Katz RS. Chronic Conditions and Health Problems in Rheumatic Diseases: Comparisons with Rheumatoid Arthritis, Noninflammatory Rheumatic Disorders, Systemic Lupus Erythematosus, and Fibromyalgia. J Rheumatol. 2010 Feb 1;37(2):305–15.

6. Lachaine J, Beauchemin C, Landry PA. Clinical and Economic Characteristics of Patients with Fibromyalgia Syndrome. Clin J Pain. 2010 May;26(4):284.

7. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep. 1985;100(2):126–31.

8. Busch AJ, Barber KAR, Overend TJ, Peloso PMJ, Schachter CL. Exercise for treating

fibromyalgia syndrome. Cochrane Database Syst Rev [Internet]. 2007 [cited 2023 May 8] ;(4). Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD003786.pub2/full

9. Bennett RM, Friend R, Jones KD, Ward R, Han BK, Ross RL. The Revised Fibromyalgia Impact Questionnaire (FIQR): validation and psychometric properties. Arthritis Res Ther. 2009;11(4): R120.

10. Tomas-Carus P, Gusi N, Häkkinen K, Leal A, Ortega-Alonso A. Eight months of physical training in warm water improves physical and mental health in women with fibromyalgia: A randomized controlled trial [Internet]. 2008 [cited 2023 May 8]. Available from: http://medicaljournals.se/jrm/content/abstract/10.2340/16501977-0168

11. Sañudo B, Galiano D, Carrasco L, Blagojevic M, Hoyo M de, Saxton J. Aerobic Exercise Versus Combined Exercise Therapy in Women with Fibromyalgia Syndrome: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2010 Dec 1;91(12):1838–43.

12. Kayo AH, Peccin MS, Sanches CM, Trevisani VFM. Effectiveness of physical activity in reducing pain in patients with fibromyalgia: a blinded randomized clinical trial. Rheumatol Int. 2012 Aug 1;32(8):2285–92.

13. Román PÁL, Santos e Campos MA, García-Pinillos F. Effects of functional training on pain, leg strength, and balance in women with fibromyalgia. Mod Rheumatol. 2015 Sep 8;25(6):943–7.

14. Collado-Mateo D, Dominguez-Muñoz FJ, Adsuar JC, Garcia-Gordillo MA, Gusi N. Effects of Exergames on Quality of Life, Pain, and Disease Effect in Women with Fibromyalgia: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2017 Sep 1;98(9):1725–31.

15. Wong A, Figueroa A, Sanchez-Gonzalez MA, Son WM, Chernykh O, Park SY. Effectiveness of Tai Chi on Cardiac Autonomic Function and Symptomatology in Women with Fibromyalgia: A Randomized Controlled Trial. J Aging Phys Act. 2018;26(2):214–21.

