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[Intervention Review]

Aquatic exercise training for fibromyalgia

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ABSTRACT

Background

Exercise training is commonly recommended for individuals with fibromyalgia. This review examined the effects of supervised group aquatic training programs (led by an instructor). We defined aquatic training as exercising in a pool while standing at waist, chest, or shoulder depth. This review is part of the update of the 'Exercise for treating fibromyalgia syndrome' review first published in 2002, and previously updated in 2007.

Objectives

The objective of this systematic review was to evaluate the benefits and harms of aquatic exercise training in adults with fibromyalgia.

Search methods

We searched *The Cochrane Library* 2013, Issue 2 (Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects, Cochrane Central Register of Controlled Trials, Health Technology Assessment Database, NHS Economic Evaluation Database), MEDLINE, EMBASE, CINAHL, PEDro, Dissertation Abstracts, WHO international Clinical Trials Registry Platform, and AMED, as well as other sources (i.e., reference lists from key journals, identified articles, meta-analyses, and reviews of all types of treatment for fibromyalgia) from inception to October 2013. Using Cochrane methods, we screened citations, abstracts, and full-text articles. Subsequently, we identified aquatic exercise training studies.

Selection criteria

Selection criteria were: a) full-text publication of a randomized controlled trial (RCT) in adults diagnosed with fibromyalgia based on published criteria, and b) between-group data for an aquatic intervention and a control or other intervention. We excluded studies if exercise in water was less than 50% of the full intervention.

Data collection and analysis

We independently assessed risk of bias and extracted data (24 outcomes), of which we designated seven as major outcomes: multidimensional function, self reported physical function, pain, stiffness, muscle strength, submaximal cardiorespiratory function, withdrawal rates and adverse effects. We resolved discordance through discussion. We evaluated interventions using mean differences (MD) or standardized mean differences (SMD) and 95% confidence intervals (95% CI). Where two or more studies provided data for an outcome, we carried out meta-analysis. In addition, we set and used a 15% threshold for calculation of clinically relevant differences.

Main results

We included 16 aquatic exercise training studies (N = 881; 866 women and 15 men). Nine studies compared aquatic exercise to control, five studies compared aquatic to land-based exercise, and two compared aquatic exercise to a different aquatic exercise program.

We rated the risk of bias related to random sequence generation (selection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias), blinding of outcome assessors (detection bias), and other bias as low. We rated blinding of participants and personnel (selection and performance bias) and allocation concealment (selection bias) as low risk and unclear. The assessment of the evidence showed limitations related to imprecision, high statistical heterogeneity, and wide confidence intervals.

Aquatic versus control

We found statistically significant improvements (P value < 0.05) in all of the major outcomes. Based on a 100-point scale, multidimensional function improved by six units (MD -5.97, 95% CI -9.06 to -2.88; number needed to treat (NNT) 5, 95% CI 3 to 9), self reported physical function by four units (MD -4.35, 95% CI -7.77 to -0.94; NNT 6, 95% CI 3 to 22), pain by seven units (MD -6.59, 95% CI -10.71 to -2.48; NNT 5, 95% CI 3 to 8), and stiffness by 18 units (MD -18.34, 95% CI -35.75 to -0.93; NNT 3, 95% CI 2 to 24) more in the aquatic than the control groups. The SMD for muscle strength as measured by knee extension and hand grip was 0.63 standard deviations higher compared to the control group (SMD 0.63, 95% CI 0.20 to 1.05; NNT 4, 95% CI 3 to 12) and cardiovascular submaximal function improved by 37 meters on six-minute walk test (95% CI 4.14 to 69.92). Only two major outcomes, stiffness and muscle strength, met the 15% threshold for clinical relevance (improved by 27% and 37% respectively). Withdrawals were similar in the aquatic and control groups and adverse effects were poorly reported, with no serious adverse effects reported.

Aquatic versus land-based

There were no statistically significant differences between interventions for multidimensional function, self reported physical function, pain or stiffness: 0.91 units (95% CI -4.01 to 5.83), -5.85 units (95% CI -12.33 to 0.63), -0.75 units (95% CI -10.72 to 9.23), and two units (95% CI -8.88 to 1.28) respectively (all based on a 100-point scale), or in submaximal cardiorespiratory function (three seconds on a 100-meter walk test, 95% CI -1.77 to 7.77). We found a statistically significant difference between interventions for strength, favoring land-based training (2.40 kilo pascals grip strength, 95% CI 4.52 to 0.28). None of the outcomes in the aquatic versus land comparison reached clinically relevant differences of 15%. Withdrawals were similar in the aquatic and land groups and adverse effects were poorly reported, with no serious adverse effects in either group.

Aquatic versus aquatic (Ai Chi versus stretching in the water, exercise in pool water versus exercise in sea water)

Among the major outcomes the only statistically significant difference between interventions was for stiffness, favoring Ai Chi (1.00 on a 100-point scale, 95% CI 0.31 to 1.69).

Authors' conclusions

Low to moderate quality evidence relative to control suggests that aquatic training is beneficial for improving wellness, symptoms, and fitness in adults with fibromyalgia. Very low to low quality evidence suggests that there are benefits of aquatic and land-based exercise, except in muscle strength (very low quality evidence favoring land). No serious adverse effects were reported.

PLAIN LANGUAGE SUMMARY

Aquatic exercise training for fibromyalgia

Research question

We reviewed studies on the effects of aquatic exercise training for people with fibromyalgia on wellness, symptoms, fitness, and adverse effects.

Background: what is fibromyalgia and what is aquatic training?

People with fibromyalgia have persistent, widespread body pain and often experience symptoms such as fatigue, stiffness, depression, and difficulty sleeping.

Aquatic training is exercising in a pool while standing at waist, chest, or shoulder depth. This review examined the effects of supervised group aquatic training programs (led by an instructor).

Study characteristics

We searched the literature up to October 2013 and found 16 studies with 866 women and 15 men with fibromyalgia; 439 were assigned to aquatic training programs.

Nine studies compared aquatic exercise to no exercise; five studies compared aquatic exercise to land-based exercise, and two studies compared aquatic training to a different aquatic training.

Key results: for those who took part in aquatic exercise training compared to people who did not exercise

Overall well-being (multidimensional function) on a scale of 0 to 100 units

Those who did aquatic exercise rated their overall well-being six units better at the end of the study than those who did not exercise.

Physical function (ability to do normal activities) on a scale of 0 to 100 units

Those who did aquatic exercise rated their ability to function four units better at the end of the study than those who did not exercise.

Pain on a scale of 0 to 100 units

Those who did aquatic exercise rated their pain seven units better at the end of the study than those who did not exercise.

Stiffness on a scale of 0 to 100 units

Those who did aquatic exercise rated their stiffness 18 units better at the end of the study than those who did not exercise.

Muscle strength

People who did aquatic training improved their muscle strength by 37% more than those who did not do aquatic training.

Cardiovascular fitness estimated by meters walked in six minutes

Those who did aquatic exercise walked 37 meters further at the end of the study than those who did not exercise.

Dropping out of the studies

Two more participants out of 100 in the aquatic training groups dropped out of the studies (15 aquatic exercisers dropped out while 13 non-exercisers dropped out).

Quality of evidence - aquatic versus control

Further research on overall well being and ability to function is likely to have an important impact on our confidence in these results and may change the results.

Further research on pain, stiffness, muscle strength, and cardiovascular fitness is very likely to have an important impact on our confidence in these results and is likely to change the results.

Key results: for those who did aquatic training compared to people who did land-based exercise

People who did both programs had similar results for overall well-being, physical function, pain, and stiffness. However, people who exercise on land improved their muscle strength by 9% more than those who did aquatic training. About the same number of people from both groups dropped out.

Quality of evidence - aquatic versus land-based

As so few studies have been done so far, we are very uncertain about the results.

Key results: for those who did one kind of aquatic training compared to a different kind of aquatic training

There were two studies in this comparison: one compared Ai Chi (Tai Chi in the water) to stretching in the water, and the other compared aquatic training in a pool to aquatic training in sea water. The only important difference found was for stiffness, favoring the Ai Chi aquatic training.

Quality of evidence - aquatic versus aquatic programs

As so few studies have been done so far, further research is likely to change this result.

SUMMARY OF FINDINGS FOR THE MAIN COMPARISON [Explanation]

Aquatic training versus control for fibromyalgia

Patient or population: adults with fibromyalgia
Settings: supervised group intervention
Intervention: aquatic training

Outcomes	Assumed risk Control	Corresponding risk Aquatic exercise training	Relative effect (95% CI)*	No of participants (studies)	Quality of the evidence (GRADE)	Comments
Multidimensional function Self report questionnaire FIQ - total (range 0 to 100, lower scores indicate greater health) Follow-up: 4 to 32 weeks	The mean change (post minus pre) in multidimensional function in the control groups was -1.3[1] Weighted mean score at baseline (all participants): 63.77	The mean change (post minus pre) in multidimensional function in the aquatics groups compared to the control groups was 5.97 units[2] lower		367 (7 studies)	⊕⊕⊕○ **Moderate**[3]	Absolute difference -6 (95% CI -9 to -3), P value < 0.05 Relative per cent change: -9% (95% CI -14% to -4.5%) SMD -0.55 (95% CI -0.83 to -0.27) NNT 5 (95% CI 3 to 9)
Self reported physical function FIQ physical function scale and SF-36 physical function scale (transformed range 0 to 100, lower scores indicate greater health) Follow-up: 4 to 32 weeks	The mean change (post minus pre) in self reported physical function in the control groups was -0.59[1] Weighted mean score at baseline (all participants): 46.82	The mean change (post minus pre) in self reported physical function in the aquatics groups compared to the control groups was 4.4 units[4] lower		285 (5 studies)	⊕⊕⊕○ **Moderate**[3]	Absolute difference -4 (95% CI -8 to -1), P value < 0.05 Relative per cent change: -9% (95% CI -16% to -2%) SMD -0.44 (95% CI -0.76 to -0.11) NNT 6 (95% CI 3 to 22)
Pain Self reported questionnaires (i.e., FIQ pain, SF-36 bodily pain, current pain VAS) (transformed	The mean change (post minus pre) in pain in the control groups was -1.94[1] Weighted mean score	The mean change (post minus pre) in pain in the aquatics groups compared to the control groups was 6.6 units[2]		382 (7 studies)	⊕⊕○○ **Low**[3,5,7]	Absolute difference -7 (95% CI -11 to -2), P value < 0.05 Relative per cent

range 0 - 100, lower scores indicate greater health). Follow-up: 4 to 32 weeks	at baseline (all participants): 69.59	lower			change: -9.5% (-15% to -4%) SMD -0.53 (95% CI -0.76 to -0.31) NNT 5 (95% CI 3 to 8)
Stiffness Self reported questionnaire FIQ Stiffness scale (0 to 100 mm VAS, lower scores indicate greater health) Follow-up: 4 to 32 weeks	The mean change (post minus pre) in stiffness in the control groups was 1.66 mm[1] Weighted mean score at baseline (all participants): 69.42	The mean change (post minus pre) in stiffness in the aquatics groups compared to the control groups was 18.34 units[6] lower	230 (4 studies)	⊕⊕◯◯ **Low**[3,4,7]	Absolute difference -18 (95% CI -36 to -1) Relative per cent change: -27% (95% CI -52% to 1%) SMD -1.00 (95% CI -1.91 to -0.10) NNT 3 (95% CI 2 to 24)
Muscle strength Isokinetic strength of knee extension and hand grip. Higher scores indicate greater health Follow-up: 12 to 32 weeks	The mean percentage change (post-pre) in muscle strength in the control groups was 0%[1]	The mean percentage change (post-pre) in muscle strength in the aquatics groups compared to the control groups was 37% higher	152 (4 studies)	⊕⊕◯◯ **Low**[3,7]	Relative per cent change: 37% (95% CI 12% to 62%) SMD 0.63 (95% CI 0.20 to 1.05) moderate effect, P value < 0.05 NNT 4 (95% CI 3 to 12)
Submaximal cardiorespiratory function 6-minute walk test (distance in meters). Higher scores indicate greater health Follow-up: 6 to 26 weeks	The mean change in submaximal cardiorespiratory function in the control groups was 5.6 fewer meters in 6 minutes[1] Weighted mean score at baseline (all participants): 484.81 m	The mean change (post minus pre) in submaximal cardiorespiratory function in the aquatics groups compared to the control groups was 37 more meters walked in 6 minutes	213 (3 studies)	⊕⊕◯◯ **Low**[3,5,7]	Absolute difference 37 m (95% CI 4 to 70 m), P value < 0.05 Relative per cent change: 6.5% (95% CI 4% to 9%) SMD 0.70 (95% CI 0.05 to 1.36) NNT 5 (95% CI 3 to 9)

Withdrawals and adverse effects[8]	All-cause withdrawal in control groups: 30/232 (12.9%)	All-cause withdrawal in aquatic groups: 38/252 (15.1%)	Risk ratio: 1.13 (0.73 to 1.77)	472 (8 studies)	⊕⊕◯◯ **Low**[9,10]	1 study: no adverse effects; 1 study: no aggravation of symptoms; 1 study: unspecified number of drop-outs due to injury and infection; 5 studies did not address adverse effects at all

*The basis for the **assumed risk** (e.g., the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **FIQ:** Fibromyalgia Impact Questionnaire; **NNT:** number needed to treat; **SMD:** standardized mean difference; **VAS:** visual analog scale

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1]Mean difference in control group(s) (post-test scores-pretest scores).
[2]Moderate effect (SMD 0.50 to 0.79).
[3]Potential limitations related to imprecision (i.e., total (cumulative) sample size is lower than 400).
[4]Statistical heterogeneity (I^2 > 50%).
[5]Small effect (SMD 0.20 to 0.49).
[6]Large effect (SMD > 0.80).
[7]Potential limitations related to high, unclear, and low risk of bias.
[8]Withdrawals may be associated with frequency, intensity, etc., in which case interventions should try to maximize retention by focusing on these events. As adverse effects are still poorly reported, withdrawals may be taken as an indicator of adverse effect.
[9]Incomplete documentation of adverse effects in at least five studies.
[10]Wide confidence interval.

BACKGROUND

Description of the condition

Fibromyalgia is a common, chronic, idiopathic condition involving widespread pain and tenderness (Mease 2005). It is often associated with other somatic complaints, disability, and physical deconditioning, which negatively impact quality of life. It is estimated that 1.1% of Canadians are affected by fibromyalgia across all ages, with higher prevalence among females. The prevalence of fibromyalgia in Canada is similar to other parts of the world (McNalley 2006), with the exception of Asia where the incidence is lower (Marcus 2011).

Several factors have been implicated in the pathophysiology of fibromyalgia, including: changes in brain and neural structure and function, muscular physiology, hormonal factors, inflammatory markers, and genetic influences (Marcus 2011a). Researchers have identified several abnormalities in brain and neural function in patients with fibromyalgia, which appear to have a genetic basis (Arnold 2013; Staud 2002). Various muscle abnormalities that may result in weakness, fatigue, and muscle pain for individuals with fibromyalgia have been described (Park 2000), and include reductions in type II fibers, abnormal muscle metabolism, and excessive agonist-antagonist co-contraction. Consistent with these findings, individuals with fibromyalgia are often less physically active and more sedentary than healthy individuals (Park 2007). Symptoms associated with fibromyalgia can have repercussions on family dynamics, employment, and independence, thereby significantly and directly impacting quality of life (Mease 2005). Some of these symptoms are poor and non-restorative sleep, stiffness, muscle and body fatigue, headaches, irritable bowel syndrome, problems with memory or concentration, and mood disturbances (Mease 2005).

High levels of healthcare utilization and healthcare costs associated with medical visits, drug prescriptions, and diagnostic testing are commonly mentioned in the fibromyalgia literature (Hauser 2010; Kelley 2011). Individuals with fibromyalgia are often seen by healthcare professionals due to concomitant medical issues (somatic comorbidities associated with fibromyalgia) and related pharmacological treatment. Recent systematic reviews of medications for the treatment of fibromyalgia have shown only limited success (amitriptyline - Moore 2012; milnacipran - Derry 2012; gabapentin - Moore 2014; antiepileptic drugs - Wiffen 2013; monoamine oxidase inhibitors - Tort 2012; serotonin and noradrenaline reuptake inhibitors - Hauser 2013; anticonvulsants - Uceyler 2013). These reviews have helped to inform recent clinical practice guidelines; Ablin 2013 recommended that drug treatments should be used in the management of fibromyalgia "with reservation regarding both efficacy and side effect profile". On the other hand, systematic reviews of non-pharmacologic methods show that evidence is accruing that suggests positive effects for non-pharmacological treatments in the management of fibromyalgia (exercise - Busch 2008; cognitive behavior therapy - Bernardy 2013; acupuncture - Deare 2013). In a review of clinical practice guidelines, Ablin 2013 noted "recent evidence-based interdisciplinary guidelines concur on the importance of treatments tailored to the individual patient and further emphasize the necessity of self-management strategies which include exercise and psychological techniques."

Exercise is regarded as an important part of fibromyalgia management (Goldenberg 2004; Gowans 2004; Hauser 2010a; Rooks 2008). The literature suggests that individuals with fibromyalgia are often deconditioned, with low levels of cardiovascular fitness (Turk 2002), muscle strength, and muscle endurance (Bennett 1989; Bennett 1998). Whether these physiological features of deconditioning play a role in the causal pathway of fibromyalgia is still unclear. However, several studies have demonstrated that individuals with fibromyalgia are able to perform different types of exercise, such as aerobic, flexibility, and resistance training programs (Carville 2008a; Hauser 2010). Exercise may contribute to reduction in pain through improving the body's response to muscle microtrauma by increasing resilience, repair, and resultant adaptation, as well as affecting brain processing and responses (McLoughlin 2011). Regular exercise is an important factor in countering age-related loss of muscle, bone mass, and functional independence for the general population, therefore it has been suggested that individuals with fibromyalgia may improve their overall health and moderate risks associated with other chronic conditions by engaging in regular exercises (Rooks 2008).

Despite interest and many new studies, the effects of various types of physical activity on specific symptoms, mental function, and physical performance in people with fibromyalgia are still unclear. In addition, answers to questions regarding the best type of exercise, intensity, and delivery options for exercise interventions are still needed. This review attempts to shed light on the effects of aquatic exercise on wellness, symptoms, and physical fitness to guide clinicians and patients with fibromyalgia in designing the most effective aquatic exercise training interventions for this condition. Definitions for some of the terms utilized in this review can be found in the glossary of terms (Table 1).

Description of the intervention

The traditional use of water as a medium for exercise

History shows that soaking baths, spa centers, water immersion, springs, and natural hot water springs were used for religious and healing purposes as early as 2400 BC (Bates 1996). The thermal effects of the water were considered to relieve pain and enhance relaxation (Vargas 2004). Also known as pool therapy and hydrotherapy (Geytenbeek 2002), aquatic exercise is defined by the Chartered Society of Physiotherapists as a therapy program designed by a qualified physiotherapist using the properties of water

to improve function, ideally in a suitably heated pool (Charter of Physiotherapists 2009). Balneotherapy refers to the use of hot-water treatment to ease pain, decrease stiffness and relax muscles, and has been further developed with various forms of salt or sulphur treatments (or both), mud packs, and jet streams (spa therapy) (Verhagen 2012)

The current use of water for therapeutic purposes

Healthcare practitioners currently use the physical properties of water for therapy and rehabilitation of a variety of musculoskeletal conditions (e.g., osteoarthritis, rheumatoid arthritis, fractures, tendonitis) (Bartels 2007; Bates 1996; Cardoso 2001; Cole 2004; Dagfinrud 2008; Verhagen 2004; Verhagen 2008). Specific properties of water (buoyancy, resistance, flow, and turbulence) are used to develop graded exercise programs. Buoyancy of the body or body segment, with or without floatation equipment, can be used to assist or to resist movements. In addition, the water viscosity itself provides resistance in all directions. During movement, submerged body parts require greater energy expenditure. This resistance can be increased or decreased by altering velocity and the directional use of water jets and turbulence. Exercise intensity can also be augmented with equipment (e.g., paddles, webbed gloves) to increase resistance of the body part moving in the water (Bates 1996). Water temperature is another important consideration when designing aquatic exercise training interventions. While most community swimming pools are heated between 26° to 28° Celsius (80° to 84° Fahrenheit), which is comfortably cool and ideal for movement, pools for therapeutic purposes are usually heated to between 30° and 32° Celsius (86° to 90° Fahrenheit).
In this review, we define aquatic exercise training intervention as "exercise conducted in a vertical standing position" in the water with the participant submerged to waist, chest or shoulder depth" (Sova 1992), in a pool (indoor or outdoor). We considered only those aquatic exercise interventions that involved exercise in the water for 50% or more of the time. We excluded mixed interventions with an aquatic component in which participants spent less than 50% of the total intervention time in the water. For example, we excluded an intervention consisting of 12 sessions with five or fewer held in the pool, as the intervention outcome could not be attributed primarily to the aquatic component.

How the intervention might work

Pathophysiological changes associated with fibromyalgia

The pathogenesis of fibromyalgia is not completely understood. However, fibromyalgia is currently thought to be a disorder of central pain processing (or central sensitivity) in which individuals have problems with sensory volume control (i.e., lower threshold for pain and other stimuli like heat, noise, odors) (Schmidt-Wilcke 2011). This hypersensitivity may be derived from neurobiologic changes related to psychological factors (Pillemer 1997). Research has also shown biochemical, metabolic, and immunoregulatory abnormalities (Schmidt-Wilcke 2011). Other pathophysiological changes commonly found in individuals with fibromyalgia are low serotonin levels (Tander 2008), low levels of adenosine triphosphate in red blood cells, dysfunction of the hypothalamic-pituitary adrenal axis (Crofford 1998; Griep 1993), low levels of growth hormone associated with poor sleep (Cuatrecasas 2007; Jones 2007a), cognitive impairment (Glass 2008; Glass 2011), and biochemical abnormalities producing sleep dysfunction (Lue 1994).
Exercise interventions might work because exercise may contribute to reduction in pain through improving the body's response to muscle microtrauma by increasing resilience, repair, and resultant adaptation. In addition, regular exercise has been shown to improve overall health, as shown in other chronic conditions (Durstine 2013).
Ideally, in fibromyalgia disease management the use of pharmacological and non-pharmacological therapies are combined. By doing this, non-pharmacological therapies such as an aquatic exercise intervention can be part of a rehabilitation model that tackles main issues such as pain. In combining these therapeutic approaches, pharmacological treatments may help alleviate the initial symptoms of pain, and aquatic exercise interventions may help to address the functional consequences of the symptoms.

Why it is important to do this review

This review evaluates whether aquatic exercise training has beneficial effects on fibromyalgia symptoms, how long these effects might last, and whether aquatic exercise training is more or less effective than land-based exercise training. It is also important to consider the effects of aquatic exercises as a non-pharmacological treatment, given that not all people with fibromyalgia successfully respond to pharmacological treatment and multimodal types of treatments have been shown to be more successful in the management of the disease (Rooks 2007). This review also aims to document harms associated with aquatic exercise training interventions in people with fibromyalgia and to determine whether aquatic exercise training should be recommended as a safe, effective component of fibromyalgia management. This review will report on injuries and other adverse effects, as well as attrition rates and adherence to training protocols as these may indicate the acceptability of this form of intervention for individuals with fibromyalgia.

OBJECTIVES

The objective of this systematic review was to evaluate the benefits and harms of aquatic exercise training in adults with fibromyalgia.

METHODS

Criteria for considering studies for this review

Types of studies

We selected randomized clinical trials (RCTs) that compared aquatic exercise training to a control group or to another exercise training protocol on land or water. We included studies if the words randomly, random, or randomization were used to describe the method of assignment of subjects to groups.

Types of participants

We selected studies that used published criteria for the diagnosis of fibromyalgia. Recently, the American College of Rheumatology (ACR) has introduced new criteria (Wolfe 2010; Wolfe 2011); however, the American College of Rheumatology (ACR) 1990 criteria (Wolfe 1990) have been the dominant diagnostic criteria used for diagnosis of fibromyalgia for the past two decades. The ACR 1990 criteria include: a) widespread pain for longer than three months duration, and b) pain on digital palpation with 4 kg pressure in at least 11 of 18 specified tender point sites. Other published criteria are: Smythe 1981, Yunus 1981, Yunus 1982, and Yunus 1984. Although some differences exist between the diagnostic criteria, for the purpose of this review we considered all to be acceptable and comparable.

Types of interventions

Although swimming was included in our search strategy we found no studies investigating this exercise modality; thus, an aquatic exercise training intervention was defined as "exercise conducted in a vertical standing position" in the water with the participant submerged to waist, chest, or shoulder depth (Sova 1992), which took place in an outdoor or indoor pool. In this review, the aquatic exercise intervention was defined as a program with exercise performed in the water for 50% or more of the time. We did not set a specific minimum intervention duration, pool temperature, or physical location (i.e. indoor versus outdoor).

We excluded studies if the outcomes could not reasonably be attributed to aquatic exercises. For example, we excluded interventions that consisted of a mixed approach (i.e., land-based and water programs including aerobic, flexibility, and resistance training) in which participants spent less than 50% of the total intervention in the water (e.g., 12 sessions with only two in the pool).

We placed no restriction on the type of aquatic exercise equipment including flutter boards, tubing, and dumbbells. We also included calisthenics that used a body segment or segments moving against water resistance as the load for the exercise. We were interested in comparisons in two categories: a) aquatic exercise training interventions compared to control conditions (treatment as usual, physical activity as usual, wait list control, placebo or sham, education-only, water immersion-only, and attention only), and b) aquatic exercise training compared to another exercise protocol (e.g., aerobic, strength) performed on land or in water.

The classification of exercise intensity during cardiorespiratory exercise in this review followed the American College of Sports Medicine (ACSM) recommendation (ACSM 2009; Garber 2011; Appendix 1) as follows:

Intensity	**%VO_2Reserve/ %HRReserve**	**%HR_{max}**	**Perceived exertion scale (RPE) 6 to 20 scale**
Very light	< 37	< 57	RPE < 9
Light	37 to 45	57 to 63	RPE 9 (very light) to 11 (fairly light)
Moderate	46 to 63	64 to 76	RPE 12 (fairly light) to 13 (somewhat hard)
Vigorous	64 to 90	77 to 95	RPE 14 (somewhat hard) to 17 (very hard)
Near maximal to maximal	≥ 91	≥ 96	RPE ≥ 18 (very hard)

Types of outcome measures

Until recently, there was no consensus on outcomes to guide research on the effectiveness of interventions for fibromyalgia. In 2004, a group of clinicians, researchers, and patients, under the auspices of the Outcome Measures in Rheumatology group

(OMERACT) initiative, set about to improve outcome measurement in fibromyalgia through a data-driven interactive consensus process used previously for other rheumatic diseases (Mease 2009). Over the course of the next five years, patient focus groups (Arnold 2008), patient and clinician Delphi exercises (Mease 2008), a systematic literature review and analysis of outcomes used in fibromyalgia intervention trials (Carville 2008), and analyses of psychometric properties of outcomes (i.e., face, construct, content, and criterion validity in fibromyalgia) (Choy 2009a) were conducted. Based on these efforts, OMERACT has recommended the following core set of outcomes for inclusion in all fibromyalgia clinical trials: pain, fatigue, multidimensional function, tenderness, and quality of sleep (Choy 2009; Mease 2009). OMERACT designated two additional outcomes, depression and dyscognition, as important but not core, and placed anxiety, morning stiffness, imaging, and biomarkers on the agenda for further research (Choy 2009).

In this review, we have extracted data for 24 outcomes, which include all the outcomes considered to be important by OMERACT (Choy 2009). We categorized the 24 outcomes into four main categories: wellness, fibromyalgia symptoms, physical fitness, and safety and acceptability. In the wellness category, we extracted six outcomes: multidimensional function, patient-rated global, clinician-rated global, self reported physical function, self efficacy, and mental health. In the symptom category of outcomes, we extracted data for eight symptoms experienced by individuals with fibromyalgia: pain, fatigue, sleep disturbance, stiffness, tenderness, depression, anxiety, and dyscognition. In the physical fitness category we extracted six outcomes associated with physiological adaptation to exercise training: muscle strength, muscle endurance, muscle power, muscle/joint flexibility, maximum cardiorespiratory function, and submaximal cardiorespiratory function. The *Cochrane Handbook for Systematic Reviews of Interventions* states (in Section 5.4.3): "It is important that Cochrane reviews include information about the undesirable as well as desirable outcomes of the interventions examined ... at least one undesirable outcome should be defined as a major outcome measure" (O'Connor 2011). With this in mind, we conceptualized the final category of outcomes as safety and acceptance of exercise training. This category consists of three outcomes associated with possible harms - injuries, exacerbations of fibromyalgia, or other adverse effects; while another outcome, withdrawal rates, served as a proxy for lack of acceptability of exercise training.

When an included study used more than one instrument to measure a particular outcome, we selected the data for extraction based on the following criteria: a) the frequency of use of the instruments in the fibromyalgia literature (e.g., the Fibromyalgia Impact Questionnaire or FIQ is a disease-specific instrument commonly used in this literature), and b) documented evidence supporting the psychometric properties of the instrument (e.g., validity, reliability, sensitivity, measurement properties) used in similar populations.

1. Outcomes representing wellness:

This category of outcomes relates to generalized health or functioning. Tools used to measure outcomes in this category included both broad-spectrum indices designed to capture an array of tasks or characteristics to yield a single summary score (e.g., SF-36), and single-item tests on which the respondent is asked to rate their status in an area of health using a single-item scale (e.g., a visual analog scale - VAS) on which the respondent places a mark on a 10 cm line between worst health on one end and best health on the other.

- **Multidimensional function** - Multidimensional function consists of multidimensional indices used to measure general health status and/or health-related quality of life. As recommended by Choy 2009, we collapsed measures of general health status or health-related quality of life or both into a single outcome. When included studies used more than one instrument to measure multidimensional function, we preferentially extracted data for the Fibromyalgia Impact Questionnaire (FIQ) total (Burckhardt 1991), followed by the SF-36 total (Ware 1993), the SF-12 total (Busija 2011), the EuroQol-5d (Wolfe 1997a), the Arthritis Impact Measurement Scales 2 total (AIMS total) (Meenan 1992), the Quality of Life scale (Burckhardt 2003; Diener 1985; Heinrichs 1984), and the Illness Intrusiveness Questionnaire (Devins 2001).

- **Patient-rated global** - Patient global assessments are commonly assessed by Likert or VAS scales. They are highly sensitive to change (Choy 2009a; Mease 2009) and appear to be reliable (Dixon 1981). We extracted data preferentially for self perceived change in VAS; followed by self perceived change-numeric rating scale; self perceived disease severity VAS; self perceived disease severity-numeric rating scale; self perceived sense of well-being VAS (de Boer 2004); and self perceived health status numeric rating scale.

- **Clinician-rated global** - Global assessments of disease severity by physicians and other health professionals using Likert or VAS are commonly used in clinical settings. We used clinician-rated disease severity measures using a VAS (Buckelew 1998).

- **Self reported physical function** - We preferentially extracted data for the FIQ (English or translated) physical impairment scale followed by the health assessment questionnaire disability scale (HAQ), the SF-36/Rand-36 Physical Function; the Sickness Impact Profile (Bergner 1981) - Physical Disability, and the Multidimensional Pain Inventory household chores scale (Huskisson 1976; Huskisson 1983).

- **Self efficacy** - (function) - Instruments included in this review were: the Arthritis Self Efficacy Scale (Lorig 1989), the Chronic Pain Self Efficacy (Anderson 1995), the FM Attitudes Index (Callahan 1988), and the Freiburg Mindfulness Inventory (Buchheld 2001).

- **Mental health** - The US Surgeon General has defined mental health as "a state of successful performance of mental function, resulting in productive activities, fulfilling relationships with people, and the ability to adapt to change and to cope with adversity." http://www.medicinenet.com/mental_health_psychology/page2.htm. In focus groups conducted by Arnold 2008, participants reported that their physical and emotional ability to complete tasks of daily living was severely limited by fibromyalgia because of pain, lack of energy, fatigue, and depression. Patients also expressed feelings of embarrassment, frustration, guilt, isolation, and shame. When several measures were used we chose in the following order: SF-36/Rand-36 Mental Health; psychosocial scale (Sickness Impact Profile); Global Severity Index of the Symptom Checklist 90 - revised (SCL-90-R) (Derogatis 2010); Profile Mood States (POMS) (McNair 1981); Psychological General Well-being (PGWB) total score (Dupuy 1984).

2. Outcomes representing fibromyalgia symptoms:

This category of outcomes includes eight symptoms associated with fibromyalgia.

- **Pain** - The International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Merskey 1994). For the purpose of this review, we focused on one aspect of the pain experience - pain intensity. When more than one measure of pain was reported in a single study, we preferentially extracted: pain VAS (FIQ Pain, FIQ-Translated, McGill pain VAS, current pain) followed by the Numerical Pain Rating Scale, and the SF-36/Rand-36 Bodily Pain scale, and the Pain Severity scale of the Multidimensional Pain Inventory.
- **Fatigue** - Fatigue is recognized by individuals with fibromyalgia and clinicians alike as an important symptom in fibromyalgia. Fatigue can be measured in a global manner, such as when an individual rates their fatigue on a single-item scale, or as a multidimensional tool that breaks the fatigue experience into two or more dimensions such as general fatigue, physical fatigue, mental fatigue, reduced motivation, reduced activity, and degree of interference with activities of daily living (Boomershine 2012). We accepted both uni- and multi-dimensional measures for this outcome. When included studies used more than one instrument to measure fatigue, we preferentially extracted the fatigue VAS (FIQ/FIQ-Translated Fatigue, or single item fatigue VAS) (Wolfe 2004), followed by the SF-36/Rand-36 Vitality sub-scale, the Chalder Fatigue Scale (total), the Fatigue Severity Scale and the Multidimensional Fatigue Inventory.
- **Sleep disturbance** - Sleep problems are almost universal in fibromyalgia, occurring in 95% of patients (Boomershine 2012). When included studies used more than one instrument to measure sleep, we preferentially extracted the Pittsburgh Sleep Quality Index (Buysse 1989), followed by the Sleep Quality VAS (Smith 2003), sleep quantity: nights/week, hours/night, hours of good to disturbed sleep, and the Hamilton Depression Sleep Items (Hamilton 1960).
- **Stiffness** - In focus groups conducted by Arnold 2008, individuals with fibromyalgia "... remarked that their muscles were constantly tense. Participants alternately described feeling as if their muscles were 'lead jelly' or 'lead Jell-O,' and this resulted in a general inability to move with ease and a feeling of stiffness". The only measure we encountered for stiffness was the FIQ stiffness VAS.
- **Tenderness** - Tenderness is defined as discomfort produced as an evoked response to mechanical pressure (Dadabhoy 2008; Gracely 2003). Although there are concerns that measures of tenderness can be biased by cognitive and emotional aspects of pain perception, many studies support the utility of measurement of tenderness in fibromyalgia using either tender point counts or pain pressure threshold (Dadabhoy 2008). When included studies used more than one instrument to measure tenderness, we preferentially extracted the tender point count followed by Pain Pressure Threshold (dolorimetry score, based on at least six of the 18 ACR tender points) and the total myalgic score (sum/mean of ordinal rating of response to thumb pressure across 18 tender points).
- **Depression** - Depression is a common mental disorder that presents with depressed mood, loss of interest or pleasure, feelings of guilt or low self worth, disturbed sleep or appetite, low energy, and poor concentration. These problems can become chronic or recurrent and lead to substantial impairments in an individual's ability to take care of his or her everyday responsibilities (WHO 2013). In focus groups conducted by Arnold 2008, the emotional disturbances most commonly experienced by participants with fibromyalgia included depression and anxiety. A complete understanding of depression and how best to assess it in fibromyalgia trials is still uncertain and is an active research issue (Mease 2009). However, the common practice of excluding patients with significant depression from fibromyalgia intervention studies leads to the underestimation of the discriminatory power of these instruments (Choy 2009). We preferentially extracted the Beck Depression Inventory (BDI) total scores, cognitive/affective sub-scale scores, BDI without FMS Symptoms; short form translated SF-36; Hamilton Depression Scale; Center for Epidemiologic Studies-Depression (CES-D) FIQ/FIQ translated - depression; mental health inventory sub-scale depression; Arthritis Impact Measurement scales - depression sub-scale; Hospital Anxiety and Depression Q-depression; Symptom checklist 90 - depression; and the Psychological General Well-Being (PGWB depression score).
- **Anxiety** - Anxiety is a feeling of apprehension and fear characterized by physical symptoms such as palpitations, sweating, irritability, and feelings of stress (http://www.medicinenet.com/anxiety/article.htm). Some participants reported that acute anxiety, panic, or depression were disruptive to activities that they were trying to complete (Choy 2009). We

preferentially extracted data for anxiety using the anxiety scale of the Arthritis Impact Measurement Scales, followed by the State Anxiety Inventory; the Hospital anxiety and Depression Q-anxiety; the Beck anxiety inventory; the mental health inventory sub-scale anxiety; the Symptom Checklist 90 - anxiety scale; psychological general well-being anxiety score; and the FIQ anxiety scale (Bond 1995).

- **Dyscognition** - Dyscognition pertains to difficulty with cognitive tasks especially memory and thought processes. The term describes symptoms related to difficulty concentrating, disorganized thinking, and inability to stay focused or alert. Although OMERACT identified dyscognition as an important outcome for fibromyalgia trials, it was rarely measured in the included studies. One measure we encountered in this review was the Paced Auditory Serial Addition Test (Munguia-Izquierdo 2007).

3. Outcomes representing physical fitness:

This category, consisting of six outcomes, is associated with physiological adaptation to exercise training. There are several facets to physical fitness including: cardiovascular function (maximal capacity and submaximal endurance), body composition, muscle strength, muscle endurance, flexibility, agility, co-ordination, balance, power, reaction time, and speed (ACSM 2009a). Given the nature of the intervention, outcomes reflecting physical fitness are highly relevant.

- **Muscle strength** - Muscular strength is a measure of a muscle's ability to generate force. It is commonly expressed as maximal voluntary contraction (MVC) during isometric testing; one-repetition maximum (1RM) during dynamic isotonic testing (Howley 2001); and/or peak torque muscle contraction during isokinetic testing. When more than one measure of strength was reported, we preferentially extracted dynamic test results over isometric test results, lower limb test results over upper limb results, and extensor muscle strength over flexor muscle strength.
- **Muscle endurance -** Muscular endurance refers to the ability to exert submaximal force for extended periods, and it can be assessed during static or dynamic muscular contraction (Heyward 2010). For the purpose of this review, when more than one measure of muscle endurance was reported we preferentially extracted: lower extremity dynamic endurance (stair step; sit to stand chair test or fatigue curve), followed by lower extremity static endurance including fatigue curve, number of squats performed in 60 seconds, fatigue index (the ratio of average power in last five repetitions to the average power in the first five during a test of 60 repetitions), and upper extremity dynamic endurance measured using a fatigue curve and grip endurance test.
- **Muscle power -** Power (the explosive aspect of strength) is defined as the rate of muscle work (Trew 2005), and is the product of force and speed of movement (power = (force x distance)/time) (ACSM 2009a). When more than one measure of power was reported we preferentially extracted: the vertical jump test (m), horizontal jump, isokinetic power (lower extremity before upper extremity) and maximum power test (maximum power in watts on best of three repetitions doing squats).
- **Maximum cardiorespiratory function** - Cardiorespiratory function is the ability of the heart, lungs, and circulatory system to efficiently supply oxygen and nutrients to working muscles. Rhythmic, aerobic type exercises involving large muscle groups are recommended for improving cardiovascular fitness. Maximal oxygen uptake (VO^2_{max}) is accepted as the best criterion to measure cardiorespiratory fitness. Maximal oxygen uptake is the product of the maximal cardiac output (L blood x min^{-1}) and arterial-venous oxygen difference (ml O_2/L blood). Maximal tests have the disadvantage of requiring the participant to exercise to the point of volitional fatigue and often require medical supervision and access to emergency equipment. For this reason, maximal exercise testing is not always feasible in research, health, and fitness settings. For this review, we preferentially extracted data from maximal or symptom-limited treadmill or cycle ergometer tests in units of ml/kg/min, energy expended, peak workload, or test duration. We also accepted data from exercise tests which yielded predicted maximum oxygen uptake.
- **Submaximal cardiorespiratory function or testing -** There are two major categories of submaximal tests: predictive and performance tests. Predictive tests are submaximal tests that are used to predict maximal aerobic capacity (Noonan 2000). Performance tests involve measuring the responses to standardized physical activities that are typically encountered in everyday life. In this review we preferentially extracted data from work completed at a specified exercise heart rate (e.g., PWC170 test), followed by distance walked in six minutes (meters), the two-minute walk test (meters), walking time for a set distance (seconds), anaerobic threshold test, and timed walking distance (e.g., Quarter Mile Walk Test).
- **Muscle/joint flexibility -** Flexibility is the ability to move a joint or a series of joints fluidly through the complete range of motion (Heyward 2010). It is important to carry out activities of daily living, and it depends on several specific variables, including the geometry and distensibility of the joint capsule, ligaments, tendon, and muscles spanning the joint (Heyward 2010). Flexibility is joint-specific, therefore no single test can evaluate total body flexibility. Tests quantify flexibility in terms of range of motion (ROM) expressed in degrees. For the purpose of this review the following were used: sit and reach test (commonly used to assess low back and hip joint flexibility) and ROM measures. When there were multiple ROM measures we took the first measure in the researcher's data table.

4. Outcomes representing safety and acceptability

We used four outcomes grouped into two categories to represent safety (i.e., adverse events, injuries, exacerbations) and acceptability (i.e., withdrawals). We recorded qualitative descriptions of any adverse events, injuries, exacerbations of pain, and/or other fibromyalgia symptoms. We also extracted withdrawals as a proxy

for acceptability of interventions.

Major outcomes

We designated seven of the 24 outcomes as major outcomes. All are presented in the 'Summary of findings' tables.

- Multidimensional function (wellness)
- Self reported physical function (wellness)
- Pain (symptoms)
- Stiffness (symptoms)
- Muscle strength (physical fitness)
- Submaximal cardiorespiratory function (physical fitness)
- Withdrawals* (safety and acceptability)
- Adverse effects* (safety and acceptability)

* Withdrawals and adverse effects are presented together in the 'Summary of findings' tables.

Minor outcomes

We designated the remaining outcomes as minor outcomes.
Minor wellness outcomes:

- Patient-rated global
- Mental health
- Self efficacy
- Clinician-rated (single-item instrument)

Minor symptom outcomes:

- Tenderness
- Fatigue
- Sleep disturbance
- Depression
- Anxiety
- Dyscognition

Minor physical fitness outcomes:

- Muscle endurance
- Muscle power
- Maximum cardiorespiratory function
- Muscle/joint flexibility

Search methods for identification of studies

Interventions in this review are part of a comprehensive search for all physical activity interventions. We screened the citations found in the electronic searches and then classified them by type of exercise training (e.g., aerobic, resistance, flexibility and yoga, aquatic exercise, mixed exercise and composite interventions, and innovative interventions).

Electronic searches

We searched the following databases from database inception to 24 October 2013 using current methods outlined in Chapter 6 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Lefebvre 2011). We applied no language restrictions. Full search strategies for each database are found in the appendices as indicated in the list.

- *The Cochrane Library* (Wiley) 2013, Issue 2 (http://www.thecochranelibrary.com/view/0/index.html) (Appendix 2)
    - Cochrane Database of Systematic Reviews (Cochrane Reviews)
    - Cochrane Central Register of Controlled Trials (CENTRAL)
    - Database of Abstracts of Reviews of Effects (DARE)
    - Health Technology Assessment Database (HTA)
    - NHS Economic Evaluation Database (EED)
- MEDLINE (OVID) 1946 to March Week 1 2013, 24 October 2013 (Appendix 3)
- EMBASE (OVID) EMBASE Classic + EMBASE 1947 to 24 October 2013 (Appendix 4)
- CINAHL (EBSCO) 1982 to 24 October 2013 (Appendix 5)
- PEDro (www.pedro.org.au/), accessed 24 October 2013 (Appendix 6)
- Dissertation Abstracts (ProQuest), accessed 24 October 2013 (Appendix 7)
- Current Controlled Trials, accessed 24 October 2013 (Appendix 8)
- WHO International Clinical Trials Registry Platform (www.who.int/ictrp/), accessed 24 October 2013 (Appendix 9)
- AMED (Allied and Complementary Medicine) (OVID) 1985 to October 2013, accessed 24 October 2013 (Appendix 10)

Searching other resources

Two review authors independently reviewed the reference lists from key journals, identified articles, meta-analyses, and reviews of all types of treatment for fibromyalgia, scrutinized all promising or potential references and added appropriate titles to the search output.

Data collection and analysis

Review team

The review team was made up of 12 members, including two consumers, one librarian, and nine review authors, however not all team members are listed as authors on this review. Review authors were from physical therapy, kinesiology, and dietetics backgrounds, and were trained in data extraction using a standardized orientation program designed for this review. Review authors worked in pairs (with at least one physical therapist in each pair) for the data extraction process. The team met monthly to discuss

progress, clarify procedures, make decisions regarding study inclusion/exclusion, classify outcome variables, and work collaboratively in the production of this review.

Selection of studies

Review authors independently screened titles and reviewed study abstracts generated from searches using a set of criteria (see Appendix 11 - Screening and Classification Criteria - Level 1 and Level 2). We retrieved full-text publications for all promising abstracts. The methods and results sections for all non-English reports were translated, and then two review authors independently examined the full-text reports and translations to determine if the study met the selection criteria (see Appendix 11 Screening and Classification Criteria - Level 3). Disagreements between the two review authors and questions regarding interpretation of inclusion criteria were resolved in discussion with partners unless the pair agreed to take the issue to the team.

Data extraction and management

We developed electronic data extraction forms to facilitate independent data extraction and consensus. Pairs of review authors worked independently to extract the descriptive and quantitative data from the studies (i.e., characteristics of each study, details of participants, interventions and comparators, outcomes, and study design). After the data were extracted, the pairs reviewed the data together and reached a consensus. We frequently encountered questions regarding the acceptability of outcome measures used in the studies; these questions were referred to the team for resolution if not solved with partners.

Assessment of risk of bias in included studies

We followed the procedure to assess bias recommended in the *Cochrane Handbook for Systematic Reviews of Interventions*. Two review authors independently evaluated the risk of bias in each included study using a customized form based on the Cochrane 'Risk of bias' tool (Higgins 2011a). The tool addresses seven specific domains: sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective outcome reporting, and other sources of bias. For other sources of bias, we considered potential sources of bias such as baseline inequities despite randomization, or inequities in the duration of interventions being compared. We rated each criterion as low, high, or unclear risk of bias. We used the criterion 'unclear risk' when the assessors' ability to determine the potential for bias could not be determined by information on the primary article or contact with author. In such cases, we revised the assessments if the authors responded to our requests for more information. We resolved disagreements on classifying risk of bias between the review authors pairs through discussion at consensus meetings. If agreement could not be reached, the issue was referred to the review team for a decision.

Assessment of congruence of interventions with exercise guidelines

While exercise programs for individuals with fibromyalgia commonly focus on relief of symptoms, exercise has been shown to have wide, sweeping positive effects on various aspects of health when performed regularly at and beyond certain minimum volumes. We believe that this should be addressed for individuals with fibromyalgia and therefore we have sought to establish congruence of the exercise interventions with the widely accepted ACSM guidelines that describe the exercise dosages recommended to improve and maintain physical fitness and minimize the health effects of chronic inactivity (Garber 2011). While we have chosen to evaluate interventions against these guidelines (see Appendix 1), it is also important to acknowledge that for individuals who are deconditioned, participation in exercise that falls below the guidelines outlined in the ACSM position stand in Garber 2011 can provide enough of a stimulus to cause physiological adaptations that enhance physical performance as well. While individuals who are deconditioned should begin their participation in exercise at lower dosages, they will experience greater benefits as they gradually increase their exercise programs to levels within the guidelines. We extracted data on exercise frequency, time, duration, intensity, and planned progression model of each intervention, and compared the aerobic, strengthening, and flexibility components of the interventions with guidelines in the 2011 ACSM Position Stand on the quantity and quality for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults (Garber 2011; Appendix 1; Characteristics of included studies).

Measures of treatment effect

The outcome measures of interest were most often presented as continuous data with pre-test means and standard deviations. We calculated change scores and estimated standard deviations for the change scores using the formula described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011b). We used the Review Manager analysis software (RevMan 2012): (1) to calculate effect sizes in the form of mean differences (MD) or standardized mean differences (SMD) and 95% confidence intervals (95% CI) (when different scales were used to measure the same conceptual outcome (e.g., multidimensional function), and we were unable to present the information using MDs, we calculated standardized mean differences (SMD) with corresponding 95% CI or per cent change) (2) to generate forest plots to display the results, and (3) to calculate and meta-analyze withdrawals using odds ratios.

When we found statistically significant results, we also evaluated the clinical relevance of the effects on major outcomes by calcu-

lating the relative difference in change from a pooled baseline in the intervention group compared to the change from a pooled baseline in the control or comparison group. We calculated the pooled baseline as follows:

- Pooled baseline = $(X_{1pre} * n_1 + X_{2pre} * n_2) / (n_1 + n_2)$
- Relative difference (%) = weighted mean difference/pooled baseline

Where the weighted mean difference was calculated in RevMan, X_{1pre} and X_{2pre} are the pre-test means in the experimental and the control groups respectively, and n_1 and n_2 are the number of participants in the experimental group and the control groups respectively. When calculating relative difference when instruments for an outcome measure were markedly different (e.g., muscle strength - isometric quadriceps strength, grip strength) and units of measurement were also different (e.g., Newton-meters, mm Hg), we calculated the relative difference for the outcome measure study-by-study and then used the median relative difference across all studies to represent the pooled value. In keeping with the practice of the Philadelphia Panel, we used 15% as the level for clinical relevance (Philadelphia Panel 2001). We calculated relative changes for major outcomes in the aquatic exercise training versus control and land analyses only.

Unit of analysis issues

The unit of analysis of the primary studies was individuals.
This review examined data from randomized trials with two or more parallel groups. We preferentially used data (mean change scores) from intention-to-treat analysis, so that the number of observations in the analyses matched the number of individuals that were randomized. However, when data are presented for completers only, the number of individuals whose data were analyzed may be fewer than the number of individuals that were randomized. When a control group was used as a comparator twice in the same analysis, we halved the sample size of the control group.

Dealing with missing data

When numerical data were missing, we contacted the study authors, requesting additional data required for analysis. When information needed to describe the intervention or to determine risk of bias was missing, we contacted authors using open-ended questions. When numerical data were available only in graphic form, we used Engauge version 4.1 to extrapolate means and standard deviations by digitizing data point on the graphs (Mitchell 2002). When unavailable, we calculated the standard deviations of the change scores using the formulae in Higgins 2011b (Section 16.1.3.2). We estimated the correlation between baseline and end of study measurements at 0.8.

Assessment of heterogeneity

We assessed statistical heterogeneity among the trials using the Chi^2 test and I^2 statistic. We considered values of $P < 0.1$ to be indicative of significant heterogeneity. Where $P < 0.1$ or $I^2 > 50\%$ or both, we examined the results for sources of clinical heterogeneity and methodological differences. When statistical heterogeneity was evident, we used a random-effects model for meta-analysis.
As recommended in the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2011), the interpretation of an I^2 value of 0% to 40% might 'not be important'; 30% to 60% may represent 'moderate' heterogeneity; 50% to 90% may represent 'substantial' heterogeneity; and 75% to 100% represents 'considerable' heterogeneity. We interpreted the Chi^2 test where a P value ≤ 0.10 will indicate evidence of statistical heterogeneity.

Assessment of reporting biases

We planned methods as described in the *Cochrane Handbook for Systematic Reviews of Interventions* (funnel plots, statistical tests, imputation (Sterne 2011)), pending a large enough sample of studies (i.e., more than 10 studies). For studies published after 1 July 2005, we screened the Clinical Trial Register at the International Clinical Trials Registry Platform of the World Health Organization (http://www.who.int/ictrp/search/en/) for the a priori trial protocol. We evaluated whether selective reporting of outcomes was present (outcome reporting bias). We compared the fixed-effect estimate against the random-effects estimate to assess the possible presence of small sample bias in the published literature (i.e., in which the intervention effect is more beneficial in smaller studies). In the presence of small sample bias, the random-effects estimate of the intervention is more beneficial than the fixed-effect estimate (Sterne 2011).

Data synthesis

When two or more sets of data were available for the same outcome, we used the RevMan analyses to pool the data (meta-analysis). In order to perform meta-analysis, we performed arithmetic conversions of the point estimates of outcomes: a) to express results in the same units (e.g., cm were transformed to mm), or b) to resolve differences in the direction of the scale (when scores derived from scales with higher score indicating greater health were combined with scores derived from scales with high scores indicating greater disease). These conversions enabled calculation of relative change, pooling of data, or both.
We used a fixed-effect model for meta-analysis unless heterogeneity was evident ($I^2 > 50\%$), in which case we used a random-effects model and sensitivity analysis. When back-translation of SMD effect sizes was not possible, we used Cohen's guidelines (no effect < 0.2, small effect = 0.2 to 0.49, moderate effect = 0.5 to 0.79, large effect ≥ 0.80) (Cohen 1988), to evaluate the magnitude of the effect and help with the interpretation of SMDs.

Subgroup analysis and investigation of heterogeneity

We conducted subgroup analysis to explore the relative effects (as represented by the SMD) of a variety of participant and intervention-related characteristics on multidimensional function, pain, and muscle strength outcomes. We only examined studies comparing aquatics training to control.

Participant characteristics - We classified studies into high and low subgroups for each of the following participant characteristics at baseline: age, impact of fibromyalgia, pain, and duration of symptoms. We determined high and low groups based on 90% confidence intervals using the following steps:

- We calculated weighted means, pooled standard errors, and 90% confidence intervals for each study.
- The studies with means below the median were candidates for the low group while studies with weighted means greater than the median were candidates for the high group.
- When the 90% confidence interval of a study of one group overlapped with one or more confidence intervals of the other group, we discarded it. Thus, the baseline means of studies in the lower group were statistically different to the means of studies in the higher group (P value < 0.1).

Characteristics of the intervention - We planned to carry out subgroup analysis to determine the effects of features of the intervention on multidimensional function, pain, and strength as follows:

- Temperature of the pool: a) cool (28 to 32 degrees Celsius), b) temperate (33 to 36 degrees Celsius), c) warm (more than 36 degrees Celsius)
- Duration of the program in weeks: a) less than seven weeks, b) 7 to 12 weeks, c) more than 12 weeks
- Frequency of training per week: a) one time/week, b) two times/week, c) three times/week, d) more than three times/week
- Exercise intensity: a) very light, b) light to moderate, c) moderate, d) light to vigorous, e) non-specified, f) self selected
- Accumulated time in the pool: a) less than 1000 minutes, b) 1000 to 2000 minutes, c) more than 2000 minutes

We used caution in the interpretation of subgroup analyses as advised in section 9.6 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2011).

Sensitivity analysis

We planned no sensitivity analyses a priori. In this review, we conducted a sensitivity analysis when the results of one study in the *aquatics versus control* comparisons were found be more extreme than the other studies (Deeks 2011). We carried out a sensitivity analysis by excluding the study in question from the meta-analyses and evaluating the impact on heterogeneity. The exclusion of the study substantially reduced the heterogeneity observed in the meta-analyses, therefore we used the revised meta-analysis for assessment of treatment effects.

'Summary of findings' tables

We used GRADEpro (version 3.6, Schünemann 2011) to prepare 'Summary of findings' tables for the seven major outcomes for each of the three comparisons. In the 'Summary of findings' tables, we integrated analysis of quality of evidence and the magnitude of effect of the interventions. We applied the GRADE Working Group grades of evidence, which considers the risk of bias and the body of literature to rate quality into one of four levels:

- High quality: Further research is very unlikely to change our confidence in the estimate of effect.
- Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
- Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
- Very low quality: We are very uncertain about the estimate.

We made quality ratings separately for each of the seven major outcomes. We selected multidimensional function, a comprehensive and encompassing outcome measure, among the seven outcomes variables to be highlighted in the 'Summary of findings' table and the 'Plain language summary'. We carried out calculations based on the guidelines of the Cochrane Musculoskeletal Review Group. For the continuous outcomes, we calculated the absolute per cent difference (i.e., the improvement in the intervention group minus the improvement in the control group, in the original units) and the relative per cent change from baseline (calculated as the absolute benefit divided by the baseline pooled mean of the control group and the intervention groups at baseline). When a continuous outcome showed a statistically significant difference, we also calculated the number needed to treat (NNT) using the Wells calculator (available at the CMSG Editorial office). We reported these analyses in the comments column of the 'Summary of findings' table.

For dichotomous outcomes, such as serious adverse events, we calculated the number needed to treat from the control group event rate and the relative risk using the Visual Rx NNT calculator (Cates 2008). We calculated the absolute risk difference using the risk difference statistics in RevMan and expressed the result as a percentage. We calculated the relative per cent change for dichotomous data as the risk ratio -1 and expressed this as a percentage.

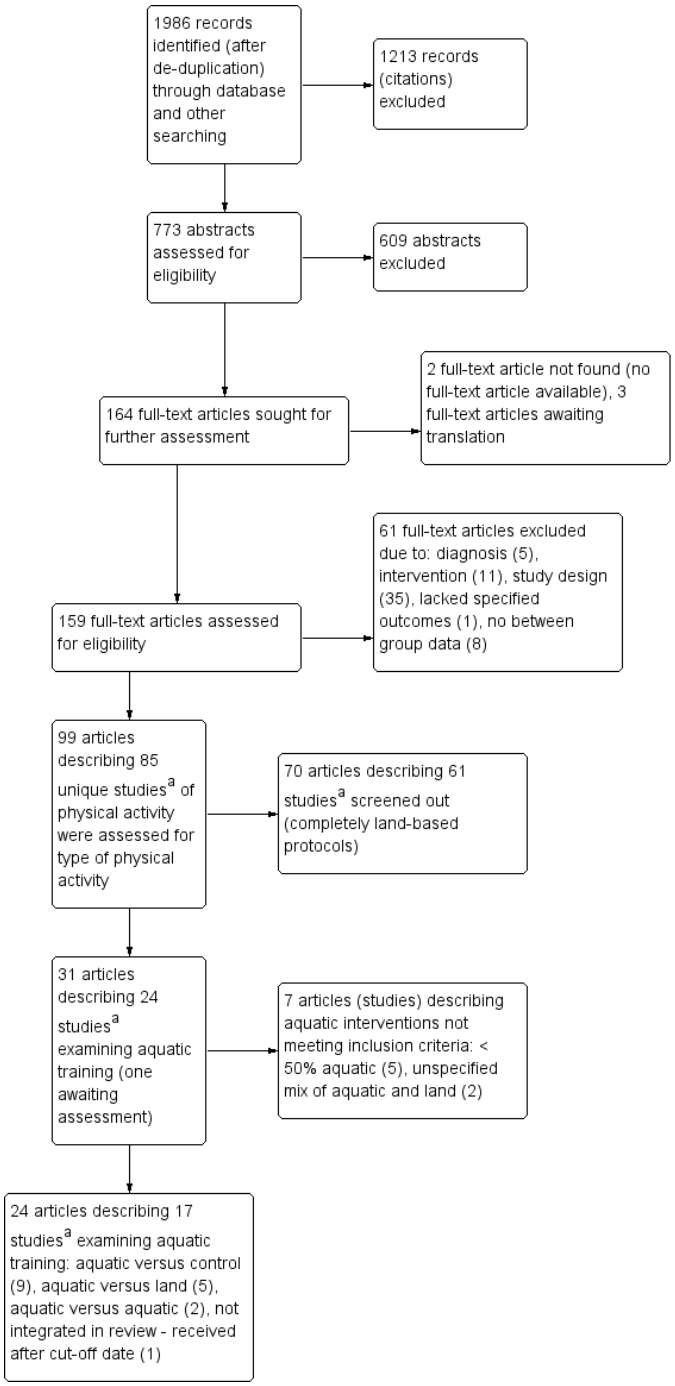
RESULTS

Description of studies

Results of the search

The search resulted in a total of 1986 citations. We excluded 1213 on citation screening and 609 based on abstract screening (see Figure 1). On examination of full-text articles, we excluded 61 studies because they did not meet the selection criteria related to: a) diagnosis of fibromyalgia (n = 5), b) physical activity intervention (n = 11), c) study design (n = 35), or d) outcomes (n = 9). One hundred and fifty-nine research publications described 84 RCTs with physical activity interventions for individuals with fibromyalgia. We screened the 84 RCTs to identify studies which compared interventions that were exclusively aquatic exercise interventions to control groups or other interventions, with the result that we screened out an additional 60 trials (see Table 2). We examined 31 articles describing 24 studies examining aquatic training in detail. Seven articles did not meet the inclusion criteria: < 50% aquatic (n = 5), unspecified mix of aquatic and land (n = 2). One study is awaiting assessment (López-Rodríguez 2012). Four additional studies are awaiting classification.

Figure 1. Study flow diagram.aDiscrepancy between the number of articles and studies denotes that multiple papers may have described the same study.



Included studies

Twenty-three articles describing 16 research publications met our selection criteria and we included them for analysis (Altan 2004; Arcos-Carmona 2011; Assis 2006; Calandre 2010; De Andrade 2008; de Melo Vitorino 2006; Evcik 2008; Gowans 2001; Gusi 2006; Hecker 2011; Ide 2008; Jentoft 2001; Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008). Although there were 23 separate articles, there were only 16 included studies. Three publications by Tomas-Carus, published in 2007, reported additional variables from the Gusi 2006 primary study, therefore we included the four reports and counted them as one study for analysis (hereafter identified as Gusi 2006). Likewise, Gowans 2002 reported on additional variables from the Gowans 2001 primary study and we included this pair but also counted them as one study (hereafter both reports are identified as Gowans 2001). Similarly, Munguia Izquierdo 2008 reported additional variables from the Munguia-Izquierdo 2007 primary study and we included these two studies and counted them as one (hereafter both reports are identified as Munguia-Izquierdo 2007). Furthermore, two publications by Tomas-Carus, one in 2007 and another one in 2009, reported on additional variables from the Tomas-Carus 2008 primary study so we counted the included trio as one study (hereafter identified as Tomas-Carus 2008).

Of 881 participants in the included studies, 866 were females with fibromyalgia. There were 439 individuals assigned to aquatic exercise training intervention: 248 in the aquatic versus control comparison, 116 in the aquatic versus land-based comparison, and 65 in the aquatic versus other types of intervention comparison. Outcome measures extracted for included studies are presented in Table 3.

We contacted authors using open-ended questions to obtain the information needed to assess risk of bias, the treatment effect, or both. We received responses from the following authors: Altan 2004; Arcos-Carmona 2011; Assis 2006; Evcik 2008; Gusi 2006; Hecker 2011; Ide 2008; Jentoft 2001; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008.

Description of the intervention

The main characteristics of the studies are summarized in the Characteristics of included studies table and described below:

Aquatic versus control

Settings

We analyzed nine studies. Seven studies were conducted in Europe (Altan 2004; Arcos-Carmona 2011; Gusi 2006; Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008), one in North America (Gowans 2001), and one in South America (Ide 2008). All studies were published after the year 2000. Among the 16 research reports that provided data for the nine included studies, there were four articles written in Spanish (Arcos-Carmona 2011; Gusi 2006 (two studies) and Tomas-Carus 2008 (one study)); two authors had primary and secondary articles written in both languages (Gusi 2006; Tomas-Carus 2008). The remaining articles were written in English.

Participants

A total of 513 female and six male individuals with an average age of 46.3 to 48.3 years were included. Fibromyalgia diagnosis followed the ACR 1990 criteria in all studies. Average disease duration/time since diagnosis was 12 years (6 to 24); however, some of the studies did not report this information (Altan 2004; Arcos-Carmona 2011; Ide 2008). Some studies excluded participants who were not sedentary (as described by authors as those who: a) were engaging in regular exercise (Ide 2008), b) were participating in ongoing exercise (Mannerkorpi 2009), c) had a history of physical activity more strenuous than slow-paced walking more than twice per week over four months prior to study (Munguia-Izquierdo 2007), or d) had a history of more than 30 minutes exercise/week during two weeks in the last five years (Gusi 2006; Tomas-Carus 2008).

Characteristics of the intervention

Water temperature was 27 to 32 degrees Celsius in three studies (Arcos-Carmona 2011; Ide 2008; Munguia-Izquierdo 2007), and 33 to 37 degrees Celsius in four studies (Altan 2004; Gusi 2006; Mannerkorpi 2009; Tomas-Carus 2008). Two of the studies did not specify water temperature (Gowans 2001; Mannerkorpi 2000). In six interventions, all sessions were performed in the water 100% of the time (Gowans 2001; Gusi 2006; Ide 2008; Mannerkorpi 2000; Munguia-Izquierdo 2007; Tomas-Carus 2008), in one intervention, 70% of the total intervention consisted of exercise in the water (Mannerkorpi 2009), and the two remaining interventions consisted of exercise in the water 50% of the time (Altan 2004; Arcos-Carmona 2011). All interventions were conducted in a supervised group setting and lasted an average of 17 weeks (range 4 to 32 weeks). Only three studies provided follow-up data: Altan 2004 and Gusi 2006 at 12 weeks and Mannerkorpi 2009 at 48 to 52 weeks. Four studies described the depth of water: Ide 2008 specified participants exercised with shoulders in the water, Munguia-Izquierdo 2007 at chest height, and water was at waist height in two studies (Gusi 2006; Tomas-Carus 2008). Average session duration was 45 minutes (range 30 to 70). Frequency varied from one time per

week in two studies (Mannerkorpi 2000; Mannerkorpi 2009), two times per week in one study (Arcos-Carmona 2011), three times per week in five studies (Altan 2004; Gowans 2001; Gusi 2006; Munguia-Izquierdo 2007; Tomas-Carus 2008), to four times per week in one study (Ide 2008). Exercise intensity levels varied as follows:

- very light (< 57% predicted HR_{max}) (Arcos-Carmona 2011);
- light to moderate (57% to 76% predicted HR_{max}) (Altan 2004; Tomas-Carus 2008);
- moderate (64% to 76% predicted HR_{max}) (Gowans 2001; Gusi 2006);
- light to vigorous (57% to 95% predicted HR_{max}) (Munguia-Izquierdo 2007);
- self selected (Mannerkorpi 2000; Mannerkorpi 2009);
- non-specified (Ide 2008).

None of the studies met the ACSM exercise guidelines specified for aerobic or strength training. Only Ide 2008 met the ACSM guidelines for flexibility training. There was a disagreement between review authors and trialists for one study in classifying the congruence with ACSM guidelines (Munguia-Izquierdo 2007). While Munguia-Izquierdo 2007 reported "the intervention program met the minimum training standards of the American College of Sports Medicine pg 826 ...", the review authors evaluated the program as described as not meeting ACSM guidelines.

Types of exercise

Six studies provided an aquatic mixed intervention, including a combination of aerobics, flexibility, co-ordination and/or strength. Gowans 2001 presented an aquatic aerobic intervention for six weeks that progressed from full exercise time in the water to fewer hours in the water and more land-based. For the purpose of this review we have used data corresponding to the period, zero to six weeks (i.e., the time participants exercised 100% in the water). Two authors split the intervention into water and land: 30/30 minutes for Arcos-Carmona 2011 and in Altan 2004 two land based sessions preceded the aquatics sessions. In Ide 2008 the intervention had an aquatic aerobic exercise component combined with a non-exercise relaxation session.

Control

Six studies had a standardized control group. Two studies provided a specialized type of control (balneotherapy, Altan 2004), and education-relaxation (Mannerkorpi 2009). One study used sedentary recreational activities as a control (Ide 2008).

Aquatic versus land-based training

Settings

We analyzed five studies: two studies were conducted in Europe (Evcik 2008; Jentoft 2001), and three in South America (Assis 2006; de Melo Vitorino 2006; Hecker 2011). All studies were conducted after 2000. All studies but one (Hecker 2011 - Portuguese) were written in English.

Participants

The studies included 203 females and one male with an average age of 44 years. All participants were diagnosed following the ACR 1990 criteria. Only one study had an exclusion criterion based on physical activity: participants were excluded if they had exercised in the six weeks prior to the intervention (Assis 2006).

Aquatic interventions

Water temperature was 27 to 32 degrees Celsius in one study (Assis 2006), and 33 to 37 degrees Celsius in two studies (Evcik 2008; Jentoft 2001). In Hecker 2011 water temperature was 32 to 34 degrees Celsius. Only one study did not report water temperature (de Melo Vitorino 2006). All activities were conducted in a group setting and were supervised. All but one study presented a mixed exercise intervention, including strength, aerobic, flexibility exercise plus and non-exercise relaxation components. The land-based exercises followed the same program as the aquatic exercise training intervention. Assis 2006 used an aquatic aerobic intervention in the deep water part of the pool.

The average intervention duration was 13 weeks (range 3 to 23 weeks). Two studies carried out a follow-up assessment at 19 and 24 weeks (Evcik 2008; Jentoft 2001). Duration of the individual sessions within the intervention was 60 minutes, with a frequency of one time per week (Hecker 2011), two times per week (Jentoft 2001), and three times per week (Assis 2006; de Melo Vitorino 2006; Evcik 2008). Intensity of the intervention was reported in three studies and varied from very light (Hecker 2011), light to moderate (Assis 2006), to light to vigorous (Jentoft 2001). Three studies did not meet the ACSM exercise guidelines for aerobic or strength criteria (de Melo Vitorino 2006; Evcik 2008; Hecker 2011), and information was insufficient to determine congruence in two cases (Assis 2006; Jentoft 2001). Only de Melo Vitorino 2006 met the ACSM criteria for flexibility.

Land-based interventions

All studies replicated the aquatic exercise training intervention as a land-based intervention. Authors gave these interventions different names (e.g., conventional physiotherapy, kinesiotherapy) but components such as frequency, duration, and intensity were identical. One study had a non-supervised, home-based exercise control (Evcik 2008).

Aquatic versus aquatic

Settings

We analyzed two studies (Calandre 2010; De Andrade 2008). One was conducted in Europe/Spain (Calandre 2010), and the other in South America/Brazil (De Andrade 2008). Both studies were published after 2007 and were written in the English language.

Types of interventions

Calandre 2010 conducted a direct comparison of Ai Chi (Tai Chi in the water) versus stretching in the water (intervention 1 and intervention 2 respectively); De Andrade 2008 conducted a direct comparison of an aquatic aerobic intervention in sea water (intervention 1) to an aquatic aerobic intervention in a pool (intervention 2).