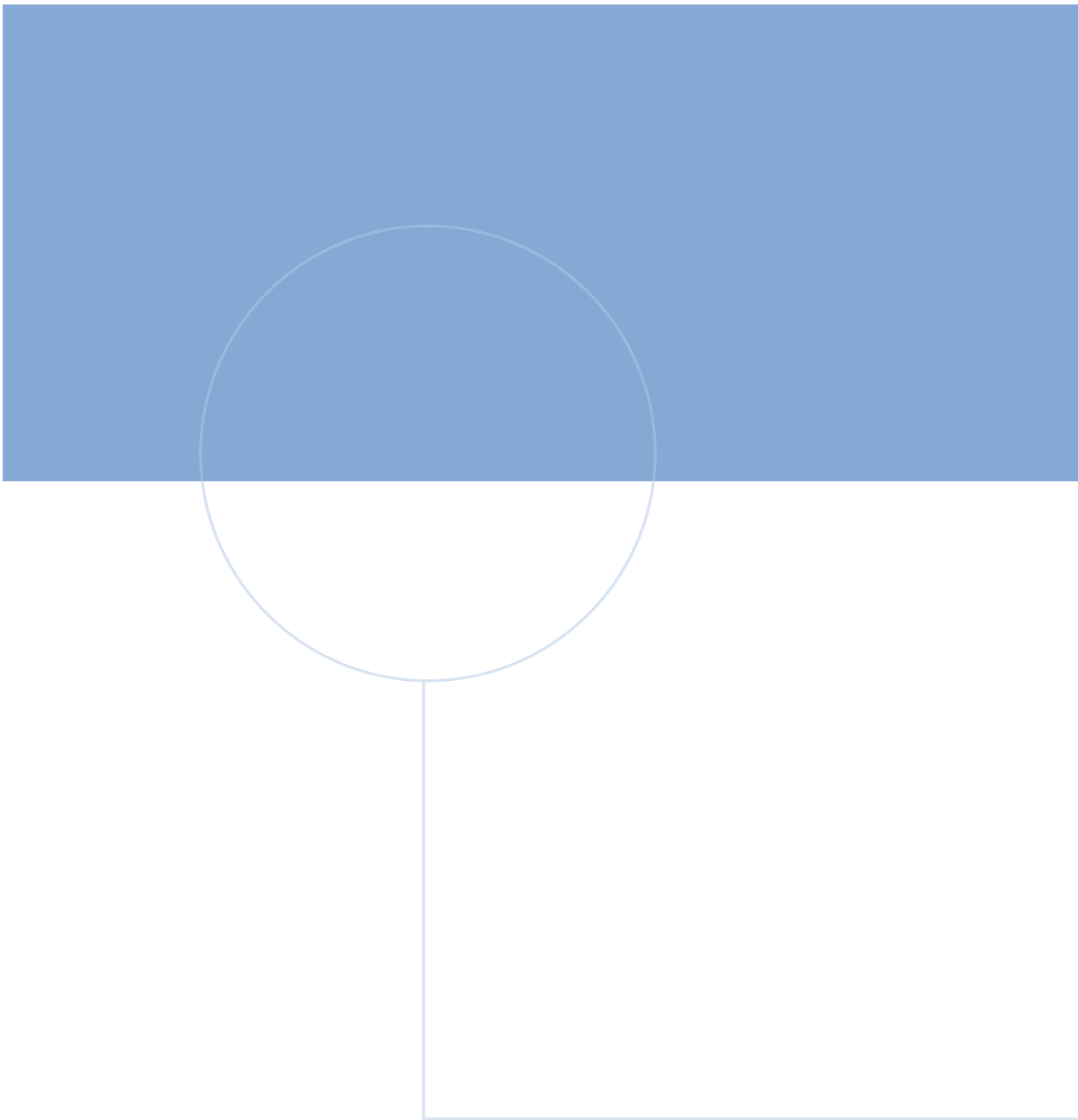
16. Assumpção A, Matsutani LA, Yuan SL, Santo AS, Sauer J, Mango P, et al. Muscle stretching exercises and resistance training in fibromyalgia: which is better? A three-arm randomized controlled trial. Eur J Phys Rehabil Med. 2018 Oct;54(5):663–70.

17. Hernando-Garijo I, Ceballos-Laita L, Mingo-Gómez MT, Medrano-de-la-Fuente R, Estébanez-de-Miguel E, Martínez-Pérez MN, et al. Immediate Effects of a Telerehabilitation Program Based on Aerobic Exercise in Women with Fibromyalgia. Int J Environ Res Public Health. 2021 Jan;18(4):2075.

18. Morris JN, Hardman AE. Walking to health. Sports Med Auckl NZ. 1997 May;23(5):306–32. Available from: https://link.springer.com/article/10.2165/00007256-199723050-00004

19. Wolfe F, Smythe HA, Yunus MB, Bennett RM, Bombardier C, Goldenberg DL, et al. The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. Arthritis Rheum. 1990;33(2):160–72.

20. Wolfe F, Clauw DJ, Fitzcharles MA, Goldenberg DL, Häuser W, Katz RL, et al. 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. Semin Arthritis Rheum. 2016 Dec;46(3):319–29.



NTNU

Norwegian University of
Science and Technology