Characteristics of the intervention

In Calandre 2010 there were 73 female and eight male participants with an average age from 49 to 51 years who were diagnosed with fibromyalgia according to the ACR 1990 criteria. Average disease duration was 14.1 to 15.6 years in each of the groups. Pool temperature was 36 degrees Celsius and individuals had a warm water shower to acclimatize prior to getting in the pool. The length of the intervention was six weeks, with follow-up at 10 and 18 weeks. The intervention was carried out in a supervised group setting and was 60 minutes, three times per week at intensity levels that met individual needs. The intervention did not meet the ACSM exercise guidelines for aerobic or strength but met them for flexibility. The stretching group sessions were 60 minutes long, three times per week, with intensity levels to meet individual needs. In De Andrade 2008 there were 46 females with an average age of 48.3 to 48.8 years in each of the groups respectively diagnosed according to the ACR 1990 criteria. Participants were excluded if they had engaged in physical activity in the three months prior to the intervention.The supervised group activity took place in an outdoor pool (during summer months) with water temperature ranging from 28 to 33 degree Celsius. The 12-week intervention consisted of three 60-minute weekly sessions, at a moderate to vigorous intensity level (50 to 75% $VO2_{max}$,12 to 13 on the Borg RPE). The intervention did not meet the ACSM exercise guidelines for aerobic, strength or flexibility training requirements. The sea water group exercised in water at shoulder level in an area with no waves, with the same duration, frequency, and intensity as the pool intervention.

Excluded studies

Following screening of citations and abstracts, we excluded 60 studies on the assessment of the full-text article, when the study did not meet the inclusion criterion for: a) diagnosis of fibromyalgia (n = 5), b) physical activity intervention (n = 10), c) study design (n = 34), or d) between-group data for specified outcomes (n = 9, see Characteristics of excluded studies).

Risk of bias in included studies

Results of the 'Risk of bias' assessment for the 16 studies are provided in the Characteristics of included studies table and in Figure 2 and Figure 3. The 'Risk of bias' assessments were based on primary article data supplemented by responses from authors.

Figure 2. 'Risk of bias' summary: review authors' judgements about each risk of bias item for each included study.

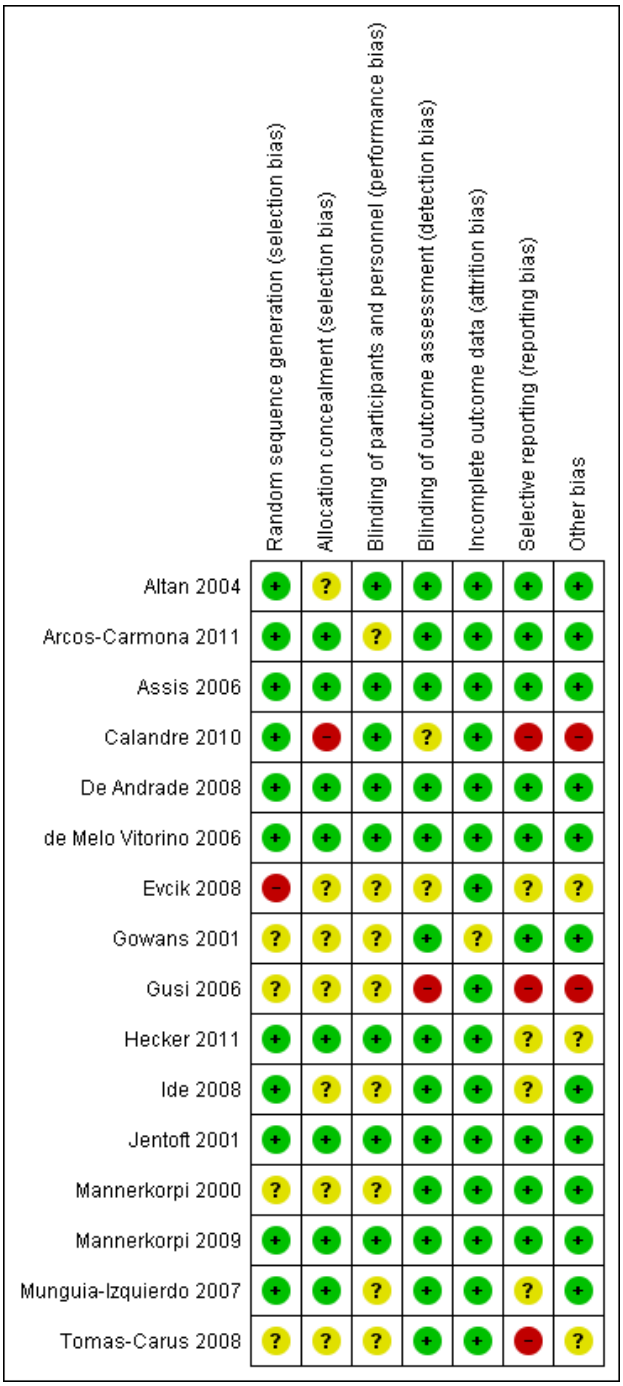
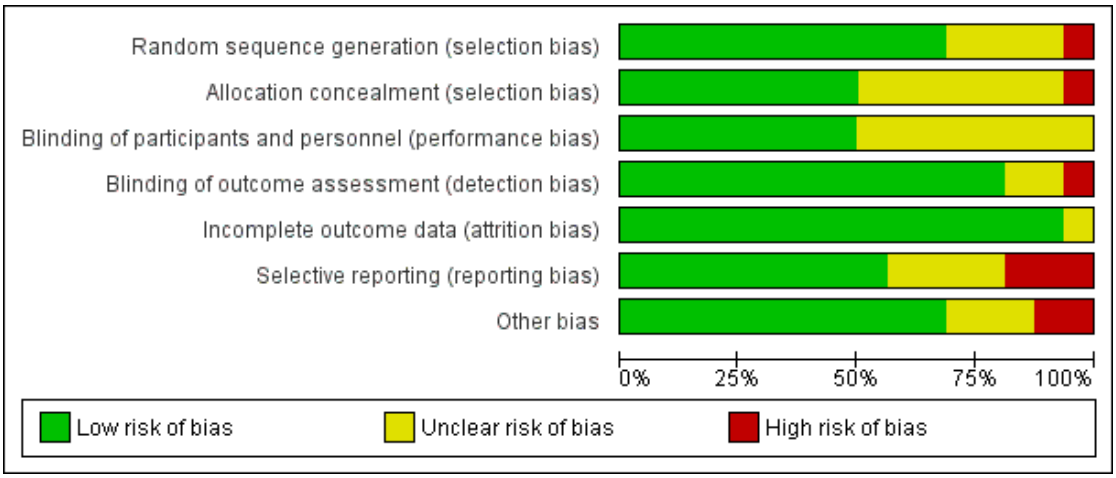


Figure 3. 'Risk of bias' graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.



Allocation

Eleven of the 16 studies used an acceptable method of random sequence generation (computer-generated sequence, coin toss, drawing of cards, or lots) and we rated them low risk (Altan 2004; Arcos-Carmona 2011; Assis 2006; Calandre 2010; De Andrade 2008; de Melo Vitorino 2006; Hecker 2011; Ide 2008; Jentoft 2001; Mannerkorpi 2009; Munguia-Izquierdo 2007). In four studies allocation methods were unclear (Gowans 2001; Gusi 2006; Mannerkorpi 2000; Tomas-Carus 2008); we rated only one study as high risk as it had not utilized an acceptable method of random generation (date of admission) (Evcik 2008).

Eight studies were rated as low risk as they utilized acceptable methods to conceal the allocation sequence, such as central allocation (including telephone, web-based, and pharmacy-controlled randomization) or sequentially numbered, opaque, sealed envelopes (Arcos-Carmona 2011; Assis 2006; De Andrade 2008; de Melo Vitorino 2006; Hecker 2011; Jentoft 2001; Mannerkorpi 2009; Munguia-Izquierdo 2007). We rated seven studies that did not present sufficient information to allow definitive judgement as unclear (Altan 2004; Evcik 2008; Gowans 2001; Gusi 2006; Ide 2008; Mannerkorpi 2000; Tomas-Carus 2008). One study used an unacceptable method of allocation concealment and thus we classified it as high risk (Calandre 2010).

Blinding

In exercise studies, blinding of participants and care providers is very rare. Among the included studies, we rated blinding of participants and personnel (performance bias) as low risk for eight studies (Altan 2004; Assis 2006; Calandre 2010; De Andrade 2008; de Melo Vitorino 2006; Hecker 2011; Jentoft 2001; Mannerkorpi 2009), and unclear risk for eight studies (Arcos-Carmona 2011; Evcik 2008; Gowans 2001; Gusi 2006; Ide 2008; Mannerkorpi 2000; Munguia-Izquierdo 2007; Tomas-Carus 2008).

Thirteen studies blinded outcome assessors to participant group assignment (detection bias) and we rated these studies as low risk (Altan 2004; Arcos-Carmona 2011; Assis 2006; De Andrade 2008; de Melo Vitorino 2006; Gowans 2001; Hecker 2011; Ide 2008; Jentoft 2001; Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008), we rated two as unclear risk (Calandre 2010; Evcik 2008), and one study as high risk (Gusi 2006).

Incomplete outcome data

We rated two studies that reported incomplete outcome data as unclear risk; there was insufficient information provided by Gusi 2006 and Gowans 2001 to determine whether incomplete outcome data were adequately addressed.

Aquatic versus control

Drop-out rates for all interventions were as follows: Altan 2004 6% (3/46); Arcos-Carmona 2011 5% (3/57 participants); Gowans 2001 2% (1/50 participants); Gusi 2006 3% (1/35 participants); Ide 2008 13% (5/40 participants); Mannerkorpi 2000 16% (11/69 participants); Mannerkorpi 2009 17% (23/134 participants); Munguia-Izquierdo 2007 5% (3/60 participants); and Tomas-Carus 2008 9% (3/33 participants). Reasons for drop-out stated by the authors were: failure to attend 95% of exercise sessions or missing more than 25% of activities/classes, failure to attend post measurement for personal reasons, transportation problems and employment commitments, failure to attend assessment, failure to begin exercise program due to scheduling conflicts, unknown reasons, not starting program due to randomization, concomitant disease, family reasons, move from city, falling on the street, seeking professional support for stress, or change of medication. Only two studies used intention-to-treat analysis (Gowans 2001; Munguia-Izquierdo 2007).

Aquatic versus land-based

Drop-out rates were as follows: Assis 2006 13% (4/30 participants); de Melo Vitorino 2006 6% (3/50 participants); Evcik 2008 3% (2/63 participants); and Jentoft 2001 reported a 23% drop-out rate (10/44 participants). Hecker 2011 did not specify a drop-out rate but author communication clarified that "all participants in each group were followed to the end of the study". Reasons for drop-out stated by the authors were low attendance (less than 50% of sessions), no attendance, inflammatory rheumatic disease, personal reasons, reasons not given (Evcik 2008), and incompatibility with work schedule. Intention-to-treat analysis was used by Assis 2006 and de Melo Vitorino 2006.

Aquatic versus aquatic

Drop-out rates were as follows: De Andrade 2008 17% (8/46 participants); Calandre 2010 19% (15/81 participants). Reasons for drop-out stated by the authors were no excuse, hypertension, cardiac arrhythmia, personal problems and incompatibility with work schedule, lack of time, and adverse effects like chlorine sensitivity and pain exacerbation. Calandre 2010 used intention-to-treat analysis.

Missing outcome data were balanced in numbers across intervention groups, with similar reasons for missing data across groups, suggesting low risk of bias in 14/16 studies. Overall we rated the risk due to incomplete outcome data as low (~80%, Figure 3).

Selective reporting

It was difficult to assess selective reporting bias because a priori research protocols were not available for any of the reviewed studies. We rated three out of 16 studies as having high risk of selective reporting (Calandre 2010; Gusi 2006; Tomas-Carus 2008), because some of the reported outcome measures were not prespecified and point/variability estimates were not provided for all outcomes. We rated four out of 16 studies as unclear risk (Evcik 2008; Hecker 2011; Ide 2008; Munguia-Izquierdo 2007). Overall we rated the risk of selective reporting as low (~60%, Figure 3).

Information on adverse effects was seldom included in the primary studies. Only five studies reported adverse effects. Altan 2004 described participant drop-out due to hypertension and cardiac arrhythmias - these participants were in the balneotherapy group. The De Andrade 2008 study reported "adverse events were not indicated as a cause of interruptions." There were 20 adverse events in this study (nine in the pool group and 11 in the sea group). Nine patients reported muscle pain in the pool group. Two patients reported first-degree burns, one patient presented with a urinary infection, and eight in the sea group (pg 149) reported muscle pain. Evcik 2008 states "no side effects were observed during the program" (pg 886-7). Assis 2006 states "there were 10 adverse events in the deep water running group and 16 in the land-based exercise group ... four patients in the deep water running reported muscle pain and 1 reported tinea pedis. There were 12 patients in the land-based exercise group who reported muscle pain. One of them had an impingement syndrome; another a bilateral ankle arthritis; a third a Baker cyst." (pg 61); Calandre 2010 states "Fifteen patients withdrew from the trial ... three of them belonging to the Ai Chi group due to adverse reactions: one case of chlorine hypersensitivity and two cases of pain exacerbation" (pg s-16); Mannerkorpi 2000 stated "main reasons for not starting or interrupting the program were lack of time due to commitments related to child care or employment, or the occurrence of infection or injury" (pg 2474).

Other potential sources of bias

Overall, we rated the risk due to other sources of bias as low (~75%, Figure 3). We rated one study high risk for other serious potential sources of bias because it reported extreme baseline imbalances in one of the outcome measures (Calandre 2010). We rated three studies as unclear risk: in one of them we considered that the methodology had some flaws and many areas assessed were not discussed by the authors (Evcik 2008); in another study there was insufficient information to assess whether an important risk of bias existed (Hecker 2011); and in the third study we noted that there was incongruence of data among primary and companion studies (Tomas-Carus 2008).

Poor adherence is also a potential source of bias in exercise studies. None of the studies reported detailed results of systematic data collection and analysis of participant adherence to exercise performance in a way that would allow the review authors to understand the amount of exercise training actually performed by participants.

Effects of interventions

See: **Summary of findings for the main comparison** Aquatic training compared to control; **Summary of findings 2** Aquatic training compared to land-based training

The results related to effects of the interventions have been grouped below to correspond to the objectives of the review.

Aquatic versus control

After visually inspecting the results produced in the meta-analyses, it was apparent that one study was atypical (i.e., an outlier) (Ide 2008). On reviewing Ide 2008, we noted that the intervention differed from the others; the focus of the Ide 2008 intervention was on combined breathing with flexibility maneuvers in the water, whereas the other studies concentrated on aerobic and resistance training exercises. We conducted a sensitivity analysis to evaluate this decision. We decided to remove the Ide 2008 study from the meta-analysis. Subsequently, heterogeneity improved in all but one analysis (Table 4). The meta-analyses results are described below and in the Summary of findings for the main comparison.

Wellness

Seven studies (367 participants) provided data for the major outcome measure, multidimensional function (Altan 2004; Gowans 2001; Gusi 2006; Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008), and five studies (285 participants) reported on self reported physical function (Arcos-Carmona 2011; Gusi 2006; Mannerkorpi 2000; Mannerkorpi 2009; Tomas-Carus 2008). Only one study (46 participants) provided data on the minor wellness outcome of patient-rated global (Altan 2004).

Among the major outcomes in the wellness category, the mean multidimensional function in the aquatic groups improved by -5.97 Fibromyalgia Impact Questionnaire (FIQ) units compared to the control groups (mean difference (MD) -5.97, 95% confidence interval (CI) -9.06 to -2.88; standardized mean difference (SMD) -0.55, 95% CI -0.83 to -0.27; moderate difference, seven studies, 367 participants, Analysis 1.1). The absolute difference was -6 (95% CI -9 to -3) and the number needed to treat (NNT) was 5 (95% CI 3 to 9). The mean self reported physical function improved by 4.35 units (on a 100-point scale) more in the aquatic groups than in the control groups (MD -4.35, 95% CI -7.77 to -0.94; SMD -0.44 95% CI -0.76 to -0.11; small difference, five studies, 285 participants, Analysis 1.2). The absolute difference was -4 (95% CI -8 to -1) and the NNT was 6 (95% CI 3 to 22). Among the major wellness outcomes, none of the outcomes met the threshold for clinically relevant differences (15%); the relative change (improvement based on baseline values) compared to the control groups was -9% (CI -14% to -4.5%) in multidimensional function outcome, and -9% (95% CI -16% to -2%) improvement for self reported physical function.

Minor wellness outcomes

There was no evidence of an effect for patient-rated global (MD -0.87 on a 10 cm visual analog scale (VAS), 95% CI -1.74 to 0.00, one study, 46 participants, Analysis 1.7), self efficacy (MD 9.54, 95% CI -3.39 to 22.46, two studies, 88 participants, Analysis 1.10), mental health (MD -3.03, 95% CI -8.06 to 2.01, four studies, 243 participants, Analysis 1.8), or clinician-rated global (MD 0.08 on a 10 cm scale, 95% CI -0.75 to 0.91, one study, 46 participants, Analysis 1.9).

Symptoms

Seven studies (382 participants) provided data on pain (Altan 2004, Arcos-Carmona 2011; Gusi 2006; Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007); six studies (329 participants) assessed fatigue (Altan 2004, Arcos-Carmona 2011; Gusi 2006; Mannerkorpi 2000; Mannerkorpi 2009; Tomas-Carus 2008); seven studies (368 participants) reported on tenderness (Altan 2004; Gowans 2001; Gusi 2006; Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008); and four studies (230 participants) evaluated stiffness (Gusi 2006; Mannerkorpi 2000; Mannerkorpi 2009; Tomas-Carus 2008).

We found a moderate effect favoring the aquatic exercise training for pain, with the mean pain in the aquatic groups improving by -6.59 units on a 100-point scale (MD -6.59, 95% CI -10.71 to -2.48; SMD -0.53, 95% CI -0.76 to -0.31; moderate effect, seven studies, 382 participants, Analysis 1.3), with an absolute difference of -7% (95% CI -11 to -3) and a NNT of 5 (95% CI 3 to 8). Mean stiffness in the aquatic groups improved by 18.48 units on a 100-point scale compared to the control groups (MD -18.34, 95% CI -35.75 to -0.93; SMD 1.00, 95% CI -1.91 to -0.10; large effect, four studies, 230 participants, Analysis 1.4). Among the major symptom outcomes, only one met the threshold for clinically relevant differences (15%); compared to control groups, aquatic exercise training reduced stiffness by 26.8% (95% CI -52.2% to -1.1%) following the intervention. The reduction in pain did not meet the threshold for clinical relevance (relative difference 9.5%, 95% CI -15.3% to -3.7% improvement).

Minor symptoms outcomes

We found a small effect favoring the aquatic intervention for depression (SMD -0.45, 95% CI -0.82 to -0.08; 362 participants, Analysis 1.13) and tenderness (SMD -0.47, 95% CI -0.80 to -0.13, seven studies, 368 participants, Analysis 1.12), while we found no evidence of an effect for fatigue (SMD -0.31, 95% CI -0.75 to 0.13, six studies, 329 participants, Analysis 1.11). We found a moderate effect on sleep favoring aquatic exercises (SMD -0.63, 95% CI -1.12 to -0.14; two studies, 104 participants, Analysis 1.15), anxiety (SMD -0.57, 95% CI -0.95 to -0.19; seven studies, 374 participants, Analysis 1.16), and dyscognition (number

of correct responses over 60 trials, MD -4.70, 95% CI -9.29 to -0.11, one study, 58 participants, Analysis 1.17).

Physical fitness

Four studies (152 participants) evaluated muscle strength (Gowans 2001; Gusi 2006; Mannerkorpi 2000; Tomas-Carus 2008); three (162 participants) evaluated muscle endurance (Altan 2004; Mannerkorpi 2000; Munguia-Izquierdo 2007); two (64 participants) evaluated maximal cardiorespiratory function (Gusi 2006; Tomas-Carus 2008); and three studies (194 participants) evaluated submaximal cardiorespiratory function (Gowans 2001; Mannerkorpi 2000; Mannerkorpi 2009).

The effects for the physical fitness training in strength and submaximal cardiorespiratory function showed a moderate effect favoring aquatic exercise training interventions. Muscle strength was measured using isometric knee extension in Newton meters (Gowans 2001), isometric knee extension in Newtons (Gusi 2006), grip strength in kilograms (Tomas-Carus 2008), and grip strength in unspecified units (Mannerkorpi 2000). Different instruments and muscle groups were used to evaluate the effects of aquatic interventions on muscle strength, therefore we pooled the data using the SMD only. The aquatic group improved 0.63 standard deviations compared to the control group (SMD 0.63, 95% CI 0.20 to 1.05, four studies, 152 participants, moderate effect, Analysis 1.5), with an absolute difference of 0.63 standard deviations (95% CI 0.20 to 1.05) and a NNT of 4 (95% CI 3 to 12). Submaximal cardiorespiratory function improved by 37.03 meters on a six-minute walk test (MD 37.03, 95% CI 4.14 to 69.92, SMD 0.70, 95% CI 0.05 to 1.36, moderate effect, three studies, 194 participants, Analysis 1.6), with an absolute difference of 37 meters walked in six minutes (95% CI 4 to 70 m) and a NNT of 5 (95% CI 3 to 9). We found a clinically relevant difference favoring the aquatic exercise training intervention for muscle strength (relative per cent change 37%, 95% CI 12% to 62%), but submaximal cardiorespiratory function did not meet the 15% threshold for clinical relevance (relative per cent change 6.5%, 95% CI 4% to 9%).

The minor outcome, flexibility, was measured in one study (Tomas-Carus 2008); the difference in the sit reach test was not statistically significant (MD 1.50 cm, 95% CI -2.04 to 5.04; one study, 30 participants, Analysis 1.14). In addition, we found a lack of evidence for muscle endurance (SMD -0.00, 95% CI -0.67 to 0.67, three studies, 162 participants, Analysis 1.19) and maximal cardiorespiratory function (SMD 0.23, 95% CI -1.00 to 1.47, two studies, 64 participants, Analysis 1.18).

Additional evidence

We did not meta-analyze the study by Ide 2008, which compared the effects of respiratory exercises with arm and trunks movements in 18 participants with fibromyalgia to 17 control participants, with the other studies due to statistical and clinical heterogeneity. Ide 2008 reported effects as follows:

Wellness outcomes

- Multidimensional function measured by the FIQ total (0 to 100) (MD -2.05, 95% CI -2.40 to -1.70).
- Self reported physical function measured by the FIQ physical functional scale (0 to 100) (MD -0.80, 95% CI -1.0 to -0.5).
- Mental health measured by the SF-36 Mental Health Scale (0 to 100) (SMD -1.85, 95% CI -2.66 to -1.05).

Symptoms outcomes

- Pain measured on the FIQ VAS scale (0 to 100) (MD -2.02, 95% CI -2.4 to -1.64).
- Tenderness: active tender points out of 18 (SMD -2.29, 95% CI -3.16 to -1.42).
- Fatigue measured by the FIQ fatigue scale (0 to 100) (SMD -5.01, 95% CI -6.42 to -3.60).
- Stiffness measured by the FIQ stiffness scale (0 to 100) (MD -1.10, 95% CI -1.55 to -0.65).
- Depression measured by the FIQ depression scale (0 to 100) (SMD -2.98, 95% CI -3.97 to -1.98).
- Anxiety measured by the FIQ anxiety scale (0 to 100) (SMD -3.88, 95% CI -5.05 to -2.71).
- Sleep measured by the Pittsburgh Sleep Quality Index (0 to 21) (SMD -4.25, 95% CI -5.49 to -3.00).

Safety and acceptability

Reporting of adverse effects was incomplete and sometimes absent in the studies. Mannerkorpi 2000 reported an unspecified number of withdrawals due to injury and infection. Gusi 2006 explicitly stated that the intervention did not aggravate symptoms. Altan 2004 stated that participants in the balneotherapy group dropped out due to developing hypertension and cardiac arrhythmias. In the five remaining studies, adverse effects were not addressed (Arcos-Carmona 2011; Gowans 2001; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008).

All-cause withdrawal rates for the aquatic exercise training groups (n1/N1) versus control (n2/N2) were: 1/24 versus 2/22 (Altan 2004); 1/28 versus 2/28 (Arcos-Carmona 2011); 12/27 versus 8/24 (Gowans 2001); 1/18 versus 0/17 (Gusi 2006); 9/37 versus 2/32 (Mannerkorpi 2000); 9/66 versus 14/68 (Mannerkorpi 2009); 3/35 versus 1/25 (Munguia-Izquierdo 2007); and 2/17 versus 1/16 (Tomas-Carus 2008). Pooled analysis resulted in a non-statistically significant risk ratio (RR 1.13, 95% CI 0.73 to 1.77, Analysis 1.20).

Long-term effects

Six studies measured the effects of the intervention once again after the end of the supervised intervention (Altan 2004; Calandre 2010; Evcik 2008; Gusi 2006; Jentoft 2001; Mannerkorpi 2009);

Altan 2004 and Gusi 2006 conducted a follow-up at 12 weeks; Calandre 2010 assessed outcomes again 12 weeks post-intervention; Evcik 2008 had two follow-up periods at 12 and 24 weeks; Jentoft 2001 reported a follow-up at 26 weeks post-intervention; and Mannerkorpi 2009 followed up at 48 to 52 weeks post-intervention. We calculated the results for the follow-up period for the aquatic versus control comparison.

The three studies, Gusi 2006, Altan 2004, and Mannerkorpi 2009, from the *aquatic versus control* comparison employed follow-up testing after the intervention finished, evaluating outcomes at 12, 12 and 48 to 52 weeks, respectively. The clinical heterogeneity among these studies meant that we did not meta-analyze the long-term effects of aquatic exercises. Our analyses show the long-term effects on outcome variables of each of the studies by displaying change from baseline to end of intervention (T2) and to follow-up (T3) (Figure 4; Figure 5). The data are presented in SMDs for ease of comparison. The long-term results were as follows:

Figure 4. Aquatic exercise versus control - Follow-up analysis of wellness and symptom outcomes. Mann = Mannerkorpi, T2 change from baseline to end of intervention, T3 change from baseline to follow-up assessment.

	Experimental			Control			Std. Mean Difference	Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Random, 95% CI	IV, Random, 95% CI
1.1.1 Multidimensional Function								
Multidimensional.AltanT2	-14.29	11.88	24	-13.21	12.61	24	-0.09 [-0.65, 0.48]	
Multidimensional.AltanT3	-7.3	7.47	24	-4.51	10.32	22	-0.31 [-0.89, 0.28]	
Multidimensional.GusiT2	-11	12.37	17	1	10.48	17	-1.02 [-1.74, -0.30]	
Multidimensional.GusiT3	-6	12	17	1	10.48	17	-0.61 [-1.30, 0.08]	
Multidimensional.MannT2	-3.39	11.49	57	-1.38	9.87	54	-0.19 [-0.56, 0.19]	
Multidimensional.MannT3	-4.03	12.77	51	-6.03	12.63	53	0.16 [-0.23, 0.54]	
1.1.2 Self Reported Physical Function								
Physical Function.GusiT2	-19	18.03	17	-4	11.54	17	-0.97 [-1.68, -0.25]	
Physical Function.GusiT3	-12	14.04	17	-4	11.54	17	-0.61 [-1.30, 0.08]	
Physical Function.MannT2	-0.84	14.93	57	0.9	13.3	54	-0.12 [-0.49, 0.25]	
Physical Function.MannT3	-4.72	14.85	51	-1.63	13.61	53	-0.22 [-0.60, 0.17]	
1.1.3 Pain								
Pain.AltanT2	-2.1	1.66	24	-1.87	1.1	22	-0.16 [-0.74, 0.42]	
Pain.AltanT3	-2.52	1.77	24	-1.14	1.4	22	-0.85 [-1.45, -0.24]	
Pain.GusiT2	-23	18.03	17	5	11.54	17	-1.81 [-2.62, -0.99]	
Pain.GusiT3	-22	14.04	17	5	11.54	17	-2.05 [-2.90, -1.20]	
Pain.MannT2	-4.85	12.95	57	-0.02	11.86	52	-0.39 [-0.76, -0.01]	
Pain.MannT3	-3.69	15.78	50	-4.7	13.7	53	0.07 [-0.32, 0.45]	
1.1.4 Tenderness								
Tenderness.AltanT2	-6.83	2.35	24	-5.91	2.13	22	-0.40 [-0.99, 0.18]	
Tenderness.AltanT3	-6.5	2.42	24	-5.18	3.8	22	-0.41 [-1.00, 0.17]	
Tenderness.GusiT2	16.9	1.1	17	17.2	1.5	17	-0.22 [-0.90, 0.45]	
Tenderness.GusiT3	17.2	1.3	17	17.3	1.2	17	-0.08 [-0.75, 0.59]	
1.1.5 Stiffness								
Stiffness.MannT2	-0.25	17.09	57	-0.29	12.85	52	0.00 [-0.37, 0.38]	
Stiffness.MannT3	-7.13	18.43	50	-3.56	13.96	53	-0.22 [-0.61, 0.17]	
1.1.6 Fatigue								
Fatigue.AltanT2	-2.58	1.72	24	-1.23	1.65	22	-0.79 [-1.39, -0.18]	
Fatigue.AltanT3	-2.17	1.8	24	-0.82	1.65	22	-0.77 [-1.37, -0.17]	
Fatigue.GusiT2	-17	18.03	17	-5	11.54	17	-0.77 [-1.47, -0.07]	
Fatigue.GusiT3	-5.6	14.04	17	-5	11.54	17	-0.05 [-0.72, 0.63]	
Fatigue.MannT2	-4.34	15.18	57	-3.62	12.54	52	-0.05 [-0.43, 0.32]	
Fatigue.MannT3	-3.08	15.74	50	-8.02	15.58	53	0.31 [-0.08, 0.70]	

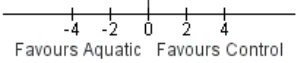
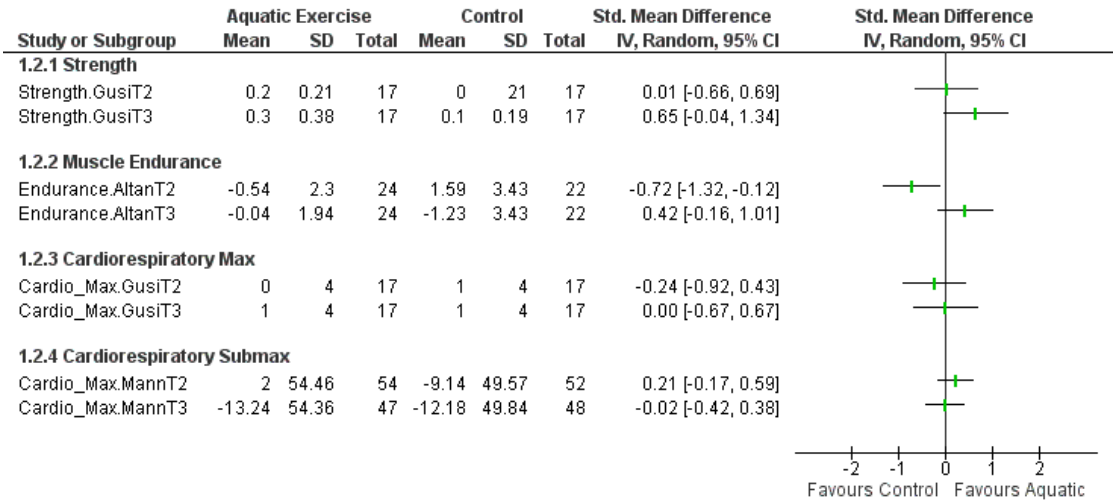


Figure 5. Aquatic versus control - Follow-up fitness outcomes. Mann = Mannerkorpi, T2 change from baseline to end of intervention, T3 change from baseline to follow-up assessment.



- Aquatics versus control (treatment as usual, Gusi 2006): Improvement in multidimensional function, self rated physical function, and fatigue favoring aquatics, which had been observed at T2, had regressed to lack of evidence of effect. The improvement in pain observed at T2 was maintained at T3. There were no between-group differences at T2 or T3 in tenderness, strength, and maximal cardiorespiratory function.
- Aquatics versus balneotherapy (Altan 2004): Improvement in fatigue favoring aquatics, which had been observed at T2, was maintained at T3. The improvement in endurance favoring balneotherapy, observed at T2, had regressed to lack of evidence of effect at T3. Although lack of evidence of an effect had been observed in pain at T2, an improvement favoring aquatics emerged at T3. There was no between-group difference in multidimensional function and tenderness at either T2 or T3.
- Aquatics versus education (Mannerkorpi 2009): Improvement in pain favoring aquatics, which had been observed at T2, was not retained at T3. There was no between-group difference in multidimensional function, self reported physical function, fatigue, or cardiorespiratory submaximal function at either T2 or T3.

Aquatic exercise training versus land-based training

The meta-analyses results are described below and in the Summary of findings 2.

Wellness

One study (61 participants) provided data on multidimensional function (Evcik 2008), and two studies (74 participants) reported on self reported physical function (de Melo Vitorino 2006; Hecker 2011). Among the major outcomes in the wellness category, there was no evidence of an effect on multidimensional function outcomes between aquatic and land-based interventions: the mean difference was 0.91 FIQ units on a 100-point scale (MD 0.91, 95% CI -4.01 to 5.83, one study, 61 participants, Analysis 2.1), an absolute difference of 4% to 6% and relative difference of 1% (-6% to 9%). There was also no evidence of an effect on self reported physical function: the mean difference was -5.85 SF-36 units on a 100-point scale (MD -5.85, 95% CI -12.33 to 0.63, two studies, 74 participants, Analysis 2.2), an absolute difference of -12% to 1% and a relative difference of 2.4% (-41% to 37%). We observed only relatively small clinical differences in multidimensional function and self reported physical function: 1.4% and -2.4% respectively. There was no evidence of an effect on the minor wellness outcome mental health (SMD -0.08, 95% CI -0.54 to 0.38; 2 studies, 74 participants, Analysis 2.11). None of the studies provided data on patient-rated global, clinician-rated, or self efficacy in the wellness category.

Symptoms

Four studies (169 participants) provided data on pain (de Melo Vitorino 2006; Evcik 2008; Hecker 2011; Jentoft 2001); four studies (169 participants) assessed fatigue (de Melo Vitorino 2006; Hecker 2011; Jentoft 2001); one study (61 participants) reported on tenderness (Evcik 2008) and one study (34 participants) reported on stiffness (Jentoft 2001). We found no evidence of an effect on pain between aquatic and land-based exercise training (-0.75 mm on a 100 mm scale, MD -0.75, 95% CI -10.72 to

9.23, four studies, 169 participants, Analysis 2.3), an absolute difference of -11% to 9% and relative difference of -1% (-15% to 13%). We also found no evidence of an effect on stiffness (2 mm on a 100 mm scale, MD 2.00, 95% CI -8.82 to 12.82, one study, 34 participants, Analysis 2.6), an absolute difference of -1% to 1%, and relative difference of 3% (-12% to 17%) favoring land-based intervention. None of the major outcomes reached the 15% threshold for clinical relevance (pain: -1% favoring aquatic, stiffness: 3% favoring land-based exercise training).

Minor symptoms outcomes

We found no evidence of an effect on tenderness (SMD -0.45, 95% CI -0.96 to 0.06, one study, 61 participants, Analysis 2.4) or fatigue (SMD -0.13, 95% CI -0.70 to 0.45, four studies, 169 participants, Analysis 2.5). There was no evidence of an effect on the minor symptoms outcomes of anxiety (SMD -0.49, 95% CI -1.18 to 019, one study, 34 participants, Analysis 2.14) or depression (SMD -0.11, 95% CI -0.88 to 0.67, two studies, 95 participants, Analysis 2.13). There was a moderate effect, however, on sleep (total sleep time in hours MD -0.56, 95% CI -0.97 to -0.15, one study, 50 participants, Analysis 2.12).

Physical fitness

One study reported on muscle strength, muscle endurance, and maximal and submaximal cardiorespiratory function outcomes (34 participants) (Jentoft 2001). We found a moderate difference in muscle strength favoring the land-based intervention (MD -2.40 kilo Pascals grip strength, 95% CI -4.52 to -0.28, one study, 34 participants, Analysis 2.7), an absolute difference of 2.40 KPa and a relative difference of -9% (-16% to 1%); NNT 4 (2 to 60). However, we found no evidence of an effect on submaximal cardiorespiratory function (three seconds to walk 100 meters, MD 3.00, 95% CI -1.77 to 7.77, one study, 34 participants, Analysis 2.10), an absolute difference of -2% to 8% and a relative difference of 5% (-3% to 13%) favoring the land intervention. These differences did not meet the 15% threshold for clinical relevance: 8.7% for strength and 5% for submaximal cardiorespiratory function.

Minor physical fitness outcomes

There was lack of evidence of an effect on muscle endurance between aquatics and land-based interventions (SMD 0.13, 95% CI -0.54 to 0.81, one study, 34 participants, Analysis 2.8) or maximal cardiorespiratory function (SMD -0.36, 95% CI -1.04 to 0.32, one study, 34 participants, Analysis 2.9). None of the studies reported on the minor outcome flexibility.

Safety and acceptability

Adverse effects were poorly reported. Three studies did not address adverse effects in their reports (de Melo Vitorino 2006; Hecker 2011; Jentoft 2001) and one study reported no adverse effects (Evcik 2008). In contrast, Assis 2006 reported 10 adverse effects in the deep water running intervention: muscle pain (n = 4), tinea pedis (n = 1), and unspecified (n = 5), compared to 15 in the land-based exercise intervention: muscle pain (n = 12), shoulder impingement (n = 1), bilateral ankle arthritis (n = 1), Baker Cyst (n = 1). All-cause withdrawals for aquatic exercise training versus land-based group were: 4/30 versus 4/30 (Assis 2006); 1/25 versus 2/25 (de Melo Vitorino 2006); 2/33 versus 0/30 (Evcik 2008); and 4/22 versus 6/22 (Jentoft 2001). The risk ratio showed no statistically significant between-group differences (risk ratio 0.91, 95% CI 0.43 to 1.91, Analysis 2.15).

Additional evidence (aquatic versus land-based)

The study conducted by Assis 2006 could not be meta-analyzed due to skewness of the data. Contrary to our findings the 15 weeks of training employed in Assis 2006 resulted in a reduction in pain intensity as measured by a visual analog scale. In addition, a 40% improvement in the patient's global assessment response was noticed in the deep water running group compared to a land-based aerobic training program matched for training frequency, intensity, and duration. The wellness outcome in the aquatic exercise intervention improved more rapidly than in the land-based exercise group; this was also true for depression. In the area of physical fitness, Assis 2006 did not find any statistically significant between-group differences for maximal cardiorespiratory function (which differs from findings by Jentoft 2001).

Aquatic versus aquatic

Calandre 2010 conducted a direct comparison of Ai Chi (Tai Chi in water) to stretching in the water (81 participants). Ai Chi uses breathing plus the traditional movements: "Tai Chi is performed standing in shoulder-depth water using a combination of deep breathing and slow, broad movements of the arms, legs, and torso". We observed no significant between-group differences for the three major outcomes measured: multidimensional function (SMD -0.35, 95% CI -0.79 to 0.09, Analysis 3.1), pain (SMD -0.37, 95% CI -0.81 to 0.07, Analysis 3.3), or tenderness (SMD 0.14, 95% CI -0.30 to 0.58, Analysis 3.4). We observed no statistically significant differences for mental health (SMD -0.19, 95% CI -0.63 to 0.24), fatigue (SMD -0.42, 95% CI -0.86 to 0.03, Analysis 3.5), depression (SMD 0.16, 95% CI -0.28 to 0.60), or anxiety (SMD -0.25, 95% CI -0.68 to 0.19), but we observed a positive effect favoring the Ai Chi intervention for stiffness (SMD -0.62, 95% CI -1.07 to -0.17, Analysis 3.6) and sleep (SMD -0.45, 95% CI -0.89 to -0.01). No physical fitness outcomes were measured in Calandre 2010. The only outcome approaching the 15% threshold for clinical relevance was the stiffness value, which was -14% (average), favoring Ai Chi. Regarding adverse effects, Calandre 2010 stated "Fifteen patients withdrew from the trial

... three of them belonging to the [Ai Chi] group due to adverse reactions: one case of chlorine hypersensitivity and two cases of pain exacerbation“ (pg S16). All-cause withdrawals in Calandre 2010 was 10/42 versus 5/39 (risk ratio 2.13, 95% CI 0.65 to 6.90, Analysis 3.11).

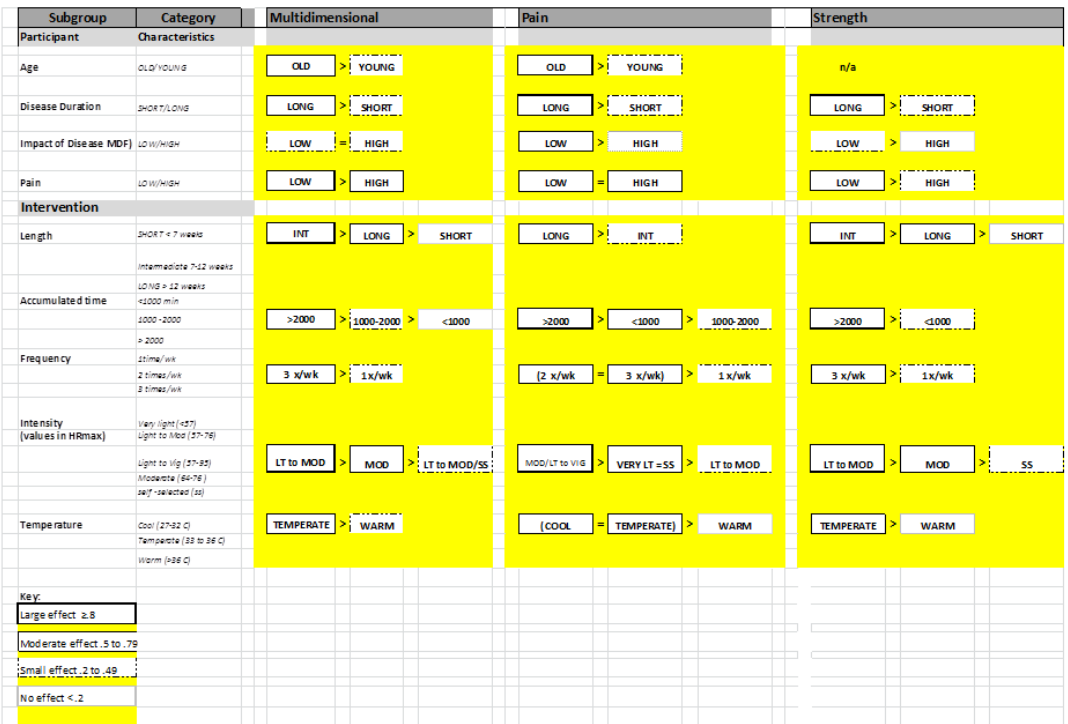
A single study in this category examined the effects of salinity of the water. In De Andrade 2008 (38 participants) one group performed aerobic exercise in an outdoor pool and the other group performed the same aerobics program in sea water (no waves). Both groups improved at post-treatment in all outcomes. However, there were no statistically significant differences between the two groups, with the exception of the Beck Depression Inventory (SMD -1.88, 95% CI -2.66 to -1.10, Analysis 3.8), favoring the sea intervention. Both groups showed important changes in symptoms like pain, fatigue, tenderness, and sleep quality as well as wellness outcomes of multidimensional function, physical function, and mental health. No physical fitness outcomes were measured in De Andrade 2008. None of the outcomes reached the 15% threshold for clinical relevance. De Andrade 2008 reported that there were ”20 adverse events (9 in pool group and 11 in the sea group). Nine patients reported muscle pain in pool group. Two patients reported first-degree burn...one patient presented urinary infection, and eight reported muscle pain in sea group“ (pg 149). All-cause withdrawal rates for pool versus sea water were 4/23 versus 4/23 (risk ratio 1.00, 95% CI 0.22 to 4.59, Analysis 3.11) (De Andrade 2008).

The standardized mean differences (95% CIs) for both studies for wellness, symptoms, and physical fitness outcomes are summarized in Table 5, Table 6, and Table 7.

Subgroup analysis

The summary of subgroup analysis findings can be seen in Figure 6

Figure 6. Summary of aquatic versus control subgroup analysis findings



Participant-related subgroups

Younger versus older age

The mean age of participants in four studies fell below the median age (46.7 years) and we classified them in the younger category (Altan 2004; Arcos-Carmona 2011; Mannerkorpi 2009; Mannerkorpi 2000), and participants in three studies had ages above the median and we classified them as older (Gusi 2006; Munguia-Izquierdo 2007; Tomas-Carus 2008). On analysis of the confidence intervals, two studies could not be classified as the 90% confidence intervals extended into both the younger and the older group (see Table 8) (Mannerkorpi 2009, Gowans 2001). Aquatic exercise produced:

- less improvement in multidimensional function in the younger participants (SMD -0.33, 95% CI -0.64 to -0.01) than in the older participants (SMD -0.75, 95% CI -1.12 to -0.38) (Analysis 4.1);
- less improvement in pain in the younger participants (SMD -0.39, 95% CI -0.66 to -0.11) than in the older participants (SMD -0.83, 95% CI -1.21 to -0.45) (Analysis 4.2).

None of the studies in the younger category assessed muscle strength.

Short versus long disease duration

The median value for disease duration was 9.5 years in studies comparing aquatic training to control, which provided data. Of the studies with weighted mean values less than the median, we classified three studies as short disease duration (Gowans 2001; Mannerkorpi 2000; Mannerkorpi 2009), and three studies as long disease duration (Gusi 2006; Munguia-Izquierdo 2007; Tomas-Carus 2008). On inspection of the confidence intervals, one study could not be classified as the 90% confidence intervals extended into both the lower and the higher group (Arcos-Carmona 2011) (see Table 8). Aquatic exercise produced:

- smaller improvements in multidimensional function in the short disease duration groups (SMD -0.31, 95% CI -0.59 to -0.03) compared to the long disease duration groups (SMD -0.75, 95% CI -1.12 to -0.38) (Analysis 5.1);
- similar improvements in pain in the short disease duration groups (SMD -0.41, 95% CI -0.72 to -0.10) compared to the long disease duration groups (SMD -0.83, 95% CI -1.21 to -0.45) (Analysis 5.2);
- smaller improvements in muscle strength in the short disease duration groups (SMD 0.32, 95% CI -0.10 to 0.74) compared to the long disease duration groups (SMD 1.04, 95% CI 0.51 to 1.57) (Analysis 5.3).

Low versus high impact of fibromyalgia on wellness

The median value for multidimensional function score (the measure used for wellness) was 62 in studies comparing aquatic training to control, which provided data. Of the studies with weighted mean values less than the median, we classified two studies as having low levels of impact on wellness (Altan 2004; Gowans 2001), and three studies as having high impact on wellness (Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007). On inspection of the confidence intervals, two studies could not be classified as the 90% confidence intervals extended into both the lower and the higher group (Gusi 2006; Tomas-Carus 2008) (see Table 8). Aquatic exercise produced:

- similar improvements in multidimensional function in the low impact groups (SMD -0.35, 95% CI -0.62 to -0.09) and in the high impact groups (SMD -0.47, 95% CI -0.93 to -0.02) (Analysis 6.1);
- larger improvements in pain in the low impact groups (SMD -0.61, 95% CI -1.04 to -0.19) compared to the high impact groups (SMD -0.16, 95% CI -0.74 to 0.42) (Analysis 6.2);
- similar non-significant changes in strength (low impact SMD 0.39, 95% CI -0.13 to 0.91; high impact SMD 0.18, 95% CI -0.54 to 0.90) (Analysis 6.3).

Low versus high pain at baseline

The median value for pain was 70.9 in studies comparing aquatic training to control, which provided data. Three studies were classified as 'low baseline pain' (Arcos-Carmona 2011; Gusi 2006; Tomas-Carus 2008) and three studies were classified as 'high baseline pain' (Altan 2004; Mannerkorpi 2002; Munguia-Izquierdo 2007). On inspection of the confidence interval, one study could not be classified because the 90% confidence interval extended into both the lower group and the higher group (Mannerkorpi 2009) (see Table 8). Aquatic exercise produced:

- larger improvements in multidimensional function in the low pain groups (SMD -1.11, 95% CI -1.64 to -0.58) than in the high pain groups (SMD -0.57, 95% CI -0.89 to -0.25) (Analysis 7.1);
- similar improvements in pain in the low pain groups (SMD -0.60, 95% CI -0.98 to -0.23) and in the high pain groups (SMD -0.57, 95% CI -1.11 to -0.03) (Analysis 7.2);
- larger improvements in muscle strength in the low pain groups (SMD 1.04, 95% CI 0.51 to 1.57) compared to the high pain groups (SMD 0.39, 95% CI -0.13 to 0.91) (Analysis 7.3).

Intervention-related subgroups

Length of Intervention

One study was less than seven weeks in length (Gowans 2001), three were 7 to 12 weeks in length (Altan 2004; Arcos-Carmona 2011; Gusi 2006), and four were longer than 12 weeks (Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008).

- There was lack of evidence of effect on multidimensional function in the shortest program (SMD -0.17, 95% CI -0.88 to 0.53), a large effect in the intermediate intervention length studies (SMD -0.82, 95% CI -1.28 to -0.36), and a moderate effect in the longer studies (SMD -0.52, 95% CI -0.90 to -0.14) (Analysis 8.1).
- There was a small effect on pain in the intermediate intervention length studies (SMD -0.49, 95% CI -0.84 to -0.14) and a moderate effect in the longer studies (SMD -0.54, 95% CI -0.80 to -0.29) (Analysis 8.2).
- There was a lack of evidence of an effect on muscle strength in the shortest programs (SMD 0.18, 95% CI -0.54 to 0.90), a large effect in the intermediate intervention length studies (SMD 0.93, 95% CI 0.22 to 1.64), and a moderate effect in the longer studies (SMD 0.63, 95% CI 0.20 to 1.06) (Analysis 8.3).

Accumulated time in the pool

The accumulated time (time in minutes x frequency x length of intervention) in the pool was less than 1000 minutes in three studies (Arcos-Carmona 2011; Gowans 2001; Mannerkorpi 2000), between 1000 minutes and 2000 minutes in two studies (Altan 2004; Mannerkorpi 2009), and more than 2000 minutes in three studies (Gusi 2006; Munguia-Izquierdo 2007; Tomas-Carus 2008).

- Multidimensional function: Accumulated time of less than 1000 minutes had a small effect (SMD -0.48, 95% CI -0.91 to -0.05), 1000 to 2000 minutes had a small effect (SMD -0.33, 95% CI -0.64 to -0.01), and accumulated time of more than 2000 minutes had a moderate effect (SMD -0.75, 95% CI -1.12 to -0.38) (Analysis 9.1).
- Pain: Accumulated time of less than 1000 minutes had a moderate effect (SMD -0.52, 95% CI -0.90 to -0.13), 1000 to 2000 minutes had a small effect (SMD -0.32, 95% CI -0.64 to -0.00), and accumulated time of more than 2000 minutes had a large effect (SMD -0.82, 95% CI -1.24 to -0.41) (Analysis 9.2).
- Strength: Accumulated time of less than 1000 minutes had a small effect (SMD 0.32, 95% CI -0.10 to 0.74), whereas accumulated time of more than 2000 minutes had a large effect (SMD 1.04, 95% CI 0.51 to 1.57) (Analysis 9.3).

Frequency of pool sessions per week

The frequency of pool sessions was once per week in two studies (Mannerkorpi 2000; Mannerkorpi 2009), twice a week in one study (Arcos-Carmona 2011), and three times per week in five studies (Altan 2004; Gowans 2001; Gusi 2006; Munguia-Izquierdo 2007; Tomas-Carus 2008).

- Multidimensional function: Once a week had a small effect (SMD -0.34, 95% CI -0.65 to -0.03), while three times a week had a moderate effect (SMD -0.64, 95% CI -0.93 to -0.35) (Analysis 10.1).
- Pain: Once a week had a small effect (SMD -0.39, 95% CI -0.65 to -0.12), twice a week had a moderate effect (SMD -0.59, 95% CI -1.14 to -0.04), and three times a week also had a moderate effect (SMD -0.63, 95% CI -1.08 to -0.17) (Analysis 10.2).
- Strength: Once a week had a small effect (SMD 0.39, 95% CI -0.13 to 0.91), while three times a week had a moderate effect (SMD 0.74, 95% CI 0.31 to 1.16) (Analysis 10.3).

Exercise intensity

Exercise intensity was: a) very light (< 57% predicted HR_{max}) in one study (Arcos-Carmona 2011), b) light to moderate (27% to 63% predicted HR_{max}) in two studies (Altan 2004; Tomas-Carus 2008), c) moderate (64% to 76% predicted HR_{max}) in two studies (Gowans 2001; Gusi 2006), d) light to vigorous (77% to 95% predicted HR_{max}) in one study (Munguia-Izquierdo 2007), and e) self selected in two studies (Mannerkorpi 2000; Mannerkorpi 2009).

- Multidimensional function: interventions employing a light to moderate intensity had a large effect (SMD -0.89, 95% CI -1.40 to -0.38), those using a moderate intensity had a small effect (SMD -0.39, 95% CI -0.92 to 0.13), those using moderate intensity had a moderate effect (SMD -0.59, 95% CI -1.43 to 0.24), and those using self selected intensity had a small effect (SMD -0.38, 95% CI -0.84 to 0.07) (Analysis 11.1).
- Pain: interventions using a very light exercise intensity had a moderate effect (SMD -0.59, 95% CI -1.14 to -0.04), those using a light to moderate intensity had a small effect (SMD -0.25, 95% CI -0.70 to 0.20), a moderate intensity had a large effect (SMD -0.82, 95% CI -1.53 to -0.12), a light to vigorous intensity had a large effect (SMD -1.12, 95% CI -1.71 to -0.54), and a self selected intensity had a moderate effect (SMD -0.41, 95% CI -0.72 to -0.10) (Analysis 11.2).
- Strength: interventions having a light to moderate intensity had a large effect (SMD 1.17, 95% CI 0.39 to 1.96), a moderate intensity had a moderate effect (SMD 0.56, 95% CI 0.05 to 1.06), and a self selected intensity had a small effect (SMD 0.39, 95% CI -0.13 to 0.91) (Analysis 11.3).

Temperature of the pool

The temperature of the pool was 27 to 32 degrees Celsius (cool pool) in one study (Arcos-Carmona 2011), 33 to 37 degrees Celsius (temperate pool) in five studies (Gusi 2006; Mannerkorpi 2000; Mannerkorpi 2009; Munguia-Izquierdo 2007; Tomas-Carus 2008), and more than 36 degrees Celsius (temperate pool) in two studies (Altan 2004; Gowans 2001).

- Multidimensional function: the temperate pool had a moderate effect (SMD -0.60, 95% CI -0.97 to -0.24), and the warm pool had a small effect (SMD -0.47, 95% CI -0.96 to 0.03) (Analysis 12.1).
- Pain: moderate effects were seen in the cool pool (SMD -0.52, 95% CI -0.73 to -0.32) and the temperate pool (SMD -0.57, 95% CI -0.81 to -0.34), while the warm pool lacked

evidence of effect (SMD -0.16, 95% CI -0.74 to 0.42) (Analysis 12.2).

- Strength: the temperate pool had a moderate effect (SMD 0.71, 95% CI 0.34 to 1.08), while the warm pool lacked evidence of effect (SMD 0.18, 95% CI -0.54 to 0.90) (Analysis 12.3).

ADDITIONAL SUMMARY OF FINDINGS [*Explanation*]

Aquatic training compared to land-based training for fibromyalgia

Patient or population: adults with fibromyalgia
Settings: supervised group
Intervention: aquatic training
Comparison: land-based training

Outcomes	Assumed risk Land-based training	Corresponding risk Aquatic training	Relative effect (95% CI)	No of participants (studies)	Quality of the evidence (GRADE)	Comments
Multidimensional function Self report questionnaire FIQ-total (range 0 to 100 mm, higher scores mean worse function) Follow-up: 4 weeks	The mean change in multidimensional function was -8.21[1] Weighted mean score at baseline: 64.4	The mean difference in multidimensional function was 0.91 mm lower in the land-based groups (-4.01 to 5.83) than the aquatic groups		61 (1 study)	⊕○○○ **Very low**[2,3,4]	Absolute difference 1 (95% CI -4 to 6) Relative difference 1% (95% CI -6% to 9%) SMD 0.09 (95% CI -0.41 to 0.59)
Self reported physical function SF-36 (0 to 100, transformed so higher scores mean poorer function) Follow-up: 3 to 23 weeks	The mean change in self reported physical function was 27.44 SF-36 units[1] Weighted mean score at baseline: 32.16	The mean difference in change scores between interventions in self reported physical function was -5.85 units (-12.33 to 0.63)		74 (2 studies)	⊕○○○ **Very low**[3,4,5]	Absolute difference -6 (95% CI -12 to 1) Relative difference 2.4% (95% CI -41% to 37%) SMD -0.38 (95% CI -0.84 to 0.09)
Pain Self reported measures FIQ pain, SF-36 bodily pain and VAS (transformed range 0 to 100, higher scores mean more pain) Follow-up: 3 to 23	The mean change in pain was -21.48[1] Weighted mean score at baseline: 69.9	The mean difference in change scores in pain was 0.75 mm (-10.72 to 9.23) better in the aquatic groups than in land-based groups		169 (4 studies)	⊕⊕○○ **Low**[3,6]	Absolute difference 1 (-95% CI 11 to 9) Relative difference -1% (95% CI -15% to 13%) SMD -0.06 (95% -0.84 to 0.71)

weeks						
Stiffness Self reported measures FIQ stiffness (0 to 100 mm) Follow-up: 20 weeks	The mean change in stiffness was -18[1] Weighted mean score at baseline: 75.64	The mean difference in change scores in stiffness was 0.20 mm (-0.88 to 1.28) better in the land-based group		34 (1 study)	⊕○○○ **Very low**[2,3,4]	Absolute difference 2 (95% CI -9 to 13) Relative difference 3% (95% CI -12% to 17%) SMD 0.12 (95% CI -0.55 to 0.80)
Muscle strength Grip strength Kilo Pascals (kPa). Higher scores indicate greater health Follow-up: 20 weeks	The mean change in muscle strength was 3.3 kPa[1] Weighted mean score at baseline: 28.57	The mean difference in change scores in muscle strength was 2.40 kPa (0.28 to 4.52) better in the land-based group		34 (1 study)	⊕○○○ **Very low**[2,3,4]	Absolute difference 2.40 kPa (95% CI 0 to 5) better in the land-based group Relative difference: -9% (95% CI -16% to 1%) favoring land-based intervention SMD -0.74 (95% CI -1.44 to -0.04).[7] NNT 4 (95% CI 2 to 60)
Submaximal cardiorespiratory function Walking time (seconds required to complete 100 meters) Follow-up: 20 weeks	The mean change in submaximal cardiorespiratory function was 5.6 seconds (improvement)[1] Weighted mean score at baseline: 60.08	The mean difference in submaximal cardiorespiratory function was 3 seconds (-1.77 to 7.77) better in the aquatic group		34 (1 study)	⊕○○○ **Very low**[2,3,4]	Absolute difference 3 seconds (95% CI -2 to 8) Relative difference in change score 5% (95% CI -3% to 13%)
Withdrawals and adverse effects[8]	All-cause withdrawal in control groups: 12/107 (11.2%)	All-cause withdrawal in aquatic groups: 11/110 (10%)	Risk ratio 0.91 (0.43 to 1.91)	217 (4 studies)	⊕⊕○○ **Low**[4]	1 study: no adverse effects either group; 1 study described several musculoskeletal adverse effects in both groups and 1 instance of tinea pedis, no aggravation of symptoms; 3

				studies did not address adverse effects at all[9]

*The basis for the **assumed risk** (e.g., the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: Confidence interval; **FIQ:** Fibromyalgia Impact Questionnaire; **NNT:** number needed to treat; **SMD:** standardized mean difference; **VAS:** visual analog scale

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1]Mean difference in control group(s) (post-test scores-pretest scores).
[2]Evidence based on a single study.
[3]Potential limitations related to imprecision (i.e., total (cumulative) sample size is lower than 400).
[4]Potential limitations related to high, unclear, and low risk of bias.
[5]Evidence based on two small studies.
[6]Statistical heterogeneity ($I^2 > 50\%$).
[7]Moderate effect favoring the land-based exercise (SMD 0.50 to 0.79).
[8]Whithdrawals may be associated with frequency, intensity, etc., in which case interventions should try to maximize retention by focusing on these events. As adverse effects are still poorly reported, withdrawal may be taken as an indicator of adverse effects.
[9]Incomplete documentation of adverse effects in at least three studies.

DISCUSSION

The effects of aquatic exercise training on fibromyalgia have been investigated in an increasing number of studies since the publication of our last review (Busch 2008). In this review, we found the role of aquatic exercise training to be beneficial, particularly for fibromyalgia symptoms. We assumed the water allowed for ease of movement and therefore promoted better conditions for exercise. However, the evidence does not yet support a standard aquatic exercise program for individuals with fibromyalgia due to variability in the types of exercise and the wide ranges in intensity, duration, and frequency of exercise recommendations.

A conflict of interest statement was not reported in seven articles (Altan 2004; de Melo Vitorino 2006; De Andrade 2008; Evcik 2008; Ide 2008; Hecker 2011; Munguia-Izquierdo 2007), two studies provided a "none to declare" statement (Arcos-Carmona 2011; Calandre 2010), and seven studies reported receiving support from different sources (e.g., European social funds, regional government grant, health department funding, etc.) (Assis 2006; Gowans 2001; Gusi 2006; Jentoft 2001; Mannerkorpi 2000; Mannerkorpi 2009; Tomas-Carus 2008).

Summary of main results

This review is one part of a larger review examining the effects of physical activity interventions for individuals with fibromyalgia. Of the 84 studies we found that examined the effects of physical activity, only 17 studies examined aquatic exercise training where individuals remained in the water 50% or more of the time. Historical and modern beliefs about the effects of exercising in warm water make this review particularly important. In addition, aquatic exercise programs are offered in many communities. This review provides a valuable opportunity to evaluate the effects of aquatic exercise training and the benefits, risks, and harms regarding this important and popular type of exercise. The main results of our review were as follows.

Aquatic versus control

Nine studies, including 513 female and six male participants diagnosed with fibromyalgia according to the ACR 1990 criteria, compared aquatic exercise training to control. All programs were supervised group interventions consisting of a mix of aerobic, resistance training, and flexibility exercise. Six interventions were conducted exclusively in the water, one included 70% of the time in the water, and in two studies participants were in the water 50% of the time. One program was less than six weeks in duration, four were six to 12 weeks long, and four were more than 12 weeks in duration. Frequency of sessions was at least three times per week in most studies. Average session duration was 45 minutes (range 30 to 70). The intensity of exercise varied: three studies prescribed mild or self selected intensities, four were mild to moderate, one was mild to vigorous and in one study the intensity was not specified. While none of the studies met the ACSM criteria for aerobic or resistance training, one study met the ACSM criteria for flexibility.

We determined eight studies to be similar enough to be included in the meta-analyses (one study appeared to be an outlier and we excluded it from the meta-analyses). The meta-analyses yielded two statistically significant effects in the wellness category favoring aquatic exercise training: a moderate effect on multidimensional function and a small effect on self reported physical function. There was lack of evidence of effect for mental health, patient-rated global, self efficacy, and clinician-rated global. The meta-analysis also produced statistically significant results favoring aquatic exercise training in several symptoms outcomes: a large effect on stiffness and a moderate effect on pain, sleep, and anxiety, and small effects on tenderness and depression. When aquatic exercise training was compared to control, we observed moderate effects on strength and submaximal cardiorespiratory function. We observed a lack of evidence of effects on flexibility, maximal cardiorespiratory function, or on muscular endurance. These results were clinically relevant for stiffness and muscle strength only, however we rated the quality of the evidence as low for these two outcomes.

Aquatic exercise training versus land-based training

Four studies, with 203 females and one male participant diagnosed with fibromyalgia according to ACR 1990 criteria, compared aquatic exercise training to land-based training. All aquatic exercise training programs were supervised group interventions with most being mixed programs consisting of resistance, aerobic, flexibility training, and relaxation components. The land-based exercises followed the same protocols as the aquatic exercise training interventions. One of the studies had a non-supervised home-based control program. Four aquatic intervention studies were 100% water-based, while one was based in the water 65% of the time. Intervention duration was less than six weeks in two studies, between six to 12 weeks in one study, and more than 12 weeks in another. Session frequency was three times a week in three studies, two times per week in one study, and once weekly in one study. Average session duration was 60 minutes. Exercise intensity varied from very light, light to moderate, and light to vigorous. No study met the ACSM criteria for aerobic or resistance training.

Although we extracted data for 14 outcomes, only five could be meta-analyzed: pain and fatigue (four studies), self reported physical function (two studies), mental health (two studies), and depression (two studies). The meta-analyses yielded a lack of evidence of effect on any outcome. Among the nine outcomes that could not be meta-analyzed, there was lack of evidence of effect on wellness outcomes, but there were statistically significant differences in one study for symptoms, i.e., a moderate difference in sleep (favoring aquatic exercise training). When aquatic exercise training interventions were compared to land-based interventions, one statistically significant difference was found in physical fitness;

based on one study there was a moderate difference in strength favoring land-based training. We found a lack of evidence of effect for pain, stiffness, tenderness, fatigue, depression or anxiety, muscle endurance, or maximal or submaximal cardiorespiratory function.

Aquatic versus aquatic exercise intervention

In this group, we analyzed two studies. Calandre 2010 conducted a direct comparison of stretching in the water to Ai Chi (Tai Chi in the water); De Andrade 2008 conducted a direct comparison of aerobic exercise in a pool to aerobic exercise in the sea. Among the 10 outcomes reported in these studies, the analyses yielded no statistically significant results in the wellness outcomes (multidimensional, self reported physical function and mental health). There was a small effect on symptoms - sleep (one study), a moderate effect on stiffness (one study), and a large effect on depression (one study). No physical fitness outcomes were measured.

One study examined the effects of characteristics of the water (De Andrade 2008). While it is widely accepted and traditionally used in some countries, mineral water used as a medium for aquatic exercise training intervention in individuals with fibromyalgia is new. The single study in our review examining the effects of exercise in mineral water showed greater (but non-statistically significant) improvement in the evaluated parameters (Analysis 3.1; Analysis 3.2; Analysis 3.3; Analysis 3.4, etc.), with the exception of depression, which had a large effect size favoring the mineral water intervention. No physical fitness outcomes were measured.

Is aquatic exercise training safe for and acceptable to individuals with fibromyalgia?

All-cause withdrawal rates were not higher for the aquatic exercise training intervention than for comparators. When considering the evidence of adverse effects and withdrawal rates in the 16 included studies, individuals with fibromyalgia were able to perform supervised aquatic exercise training safely. However, given the low number of studies and the lack of detail provided by the authors on adverse effects, the evidence should be taken with caution.

Follow-up data (aquatic versus control)

Follow-up data on the effects of exercise are important when considering the chronic nature of fibromyalgia and because exercise training is a component of the recommended management of fibromyalgia. Unfortunately, investigation of long-term effects is limited. Few studies in our review re-evaluated outcomes weeks or months after the completion of the intervention. However, three studies examined long-term follow-up in the aquatic exercise training group compared to control. Although the studies belong to the same comparison group, there was substantial clinical heterogeneity: one compared aquatic exercise training to treatment as usual at 12 weeks, another compared aquatic exercise training to balneotherapy (a specialized type of control) at 12 weeks, and a third study compared aquatic exercise training to education (a specialized type of control) at 45 to 52 weeks. At follow-up, we observed several patterns:

- **Regression of improvements** from post-test (T2) to follow-up (T3): multidimensional function in one out of three studies (1/3), self rated physical function 1/2, pain 1/3, fatigue 1/3, endurance 1/1.
- **Maintenance of improvements** observed at T2: pain 1/3, fatigue 1/3.
- **No change** (lack of evidence of effect at either T2 or T3): multidimensional function 2/3, self rated physical function 1/2, fatigue 1/3, tenderness 2/2, strength 1/1, maximal cardiorespiratory 1/1, submaximal cardiorespiratory 1/1.
- **Improvement** at follow-up T2 to T3: pain 1/3.

The literature on healthy individuals shows that when exercise training ceases, loss of physical fitness gains occur over time. We can assume this is true for individuals with fibromyalgia. Pertinent questions about follow-up that remain unanswered for individuals with fibromyalgia include: a) do individuals continue to exercise and at what frequency/intensity/duration after the intervention is finished? b) are wellness or symptom improvements that occurred during the study maintained and are they linked to the amount of physical activity performed during follow-up?; c) if the exercise is discontinued, what happens to any gains in wellness and symptoms? Further research monitoring physical activity behavior during follow-up after interventions is required to answer questions about the long-term benefits of these interventions.

Subgroup analyses

Regarding the subgroup analyses, we must be cautious in interpreting the results as definitive. The same concerns about risk of bias, imprecision of results, and the low number of studies apply to our interpretation. Nevertheless, the subgroup analyses may point to participant and intervention-related factors that may influence the effects of aquatic exercise.

Subgroups based on participant characteristics

The subgroup analysis showed that older individuals (mean 48.2 to 51 years) had greater improvements than younger individuals (mean 43.5 to 45.6 years) in the multidimensional function and pain outcomes. Similarly, individuals who had a longer disease duration responded better than those with a shorter duration in multidimensional function, pain, and strength. The upper limit of the 90% confidence interval for the younger group was 46.7 compared to the lower limit of the older group being 46.5, therefore the two subgroups likely differed in terms of menopausal status. It is unknown if premenopausal women with fibromyalgia respond differently to exercise than postmenopausal women with fibromyalgia. Another possible explanation for the findings may

be that the older subgroup and the subgroup with greater disease duration may have been more deconditioned at study entry; consequently, they would be more likely to experience improvement with exercise.

The subgroups with lower baseline estimates for impact of the disease had better outcomes for pain and strength, and subgroups with lower baseline estimates of pain had better outcomes in multidimensional function and strength than their counterparts. A possible explanation for these findings is that the participants with less pain and lower disease severity were better able to perform exercise and reap the benefits than those with more severe disease and more pain.

Subgroups based on exercise volume

The subgroup analyses showed that longer programs (more than 12 weeks) had greater effects on multidimensional function and pain than did shorter programs (less than seven weeks). In addition, longer programs (more than 12 weeks) had greater effects on strength than intermediate length programs (7 to 12 weeks). This is consistent with findings regarding (a) accumulated time in the pool and frequency of pool sessions; greater amounts of accumulated time (1000 minutes or more) and more frequent sessions (two and three times per week) showed greater effects on multidimensional function, pain, and strength than less accumulated time (less than 1000 minutes) and lower exercise frequency (once a week). Short programs lack evidence of an effect on multidimensional function outcomes; accumulated time less than 1000 minutes lacked evidence of an effect on multidimensional outcomes or strength.

Although the subgroup analyses related to exercise intensity were hampered by overlapping categories, we found large effects in multidimensional function, pain, and strength when intensity was started at light values (57% to 63% predicted HR_{max}) and progressed either to moderate (64% to 76% predicted HR_{max}) or vigorous intensity (77% to 95% predicted HR_{max}). When the intensity was left to the participants (self selected) the effect was moderate for pain and small for multidimensional function and strength, suggesting that without guidance regarding exercise intensity, participants may not benefit as much from the exercise. Moderate intensity exercise (64% to 76% HR_{max}) produced a moderate effect on multidimensional function and strength. There were no data examining aquatic exercise performed at vigorous activity and its effect on outcomes. Very light intensity exercise (less than 57% HR_{max}) was used in one study, which demonstrated a moderate effect on pain.

Subgroups based on pool characteristics

Subgroup analyses showed that temperate pools (33 to 36 degrees Celsius) produce moderate effects on multidimensional function, pain, and strength; whereas warm pools (more than 36 degrees Celsius) had a small effect on multidimensional function and a lack evidence of an effect on pain and strength. The limited amount of evidence in these analyses impeded interpretation, but perhaps warm pools may affect energy levels and reduce the participant's ability to exercise with sufficient intensity to produce long-term effects. Unfortunately, other pool-related factors (chemical/mineral composition of the water, ambient temperature, and humidity) could not be examined as these data were not provided by most of the primary studies.

Overall completeness and applicability of evidence

Completeness

There were 16 studies included in this review, including a total of 881 individuals diagnosed with fibromyalgia (866 women and 15 men); 439 were assigned to aquatic exercise training. Given the 9:1 female:male prevalence ratio of the disease (Bartels 2009), we were not expecting to find a high number of male participants. However, additional studies focusing on interventions for males will shed light on whether the aquatic exercise training interventions have similar effects for men and women.

This review has included a growing body of research, as most included studies have been published since 2000. There seems to be sufficient evidence in the *aquatic versus control* comparison to confirm that this type of intervention has important short-term effects on individuals with fibromyalgia. However, there were too few studies comparing *aquatic interventions to land-based exercise* to make a definitive statement on which is more beneficial. There is great variability in exercise protocols, especially in mode, intensity, and frequency. There seems to be some consistency in the duration of the intervention (i.e., 60 minutes) and warm-up and cool-down periods (5 to 10 minutes) across studies. However, none of the studies met the ACSM guideline criteria for aerobic or resistance training.

The ACSM guidelines outline standard parameters to understand how much exercise is enough to improve and maintain fitness and to gain other health benefits (Garber 2011). ACSM also reaffirms that regardless of the initial level of physical conditioning of individuals, the benefits of exercise outweigh the risks. In this review, despite the exercise-intervention variation of the included studies, the evidence shows that sedentary individuals with fibromyalgia are able to perform and benefit from exercise that meets the ACSM guidelines for healthy adults. Long-term effects have only recently begun to be investigated.

Until recently there has been a lack of agreement regarding core outcomes for evaluating interventions in studies on fibromyalgia, with inconsistent reporting on wellness, symptoms, and physical fitness outcomes. For example, one of the 16 studies reported effects on dyscognition, a symptom regarded as very important by individuals with fibromyalgia. Similarly, one study reported

on patient-rated and clinician-rated global, 5/16 studies reported on strength, 4/16 on endurance, 3/16 on maximal cardiorespiratory function, and 4/16 on submaximal cardiorespiratory function. The information on adverse effects is also poorly reported. Evidence of injuries, exacerbations, or adverse effects is very important and needs to be reported in a consistent and systematic form.

The effect of the characteristics of the water on the effects of exercise are still not well explored; only one study investigated the effects of water characteristics. Given the popularity of thermal waters in some countries and the availability of and access to sea water (compared to pool access) in other geographic regions, the effects of water temperature, chemical composition, and other characteristics of water warrant further attention.

Applicability

Although aquatic exercise training has been shown to have many benefits, the optimal aquatic exercise training protocol for achieving benefits in wellness, symptoms, and fitness has yet to be determined. All but one of the included studies in this review involved supervised group exercise. It is not known if unsupervised individuals or home-based programs for individuals with fibromyalgia would yield the same results as seen in these studies.

While considering other factors that might alter the applicability of the findings, warm water pools are not easily available in small, rural, or remote communities and therefore aquatic exercise training may need to be used in combination with other kinds of exercise training. While this review deals with exercise protocols composed mostly of aquatic exercise training (50% or more in the water), four studies had interventions with less than 100% of the time in the water. Therefore, the results can only be generalized to similar settings. More studies in the area of aquatic exercise training in mineral water will be valuable as many regions have access to this water source, but there is little current evidence to support this approach.

Most of the studies included in this review are European, American, and South American in origin. We believe this may represent a small portion of the research in the area available worldwide. Participants were mostly middle-aged women, with few reports of any socio-demographic backgrounds. Therefore our findings are not easily generalized beyond a middle-aged, Caucasian, female population. Regardless of these limitations, the evidence in this review aims to help health professionals to make evidence-based decisions about the effects of aquatic exercise training interventions for individuals with fibromyalgia in the context of their practice.

Common health and safety concerns relating to operating aquatic exercise training programs were not always mentioned in the included studies; however these must be considered. These would include issues such as water treatment; risk of rash and other skin problems; temperature of the water, environment, and humidity; risk of dehydration; risk of infections; handling slips, trips, and falls; and the number and qualifications of personnel present in the facility.

Quality of the evidence

Based on the *aquatic versus control* comparison, statistically significant benefits of aquatic exercise training have been found in wellness, symptoms, and physical fitness. The intervention group sample sizes in the nine studies ranged from 15 to 57 participants. Although most of the individual studies were underpowered, the meta-analyses in the aquatics versus control comparisons for wellness and symptoms provided a sufficient pooled sample size to detect differences for most variables. We found **moderate quality evidence** for benefits in multidimensional function (wellness) and self reported physical function (wellness). We downgraded the evidence due to potential limitations related to imprecision (i.e., total cumulative sample size is lower than 400). We found **low quality evidence** for benefits in stiffness, pain (symptoms), and muscle strength and submaximal cardiovascular (physical fitness). We downgraded the evidence due to potential limitations related to imprecision (i.e., total cumulative sample size is lower than 400) and limitations related to unclear and low risk of bias. Regarding harms, no serious injuries were reported, but reporting was poor in this body of studies. Withdrawals ranged between 13% to 44% and adherence to the prescribed training programs was generally poorly reported.

We rated the evidence as **very low to low** in the *aquatic versus land-based* comparisons. We downgraded the quality rating because the evidence was based on one or two small studies with the total cumulative sample size lower than 400 (leading to imprecision), and in additi0n we encountered instances of unclear and high risk of bias. We found data for 14 outcomes; our analyses identified statistically significant differences for only two outcomes - one favoring land-based exercise (muscle strength) and one favoring aquatic exercise (sleep). Based on these data, no clear preference could be found for land-based versus water-based exercise.

Potential biases in the review process

There are limitations inherent in the primary literature including incomplete description of the exercise protocols, inadequate sample sizes, inappropriate designs for assessing mixed exercise programs, and inadequate documentation of adverse effects and adherence to exercise prescriptions.

In our review process, we attempted to control for biases as follows:

- We did not limit our search to English-only publications.
- We contacted primary authors for clarification and additional information where indicated, although responses were not always obtained.
- We examined clinical sources of heterogeneity.

- Our description of the results was based on a careful consideration of intervention characteristics, study population, methodologic rigor, pre-identification of levels of evidence, and group discussion of evidence tables to reach consensus.
- We used a multi-disciplinary team with expertise in critical appraisal, pain, clinical rheumatology, physical therapy, exercise physiology, library sciences, and knowledge translation.
- Where researchers evaluated treatment effects at multiple points, we used the data points closest to 12 weeks to standardize our comparisons.

Agreements and disagreements with other studies or reviews

Over the past decade, there have been several reviews regarding aquatic exercise training for fibromyalgia. Based on their relevancy, we have chosen to comment on: Gowans 2007, Langhorst 2009, Lima 2013, McVeigh 2008, and Perraton 2009.

Gowans 2007 reviewed eight randomized controlled trials (RCTs) published from 2000 to 2007 to determine the physiological effects of exercise in warm water. Our review excluded one of the eight studies because aquatic exercise training did not make up 50% or more of the treatment time. It is not surprising that our results are in general agreement with Gowans 2007. We do differ in our findings related to long-term effects: Gowans 2007 suggested that exercise-induced improvements in physical function, pain and mood may continue for up to two years. In our review, only three studies of the aquatic versus control comparison had a follow-up. Our results show a lack of evidence of effect for physical function at the end of the intervention and follow-up; pain, however, was less at the end of the intervention but had regressed to baseline values at follow-up. Gowans 2007 pointed out that pool exercise may be better tolerated as an initial means of exercise by individuals with arthritis in weightbearing joints (because of water buoyancy) or by individuals who fear exercise will exacerbate their pain, which may be the case in individuals with fibromyalgia. Gowans 2007 also recommended that future studies should reassess subjects at multiple time points to determine the time course of exercise-induced improvements and further explore the effects of pool exercise on mood and sleep quality.

Langhorst 2009 conducted a systematic review on 13 primary studies published to December 2008 evaluating hydrotherapy (with and without exercise) in fibromyalgia. Hydrotherapy included spa, balneotherapy, and thalassotherapy, and packing and compresses. Inclusion criteria were poorly defined; for example it is not clear if non-randomised studies were included. Based on the range of types of interventions included, and differences in review methods, the Langhorst 2009 report differs considerably from our review. In contrast to our review, methodological quality was assessed by the van Tulder score (we used the Cochrane 'Risk of bias' tool). Also in contrast to our review, Langhorst found only two of 13 studies to have adequate randomization, whereas we rated 11 out of 16 studies to have adequate sequence generation. Despite these fundamental differences, Langhorst also found evidence for reduction of pain and improved health-related quality of life at the end of therapy. Langhorst 2009 also reported that there was moderate evidence that the reduction of pain and improvement of health-related quality of life could be maintained at follow-up (median 14 weeks). Our results do not support this - in our review pain regressed to close to baseline values at follow-up evaluation.

Lima 2013 conducted a systematic review on 18 studies published from 1950 to December 2012, 14 of which overlap with this review. Lima examined 10 outcomes while this review investigated the effects of aquatic exercise on 21 outcomes. There are several similarities in these reviews. For example, Lima had three equally formed comparison groups, both reviews agreed on the diversity of the outcome measures utilized, variation of exercise programs, time of follow-up, and incompleteness of information in RCTs. In both reviews, subgroup analysis based on the duration of the intervention was undertaken, and despite the use of different cut points in determining the subgroups, both reviews concurred that longer interventions were more successful. In Lima's case durations longer than 20 weeks were most successful than shorter interventions, whereas in our review interventions longer than seven weeks were more successful than shorter interventions.

An important disagreement is seen in the terminology used within Lima's review; the authors use interchangeably the terms 'aquatic physical therapy', 'aquatic exercise programs', and 'aquatic therapy'. In addition, the conceptualization of the physical function outcome and the test utilized to measure it differs in these reviews. With regard to adverse events, while Lima refers to the "use of the pool" we referred to adverse effects of the intervention. Although both reviews utilized the Cochrane 'Risk of bias' tools, there are differences in the results regarding the rigor of the studies that affect the conclusions of the reviews. Lima points out that there is low methodological rigor in the RCTs included. Our review shows low to unclear risk of bias for most studies, with the exception of blinding of personnel who deliver the intervention, which we rated as high risk.

In agreement with our review, Lima's found significant results for aquatic versus control group multidimensional function, stiffness, and cardiorespiratory submaximal outcomes (what he called physical function). Lima's analysis of follow-up was conducted in two studies and two outcome measures (pain and depression); we agree in one study and one outcome measure (pain) showing the same results. Our findings do not support Lima's recommendations related to water temperature; our evidence shows a moderate effect on multidimensional function, pain, and strength after exercising in *temperate water* (33 to 36 degrees Celsius); whereas Lima recommended that the temperature should not exceed 30/33 degrees Celsius. Both reviews agree that three pool sessions per week is the most beneficial for individuals with fibromyalgia.

McVeigh 2008 examined the effectiveness of hydrotherapy in the management of fibromyalgia; the literature search involved 10

major databases from 1990 to 2006. McVeigh found 10 studies meeting their criteria, five of which were included in our review. The authors arrived at the conclusion that the mean methodological quality of studies included was 4.5/9 on the van Tulder scale. Similar to our review, McVeigh's study participants had to have experienced a water-based intervention for more than 50% of the treatment. However, in our review the aquatic exercise training interventions had to be active, consisting in large part of exercise in the water rather than soaking or floating in the water, as with balneotherapy or some spa interventions. Nevertheless, our results from the *aquatic versus control* comparison support McVeigh's conclusions that there are positive outcomes for pain, health-status, and tenderness. However, this was not found to be the case when the aquatic exercise training intervention was compared to a land-based intervention. In addition, McVeigh presented strong evidence for the use of hydrotherapy in the management of fibromyalgia. Our results differ in that we found strong evidence of an effect of the aquatic exercise training interventions in pain, multidimensional function, and submaximal cardiorespiratory outcomes; this was not true for other wellness, symptoms, or physical fitness outcomes in our review.

Perraton 2009 conducted a systematic review of randomized controlled trials published between 1998 and 2009 to summarize the components of hydrotherapy programs in individuals with fibromyalgia. Only trials that reported significant fibromyalgia-related outcomes were included in this review. Data relating to the components of hydrotherapy programs (exercise type, duration, frequency and intensity, environmental factors, and service delivery) were analyzed. Eleven RCTs were included in this review. Aerobic aquatic exercise featured in all 11 trials and the majority of hydrotherapy programs included either a strengthening or flexibility component. There was a strong overlap with our review, with nine of the 11 studies in Perraton 2009 included in our review. In agreement with Perraton, our included studies had a similar selection of exercise mode which included either aerobic training on its own or in combination with resistance training or flexibility. Great variability was noted in both the environmental components (e.g., water temperature, depth) of hydrotherapy programs and service delivery in the Perraton 2009 studies. In our review included programs were conducted in group settings and mostly delivered by physiotherapists. Our review also found that aerobic training, warm-up and cool-down periods, and relaxation exercises are common features of hydrotherapy programs and that treatment duration is commonly 60 minutes. A frequency of three sessions per week and an intensity equivalent to 60% to 80% maximum heart rate were the most commonly reported exercise prescription parameters noted in Perraton; our review included study programs run one to four times per week at intensities ranging from 40% to 80% HR_{max}. The chemical or mineral content of the water was not described in Perraton 2009 and that was also true for the studies included in our review.

AUTHORS' CONCLUSIONS

Implications for practice

- The improvement in wellness and symptoms resulting from aquatic exercise training found in this review could be very important in the management of fibromyalgia. The improvement in pain may be due in part to the warmth of the water, which provides immediate benefits for muscle pain or stiffness that often limit exercise tolerance on land (Bender 2005). This decrease in symptoms may enhance self efficacy for exercise, mood, sleep etc., which may ultimately translate to an overall improvement in quality of life. Almost all the participants in the primary studies were females, therefore it is unclear if the results of the review can be generalized to males. Exercise in water may be an appealing way to begin exercising, especially for participants who are deconditioned such as those in the primary studies in this review. As such, exercise in warm water may be particularly beneficial as an initial means to exercise without exacerbating pain for individuals with fibromyalgia who have been sedentary. One may assume that the sense of pleasure that arises from exercising in warm water may help with adherence and influence compliance. However, without published data on the characteristics of exercise actually performed, we cannot be certain of the actual exercise volume performed by participants. We can, however, take a broader look at exercise performed by comparing withdrawal rates, and we note that there were no statistically significant differences in withdrawal rates between water and land-based interventions, suggesting both interventions were well tolerated and accepted by participants.

- Heterogeneity among study protocols and inconsistencies in reporting exercise parameters and outcomes makes interpretation of results challenging. Consequently, it is unclear what exercise protocols (intensity, duration, frequency, mode, temperature, and salinity of the water) for aquatic training will yield optimal results for adults with fibromyalgia. However, the heterogeneity of protocols also leads us to speculate that the benefits of aquatic exercise training are fairly robust as they were achieved in such a variety of conditions.

- The pharmacological treatment of individuals with fibromyalgia often lacks effectiveness and reports of adverse reactions exist; the results of this review may reinforce the benefits of using water for the therapeutic treatment of pain. Water as an exercise medium offers advantages and disadvantages: while some exercises in water are made easier (i.e., jumping), others such as walking are more difficult. Individualized therapeutic programs, developed according to participants' baseline physical activity levels, may be most beneficial.

- Although not definitive our subgroup analyses suggest that variation in the estimate effect may be explained by more than one variable. Programming may need to consider the possible impact of age, disease duration, disease severity, and pain

intensity when planning exercise programs and when setting treatment goals. The length of the program allows for adaptation and conditioning, and may lead to behavioral change with regards to adapting a physical activity routine. Regarding exercise intensity, the common approach of starting with light intensity and progressing to moderate or vigorous intensity seems to be supported; whereas leaving the intensity decisions completely to the participant (self selected intensity) does not seem to be as effective.

- The subgroup analyses for length of intervention and accumulated time in the pool, as described in Analysis 8.1; Analysis 8.2; Analysis 8.3; Analysis 9.1; Analysis 9.2 and Analysis 9.3, have important implications for practice. People with fibromyalgia may need to consider continuing with the intervention even when they appear to have little initial effect. These analyses showed that the intervention effect is higher when the intervention is longer either in weeks or minutes. Also care providers may need to consider planning interventions with sufficient dosage/duration to be effective. The dosage implications are an important factor for future research.

Implications for research

Several implications for further research arose from this review. We have used the EPICOT approach to describe the implications for future research (Brachaniec 2009).

Evidence: There are insufficient studies to allow adequate meta-analysis of the effects of aquatic exercise training compared to land-based interventions and other types of interventions. The evidence for reduction of pain warrants further work; this is the most common symptom complaint in this population. Long-term effects are poorly understood. The sample size of individual studies was generally very small, with only one study exceeding 50 participants per group.

In terms of methodological quality of RCTs, allocation concealment is not adequately addressed in most studies. Therefore, it is not possible to assess the extent to which selection bias may have occurred in these studies. The recent trend towards publication of a priori trial protocols will allow improved evaluation of selective reporting bias. The accumulation of more studies will permit better evaluation of publication bias.

Population: The majority of the individuals included in our review were women; there is no evidence to describe the effects of aquatic exercise training on men with fibromyalgia. The population consisted primarily of middle-aged Caucasian women living in developed countries, which makes results difficult to generalize to other contexts.

Information is scarce about individuals' beliefs and prior experiences with exercise, which may impact beliefs about and adherence to exercise. Most studies state that participants were sedentary (without quantification) but there is no information about previous exercise experience. In addition, there is little description of lifestyle physical activity prior to and during exercise interventions, which may also add to the total number of hours the individual is actively moving and may contribute to the presence or absence of conditioning and symptoms. It is also unclear if disease duration impacts on adherence to exercise interventions. Further consideration of age, pain severity, and disease duration of participants may further the information in our subgroup analyses.

Intervention: More detail with respect to exercise frequency, intensity, and mode is needed to more precisely identify exercise volume and to determine if the prescribed exercise protocol meets current recommendations. In addition, exercise intensity details will help to further explore the validity of the subgroup findings. Adherence to protocols needs to be tracked more carefully and reported in detail to add to the understanding of individuals' tolerance to prescribed exercise.

Patients may need to be coached to exercise in a gradually progressive manner to avoid flare-ups and worsening of pain. However, optimal planned progression and intensity recommendations are not clear.

Comparators: In this review aquatic exercise training was compared to control, land-based, and other types of interventions via direct comparison. The evidence would be strengthened with more studies in each category.

Outcomes: Cognitive dysfunction is rated by many individuals with fibromyalgia as their most distressing symptom (Jones 2009); yet, it was measured by only one study in this review (Munguia-Izquierdo 2007). Another important outcome to clinicians and consumers (individuals with fibromyalgia) are clinician and patient global assessment (Choy 2009a), again measured in this review only by one set of researchers. This may be due to the nature of our search not being set to capture this body of literature and the fact that the OMERACT recommendations are relatively new.

There was a tendency in the articles in this review to focus more on symptoms and less on physical fitness outcome measures. This has an impact on the quality of the evidence in this area. There was only one study in several instances presenting physical fitness outcomes, which did not allow us to meta-analyze results. This is an important issue when considering the quality of evidence related to aquatic exercise training and fibromyalgia.

Improved documentation is needed in the area of adverse effects (injuries, exacerbations, and other associated adverse effects). Long-term outcomes need to be assessed at least up to 12 weeks of follow-up. It would also be helpful to know if positive outcomes lead to health-related behavioral change. This behavioral change (i.e., exercising on her/his own) needs to be measured.

Timestamp: This review should be updated in three to five years.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Altan 2004

Methods	2 groups: aquatic exercises versus balneotherapy - both in mineral water Length: 12 weeks plus 12 weeks follow-up Study design: randomized clinical trial with parallel groups
Participants	Female:male: 46:0 Age: 43.14 (6.39) to 43.91 (6.26) Inclusion: diagnosis of FMS according to ACR 1990 Exclusion: rheumatoid disease, unstable hypertension, severe cardiopulmonary problems, heat intolerance, psychiatric disorder affecting compliance, abnormal blood count and chemistry, ESR, urinalysis. All patients were instructed to discontinue nonsteroidal anti-inflammatory drug medication throughout the study period
Interventions	**a) Aquatic exercise in heated pool** (37 ºC) (n = 24) Supervised aquatic Intervention: **F**REQUENCY: 3 times per week; **D**URATION: 35 minutes; **I**NTENSITY: 60% to 75% HR_{max}; **M**ODE: flex was performed to maximum length - active ROM plus static stretches: Ae: jumping, walking back and forth in the pool. Out of the pool exercises: bending back and forth, squatting, and relaxing with deep breath. Slow swimming as part of relaxation **b) No exercise - balneotherapy** (n = 22) Supervised balneotherapy: **F**REQUENCY: 3 times per week. **D**URATION: 35 minutes; **M**ode: women were instructed not to perform any exercise during the sessions
Outcomes	Pain, tender points, fatigue, sleep, stiffness, health-related quality of life, muscle endurance, patient-rated disability, clinician-rated disability, depression Measurements at: pre-post: 12 weeks; follow-up: 24 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - only 20 minutes of aerobic activity
Injuries, exacerbations, other adverse effects	**a) Aquatic exercise in heated pool:** none stated. **b) Balneotherapy:** 3 drop-outs because of hypertension (n = 1) and cardiac arrhythmia (n = 2) (other adverse)
Notes	Country: Turkey Language: English Author contacted: response received Funding sources/declaration of interest: none stated

Risk of bias		*Risk of bias*
Bias	**Authors' judgement**	**Support for judgement**

Altan 2004 (*Continued*)

Random sequence generation (selection bias)	Low risk	"They were assigned randomly into two groups (extra information: randomization was done using random number table" (pg 273)
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding of participants and personnel (performance bias)	Low risk	Quote: "the patients were fully informed about the nature and purpose of the study" pg 273. Although there was no participant or care provider blinding, we judged that the outcome was not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"evaluation were performed ... by the same researcher who was totally unaware of the patients groups" pg 273
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing outcome data - analysis of completers was done
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's prespecified outcomes that are of interest in the review have been reported in the prespecified way
Other bias	Low risk	The study appears to be free of other sources of bias Statement regarding conflict of interest: not reported

Arcos-Carmona 2011

Methods	2 groups: experimental versus placebo Length: 10 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 53:0 Age: 44.4 (9.25) Inclusion: diagnosis of FMS according to ACR 1990 Exclusion: memory loss, participating in other pharmacological therapies, infectious diseases, hypotension, and respiratory alterations that could limit participation in the treatment

Arcos-Carmona 2011 (*Continued*)

Interventions	**a) Experimental group** (28 ºC) (n = 27) Supervised aquatic intervention:**F**REQUENCY: 2 times per week; **D**URATION: 60 minutes (30 minutes in the water and 30 minutes on land following Jacobson relaxation);**I**NTENSITY: 40% of relative medium; **M**ODE: walks, jumps, grabbing, general mobility **b) Placebo** (n = 26) Sham treatment with disconnected magnet therapy device. Participants were lying prone and the machine was covered so the they could not see the machine was disconnected. **F**REQUENCY: 2 times per week;**D**URATION: 10 minutes at cervical level, 10 minutes lumbar level
Outcomes	Sleep, pain, fatigue, health-related quality of life, self rated physical function, mental health, anxiety, depression Measurements at: pre-post: 10 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - only 2 times per week
Injuries, exacerbations, other adverse effects	Unspecified injuries, exacerbations or other adverse effects
Notes	Country: Spain Language: Spanish (article translated) Author contacted: response received Funding sources/declaration of interest: authors declared no conflict of interest (pg 401)

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	From author: "participants were classified by type of medication and length of disease onset, obtaining a combination of letters AABB, ABAB, etc later on introducing this in opaque envelops to randomly generate the sequence by computer"
Allocation concealment (selection bias)	Low risk	From author: "...later on introducing this in opaque envelops to randomly generate the sequence by computer"
Blinding of participants and personnel (performance bias)	Unclear risk	Although there was participant blinding (quote: "a simulated magneto-therapy program at cervical (10') and lumbar levels (10') with disconnected equipment. The application of magneto-therapy was done with the patients in prone position, with a covered screen so the patients were

		not aware that the equipment was disconnected"), we judged the level of risk of lack of blinding as unclear because the level of exposure to exercise personnel was not equivalent
Blinding of outcome assessment (detection bias) All outcomes	Low risk	There were no observational tests; self report only
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcomes data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	The study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were prespecified
Other bias	Low risk	The study appears to be free of other sources of bias Conflict of interest: authors state there were none

Assis 2006

Methods	2 groups: deep water running versus land-based exercises Length: 15 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 60:0 Age: 42.17 (10.05) to 43.43 (10.76) Inclusion: diagnosis of FMS (ACR 1990), literate, and kept on an unchanged drug regimen for the last 4 weeks before starting the study Exclusion: symptomatic cardiac failure, uncontrolled thyroid disturbances, body mass index equal or greater than 40, infectious contagious skin diseases, coronary, pulmonary, neurologic and rheumatic diseases limiting or hindering their ability to exercise, and those who had performed regular physical activity in the 6 weeks before the trial were not included Years since onset of FM at entry/complaint duration: DWR: 7 years; land-based group: 5 years
Interventions	**a) Deep water running in heated pool** (28 °C to 31 °C) (n = 30) Supervised aquatic intervention: **F**REQUENCY: 3 times per week; **D**URATION: 60 minutes (warm up: 10', Ae: 40', cool down: 10'); **I**NTENSITY: 60% to 75% HR_{max}. Low to moderate (a researcher calculated anaerobic threshold); **M**ODE: deep water running **b) Land-based exercise:** (n = 30) Supervised land-based intervention: **F**REQUENCY: 3 times per week; **D**URATION: 60

Assis 2006 (*Continued*)

	minutes (warm-up: 10', Ae: 40', cool-down: 10'); **I**NTENSITY: 60% to 75% HR_{max}. Intensity: moderate (a researcher calculated anaerobic threshold); **M**ODE: outdoor walking and jogging
Outcomes	Pain, patient-rated global, health-related quality of life, depression, self reported physical function, submaximal cardiorespiratory, maximal cardiorespiratory, mental health, anxiety Measurements at: pre; middle: 8 weeks; post: 15 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	Not enough information to judge
Injuries, exacerbations, other adverse effects	**a) Deep water running:** impingement syndrome; muscle pain (exacerbation) **b) Land-based exercise:** 2 events = bilateral ankle arthritis, Baker's cyst; tinea pedis (injury); muscle pain (exacerbation)
Notes	Country: Brazil Language: English Author contacted: response received Funding sources/declaration of interest: supported by a grant from FAPESP (Research Support Fund of the State of Sao Paulo) (pg 57)

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"The 60 patients were randomly assigned to either DWR in a warmed swimming pool...or LBE..." (pg 58)
Allocation concealment (selection bias)	Low risk	"folded pieces of paper in which intervention labels were written were contained in a set of sealed envelopes. One of the investigators took the envelopes out of a container to see who would go to which group. He remained unaware of screening and assessments of the patients during the randomization process." (pg 58)
Blinding of participants and personnel (performance bias)	Low risk	Although there was no participant or care provider blinding, we judged that the study outcome is not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5). Quote: "All sessions were supervised by 2 physiotherapists who alternated groups weekly" (pg

Assis 2006 (*Continued*)

		59)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"all assessment were performed by the same investigator who remained unaware of the allocation throughout the trial." (pg 59)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified and ITT used
Selective reporting (reporting bias)	Low risk	Protocol is available and all of the study's prespecified (primary and secondary) outcomes that are of interest in the review have been reported in the prespecified way
Other bias	Low risk	The study appears to be free of other sources of bias Conflict of Interest: grant from FAPEST (research support fund of the state of Sao Paulo)

Calandre 2010

Methods	2 groups: stretching in the water versus Tai Chi in the water (Ai Chi) Length: 6 weeks; follow-up at 10 and 18 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 73:8 Age 51 (8) to 49 (8.4) Inclusion: diagnosis of FMS (ACR 1990) Exclusion: those who never attended a swimming pool, had disease susceptible to worsen with warm water exercise such as coronary disease, allergy to chlorine, etc. Participants followed their pharmacological treatment during study and follow-up period Years since onset of FM at entry: 14.1 (8.4) to 15.6 (8.7)
Interventions	**a) Ai Chi** (pool temperature 36 °C preceded by warm shower to condition the body 34.5 to 35.5 °C) (n = 42) Supervised aquatic intervention. **F**REQUENCY: 3 times per week; **D**URATION: 60 minutes (first and last 10 minutes patient relax, 40 minutes exercises); **I**NTENSITY: to individual needs depending on degree of pain and fatigue; **M**ODE: patients were taught the 16 movements which constitute the Tai Chi therapy without the help of any material - they use a combination of deep breathing and slow, broad movements of the arms, legs and torso **b) Stretching in the water** (pool temperature 36 °C preceded by warm shower to condition the body 34.5 to 35.5 °C) (n = 39) Supervised aquatic intervention. **F**REQUENCY: 3 times per week; **D**URATION: 60 minutes (first and last 10 minutes patient relax, 40 minutes exercises); **I**NTENSITY: to individual needs depending on degree of pain and fatigue; **M**ODE: in order to facilitate stretching participants were given 1 meter long wooden sticks, 1.5 meter flexible tube.

Calandre 2010 (*Continued*)

	Stretching was performed over muscles of main body areas: cervical, upper, and lower extremities and trunk
Outcomes	Pain, fatigue, sleep disturbance, stiffness, tender points, health-related quality of life, physical function, depression, anxiety Measurements at: pre-post: 6 weeks; follow-up 1: 10 weeks; follow-up 2: 18 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	Not applicable
Injuries, exacerbations, other adverse effects	Injuries unspecified for either group **a) Ai Chi:** pain exacerbation; chlorine hypersensitivity (n = 1) (other adverse)
Notes	Country: Spain Language: English Author contacted: n/a Funding sources/declaration of interest: article states "none declared" (pg S-13)

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Participants were randomly assigned by means of a computer-generated table of random numbers. pg S14"
Allocation concealment (selection bias)	High risk	"open label design. pg S14"
Blinding of participants and personnel (performance bias)	Low risk	Although there was no participant or care provider blinding, the review authors judged that the outcome is not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5). "As the study was not blinded…" and " A trained physiotherapist, always the same for all of the exercise groups (pg S-14)
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Correspondence with author "as for your question, given that the study has an open-label design, the therapist who performed the tender point assessment was not blinded". However, because the majority of outcomes were self reported but TP count was not blinded this section is unclear
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified and ITT used

Calandre 2010 (*Continued*)

Selective reporting (reporting bias)	High risk	No information on TPs as an outcome, yet show up in the results
Other bias	High risk	Had baseline imbalances: "One of the groups showed significantly better scores of mental health at baseline S-18." Statement regarding conflict of interest: "none declared"

De Andrade 2008

Methods	2 groups: aerobic aquatic exercises versus aerobic aquatic exercises in sea water (thalassotherapy) Length: 12 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 23:0 Age: 48.8 (9.9) to 48.3 (8.9) Inclusion: diagnosis of FMS (ACR 1990), be without physical activity for at least 3 months Exclusion: pregnancy, infectious contagious skin disease, coronary, pulmonary, neurological or other limiting rheumatic diseases Years since onset of FM at entry: not specified
Interventions	**a) Aerobic aquatic exercises** (28 to 33 °C) (n = 23) Supervised aerobic aquatic exercise in outdoor pool during summer months. **F**REQUENCY: once a day, 3 times per week; **D**URATION: 60 minutes (10 minutes stretching, 40 minutes low impact aerobic, 10 minutes relaxation); **I**NTENSITY: training level was set at 50% to 75% of $VO2_{max}$ or levels 12 to 13 on BORG scale; **M**ODE: racing against the water resistance, bicycling simulation, stationary march, shoulders and elbows bending and extension with dumbbells, punches in the air, multidirectional kicks against water resistance, pushing and pulling floater against water resistance, stepping and sinking the floaters with feet and jumping jacks and low jumps using calf for leverage **b) Aerobic aquatic exercises in sea water (thalassotherapy)** (n = 23) Supervised aerobic thalassotherapy performed in sea water - no waves and water stood at shoulder level of participants **F**REQUENCY: once a day-3 times per week; **D**URATION: 60 minutes (10 minutes stretching, 40 minutes low impact aerobic - 10 minutes relaxation); **I**NTENSITY: training level was set at 50-75% of VO2max. or levels 12 to 13 on BORG scale; **M**ODE: racing against the water resistance, bicycling simulation, stationary march, shoulders and elbows bending and extension with dumbbells, punches in the air, multidirectional kicks against water resistance, pushing and pulling floater against water resistance, stepping and sinking the floaters with feed and jumping jacks and low jumps using calf for leverage
Outcomes	Pain, fatigue, tender points, sleep, health-related quality of life, depression, self rated physical function, mental health Measurements at: pre-post: 12 weeks

De Andrade 2008 (*Continued*)

Congruence with ACSM guidelines for aerobic training (yes/no)	No - only 3 times a week or 120 minutes of aerobic exercise
Injuries, exacerbations, other adverse effects	**a) Aquatic exercises:** muscle pain (n = 9) (exacerbation); urinary infection (n = 1) (other adverse) **b) Aquatic exercises in sea water:** first degree burn (n = 2) (injuries); muscle pain (n = 8) (exacerbation)
Notes	Country: Brazil Language: English Author contacted: n/a Funding sources/declaration of interest: none stated

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Patients eligible for inclusion were randomly allocated into the pool (n = 23) or sea group (n = 23) using a computer generated randomization list and closed numbered envelopes" (pg 148)
Allocation concealment (selection bias)	Low risk	"Sequentially numbered, opaque, sealed envelopes" (pg 148)
Blinding of participants and personnel (performance bias)	Low risk	Although there was no participant or care provider blinding, we judged that the outcome is not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	All patients were evaluated before and immediately after intervention (pre-treatment and post-treatment). Assessments were performed by the same observer, who was blinded to the mode of treatment. Patients were randomized after the initial assessment (pg 148)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified. No missing outcome data
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's prespecified outcomes that are of interest in the review have been reported

De Andrade 2008 (*Continued*)

		in the pre specified way
Other bias	Low risk	The study appears to be free of other sources of bias. Statement regarding conflict of interest: not reported

de Melo Vitorino 2006

Methods	2 groups: hydrotherapy versus conventional physiotherapy Length: 3 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 25:0 Age: 48.9 (9.2) to 46.6 (8.4) Inclusion: diagnosis according to ACR (1990) Exclusion: no contraindications to pool treatment Years since onset of disease/symptoms: unspecified
Interventions	**a) Hydrotherapy** (temperature unspecified) (n = 19) Supervised aquatic intervention.**F**REQUENCY: 3 times per week; **D**URATION: 60 minutes (warm-up: 5', flexibility: 6', aerobics: 30', flexibility: 6', relaxation: 13'); **I**NTENSITY: unspecified; **M**ODE: jumping walking, sliding with arm movement versus resistance. Flexibility - unspecified **b) Conventional physiotherapy** (n = 19) Supervised conventional intervention. **F**REQUENCY: 3 times per week; **D**URATION: 60 minutes; (infrared at beginning 10', flexibility 5' x 2; aerobics: 30', relaxation: 10); **I**NTENSITY: unspecified; **M**ODE: aerobic:leg-ergometry, flexibility-unspecified
Outcomes	Sleep, self rated physical function, pain, fatigue, mental health Measurements at: pre-post: 3 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - intensity unspecified
Injuries, exacerbations, other adverse effects	**a) Hydrotherapy:** unspecified injuries, exacerbations or adverse effects **b) Conventional physiotherapy:** unspecified injuries, exacerbations or adverse effects
Notes	Country: Brazil Language: English Author contacted: n/a Funding sources/declaration of interest: none stated

Risk of bias		***Risk of bias***
Bias	**Authors' judgement**	**Support for judgement**

de Melo Vitorino 2006 (*Continued*)

Random sequence generation (selection bias)	Low risk	"Patients were randomly assigned into two groups to perform either HT or CP...we prepared a randomization table for 50 individuals and two groups in advance. As the patients were consecutively included they received an opaque envelope, sequentially numbered, and inside was his or her assigned group. Neither the investigators nor the patients could know to what group each patient would be allocated" (pg 294)
Allocation concealment (selection bias)	Low risk	"Sequentially numbered and opaque" but did not mention they were sealed (pg 294)
Blinding of participants and personnel (performance bias)	Low risk	Although there was no participant or care provider blinding, we judged that the outcome is not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Patients were evaluated (pre and post) by other trained physiotherapist blind to the randomization" (pg 294)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified and ITT used. Missing data have been imputed using appropriate methods
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's prespecified outcomes that are of interest in the review have been reported in the prespecified way
Other bias	Low risk	The study appears to be free of other sources of bias Statement regarding conflict of interest: not reported

Evcik 2008

Methods	2 groups: aquatic exercise program versus home-based exercise program Length: 5 weeks plus 19 weeks follow-up Study design: randomized clinical trial with parallel groups

Participants	Female:male: 62:1 Age: 42.8 (7.6) to 43.8 (7.7) Inclusion: diagnosis of FM according the ACR (1990) Exclusion: severe cardiovascular disease, unstable hypertension, malignancy, inflammatory joint disease, heat intolerance and pregnancy, use of antidepressive or nonsteroidal anti-inflammatory drugs, exercises regularly Years since onset of FM at entry (in years): 3
Interventions	**a) Aquatic exercise program** (33 °C) (n = 31) Supervised aquatic mixed program. **F**REQUENCY: 3 times per week; **D**URATION: 60 minutes (35 minutes aquatic - 20 minutes poolside exercises such as warming up active range of motion and relaxation); **I**NTENSITY: unspecified; **M**ODE: stretches, walking, jogging and low impact swimming **b) Home-based exercise program** (n = 30) Exercises were demonstrated on one occasion and participants were given written advice; **F**REQUENCY: 3 times per week; **D**URATION: 60 minutes; **I**NTENSITY: unspecified; **M**ODE: aerobic, general mobility, flexibility and relaxation
Outcomes	Pain, tender points, fatigue, stiffness, sleep disturbance, paresthesia, irritable bowel, pseudo Raynaud's, sicca symptoms, headache, bladder dysfunction, depression, health-related quality of life Measurements at: pre-post: 4 weeks; follow-up 1: 12 weeks; follow-up 2: 24 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	Not enough information to judge - intensity not stated
Injuries, exacerbations, other adverse effects	Authors stated "no side effects were observed during the program" pg 886-87
Notes	Country: Turkey Language: English Author contacted: response received Funding sources/declaration of interest: none stated

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	"Participants were allocated to the groups in order to their admittance". The authors describe the study as "prospective, randomized, controlled open-study" pg 886
Allocation concealment (selection bias)	Unclear risk	No description
Blinding of participants and personnel (performance bias)	Unclear risk	No information is available in the paper; however, it is unlikely that there was participant or care provider blinding. Neverthe-

		less, we judged the risk of bias due to lack of blinding of participants and care providers to be unclear in this study (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No description of assessors or blinding procedures, uncertain whether co-existing symptoms (related to disease) were self reported or clinician-rated
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups. "Dropouts in group 1 bring the 'n' for each group near equivalent" (pg 887)
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to assess whether an important risk of bias exists Statement regarding conflict of interest: not reported

Gowans 2001

Methods	2 groups: aerobic versus untreated control Length: 23 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 44:6 Age: 44.6 (8.7) to 49.9 (7.3) Inclusion: meet diagnostic criteria and be willing to comply with the experimental protocol Exclusion: diagnosis of high blood pressure or symptomatic cardiac disease, other serious systemic diseases (e.g., cancer, diabetes), intention of changing medications for anxiety or depression or seek professional treatment for anxiety or depression during the study period, and be enrolled in or intended to begin an aerobic exercise program Years since disease symptoms (Mean (SD)): 6.4 (7) to 11.6 (10.4) years; duration of diagnosis: 3.2 (3.3) to 3.5 (3.2) years
Interventions	**a) Aerobic** (warm water pool - temperature not specified) (n = 27) Classes for the first 6 weeks were conducted in a warm therapeutic pool. At 7 week participants progressed to 2 walking classes in a gym and 1 pool class. Data for this review were extracted to represent the aquatic exercise training at the 6-week mark **F**REQUENCY: 3 hospital based classes per week; **D**URATION: 30 minutes (20 minutes aerobic);**I**NTENSITY: low to moderate 60% to 75% age-adjusted HR_{max}; **M**ODE:

Gowans 2001 (*Continued*)

	water (warm) walking/running progressing to land walking/running **b) Wait list control** (n = 23): "continue ad libitum activity"
Outcomes	Depression, submaximal cardiovascular, anxiety, mental health, tender points, strength, health-related quality of life, self efficacy Measurements at: pre; middle: 6 weeks; post: 23 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - only 20 minutes of aerobic exercise
Injuries, exacerbations, other adverse effects	No reported injuries, exacerbations or other adverse effects
Notes	Country: Canada Language: English Author contacted: n/a Funding sources/declaration of interest: the work was supported by a grant from the Toronto Hospital Auxiliary Women's Health Project on Women and Arthritis (pg 528)

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	"Subjects were stratified by sex and randomly assigned to..." pg 520
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding of participants and personnel (performance bias)	Unclear risk	No information is available in the paper; however, it is unlikely that there was participant or care provider blinding. Nevertheless, we judged the risk of bias due to lack of blinding of participants and care providers to be unclear in this study (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"their distance was recorded to the nearest meter by an assessor blinded to subjects' group assignments" pg 520
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Drop-outs specified and ITT used. However, ITT was missing 1 C person who did not return for post-test. It is unclear why they did not do LOCF
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's prespecified (primary and secondary) outcomes that are of interest in the

Gowans 2001 (*Continued*)

		review have been reported in the prespecified way
Other bias	Low risk	The study appears to be free of other sources of bias Conflict of Interest: statement provided (hospital auxiliary funding acknowledged)

Gusi 2006

Methods	2 groups: aquatic exercise versus control Length: 12 weeks plus 12 weeks follow-up Study design: randomized clinical trial with parallel groups
Participants	Female:male: 35:0 Age: 51 (9) to 51 (10) Inclusion: diagnosis of FM according the ACR (1990) Exclusion: any severe disorder of the spine (e.g., prolapsed disk, spinal stenosis), severe trauma, frequent migraines, peripheral nerve entrapment, inflammatory rheumatic diseases, and severe psychiatric illness. Participants with diseases that prevent physical loading, pregnant, those who attended another psychological or physical therapy or history of more than 30 minutes exercise session per week during 2 weeks in the last 5 years Years since onset of disease/symptoms: 24 and 19 years
Interventions	**a) Aquatic exercise** (33 °C) (n = 17) Supervised exercises in waist high warm pool. **F**REQUENCY: 3 times per week; **D**URATION: 60 minutes (10 minutes warm up, 2 x 10 minutes aerobic, 10 minutes strength, 10 minutes cool down); **I**NTENSITY: aerobic 65% to 75% HR_{max}, strength slow pace; **M**ODE: aerobic - unspecified; strength - low extremity exercises (knee flexion and extension) against water resistance **b) Control** (n = 17) The control group continued to follow normal daily activities and did not perform any form of exercise, as those in the exercise group
Outcomes	Pain, health-related quality of life, self reported physical function, strength Measurements at: pre-post: 12 weeks; follow-up: 24 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - only 20' 3 times per week
Injuries, exacerbations, other adverse effects	No injuries, exacerbation or other adverse effects specified; authors mentioned "strength training in water did not aggravated the symptoms" pg 71
Notes	Country: Spain Language: English (2) and Spanish (2) Spanish articles translated Author contacted: response received. Funding sources/declaration of interest: support received from the European Social Funds

	and Regional Government of Extremadura (pg 66)

Risk of bias ***Risk of bias***

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	The method of randomization has not been clearly described: "women...were randomly assigned to either an exercise group or control group" (pg 67)
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias)	Unclear risk	No information is available in the paper; however, it is unlikely that there was participant or care provider blinding. Nevertheless, we judged the risk of bias due to lack of blinding of participants and care providers to be unclear in this study (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	High risk	No information provided on outcome assessments other than "the doctor responsible for the investigation, following ACR criteria, evaluated TPs" (article 8215 pg 78)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Only one participant dropped out out of the study (a participant in the exercise group had a fall in the street)
Selective reporting (reporting bias)	High risk	Not all of the study's prespecified primary outcomes have been reported. While reviewing primary and companion articles there are discrepancies in the values of certain outcomes (e.g., FIQ pain)
Other bias	High risk	Inconsistencies among primary and companion articles Conflict of interest: statement provided (study was funded by grants from government and health region)

Hecker 2011

Methods	2 groups (hydrokinesiotherapy and kinesiotherapy) Length: 23 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 24:0 Age (years): 47.5 to 45.3 Inclusion: females with a diagnosis of FM for at least 2 years, without diagnoses of associated diseases, not engaged in regular physical activities and not on any medication Exclusion: patients with pathologies that would prevent attending less than 75% of the visits to either group. Also excluded were the patients that were taking any kind of medication, as well those who started taking medication during the study Duration of illness (years): 3 to 4.5
Interventions	**a) Hydrokinesiotherapy** (32 ºC to 34 ºC) (n = 12) **F**REQUENCY: 1 time per week; **D**URATION: 60 minutes (15' flexibility, 15' aerobic, 15' unloaded AROM, 15' flexibility); **I**NTENSITY: 40% - low intensity for the aerobic portion; **M**ODE: aerobic working major muscle groups of the lower limbs, upper limbs, trunk and neck **b) Kinesiotherapy** (n = 12) **F**REQUENCY: 1 time per week; **D**URATION: 60 minutes (15' flexibility, 15' aerobic, 15' unloaded AROM, 15' flexibility); **I**NTENSITY: 40% - low intensity for the aerobic portion; **M**ODE: aerobic working major muscle groups of the lower limbs, upper limbs, trunk and neck
Outcomes	Pain, fatigue, physical function, mental health, global well-being, multidimensional function Measurements at: pre-post: 23 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - frequency 1 per week and no description of intensity
Injuries, exacerbations, other adverse effects	No injuries, exacerbations or other adverse effects specified
Notes	Country: Brazil Language: Portuguese Article translated Author contacted: response received Funding sources/declaration of interest: none stated

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Drawing of lots
Allocation concealment (selection bias)	Low risk	Sequentially numbered, opaque, sealed envelopes

Hecker 2011 (*Continued*)

Blinding of participants and personnel (performance bias)	Low risk	From author correspondence: "Regarding "the blinding", those responsible for carrying out the treatment and the patients in each group were unaware of the existence of another group receiving another treatment"
Blinding of outcome assessment (detection bias) All outcomes	Low risk	From author: "as mentioned earlier, the assessors of outcomes were unaware of the allocation of voluntary groups"
Incomplete outcome data (attrition bias) All outcomes	Low risk	From author: "All 12 participants in each group followed to the end of the study"
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement of yes or no
Other bias	Unclear risk	Insufficient information to assess whether an important risk of bias exists Statement regarding conflict of interest: not reported

Ide 2008

Methods	2 groups: aquatic respiratory exercise-based program versus control Length: 4 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 40:0 Age: 46.61 (9.8) to 45.47 (8.65) Inclusion: diagnosis of FM according to the ACR (1990), time availability, means of transportation and acceptance of training routine Exclusion: the presence of musculoskeletal, respiratory, neurological, cardiovascular, skin diseases or hydrophobia reported. Participants enrolled in any other regular exercise activity or institutionalized were excluded Years since onset of disease/symptoms: unspecified
Interventions	**a) Aquatic respiratory exercise-based program** (32 °C) (n = 20) Exercise program performed in a 1.05 m deep heated pool - participants were asked to keep their shoulders in the water. **F**REQUENCY: 4 times week; **D**URATION: 60 minutes (5 minutes warm-up walking, jogging and running, 45 minutes general exercises and specific breathing patterns, 10 minutes cool-down free floating and breathing; **I**NTENSITY: unspecified; **M**ODE: shoulder, hip and trunk movement combined with breathing exercises **b) Control** (n = 20) Non-exercise program involved no exercises, no health-related issues and consisted of recreational card games, music and general interest seminars; **F**REQUENCY: 1 time per week; **D**URATION: 60 minutes

Ide 2008 (*Continued*)

Outcomes	Pain, dyspnea, tender points, anxiety, sleep disturbance, fatigue, stiffness, health-related quality of life, self reported physical function, mental health, depression, patient-rated global Measurements at: pre-post: 4 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - intensity unspecified
Injuries, exacerbations, other adverse effects	No injuries, exacerbations or other adverse effects specified
Notes	Country: Brazil Language: English Author contacted: response received Funding sources/declaration of interest: none stated

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"...patients were randomly assigned to the aquatic respiratory exercise-based program on the control group by drawing lots" (pg 132)
Allocation concealment (selection bias)	Unclear risk	"Each patient chose a sealed envelope containing the group designation" (pg 132)
Blinding of participants and personnel (performance bias)	Unclear risk	Although there was no participant or care provider blinding, we judged that the outcome is not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"After completing the program, patients of both groups were evaluated by an assessor blinded to the groups' assignments and the questionnaires were applied" (pg 132)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified. No missing outcome data
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgment

Ide 2008 (*Continued*)

Other bias	Low risk	The study appears to be free of other sources of bias Statement regarding conflict of interest: not reported

Jentoft 2001

Methods	2 groups: aquatic exercise program versus land-based exercise program Length: 20 weeks plus 6 months follow-up Study design: randomized clinical trial with parallel groups
Participants	Female:male: 34:0 Age: 39.4 (8.8) to 42.9 (8.6) Inclusion: diagnosis of FMS (ACR 1990) Exclusion: inflammatory rheumatic disease, hypothyroidism, heart and lung disease, pregnancy Years since onset of disease/symptoms (years): 11.1
Interventions	**a) Aquatic exercise program** (34 °C) (n = 18) Supervised program based on an aquatic adaptation of the Norwegian Aerobic Fitness Model. **F**REQUENCY: 2 times week; **D**URATION: 60 minutes; **I**NTENSITY: 60% to 80% HR_{max} age adjusted; **M**ODE: dynamic muscle work accompanied by music (aerobic dance, stretching, strengthening) **b) Land-based exercise program** (n = 16) Supervised program based on the original form of the Norwegian Aerobic Fitness Model. Strength for thighs and trunk: gymnastic hall with normal room temperature and a wooden floor was used; **F**REQUENCY: 2 times week; **D**URATION: 60 minutes; **I**NTENSITY: 60% to 80% HR_{max} age adjusted; **M**ODE: dynamic muscle work accompanied by music (aerobic dance, stretching, strengthening)
Outcomes	Pain, fatigue, sleep, stiffness, tender points, patient global rating, self rated physical function, submaximal cardiovascular, maximal cardiovascular, strength, endurance, self efficacy, depression, anxiety Measurements at: pre-post: 20 weeks; follow-up: 46 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	Not enough information to judge
Injuries, exacerbations, other adverse effects	No injuries, exacerbations or other adverse effects specified
Notes	Country: Norway Language: English Author contacted: response received Funding sources/declaration of interest: support from the Norwegian Ministry of Health and Social Affairs/Rogaland County Council, Department of Health and Social Services, and by the Haugesund Women's Public Health Association (pg 42)

Jentoft 2001 (*Continued*)

Risk of bias		*Risk of bias*
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Forty-four patients were then randomized by lot to either a pool based exercise group (n = 22) or a land-based exercise group (n = 22)" pg 43
Allocation concealment (selection bias)	Low risk	Author indicated that participants drew, from an envelope, numbers which had been pre-allocated to 1 of the 2 groups
Blinding of participants and personnel (performance bias)	Low risk	Although there was no participant or care provider blinding, we judged that the outcome is not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"The outcome measures were examined by 2 trained physiotherapists who were blinded for the patients group affiliation" (pg 43)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified and reasons for missing outcome data unlikely to be related to true outcome
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's prespecified outcomes that are of interest in the review have been reported in the prespecified way
Other bias	Low risk	The study appears to be free of other sources of bias Conflict of Interest: supported by the Norwegian Ministry of Health ad Social Affairs/Rogaland County Council, Department of Health and Social Services, and by the Haugesund Women's Public Health Association

Mannerkorpi 2000

Methods	2 groups: aquatic exercise program versus control Length: 24 weeks (includes 6 weeks of education) Study design: randomized clinical trial with parallel groups
Participants	Female:male: 57:0 Age: 45 (8) to 47 (11.6) Inclusion: diagnosis of FMS (ACR 1990) Exclusion: rheumatic diseases, severe somatic or psychiatric disorders, inability to understand Swedish, chlorine allergy, plans to start other treatments during study period Years since onset of disease/symptoms: 8.4 (6) to 8.9 (7.2) years
Interventions	**a) Aquatic exercise program** (pool temperature - unspecified) (n = 28) Supervised exercise program in groups of 6 to 10 participants. **F**REQUENCY: 1 time per week; **D**URATION: 35 minutes; **I**NTENSITY: self selected below pain and fatigue threshold; **M**ODE: endurance, flexibility, co-ordination and relaxation Supervised education program. **F**REQUENCY: 1 time per week per 6 weeks; **D**URATION: 60 minutes. The aim was to introduce strategies to cope with FM symptoms and encourage physical activity. Based on active participation of the patients **b) Control group** (n = 29) treatment as usual
Outcomes	Submaximal cardiovascular, health-related quality of life, pain, self rated physical function, stiffness, anxiety, depression, fatigue, mental health, tender points, endurance, strength, flexibility, self efficacy Measurements at: pre-post: 26 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - frequency 1 per week, intensity unspecified, session duration 35' including all components
Injuries, exacerbations, other adverse effects	"Main reasons for not starting or interrupting the program were lack of time due to commitments relating to child care or employment, or the occurrence of infection or injury" pg 2474
Notes	Country: Sweden Language: English Author contacted: n/a Funding sources/declaration of interest: supported by grants from the Swedish Rheumatism Association the Vardal Foundation, and the Lansforsakringsbolagen Research Foundation (pg 2473)

Risk of bias ***Risk of bias***

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"patients were randomized to either a training group...or a control group...using sequential allocation according to age and symptom duration" (pg 2474)

Mannerkorpi 2000 (*Continued*)

Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias)	Unclear risk	Although there was no participant or care provider blinding, we judged that the outcome is not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"A trained physiotherapist, who remained blinded to the training randomization, assessed the functional limitations of the patients before the study start and after 6 months" (pg 2474)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified and reasons for missing outcome data unlikely to be related to true outcome
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's prespecified outcomes that are of interest ni the review have been reported in the prespecified way
Other bias	Low risk	The study appears to be free of other sources of bias Conflict of interest: statement provided (study was funded by grants from Swedish Rheumatism Association and research foundations)

Mannerkorpi 2009

Methods	2 groups (pool and education and education only) Length: 20 weeks; follow-up 48 to 52 Study design: randomized clinical trial with parallel groups
Participants	Female:male: 134:0 Age (years) (mean pooled): 45.64 (22 to 60 minutes - max) Inclusion: women with FM between ages of 18 and 60 years and pain at manual palpation at 11 out of 18 examined tender points (ACR 1990) Exclusion: other severe somatic psychiatric disorders such as stroke or schizophrenia, inability to understand Swedish, allergy to chlorine, ongoing exercise therapy supervised by a physical therapist, or plans to start such therapy during the study period Duration of symptoms (years ± SD): 10.6 (7.2)

Interventions	**a) Pool and education group:** (33 ºC) (n = 68) Pool -**F**REQUENCY: 1 time per week;**D**URATION: 45 minutes total;**I**NTENSITY: participant determined at low to moderate - median value for exertion (6 to 20) measured by Borg scale for perceived exertion; **M**ODE: aquatic aerobic, walking, jogging on flotation devise with arm movement. Aq flexibility/co-ordination: active and passive arm/trunk movements. Additional breathing exercises and body awareness Education - **F**REQUENCY: 1 week per 6 weeks;**D**URATION**:** 6 x 1-hour sessions;**M**ODE: discussions and practical exercises (relaxation) **b) Education group** (n = 66) -**F**REQUENCY: 1 week per 6 weeks;**D**URATION**:** 6 x 1-hour sessions;**M**ODE: discussions and practical exercises (relaxation)
Outcomes	Multidimensional function, pain, fatigue, tenderness, self reported physical function, mental health, depression, anxiety, submaximal cardiorespiratory function (outcome data specific to FM participants received upon request) Measurements at: pre-post: 20 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - 1 time per week, 45 minutes total
Injuries, exacerbations, other adverse effects	No injuries as reported from personal communication with the author. No severe exacerbations related to the program were documented
Notes	Country: Sweden Author contacted: yes - responses received. Funding sources/declaration of interest: financial support was provided by the Swedish Research Council, The Health and Medical Care Executive Board of Vastra Gotaland Region, the Swedish Rheumatism Association, the Lansforsakringsbolagens Research Foundation, the Rheumatic Pain Society in Goteborg/RiG, the Goteborg Region Foundation for Rheumatology Research/GSFR and ALF at Sahlgrenska University Hospital (pg 759)

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"... the patients were allocated to one of 2 treatment programs using stratified randomization for the disorder, FM or CWP. Sealed envelops were prepared by the statistician, who created the allocation sequence. When the patient examination had been conducted, the numbered envelop was opened by a person who was not involved in the examination, and who also informed the patient about the treatment group to which she was randomized"

Mannerkorpi 2009 (*Continued*)

Allocation concealment (selection bias)	Low risk	Pg 753 - sequentially numbered, opaque sealed envelopes
Blinding of participants and personnel (performance bias)	Low risk	Although there was no participant or care provider blinding, we judged that the outcome is not likely to be influenced by lack of blinding as both groups received an equivalent level of exposure to exercise personnel (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"... the trained examiners were blinded to the patients' group assignments..." (pg 753)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Authors used a different definition of ITT than what it is commonly seen: " in our ITT analyses, we based the analyses on measured values on all patients who attempted the posttest, despite they attended or not in the program." (correspondence with author)
Selective reporting (reporting bias)	Low risk	Additional analysis from the author was received isolating participants with FM
Other bias	Low risk	Author was very forthcoming with answers and data Conflict of interest: statement provided (foundation, health department funding, and hospital funding)

Munguia-Izquierdo 2007

Methods	3 groups: aquatic mixed - FM control - healthy control Length: 16 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 78:0 Age (years ± SD): 50 (7), 46 (8) and 47 (10) Inclusion: diagnosis of FMS (ACR 1990) Exclusion: morbid obesity, cardiopulmonary disease, uncontrolled endocrine or allergic disturbances, severe trauma, frequent migraines, inflammatory rheumatic disease, and severe psychiatric illness. Pregnant women, those with restriction for physical loading, those who attended another physical or psychological therapy, and those with a history of regular physical activity more strenuous than slow-paced walking a maximum of 2 times per week over 4 months prior to study entry were excluded from final analysis Years since onset of disease/symptoms (years ± SD): 14 (10) to 14 (9) (healthy group n/a)

Interventions	**a) Aquatic mixed:** (32 ºC) (n = 35) Supervised aquatic mixed (at chest high): **F**REQUENCY: 3 times per week; aerobic; **D**URATION: 20 to 30 minutes; **I**NTENSITY: low to vigorous in chest deep water (50% to 80% of predicted HR_{max}); strength for all major muscle groups; **D**URATION: 20 to 30 minutes; **I**NTENSITY: slow pace; **M**ODE: resistance from water and aquatic materials **b) Healthy controls:** (n = 25) matched for age, weight, body mass index, and educational and physical activity levels to FM participants **c) FM control:** (n = 25) instructed not to change their habits regarding physical activities during the period
Outcomes	Tender points, pain, health-related quality of life, cognitive function, endurance, anxiety, sleep disturbance Measurements at: pre-post: 16 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	From review authors: no - aerobic duration was only 20 to 30 minutes; 3 times per week From authors: "The intervention program met the minimum training standards of the American College of Sports Medicine" pg 826
Injuries, exacerbations, other adverse effects	No injuries, exacerbations or other adverse effects specified
Notes	Country: Spain Language: English (2) Author contacted: response received Funding sources/declaration of interest: work supported by the European Social Funds and Regional Government of Aragon (pg 824)

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"A final sample of 60 FM women was randomly assigned to either an exercise group or a control group, according to a computer generated randomization list." "Different numbers of patients were allocated to each group to ensure that both groups completed the intervening period with a comparable quantity of patients, despite the elevated exercise therapy attrition rate (randomization ratio, 1.4:1)" pg 2251
Allocation concealment (selection bias)	Low risk	From author: "the treatment allocation was also masked from all investigators involved in the trial. The research center was given a single sealed opaque envelopes for each patient that contained the treatment as-

Munguia-Izquierdo 2007 (*Continued*)

		signment. Treatment assignment was thus concealed and masking was successfully achieved during the study since no sealed envelope was opened voluntarily or accidentally or was tampered with during the study."
Blinding of participants and personnel (performance bias)	Unclear risk	No information is available in the paper; however, it is unlikely that there was participant or care provider blinding. Nevertheless, we judged the risk of bias due to lack of blinding of participants and care providers to be unclear in this study (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"All measurements were taken by examiners blinded to group assignment" (pg 2252)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified and ITT used. Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Low risk	The study appears to be free of other sources of bias Statement regarding conflict of interest: not reported

Tomas-Carus 2008

Methods	2 groups: aquatic mixed versus FM control Length: 34 weeks Study design: randomized clinical trial with parallel groups
Participants	Female:male: 30:0 Age (years ± SD): 50.7 to 50.9 (10.6 to 6.7) Inclusion: diagnosis of FM (ACR) Exclusion: history of severe trauma, frequent migraines, peripheral nerve entrapment, inflammatory rheumatic diseases, severe psychiatric illness, other diseases that prevent physical loading and pregnancy, attendance at another psychological or physical therapy or regular physical exercise with more than one exercise session of 30 minutes per week during a 2-week period in the last 5 years Years since onset of disease/symptoms (years ± SD): 20.1 (8) for the exercise group and 19.4 (6.9) control

Interventions	**a) Aquatic mixed (aerobic-strength):** (33 ºC) (n = 15) **F**REQUENCY: 3 times per week; **D**URATION: total 60 minutes in waist deep warm water. Aerobic: 20 minutes; **I**NTENSITY: light to moderate 60% to 65% HR_{max}; **M**ODE: walking; Strength and flexibility; **D**URATION: 20 minutes; **I**NTENSITY: 4 x 10 repetitions for each exercise - "light loads"; **M**ODE: lower extremity against water resistance, raising arms with light loads and elastic bands **b) FM control:** (n = 15). The control group continued to follow normal daily activities, and did not perform any from of exercise, as those in the exercise group
Outcomes	Pain, fatigue, morning tiredness, stiffness, tender points, health-related quality of life, physical function, cardiovascular maximum oxygen uptake, strength, endurance, flexibility, balance, anxiety, depression Measurements at: pre-post 32 weeks
Congruence with ACSM guidelines for aerobic training (yes/no)	No - only 20 minutes, 3 times per week
Injuries, exacerbations, other adverse effects	No injuries, exacerbations or other adverse effects specified
Notes	Country: Spain Funding sources/declaration of interest: study co-financed by the Regional Government of Extremadura and the Health Department (pg 251)

Risk of bias ***Risk of bias***

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	"Every two patients were randomized immediately after the physician had clinically examined them and checked they did not meet any of the exclusion criteria" pg 249 "the randomization was done by drawing the names from a bag" pg 99, with even numbers drawn assigned to one group and odd numbers drawn assigned to another group "all patients were randomized pairwise into two groups" pg 1148
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias)	Unclear risk	"This was done to ensure that neither researchers nor participants were able to choose the group influenced by their preferences" pg 249 and 1148. Nevertheless, we judged the risk of bias due to lack of

Tomas-Carus 2008 (*Continued*)

		blinding of participants and care providers to be unclear in this study (*Cochrane Handbook for Systematic Reviews of Interventions* 8.5)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Assessment was done by an assistant who was blinded to the patient's condition, group assignment in the trial and results in other test and evaluations" pg 249
Incomplete outcome data (attrition bias) All outcomes	Low risk	Drop-outs specified - no missing outcome data
Selective reporting (reporting bias)	High risk	Not all the prespecified primary outcomes have been reported
Other bias	Unclear risk	There is incongruence of data among primary and companion articles, i.e., randomization, inclusion of upper extremities exercises Conflict of interest: statement provided (study was funded by grants from government and health department)

AE: aerobic
ACR: American College of Rheumatology
AROM: active range of motion
CP: conventional physiotherapy
DWR: deep water running
ESR erythrocyte sedimentation rate
FIQ: Fibromyalgia Impact Questionnaire
FM: fibromyalgia
FMS: fibromyalgia syndrome
HT: hydrotherapy
ITT: intention-to-treat
LBE: land-based exercise
LOCF: last observation carried forward
n/a: not applicable
ROM: range of motion
SD: standard deviation
TP: tender point

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Ahlgren 2001	Diagnosis - trapezius myalgia
Alentorn-Geli 2009	This study does not provide data on outcomes used in this review - focus is on serum insulin-like growth factor
Astin 2003	Did not meet exercise criteria (Qi Gong)
Bailey 1999	Not a RCT (1 group design)
Bakker 1995	Between-group analysis not done
Carbonell-Baeza 2011	Protocol - no data
Carbonell-Baeza 2012	A study proposal (no data)
Casanueva-Fernandez 2012	Insufficient exercise component (treadmill 5 minutes, cycle ergometer 5 minutes, 1/week, 8 weeks)
Castro-Sanchez 2011	Did not meet exercise criteria
Dal 2011	Not a RCT
daSilva 2007	This study did not present data allowing isolation of effects of physical activity - focus of study was on a manipulative intervention called Tui Na
Dawson 2003	Not a RCT; a 1-group before-after design
Finset 2004	This report did not provide data for parallel groups
Gandhi 2000	Not a RCT; 3-group design: (1) non-exercising control (n = 12), (2) hospital-based exercise group (n = 10), (3) home-based videotaped exercise program (n = 10)
Geel 2002	Not a RCT
Gowans 2002	Examines measurement issues of selected variables already reported in an included study
Gowans 2004	This report describes an uncontrolled follow-up of a physical activity intervention
Guarino 2001	Diagnosis - Gulf War Syndrome
Han 1998	Not a RCT (geographic control)
Hoeger 2011	Not a RCT
Huyser 1997	Not a RCT

(*Continued*)

Jones 2011	Not a RCT (commentary)
Kadetoff 2010	Not a RCT
Karper 2001	Not a RCT (program evaluation)
Kendall 2000	Did not meet exercise criteria (body awareness)
Kesiktas 2011	Not a RCT
Khalsa 2009	Not a RCT
Kingsley 2005	Diagnosis of FMS made by physician or rheumatologist but when contacted, the authors did not verify the use of published criteria (e.g., ACR 1990 classification)
Kingsley 2010	Not a RCT (1-group before-after)
Klug 1989	Not a RCT (topical review)
Lange 2011	Not randomized
Lorig 2008	Internet ASMP web-based instruction. Content includes exercise design but no explanation is given
Mannerkorpi 2002	Not a RCT
Mason 1998	Not randomized (participants enrolled in a multimodal treatment compared to participants who were unable to participate due to insurance reasons)
Matsumoto 2011	Data for FM not isolated
McCain 1986	This study appears to present preliminary results of the McCain 1988 study and was therefore excluded
Meiworm 2000	Not randomized (participants self selected their group)
Meyer 2000	Problem with implementation of study design - randomization lost
Mobily 2001	Not a RCT (a case study)
Mutlu 2013	Study compared exercise + TENS with exercise; effects of exercise cannot be isolated in this RCT
Newcomb 2011	Not an intervention study (acute effects of exercise)
Nielens 2000	Not randomized (cross-sectional case control study of fitness)
Nijs 2004	Not a RCT (review article)
Offenbacher 2000	Non-experimental - narrative review

(*Continued*)

Oncel 1994	Insufficient description of exercise (1 group received "medical therapy and exercise"; no further information about the exercise intervention given)
Peters 2002	Diagnosis - persistent unexplained symptoms
Pfeiffer 2003	Not a RCT (1-group before-after design)
Piso 2001	Not randomized - our translator reported: "The authors wrote only how they recruited nine of the patients. They wrote nothing about if and how the patients were allocated to the two groups." We were unsuccessful in several attempts to contact the authors for clarification
Rooks 2002	Not a RCT (1-group design)
Salek 2005	Assignment to groups was not randomized (CCT)
Santana 2010	Could not confirm that diagnosis was made using published criteria
Sigl-Erkel 2011	A commentary on research by other investigators
Suman 2009	Not a RCT (1-group before-after design)
Thieme 2003	Did not meet exercise criteria (passive PT with light movement in water - the active exercise was too small a component, not described or quantified sufficiently)
Thijssen 1992	Not a RCT (1 group only)
Tiidus 1997	Not a RCT (1 group repeated measures design)
Uhlemann 2007	Not a RCT (cross over design - no parallel data reported)
Vlaeyen 1996	Insufficient description of the mode of exercise. "Each session ended with a physical exercise such as swimming or bicycling, excluding systematic physical or fitness training."
Williams 2010	This study did not present data allowing isolation of effects of physical activity - focuses on a web-based management system to increase adherence
Worrel 2001	Not a RCT (1-group design)
Zijlstra 2005	Assignment to groups was not randomized (CCT)

ACR: American College of Rheumatology
ASMP: arthritis self management program
CCT: controlled clinical trial
FMS: fibromyalgia syndrome
PT: physical therapy
RCT: randomized controlled trial

TENS: transcutaneous electrical nerve stimulation

Characteristics of studies awaiting assessment *[ordered by study ID]*

Amanollahi 2013

Methods	RCT
Participants	129 female patients with the diagnosis of primary fibromyalgia
Interventions	3 group = ibuprofen; massage; stretching
Outcomes	Pain
Translation required?	Yes
Full-text article available?	Yes
Notes	Article published in Farsi (Iran)

Aslan 2001

Methods	RCT
Participants	14 patients with FM
Interventions	Classical massage combined with superficial heating and exercise
Outcomes	Visual analog scale (VAS), number of trigger points and Neck Pain and Disability (NPAD) VAS
Translation required?	When full text is available
Full-text article available?	No, not yet found
Notes	Turkish

Ekici 2008

Methods	RCT
Participants	51 women with FM (ACR 1990)
Interventions	Pilates, connective tissue massage
Outcomes	Pain, depression
Translation required?	Yes

Ekici 2008 (*Continued*)

Full-text article available?	Yes
Notes	Turkish

Gomes da Silva 2008

Methods	2 groups
Participants	10 participants divided into 2 groups
Interventions	Hydrotherapy and TENS
Outcomes	Flexibility, pain, health-related quality of life, depression
Translation required?	Yes
Full-text article available?	Yes
Notes	Waiting for translation

López-Rodríguez 2012

Methods	RCT - 2 groups, 12 weeks
Participants	FMS women, (N = 39)
Interventions	AQ AE + dance; FX
Outcomes	Pain (McGill, VAS), tender points, depression, FIQ total
Translation required?	
Full-text article available?	
Notes	Will be included in next update

ACR: American College of Rheumatology
AE: aerobic
AQ: aquatic
FM: fibromyalgia
FX: flexibility
RCT: randomized controlled trial
TENS: transcutaneous electrical nerve stimulation

DATA AND ANALYSES

Comparison 1. Aquatic versus control (sensitivity analysis)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function	7	367	Mean Difference (IV, Random, 95% CI)	-5.97 [-9.06, -2.88]
2 Self reported physical function	5	285	Mean Difference (IV, Random, 95% CI)	-4.35 [-7.77, -0.94]
3 Pain	7	382	Mean Difference (IV, Random, 95% CI)	-6.59 [-10.71, -2.48]
4 Stiffness	4	230	Mean Difference (IV, Random, 95% CI)	-18.34 [-35.75, -0.93]
5 Muscle strength	4	152	Std. Mean Difference (IV, Random, 95% CI)	0.63 [0.20, 1.05]
6 Submaximal cardiorespiratory	3	194	Mean Difference (IV, Random, 95% CI)	37.03 [4.14, 69.92]
7 Patient-rated global	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
8 Mental health	4	243	Mean Difference (IV, Random, 95% CI)	-3.03 [-8.06, 2.01]
9 Clinician-rated global	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
10 Self efficacy	2	88	Mean Difference (IV, Random, 95% CI)	9.54 [-3.39, 22.46]
11 Fatigue	6	329	Std. Mean Difference (IV, Random, 95% CI)	-0.31 [-0.75, 0.13]
12 Tenderness	7	368	Std. Mean Difference (IV, Random, 95% CI)	-0.47 [-0.80, -0.13]
13 Depression	7	362	Std. Mean Difference (IV, Random, 95% CI)	-0.45 [-0.82, -0.08]
14 Flexibility	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
15 Sleep	2	104	Std. Mean Difference (IV, Random, 95% CI)	-0.63 [-1.12, -0.14]
16 Anxiety	7	374	Std. Mean Difference (IV, Random, 95% CI)	-0.57 [-0.95, -0.19]
17 Dyscognition	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
18 Maximal cardiorespiratory function	2	64	Std. Mean Difference (IV, Random, 95% CI)	0.23 [-1.00, 1.47]
19 Muscle endurance	3	162	Std. Mean Difference (IV, Random, 95% CI)	-.00 [-0.67, 0.67]
20 Withdrawals	8	484	Risk Ratio (M-H, Random, 95% CI)	1.13 [0.73, 1.77]

Comparison 2. Aquatic versus land-based

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
2 Self Reported Physical Function	2	74	Mean Difference (IV, Fixed, 95% CI)	-5.85 [-12.33, 0.63]
3 Pain	4	169	Mean Difference (IV, Random, 95% CI)	-0.75 [-10.72, 9.23]
4 Tenderness	1		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
5 Fatigue	4	169	Std. Mean Difference (IV, Random, 95% CI)	-0.13 [-0.70, 0.45]
6 Stiffness	1		Std. Mean Difference (IV, Fixed, 95% CI)	Totals not selected
7 Muscle strength	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
8 Muscle endurance	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
9 Maximal cardiorespiratory function	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
10 Submaximal cardiorespiratory function	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

11 Mental health	2	74	Std. Mean Difference (IV, Random, 95% CI)	-0.08 [-0.54, 0.38]
12 Sleep	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
13 Depression	2	95	Std. Mean Difference (IV, Random, 95% CI)	-0.11 [-0.88, 0.67]
14 Anxiety	1		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
15 Withdrawals	4		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
15.1 AQ versus land	4	217	Risk Ratio (M-H, Fixed, 95% CI)	0.91 [0.43, 1.91]

Comparison 3. Aquatic versus aquatic

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function	2		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
2 Self reported physical function	1		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
3 Pain	2		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
4 Tenderness	2		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
5 Fatigue	2		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
6 Stiffness	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
7 Sleep	2		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
8 Depression	2		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
9 Anxiety	1		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
10 Mental health	2		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
11 Withdrawals	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only

Comparison 4. Subgroup analysis: age - younger versus older

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (younger versus older)	5	279	Std. Mean Difference (IV, Fixed, 95% CI)	-0.50 [-0.74, -0.26]
1.1 Younger	2	157	Std. Mean Difference (IV, Fixed, 95% CI)	-0.33 [-0.64, -0.01]
1.2 Older	3	122	Std. Mean Difference (IV, Fixed, 95% CI)	-0.75 [-1.12, -0.38]
2 Pain (younger versus older)	6	325	Std. Mean Difference (IV, Fixed, 95% CI)	-0.54 [-0.76, -0.31]
2.1 Younger	3	208	Std. Mean Difference (IV, Fixed, 95% CI)	-0.39 [-0.66, -0.11]
2.2 Older	3	117	Std. Mean Difference (IV, Fixed, 95% CI)	-0.83 [-1.21, -0.45]
3 Strength (younger versus older)	2	64	Std. Mean Difference (IV, Fixed, 95% CI)	1.04 [0.51, 1.57]
3.1 Younger	0	0	Std. Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.2 Older	2	64	Std. Mean Difference (IV, Fixed, 95% CI)	1.04 [0.51, 1.57]

Comparison 5. Subgroup analysis: disease duration (short versus long)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (short versus long duration)	6	321	Std. Mean Difference (IV, Fixed, 95% CI)	-0.47 [-0.70, -0.25]
1.1 Short duration of FM	3	199	Std. Mean Difference (IV, Fixed, 95% CI)	-0.31 [-0.59, -0.03]
1.2 Long duration of FM	3	122	Std. Mean Difference (IV, Fixed, 95% CI)	-0.75 [-1.12, -0.38]
2 Pain (short versus long duration)	5	283	Std. Mean Difference (IV, Fixed, 95% CI)	-0.57 [-0.81, -0.34]
2.1 Short duration of FM	2	166	Std. Mean Difference (IV, Fixed, 95% CI)	-0.41 [-0.72, -0.10]
2.2 Long duration of FM	3	117	Std. Mean Difference (IV, Fixed, 95% CI)	-0.83 [-1.21, -0.45]
3 Strength (short versus long duration)	4	152	Std. Mean Difference (IV, Fixed, 95% CI)	0.60 [0.27, 0.93]
3.1 Short duration of FM	2	88	Std. Mean Difference (IV, Fixed, 95% CI)	0.32 [-0.10, 0.74]
3.2 Long duration of FM	2	64	Std. Mean Difference (IV, Fixed, 95% CI)	1.04 [0.51, 1.57]

Comparison 6. Subgroup analysis: low versus high impact of disease at baseline

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (low versus high disease impact at baseline	5	303	Std. Mean Difference (IV, Fixed, 95% CI)	-0.38 [-0.61, -0.15]
1.1 Low impact at baseline	3	226	Std. Mean Difference (IV, Fixed, 95% CI)	-0.35 [-0.62, -0.09]
1.2 High impact at baseline	2	77	Std. Mean Difference (IV, Fixed, 95% CI)	-0.47 [-0.93, -0.02]
2 Pain (low versus high baseline impact)	4	265	Std. Mean Difference (IV, Random, 95% CI)	-0.51 [-0.87, -0.15]
2.1 Low impact at baseline	3	219	Std. Mean Difference (IV, Random, 95% CI)	-0.61 [-1.04, -0.19]
2.2 High impact at baseline	1	46	Std. Mean Difference (IV, Random, 95% CI)	-0.16 [-0.74, 0.42]
3 Strength (low versus high disease impact at baseline multidimensional function)	2	88	Std. Mean Difference (IV, Fixed, 95% CI)	0.32 [-0.10, 0.74]
3.1 Low impact at baseline	1	58	Std. Mean Difference (IV, Fixed, 95% CI)	0.39 [-0.13, 0.91]
3.2 High impact at baseline	1	30	Std. Mean Difference (IV, Fixed, 95% CI)	0.18 [-0.54, 0.90]

Comparison 7. Subgroup analysis: low versus high baseline pain

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (low versus high baseline pain)	5	225	Std. Mean Difference (IV, Fixed, 95% CI)	-0.71 [-0.99, -0.44]
1.1 Low pain at baseline	2	64	Std. Mean Difference (IV, Fixed, 95% CI)	-1.11 [-1.64, -0.58]
1.2 High pain at baseline	3	161	Std. Mean Difference (IV, Fixed, 95% CI)	-0.57 [-0.89, -0.25]
2 Pain (low versus high baseline pain)	6	273	Std. Mean Difference (IV, Random, 95% CI)	-0.58 [-0.86, -0.31]
2.1 Low baseline pain	3	117	Std. Mean Difference (IV, Random, 95% CI)	-0.60 [-0.98, -0.23]
2.2 High baseline pain	3	156	Std. Mean Difference (IV, Random, 95% CI)	-0.57 [-1.11, -0.03]
3 Strength (low versus high baseline pain)	3	122	Std. Mean Difference (IV, Fixed, 95% CI)	0.71 [0.34, 1.08]
3.1 Low baseline pain	2	64	Std. Mean Difference (IV, Fixed, 95% CI)	1.04 [0.51, 1.57]
3.2 High baseline pain	1	58	Std. Mean Difference (IV, Fixed, 95% CI)	0.39 [-0.13, 0.91]

Comparison 8. Subgroup analysis: length of program

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (length of program)	7	367	Std. Mean Difference (IV, Random, 95% CI)	-0.55 [-0.83, -0.27]
1.1 < 7 weeks	1	31	Std. Mean Difference (IV, Random, 95% CI)	-0.17 [-0.88, 0.53]
1.2 7 to 12 weeks	2	80	Std. Mean Difference (IV, Random, 95% CI)	-0.82 [-1.28, -0.36]
1.3 > 12 weeks	4	256	Std. Mean Difference (IV, Random, 95% CI)	-0.52 [-0.90, -0.14]
2 Pain (length of program)	7	382	Std. Mean Difference (IV, Fixed, 95% CI)	-0.52 [-0.73, -0.32]
2.1 < 7 weeks	0	0	Std. Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
2.2 7 to 12 weeks	3	133	Std. Mean Difference (IV, Fixed, 95% CI)	-0.49 [-0.84, -0.14]
2.3 > 12 weeks	4	249	Std. Mean Difference (IV, Fixed, 95% CI)	-0.54 [-0.80, -0.29]
3 Strength (length of program)	4	152	Std. Mean Difference (IV, Fixed, 95% CI)	0.60 [0.27, 0.93]
3.1 < 7 weeks	1	30	Std. Mean Difference (IV, Fixed, 95% CI)	0.18 [-0.54, 0.90]
3.2 7 to 12 weeks	1	34	Std. Mean Difference (IV, Fixed, 95% CI)	0.93 [0.22, 1.64]
3.3 > 12 weeks	2	88	Std. Mean Difference (IV, Fixed, 95% CI)	0.63 [0.20, 1.06]

Comparison 9. Subgroup analysis: accumulated time in the pool

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (accumulated time in the pool)	7	367	Std. Mean Difference (IV, Fixed, 95% CI)	-0.50 [-0.71, -0.29]
1.1 < 1000 min in pool	2	88	Std. Mean Difference (IV, Fixed, 95% CI)	-0.48 [-0.91, -0.05]
1.2 1000 to 2000 min in pool	2	157	Std. Mean Difference (IV, Fixed, 95% CI)	-0.33 [-0.64, -0.01]
1.3 > 2000 min in pool	3	122	Std. Mean Difference (IV, Fixed, 95% CI)	-0.75 [-1.12, -0.38]
2 Pain (accumulated time in the pool)	7	382	Std. Mean Difference (IV, Random, 95% CI)	-0.53 [-0.76, -0.31]
2.1 < 1000 min in pool	2	110	Std. Mean Difference (IV, Random, 95% CI)	-0.52 [-0.90, -0.13]
2.2 1000 to 2000 min in pool	2	155	Std. Mean Difference (IV, Random, 95% CI)	-0.32 [-0.64, -.00]
2.3 >2000 min in pool	3	117	Std. Mean Difference (IV, Random, 95% CI)	-0.82 [-1.24, -0.41]
3 Strength (accumulated time in the pool)	4	152	Std. Mean Difference (IV, Fixed, 95% CI)	0.60 [0.27, 0.93]
3.1 < 1000 min in pool	2	88	Std. Mean Difference (IV, Fixed, 95% CI)	0.32 [-0.10, 0.74]
3.2 1000 to 2000 min in pool	0	0	Std. Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 > 2000 min in pool	2	64	Std. Mean Difference (IV, Fixed, 95% CI)	1.04 [0.51, 1.57]

Comparison 10. Subgroup analysis: exercise frequency

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (exercise frequency)	7	367	Std. Mean Difference (IV, Fixed, 95% CI)	-0.50 [-0.71, -0.29]
1.1 One pool session per week	2	168	Std. Mean Difference (IV, Fixed, 95% CI)	-0.34 [-0.65, -0.03]
1.2 Three pool sessions per week	5	199	Std. Mean Difference (IV, Fixed, 95% CI)	-0.64 [-0.93, -0.35]
2 Pain (exercise frequency)	6	434	Std. Mean Difference (IV, Random, 95% CI)	-0.51 [-0.73, -0.29]
2.1 One pool session per week	1	218	Std. Mean Difference (IV, Random, 95% CI)	-0.39 [-0.65, -0.12]
2.2 Two pool sessions per week	1	53	Std. Mean Difference (IV, Random, 95% CI)	-0.59 [-1.14, -0.04]
2.3 Three pool sessions per week	4	163	Std. Mean Difference (IV, Random, 95% CI)	-0.63 [-1.08, -0.17]
3 Strength (exercise frequency)	4	152	Std. Mean Difference (IV, Fixed, 95% CI)	0.60 [0.27, 0.93]
3.1 One pool session per week	1	58	Std. Mean Difference (IV, Fixed, 95% CI)	0.39 [-0.13, 0.91]
3.2 Two pool sessions per week	0	0	Std. Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
3.3 Three pool sessions per week	3	94	Std. Mean Difference (IV, Fixed, 95% CI)	0.74 [0.31, 1.16]

Comparison 11. Subgroup analysis: exercise intensity

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (exercise intensity)	7	367	Std. Mean Difference (IV, Random, 95% CI)	-0.55 [-0.83, -0.27]
1.1 Light to moderate intensity	2	76	Std. Mean Difference (IV, Random, 95% CI)	-0.89 [-1.40, -0.38]
1.2 Light to vigorous intensity	1	58	Std. Mean Difference (IV, Random, 95% CI)	-0.39 [-0.92, 0.13]
1.3 Moderate intensity	2	65	Std. Mean Difference (IV, Random, 95% CI)	-0.59 [-1.43, 0.24]
1.4 Self selected intensity	2	168	Std. Mean Difference (IV, Random, 95% CI)	-0.38 [-0.84, 0.07]
2 Pain (exercise intensity)	7	382	Std. Mean Difference (IV, Random, 95% CI)	-0.53 [-0.76, -0.31]
2.1 Very light intensity	1	53	Std. Mean Difference (IV, Random, 95% CI)	-0.59 [-1.14, -0.04]
2.2 Light to moderate intensity	2	76	Std. Mean Difference (IV, Random, 95% CI)	-0.25 [-0.70, 0.20]
2.3 Moderate intensity	1	34	Std. Mean Difference (IV, Random, 95% CI)	-0.82 [-1.53, -0.12]
2.4 Light to vigorous intensity	1	53	Std. Mean Difference (IV, Random, 95% CI)	-1.12 [-1.71, -0.54]
2.5 Self selected intensity	2	166	Std. Mean Difference (IV, Random, 95% CI)	-0.41 [-0.72, -0.10]
3 Strength (exercise intensity)	4	152	Std. Mean Difference (IV, Fixed, 95% CI)	0.60 [0.27, 0.93]
3.1 Light to moderate intensity	1	30	Std. Mean Difference (IV, Fixed, 95% CI)	1.17 [0.39, 1.96]
3.2 Moderate intensity	2	64	Std. Mean Difference (IV, Fixed, 95% CI)	0.56 [0.05, 1.06]
3.3 Self selected intensity	1	58	Std. Mean Difference (IV, Fixed, 95% CI)	0.39 [-0.13, 0.91]

Comparison 12. Subgroup analysis: pool temperature - cool, temperate, warm

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Multidimensional function (pool temperature)	7	367	Std. Mean Difference (IV, Random, 95% CI)	-0.55 [-0.83, -0.27]
1.1 Cool (27 to 32 degrees Celsius)	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 Temperate (33 to 36 degrees Celsius)	5	290	Std. Mean Difference (IV, Random, 95% CI)	-0.60 [-0.97, -0.24]
1.3 Warm (> 36 degrees Celsius)	2	77	Std. Mean Difference (IV, Random, 95% CI)	-0.47 [-0.96, 0.03]
2 Pain (pool temperature)	7	382	Std. Mean Difference (IV, Fixed, 95% CI)	-0.52 [-0.73, -0.32]
2.1 Cool (< 33 degrees Celsius)	1	53	Std. Mean Difference (IV, Fixed, 95% CI)	-0.59 [-1.14, -0.04]
2.2 Temperate (33 to 36 degrees Celsius)	5	283	Std. Mean Difference (IV, Fixed, 95% CI)	-0.57 [-0.81, -0.34]
2.3 Warm pool (> 36 degrees Celsius)	1	46	Std. Mean Difference (IV, Fixed, 95% CI)	-0.16 [-0.74, 0.42]
3 Strength (pool temperature)	4	152	Std. Mean Difference (IV, Fixed, 95% CI)	0.60 [0.27, 0.93]
3.1 Temperate (33 to 36 degrees Celsius)	3	122	Std. Mean Difference (IV, Fixed, 95% CI)	0.71 [0.34, 1.08]

3.2 Warm (> 36 degrees Celsius)	1	30	Std. Mean Difference (IV, Fixed, 95% CI)	0.18 [-0.54, 0.90]

Analysis 1.1. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 1 Multidimensional function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

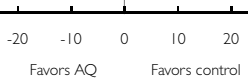
Outcome: 1 Multidimensional function

Study or subgroup	Aquatics N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Altan 2004	24	-14.29 (11.88)	22	-7.3 (7.47)		14.6 %	-6.99 [-12.68, -1.30]
Gowans 2001	15	-2.4 (8.21)	16	-1 (7.62)		14.8 %	-1.40 [-6.99, 4.19]
Gusi 2006	17	-11 (12.36)	17	1 (10.47)		10.3 %	-12.00 [-19.70, -4.30]
Mannerkorpi 2000	28	-9 (13)	29	0 (14)		11.6 %	-9.00 [-16.01, -1.99]
Mannerkorpi 2009	57	-3.39 (11.49)	54	-1.38 (9.86)		19.5 %	-2.01 [-5.99, 1.97]
Munguia-Izquierdo 2007	34	-4.8 (9.81)	24	-0.9 (9.74)		16.1 %	-3.90 [-9.00, 1.20]
Tomas-Carus 2008	15	-9 (9.633)	15	2 (7.81)		13.1 %	-11.00 [-17.28, -4.72]
Total (95% CI)	**190**		**177**			**100.0 %**	**-5.97 [-9.06, -2.88]**

Heterogeneity: $Tau^2 = 8.67$; $Chi^2 = 12.28$, df = 6 (P = 0.06); $I^2 = 51\%$

Test for overall effect: Z = 3.79 (P = 0.00015)

Test for subgroup differences: Not applicable



Analysis 1.2. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 2 Self reported physical function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 2 Self reported physical function

Study or subgroup	Aquatics N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Arcos-Carmona 2011	27	-5.56 (5.32)	26	-2.36 (4.03)		37.6 %	-3.20 [-5.74, -0.66]
Gusi 2006	17	-12 (13.4)	17	-11 (10.8)		12.7 %	-1.00 [-9.18, 7.18]
Mannerkorpi 2000	28	-9 (16)	29	4 (13)		14.2 %	-13.00 [-20.58, -5.42]
Mannerkorpi 2009	57	-0.84 (14.93)	54	0.9 (13.3)		22.3 %	-1.74 [-6.99, 3.51]
Tomas-Carus 2008	15	-6 (10.3)	15	0 (12)		13.1 %	-6.00 [-14.00, 2.00]
Total (95% CI)	**144**		**141**			**100.0 %**	**-4.35 [-7.77, -0.94]**

Heterogeneity: $Tau^2 = 6.39$; $Chi^2 = 7.20$, df = 4 (P = 0.13); $I^2 = 44\%$

Test for overall effect: Z = 2.50 (P = 0.012)

Test for subgroup differences: Not applicable

Analysis 1.3. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 3 Pain.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

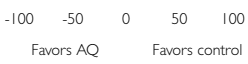
Outcome: 3 Pain

Study or subgroup	Aquatics N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Altan 2004	24	-21 (16.5)	22	-18.7 (11)		13.3 %	-2.30 [-10.34, 5.74]
Arcos-Carmona 2011	27	-2.81 (3.86)	26	-0.58 (3.6)		25.5 %	-2.23 [-4.24, -0.22]
Gusi 2006	17	-18.4 (27.55)	17	1 (17.24)		5.6 %	-19.40 [-34.85, -3.95]
Mannerkorpi 2000	28	-12 (23)	29	-2 (21)		8.8 %	-10.00 [-21.45, 1.45]
Mannerkorpi 2009	57	-4.85 (12.9)	52	-0.02 (11.86)		20.2 %	-4.83 [-9.48, -0.18]
Munguia-Izquierdo 2007	29	-11.4 (11.1)	24	3.3 (14.8)		14.9 %	-14.70 [-21.87, -7.53]
Tomas-Carus 2008	15	-3 (11.46)	15	2 (13.8)		11.7 %	-5.00 [-14.08, 4.08]
Total (95% CI)	**197**		**185**			**100.0 %**	**-6.59 [-10.71, -2.48]**

Heterogeneity: $Tau^2 = 16.27$; $Chi^2 = 16.66$, df = 6 (P = 0.01); $I^2 = 64\%$

Test for overall effect: Z = 3.14 (P = 0.0017)

Test for subgroup differences: Not applicable



Analysis 1.4. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 4 Stiffness.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

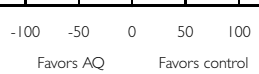
Outcome: 4 Stiffness

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Gusi 2006	17	-26 (15)	17	3 (16.2)		24.9 %	-29.00 [-39.50, -18.50]
Mannerkorpi 2000	28	-14 (23)	29	-2 (22)		24.4 %	-12.00 [-23.69, -0.31]
Mannerkorpi 2009	57	-0.25 (17.09)	52	-0.29 (12.84)		26.6 %	0.04 [-5.60, 5.68]
Tomas-Carus 2008	15	-20 (15)	15	14 (18.83)		24.1 %	-34.00 [-46.18, -21.82]
Total (95% CI)	**117**		**113**			**100.0 %**	**-18.34 [-35.75, -0.93]**

Heterogeneity: Tau^2 = 288.30; Chi^2 = 39.68, df = 3 (P<0.00001); I^2 =92%

Test for overall effect: Z = 2.06 (P = 0.039)

Test for subgroup differences: Not applicable



Analysis 1.5. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 5 Muscle strength.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 5 Muscle strength

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Gowans 2001	15	12.3 (26.36)	15	7.8 (21.61)		23.0 %	0.18 [-0.54, 0.90]
Gusi 2006	17	0.2 (0.21)	17	0 (0.21)		23.2 %	0.93 [0.22, 1.64]
Mannerkorpi 2000	28	20 (54.4)	30	-3 (61.9)		33.3 %	0.39 [-0.13, 0.91]
Tomas-Carus 2008	15	6.3 (7.16)	15	-3.9 (9.59)		20.4 %	1.17 [0.39, 1.96]
Total (95% CI)	**75**		**77**			**100.0 %**	**0.63 [0.20, 1.05]**

Heterogeneity: $Tau^2 = 0.07$; $Chi^2 = 4.82$, df = 3 (P = 0.19); $I^2 = 38\%$

Test for overall effect: Z = 2.89 (P = 0.0039)

Test for subgroup differences: Not applicable

Analysis 1.6. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 6 Submaximal cardiorespiratory.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 6 Submaximal cardiorespiratory

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Gowans 2001	15	33.9 (64.99)	16	-17.7 (65.55)		24.0 %	51.60 [5.63, 97.57]
Mannerkorpi 2000	28	39.6 (44.7)	29	-15.2 (44.5)		37.0 %	54.80 [31.64, 77.96]
Mannerkorpi 2009	52	9.14 (49.57)	54	-2 (54.46)		38.9 %	11.14 [-8.67, 30.95]
Total (95% CI)	**95**		**99**			**100.0 %**	**37.03 [4.14, 69.92]**

Heterogeneity: $Tau^2 = 621.06$; $Chi^2 = 8.68$, df = 2 (P = 0.01); $I^2 = 77\%$

Test for overall effect: Z = 2.21 (P = 0.027)

Test for subgroup differences: Not applicable

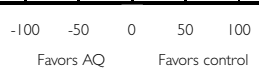
Analysis 1.7. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 7 Patient-rated global.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 7 Patient-rated global

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Altan 2004	24	-2.42 (1.73)	22	-1.55 (1.28)		-0.87 [-1.74, 0.00]



Analysis 1.8. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 8 Mental health.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 8 Mental health

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Arcos-Carmona 2011	27	-0.11 (5.81)	26	-0.19 (5.35)		34.1 %	0.08 [-2.93, 3.09]
Gusi 2006	17	-18 (13.41)	17	-1 (14.4)		16.6 %	-17.00 [-26.35, -7.65]
Mannerkorpi 2000	28	3.3 (18.6)	29	3.5 (18.9)		15.8 %	-0.20 [-9.94, 9.54]
Mannerkorpi 2009	51	1.45 (8.66)	48	2.06 (7.54)		33.5 %	-0.61 [-3.80, 2.58]
Total (95% CI)	**123**		**120**			**100.0 %**	**-3.03 [-8.06, 2.01]**

Heterogeneity: $Tau^2 = 17.01$; $Chi^2 = 11.81$, df = 3 (P = 0.01); $I^2 = 75\%$

Test for overall effect: Z = 1.18 (P = 0.24)

Test for subgroup differences: Not applicable

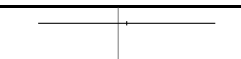
Analysis 1.9. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 9 Clinician-rated global.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 9 Clinician-rated global

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Altan 2004	24	-2.83 (1.68)	22	-2.91 (1.17)		0.08 [-0.75, 0.91]



Analysis 1.10. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 10 Self efficacy.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 10 Self efficacy

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Gowans 2001	15	6 (13.66)	16	-10.4 (17.16)		48.0 %	16.40 [5.51, 27.29]
Mannerkorpi 2000	28	3.9 (19.5)	29	0.7 (17.3)		52.0 %	3.20 [-6.38, 12.78]
Total (95% CI)	**43**		**45**			**100.0 %**	**9.54 [-3.39, 22.46]**

Heterogeneity: $Tau^2 = 59.75$; $Chi^2 = 3.18$, df = 1 (P = 0.07); $I^2 = 69\%$

Test for overall effect: Z = 1.45 (P = 0.15)

Test for subgroup differences: Not applicable

Analysis 1.11. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 11 Fatigue.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 11 Fatigue

Study or subgroup	Aquatic		Control		Std. Mean Difference	Weight	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI		IV,Random,95% CI
Altan 2004	24	-2.58 (1.71)	22	-1.23 (1.64)		16.4 %	-0.79 [-1.39, -0.19]
Arcos-Carmona 2011	27	-0.03 (4.29)	26	-0.8 (4.16)		17.4 %	0.18 [-0.36, 0.72]
Gusi 2006	17	-1.5 (1.36)	17	0.3 (1.34)		14.0 %	-1.30 [-2.05, -0.55]
Mannerkorpi 2000	28	-0.9 (1.6)	29	-0.1 (1.9)		17.7 %	-0.45 [-0.97, 0.08]
Mannerkorpi 2009	57	-4.34 (15.18)	52	-3.62 (12.54)		20.2 %	-0.05 [-0.43, 0.32]
Tomas-Carus 2008	15	-0.6 (1.36)	15	-1.2 (1.32)		14.4 %	0.44 [-0.29, 1.16]
Total (95% CI)	**168**		**161**			**100.0 %**	**-0.31 [-0.75, 0.13]**

Heterogeneity: $Tau^2 = 0.21$; $Chi^2 = 18.17$, df = 5 (P = 0.003); $I^2 = 72\%$

Test for overall effect: Z = 1.37 (P = 0.17)

Test for subgroup differences: Not applicable

Analysis 1.12. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 12 Tenderness.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 12 Tenderness

Study or subgroup	Aquatics N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Altan 2004	24	-6.83 (2.35)	22	-5.91 (2.13)		14.4 %	-0.40 [-0.99, 0.18]
Gowans 2001	15	-0.7 (1.56)	16	-0.1 (1.55)		11.9 %	-0.38 [-1.09, 0.34]
Gusi 2006	17	-0.4 (0.73)	17	0.1 (0.92)		12.3 %	-0.59 [-1.28, 0.10]
Mannerkorpi 2000	28	-1.3 (2.15)	30	0.3 (1.44)		15.3 %	-0.87 [-1.41, -0.33]
Mannerkorpi 2009	57	0.01 (1.8)	54	-0.13 (1.92)		19.4 %	0.07 [-0.30, 0.45]
Munguia-Izquierdo 2007	34	-3.9 (3.56)	24	-0.3 (3.49)		15.0 %	-1.01 [-1.56, -0.45]
Tomas-Carus 2008	15	-0.2 (1.58)	15	0.1 (1.14)		11.8 %	-0.21 [-0.93, 0.51]
Total (95% CI)	**190**		**178**			**100.0 %**	**-0.47 [-0.80, -0.13]**

Heterogeneity: $Tau^2 = 0.12$; $Chi^2 = 14.25$, df = 6 (P = 0.03); $I^2 = 58\%$

Test for overall effect: Z = 2.74 (P = 0.0061)

Test for subgroup differences: Not applicable

Analysis 1.13. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 13 Depression.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

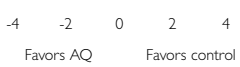
Outcome: 13 Depression

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Altan 2004	24	-4.87 (4.19)	22	-0.64 (3.68)		13.9 %	-1.05 [-1.67, -0.43]
Arcos-Carmona 2011	27	-0.28 (0.37)	26	-0.07 (0.5)		15.2 %	-0.47 [-1.02, 0.07]
Gowans 2001	15	-3.6 (7.77)	16	-0.8 (6.52)		12.4 %	-0.38 [-1.09, 0.33]
Gusi 2006	17	-1.5 (2.21)	17	-0.1 (1.76)		12.6 %	-0.68 [-1.38, 0.01]
Mannerkorpi 2000	28	-0.8 (3.4)	29	-0.3 (2.3)		15.7 %	-0.17 [-0.69, 0.35]
Mannerkorpi 2009	57	0.13 (2.48)	54	-0.35 (2.27)		18.5 %	0.20 [-0.17, 0.57]
Tomas-Carus 2008	15	-1.5 (1.98)	15	0.1 (1.26)		11.6 %	-0.94 [-1.70, -0.18]
Total (95% CI)	**183**		**179**			**100.0 %**	**-0.45 [-0.82, -0.08]**

Heterogeneity: $Tau^2 = 0.16$; $Chi^2 = 17.04$, df = 6 (P = 0.01); $I^2 = 65\%$

Test for overall effect: Z = 2.39 (P = 0.017)

Test for subgroup differences: Not applicable



Analysis 1.14. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 14 Flexibility.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 14 Flexibility

Study or subgroup	Aquatics N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Tomas-Carus 2008	15	0.8 (5.54)	15	-0.7 (4.27)		1.50 [-2.04, 5.04]

Analysis 1.15. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 15 Sleep.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

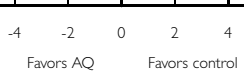
Outcome: 15 Sleep

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Altan 2004	24	-1.08 (1.12)	22	-0.64 (1.21)		47.8 %	-0.37 [-0.96, 0.21]
Munguia-Izquierdo 2007	34	-1.7 (2.67)	24	0.5 (2.24)		52.2 %	-0.87 [-1.41, -0.32]
Total (95% CI)	**58**		**46**			**100.0 %**	**-0.63 [-1.12, -0.14]**

Heterogeneity: $Tau^2 = 0.04$; $Chi^2 = 1.47$, df = 1 (P = 0.22); $I^2 = 32\%$

Test for overall effect: Z = 2.55 (P = 0.011)

Test for subgroup differences: Not applicable



Analysis 1.16. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 16 Anxiety.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

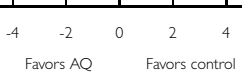
Outcome: 16 Anxiety

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Arcos-Carmona 2011	27	-1.2 (4.33)	26	0 (5.41)		15.4 %	-0.24 [-0.78, 0.30]
Gowans 2001	15	0.6 (9.4)	16	5 (9.36)		12.5 %	-0.46 [-1.17, 0.26]
Gusi 2006	17	-2.5 (1.78)	17	-1.1 (1.64)		12.7 %	-0.80 [-1.50, -0.10]
Mannerkorpi 2000	28	-1.3 (3.1)	29	0.5 (2.6)		15.6 %	-0.62 [-1.15, -0.09]
Mannerkorpi 2009	57	-0.52 (3.33)	54	0.67 (3.12)		18.4 %	-0.37 [-0.74, 0.01]
Munguia-Izquierdo 2007	34	-0.3 (9.22)	24	-0.4 (10.49)		15.7 %	0.01 [-0.51, 0.53]
Tomas-Carus 2008	15	-10.1 (5.94)	15	2.5 (5.41)		9.7 %	-2.16 [-3.08, -1.23]
Total (95% CI)	**193**		**181**			**100.0 %**	**-0.57 [-0.95, -0.19]**

Heterogeneity: $Tau^2 = 0.17$; $Chi^2 = 18.17$, df = 6 (P = 0.01); $I^2 = 67\%$

Test for overall effect: Z = 2.91 (P = 0.0036)

Test for subgroup differences: Not applicable



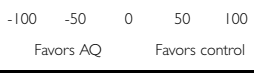
Analysis 1.17. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 17 Dyscognition.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 17 Dyscognition

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Munguia-Izquierdo 2007	34	-5.9 (9.51)	24	-1.2 (8.24)		-4.70 [-9.29, -0.11]



Analysis 1.18. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 18 Maximal cardiorespiratory function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

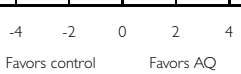
Outcome: 18 Maximal cardiorespiratory function

Study or subgroup	Aquatic		Control		Std. Mean Difference	Weight	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI		IV,Random,95% CI
Gusi 2006	17	0 (2.52)	17	1 (2.52)		50.9 %	-0.39 [-1.07, 0.29]
Tomas-Carus 2008	15	2.9 (2.17)	15	1.1 (1.83)		49.1 %	0.87 [0.12, 1.63]
Total (95% CI)	**32**		**32**			**100.0 %**	**0.23 [-1.00, 1.47]**

Heterogeneity: $Tau^2 = 0.66$; $Chi^2 = 5.92$, df = 1 (P = 0.01); $I^2 = 83\%$

Test for overall effect: Z = 0.37 (P = 0.71)

Test for subgroup differences: Not applicable



Analysis 1.19. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 19 Muscle endurance.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 19 Muscle endurance

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Altan 2004	24	-0.54 (2.29)	22	1.59 (3.42)		32.0 %	-0.73 [-1.32, -0.13]
Mannerkorpi 2000	28	-10 (25.4)	30	-17 (31.5)		34.2 %	0.24 [-0.28, 0.76]
Munguia-Izquierdo 2007	34	23.8 (33.02)	24	9.8 (28.74)		33.9 %	0.44 [-0.09, 0.97]
Total (95% CI)	**86**		**76**			**100.0 %**	**0.00 [-0.67, 0.67]**

Heterogeneity: $Tau^2 = 0.27$; $Chi^2 = 9.06$, df = 2 (P = 0.01); I^2 =78%

Test for overall effect: Z = 0.00 (P = 1.0)

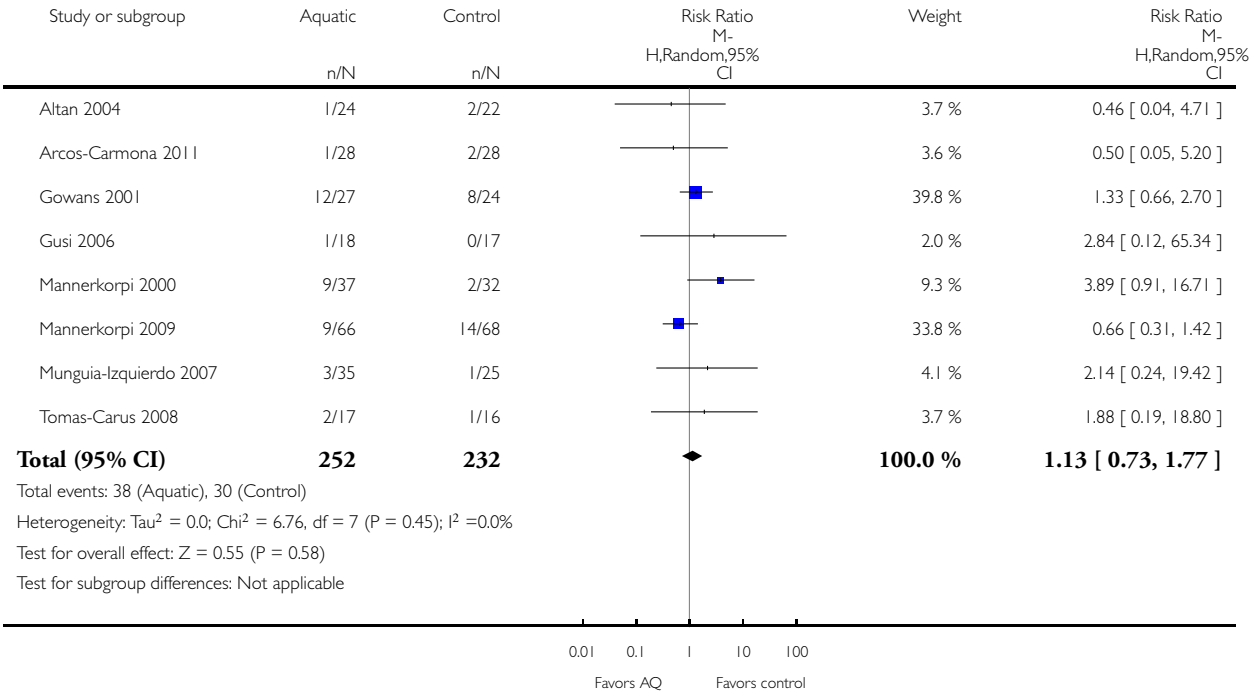
Test for subgroup differences: Not applicable

Analysis 1.20. Comparison 1 Aquatic versus control (sensitivity analysis), Outcome 20 Withdrawals.

Review: Aquatic exercise training for fibromyalgia

Comparison: 1 Aquatic versus control (sensitivity analysis)

Outcome: 20 Withdrawals



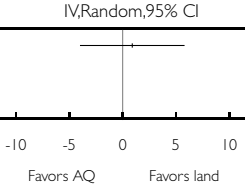
Analysis 2.1. Comparison 2 Aquatic versus land-based, Outcome 1 Multidimensional function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 1 Multidimensional function

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Evcik 2008	31	-7.29 (10.73)	30	-8.2 (8.8)		0.91 [-4.01, 5.83]



Analysis 2.2. Comparison 2 Aquatic versus land-based, Outcome 2 Self Reported Physical Function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

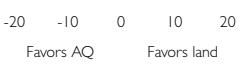
Outcome: 2 Self Reported Physical Function

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
de Melo Vitorino 2006	25	-40.1 (12.21)	25	-32.2 (14.6)		75.5 %	-7.90 [-15.36, -0.44]
Hecker 2011	12	-17.07 (16.06)	12	-17.51 (16.64)		24.5 %	0.44 [-12.64, 13.52]
Total (95% CI)	**37**		**37**			**100.0 %**	**-5.85 [-12.33, 0.63]**

Heterogeneity: $Chi^2 = 1.18$, df = 1 (P = 0.28); $I^2 = 15\%$

Test for overall effect: Z = 1.77 (P = 0.077)

Test for subgroup differences: Not applicable



Analysis 2.3. Comparison 2 Aquatic versus land-based, Outcome 3 Pain.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

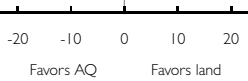
Outcome: 3 Pain

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
de Melo Vitorino 2006	25	-37.3 (9.83)	25	-46.9 (16.81)		25.6 %	9.60 [1.97, 17.23]
Evcik 2008	31	-20 (10.4)	30	-10 (12)		27.4 %	-10.00 [-15.64, -4.36]
Hecker 2011	12	-13.67 (9.34)	12	-17.83 (10.23)		25.4 %	4.16 [-3.68, 12.00]
Jentoft 2001	18	-13 (13.8)	16	-6 (19.2)		21.6 %	-7.00 [-18.36, 4.36]
Total (95% CI)	**86**		**83**			**100.0 %**	**-0.75 [-10.72, 9.23]**

Heterogeneity: $Tau^2 = 86.16$; $Chi^2 = 19.70$, df = 3 (P = 0.00020); $I^2 = 85\%$

Test for overall effect: Z = 0.15 (P = 0.88)

Test for subgroup differences: Not applicable



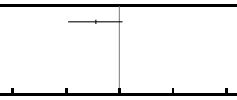
Analysis 2.4. Comparison 2 Aquatic versus land-based, Outcome 4 Tenderness.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 4 Tenderness

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
Evcik 2008	31	-3.8 (3.75)	30	-2.3 (2.76)		-0.45 [-0.96, 0.06]

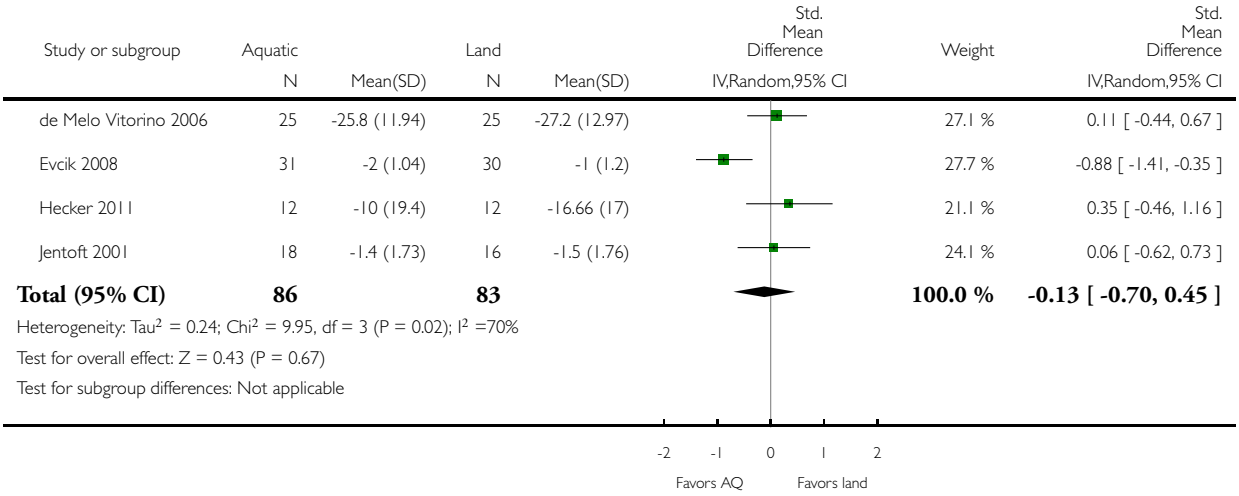


Analysis 2.5. Comparison 2 Aquatic versus land-based, Outcome 5 Fatigue.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 5 Fatigue

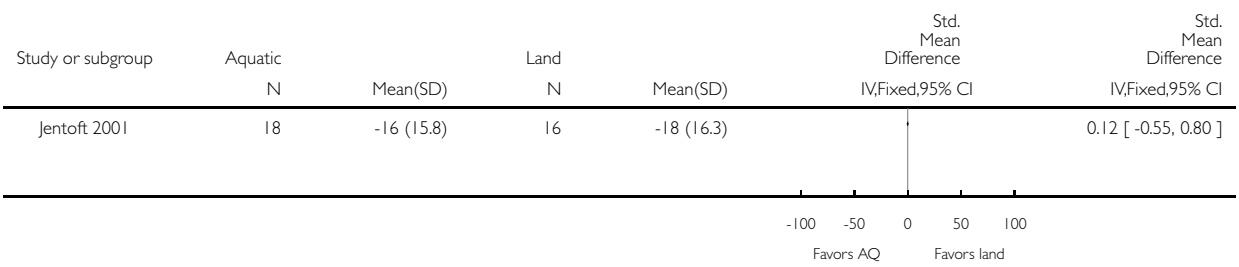


Analysis 2.6. Comparison 2 Aquatic versus land-based, Outcome 6 Stiffness.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 6 Stiffness



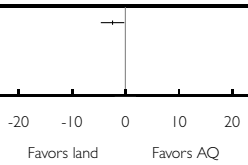
Analysis 2.7. Comparison 2 Aquatic versus land-based, Outcome 7 Muscle strength.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 7 Muscle strength

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Jentoft 2001	18	0.9 (3.3)	16	3.3 (3)		-2.40 [-4.52, -0.28]



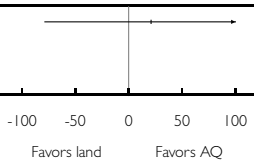
Analysis 2.8. Comparison 2 Aquatic versus land-based, Outcome 8 Muscle endurance.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 8 Muscle endurance

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Jentoft 2001	18	87 (189.94)	16	66 (97.36)		21.00 [-78.88, 120.88]



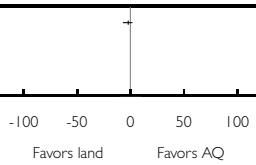
Analysis 2.9. Comparison 2 Aquatic versus land-based, Outcome 9 Maximal cardiorespiratory function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 9 Maximal cardiorespiratory function

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Jentoft 2001	18	3.4 (5.13)	16	5.9 (8.4)		-2.50 [-7.25, 2.25]



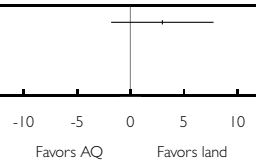
Analysis 2.10. Comparison 2 Aquatic versus land-based, Outcome 10 Submaximal cardiorespiratory function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 10 Submaximal cardiorespiratory function

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
Jentoft 2001	18	-2.6 (4.27)	16	-5.6 (8.86)		3.00 [-1.77, 7.77]



Analysis 2.11. Comparison 2 Aquatic versus land-based, Outcome 11 Mental health.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 11 Mental health

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
de Melo Vitorino 2006	25	26.9 (12.82)	25	28.4 (14.49)		67.5 %	-0.11 [-0.66, 0.45]
Hecker 2011	12	16.34 (15.49)	12	16.67 (14.45)		32.5 %	-0.02 [-0.82, 0.78]
Total (95% CI)	**37**		**37**			**100.0 %**	**-0.08 [-0.54, 0.38]**

Heterogeneity: $Tau^2 = 0.0$; $Chi^2 = 0.03$, df = 1 (P = 0.86); $I^2 = 0.0\%$

Test for overall effect: Z = 0.34 (P = 0.73)

Test for subgroup differences: Not applicable

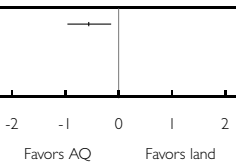
Analysis 2.12. Comparison 2 Aquatic versus land-based, Outcome 12 Sleep.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 12 Sleep

Study or subgroup	Aquatic N	Mean(SD)	Land N	Mean(SD)	Mean Difference IV,Random,95% CI	Mean Difference IV,Random,95% CI
de Melo Vitorino 2006	25	-2.39 (0.71)	25	-1.83 (0.76)		-0.56 [-0.97, -0.15]

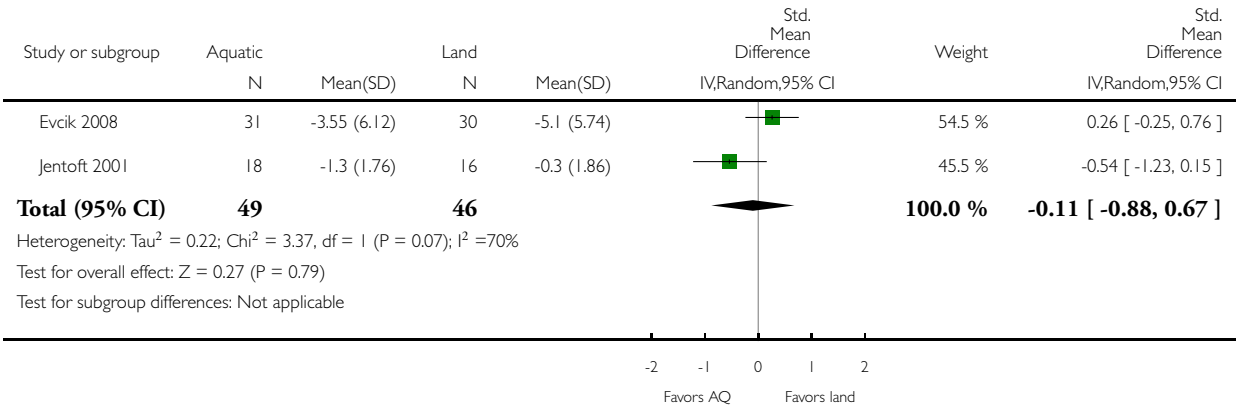


Analysis 2.13. Comparison 2 Aquatic versus land-based, Outcome 13 Depression.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 13 Depression

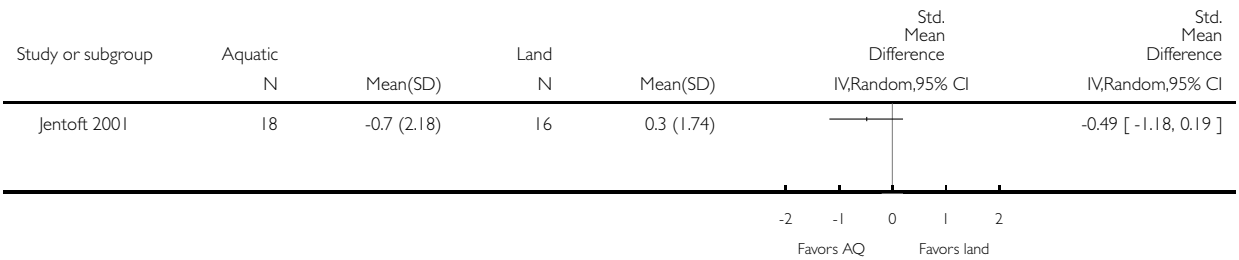


Analysis 2.14. Comparison 2 Aquatic versus land-based, Outcome 14 Anxiety.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 14 Anxiety



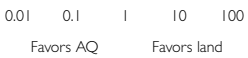
Analysis 2.15. Comparison 2 Aquatic versus land-based, Outcome 15 Withdrawals.

Review: Aquatic exercise training for fibromyalgia

Comparison: 2 Aquatic versus land-based

Outcome: 15 Withdrawals

Study or subgroup	Aquatic n/N	Land n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 AQ versus land					
Assis 2006	4/30	4/30		31.9 %	1.00 [0.28, 3.63]
de Melo Vitorino 2006	1/25	2/25		16.0 %	0.50 [0.05, 5.17]
Evcik 2008	2/33	0/30		4.2 %	4.56 [0.23, 91.30]
Jentoft 2001	4/22	6/22		47.9 %	0.67 [0.22, 2.04]
Subtotal (95% CI)	**110**	**107**		**100.0 %**	**0.91 [0.43, 1.91]**
Total events: 11 (Aquatic), 12 (Land)					
Heterogeneity: Chi^2 = 1.68, df = 3 (P = 0.64); I^2 =0.0%					
Test for overall effect: Z = 0.25 (P = 0.80)					
Test for subgroup differences: Not applicable					



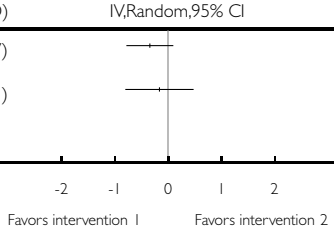
Analysis 3.1. Comparison 3 Aquatic versus aquatic, Outcome 1 Multidimensional function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 1 Multidimensional function

Study or subgroup	Aquatic N	Mean(SD)	Aquatic (other) N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
Calandre 2010	42	-6.8 (9.97)	39	-3.5 (8.57)		-0.35 [-0.79, 0.09]
De Andrade 2008	19	38.7 (10.9)	19	40.6 (11.1)		-0.17 [-0.81, 0.47]



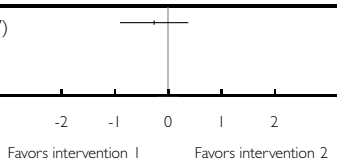
Analysis 3.2. Comparison 3 Aquatic versus aquatic, Outcome 2 Self reported physical function.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 2 Self reported physical function

Study or subgroup	Aquatic N	Mean(SD)	Aquatic (other) N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
De Andrade 2008	19	10.3 (7.7)	19	12.2 (6.7)		-0.26 [-0.90, 0.38]



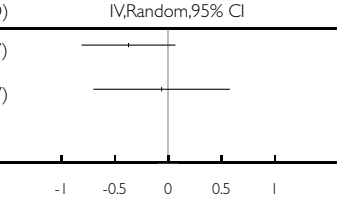
Analysis 3.3. Comparison 3 Aquatic versus aquatic, Outcome 3 Pain.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 3 Pain

Study or subgroup	Aquatic N	Mean(SD)	Aquatic (other) N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
Calandre 2010	42	-1 (1.38)	39	-0.5 (1.27)		-0.37 [-0.81, 0.07]
De Andrade 2008	19	3.6 (1.6)	19	3.7 (1.7)		-0.06 [-0.70, 0.58]



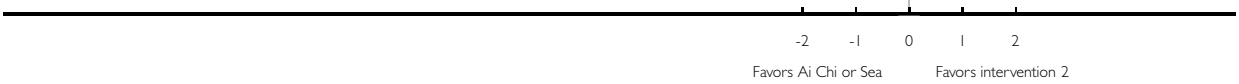
Analysis 3.4. Comparison 3 Aquatic versus aquatic, Outcome 4 Tenderness.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 4 Tenderness

Study or subgroup	Aquatic		Aquatic (other)		Std. Mean Difference	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI	IV,Random,95% CI
Calandre 2010	42	-0.5 (2.26)	39	-0.8 (1.92)		0.14 [-0.30, 0.58]
De Andrade 2008	19	3.9 (1.7)	19	4.6 (1.9)		-0.38 [-1.02, 0.26]



Analysis 3.5. Comparison 3 Aquatic versus aquatic, Outcome 5 Fatigue.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 5 Fatigue

Study or subgroup	Aquatic		Aquatic (other)		Std. Mean Difference	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI	IV,Random,95% CI
Calandre 2010	42	-0.9 (1.61)	39	-0.3 (1.21)		-0.42 [-0.86, 0.03]
De Andrade 2008	19	4.3 (1.5)	19	4.7 (1.9)		-0.23 [-0.87, 0.41]

Analysis 3.6. Comparison 3 Aquatic versus aquatic, Outcome 6 Stiffness.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 6 Stiffness

Study or subgroup	Aquatic		Aquatic (other)		Mean Difference	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI	IV,Random,95% CI
Calandre 2010	42	-1.4 (1.68)	39	-0.4 (1.51)		-1.00 [-1.69, -0.31]

Analysis 3.7. Comparison 3 Aquatic versus aquatic, Outcome 7 Sleep.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 7 Sleep

Study or subgroup	Aquatic		Aquatic (other)		Std. Mean Difference	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI	IV,Random,95% CI
Calandre 2010	42	-2.5 (2.98)	39	-1.2 (2.71)		-0.45 [-0.89, -0.01]
De Andrade 2008	19	7.4 (3.3)	19	7.6 (2.9)		-0.06 [-0.70, 0.57]

Analysis 3.8. Comparison 3 Aquatic versus aquatic, Outcome 8 Depression.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 8 Depression

Study or subgroup	Aquatic		Aquatic (other)		Std. Mean Difference	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI	IV,Random,95% CI
Calandre 2010	42	-1.1 (4.05)	39	-1.7 (3.32)		0.16 [-0.28, 0.60]
De Andrade 2008	19	9.1 (4.8)	19	21.2 (7.5)		-1.88 [-2.66, -1.10]

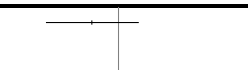
Analysis 3.9. Comparison 3 Aquatic versus aquatic, Outcome 9 Anxiety.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 9 Anxiety

Study or subgroup	Aquatic		Aquatic(other)		Std. Mean Difference	Std. Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Random,95% CI	IV,Random,95% CI
Calandre 2010	42	-2.9 (8.4)	39	-1 (6.77)		-0.25 [-0.68, 0.19]



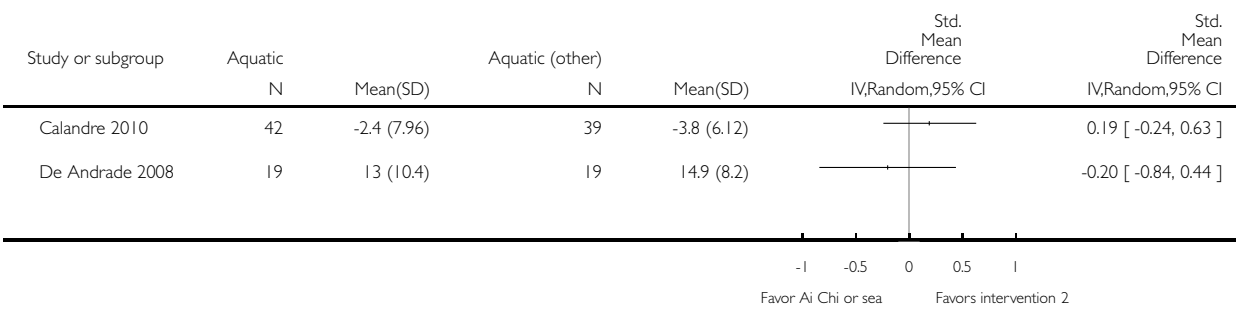
Analysis 3.10. Comparison 3 Aquatic versus aquatic, Outcome 10 Mental health.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 10 Mental health

Study or subgroup	Aquatic N	Mean(SD)	Aquatic (other) N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Std. Mean Difference IV,Random,95% CI
Calandre 2010	42	-2.4 (7.96)	39	-3.8 (6.12)		0.19 [-0.24, 0.63]
De Andrade 2008	19	13 (10.4)	19	14.9 (8.2)		-0.20 [-0.84, 0.44]



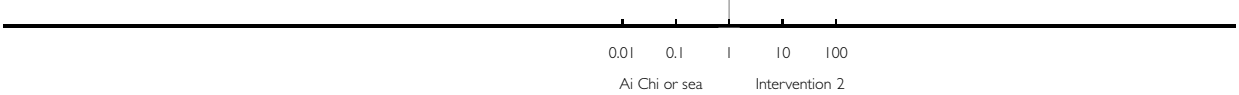
Analysis 3.11. Comparison 3 Aquatic versus aquatic, Outcome 11 Withdrawals.

Review: Aquatic exercise training for fibromyalgia

Comparison: 3 Aquatic versus aquatic

Outcome: 11 Withdrawals

Study or subgroup	Aquatic n/N	Aquatic (other) n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Calandre 2010	10/42	5/39			1.86 [0.70, 4.95]
De Andrade 2008	4/23	4/23			1.00 [0.28, 3.52]
Test for subgroup differences: Not applicable					



Analysis 4.1. Comparison 4 Subgroup analysis: age - younger versus older, Outcome 1 Multidimensional function (younger versus older).

Review: Aquatic exercise training for fibromyalgia

Comparison: 4 Subgroup analysis: age - younger versus older

Outcome: 1 Multidimensional function (younger versus older)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Younger							
Altan 2004	24	-14.29 (11.88)	22	-7.3 (7.47)		16.4 %	-0.69 [-1.28, -0.09]
Mannerkorpi 2009	57	-3.39 (11.49)	54	-1.38 (9.86)		42.0 %	-0.19 [-0.56, 0.19]
Subtotal (95% CI)	**81**		**76**			**58.4 %**	**-0.33 [-0.64, -0.01]**
Heterogeneity: Chi^2 = 1.94, df = 1 (P = 0.16); I^2 =48%							
Test for overall effect: Z = 2.02 (P = 0.043)							
2 Older							
Gusi 2006	17	-11 (12.36)	17	1 (10.47)		11.3 %	-1.02 [-1.74, -0.30]
Munguia-Izquierdo 2007	34	-4.8 (9.81)	24	-0.9 (9.74)		21.0 %	-0.39 [-0.92, 0.13]
Tomas-Carus 2008	15	-9 (9.633)	15	2 (7.81)		9.4 %	-1.22 [-2.01, -0.43]
Subtotal (95% CI)	**66**		**56**			**41.6 %**	**-0.75 [-1.12, -0.38]**
Heterogeneity: Chi^2 = 3.67, df = 2 (P = 0.16); I^2 =46%							
Test for overall effect: Z = 3.93 (P = 0.000087)							
Total (95% CI)	**147**		**132**			**100.0 %**	**-0.50 [-0.74, -0.26]**
Heterogeneity: Chi^2 = 8.48, df = 4 (P = 0.08); I^2 =53%							
Test for overall effect: Z = 4.08 (P = 0.000045)							
Test for subgroup differences: Chi^2 = 2.87, df = 1 (P = 0.09), I^2 =65%							

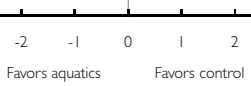
Analysis 4.2. Comparison 4 Subgroup analysis: age - younger versus older, Outcome 2 Pain (younger versus older).

Review: Aquatic exercise training for fibromyalgia

Comparison: 4 Subgroup analysis: age - younger versus older

Outcome: 2 Pain (younger versus older)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Younger							
Altan 2004	24	-21 (16.5)	22	-18.7 (11)		14.8 %	-0.16 [-0.74, 0.42]
Arcos-Carmona 2011	27	-2.81 (3.86)	26	-0.58 (3.6)		16.4 %	-0.59 [-1.14, -0.04]
Mannerkorpi 2009	57	-4.85 (12.9)	52	-0.02 (11.86)		34.6 %	-0.39 [-0.77, -0.01]
Subtotal (95% CI)	**108**		**100**			**65.9 %**	**-0.39 [-0.66, -0.11]**
Heterogeneity: Chi^2 = 1.10, df = 2 (P = 0.58); I^2 =0.0%							
Test for overall effect: Z = 2.75 (P = 0.0060)							
2 Older							
Gusi 2006	17	-18.4 (27.55)	17	1 (17.24)		10.1 %	-0.82 [-1.53, -0.12]
Munguia-Izquierdo 2007	29	-11.4 (11.1)	24	3.3 (14.8)		14.6 %	-1.12 [-1.71, -0.54]
Tomas-Carus 2008	15	-3 (11.46)	15	2 (13.06)		9.5 %	-0.40 [-1.12, 0.33]
Subtotal (95% CI)	**61**		**56**			**34.1 %**	**-0.83 [-1.21, -0.45]**
Heterogeneity: Chi^2 = 2.34, df = 2 (P = 0.31); I^2 =15%							
Test for overall effect: Z = 4.27 (P = 0.000020)							
Total (95% CI)	**169**		**156**			**100.0 %**	**-0.54 [-0.76, -0.31]**
Heterogeneity: Chi^2 = 6.91, df = 5 (P = 0.23); I^2 =28%							
Test for overall effect: Z = 4.73 (P < 0.00001)							
Test for subgroup differences: Chi^2 = 3.46, df = 1 (P = 0.06), I^2 =71%							



Analysis 4.3. Comparison 4 Subgroup analysis: age - younger versus older, Outcome 3 Strength (younger versus older).

Review: Aquatic exercise training for fibromyalgia

Comparison: 4 Subgroup analysis: age - younger versus older

Outcome: 3 Strength (younger versus older)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Younger							
Subtotal (95% CI)	**0**		**0**				**Not estimable**
Heterogeneity: not applicable							
Test for overall effect: not applicable							
2 Older							
Gusi 2006	17	0.2 (0.21)	17	0 (0.21)		54.7 %	0.93 [0.22, 1.64]
Tomas-Carus 2008	15	6.3 (7.16)	15	-3.9 (9.59)		45.3 %	1.17 [0.39, 1.96]
Subtotal (95% CI)	**32**		**32**			**100.0 %**	**1.04 [0.51, 1.57]**
Heterogeneity: Chi^2 = 0.20, df = 1 (P = 0.65); I^2 =0.0%							
Test for overall effect: Z = 3.87 (P = 0.00011)							
Total (95% CI)	**32**		**32**			**100.0 %**	**1.04 [0.51, 1.57]**
Heterogeneity: Chi^2 = 0.20, df = 1 (P = 0.65); I^2 =0.0%							
Test for overall effect: Z = 3.87 (P = 0.00011)							
Test for subgroup differences: Not applicable							

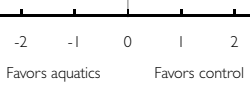
Analysis 5.1. Comparison 5 Subgroup analysis: disease duration (short versus long), Outcome 1 Multidimensional function (short versus long duration).

Review: Aquatic exercise training for fibromyalgia

Comparison: 5 Subgroup analysis: disease duration (short versus long)

Outcome: 1 Multidimensional function (short versus long duration)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Short duration of FM							
Gowans 2001	15	-2.4 (8.21)	16	-1 (7.62)		10.1 %	-0.17 [-0.88, 0.53]
Mannerkorpi 2000	28	-9 (13)	29	0 (14)		17.7 %	-0.66 [-1.19, -0.12]
Mannerkorpi 2009	57	-3.39 (11.49)	54	-1.38 (9.86)		36.3 %	-0.19 [-0.56, 0.19]
Subtotal (95% CI)	**100**		**99**			**64.1 %**	**-0.31 [-0.59, -0.03]**
Heterogeneity: Chi^2 = 2.19, df = 2 (P = 0.33); I^2 =9%							
Test for overall effect: Z = 2.19 (P = 0.028)							
2 Long duration of FM							
Gusi 2006	17	-11 (12.36)	17	1 (10.47)		9.7 %	-1.02 [-1.74, -0.30]
Munguia-Izquierdo 2007	34	-4.8 (9.81)	24	-0.9 (9.74)		18.1 %	-0.39 [-0.92, 0.13]
Tomas-Carus 2008	15	-9 (9.633)	15	2 (7.81)		8.1 %	-1.22 [-2.01, -0.43]
Subtotal (95% CI)	**66**		**56**			**35.9 %**	**-0.75 [-1.12, -0.38]**
Heterogeneity: Chi^2 = 3.67, df = 2 (P = 0.16); I^2 =46%							
Test for overall effect: Z = 3.93 (P = 0.000087)							
Total (95% CI)	**166**		**155**			**100.0 %**	**-0.47 [-0.70, -0.25]**
Heterogeneity: Chi^2 = 9.20, df = 5 (P = 0.10); I^2 =46%							
Test for overall effect: Z = 4.11 (P = 0.000040)							
Test for subgroup differences: Chi^2 = 3.34, df = 1 (P = 0.07), I^2 =70%							



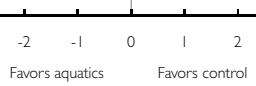
Analysis 5.2. Comparison 5 Subgroup analysis: disease duration (short versus long), Outcome 2 Pain (short versus long duration).

Review: Aquatic exercise training for fibromyalgia

Comparison: 5 Subgroup analysis: disease duration (short versus long)

Outcome: 2 Pain (short versus long duration)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Short duration of FM							
Mannerkorpi 2000	28	-12 (23)	29	-2 (21)		20.7 %	-0.45 [-0.97, 0.08]
Mannerkorpi 2009	57	-4.85 (12.9)	52	-0.02 (11.86)		39.9 %	-0.39 [-0.77, -0.01]
Subtotal (95% CI)	**85**		**81**			**60.6 %**	**-0.41 [-0.72, -0.10]**
Heterogeneity: Chi^2 = 0.03, df = 1 (P = 0.85); I^2 =0.0%							
Test for overall effect: Z = 2.59 (P = 0.0095)							
2 Long duration of FM							
Gusi 2006	17	-18.4 (27.55)	17	1 (17.24)		11.6 %	-0.82 [-1.53, -0.12]
Munguia-Izquierdo 2007	29	-11.4 (11.1)	24	3.3 (14.8)		16.8 %	-1.12 [-1.71, -0.54]
Tomas-Carus 2008	15	-3 (11.46)	15	2 (13.06)		11.0 %	-0.40 [-1.12, 0.33]
Subtotal (95% CI)	**61**		**56**			**39.4 %**	**-0.83 [-1.21, -0.45]**
Heterogeneity: Chi^2 = 2.34, df = 2 (P = 0.31); I^2 =15%							
Test for overall effect: Z = 4.27 (P = 0.000020)							
Total (95% CI)	**146**		**137**			**100.0 %**	**-0.57 [-0.81, -0.34]**
Heterogeneity: Chi^2 = 5.26, df = 4 (P = 0.26); I^2 =24%							
Test for overall effect: Z = 4.70 (P < 0.00001)							
Test for subgroup differences: Chi^2 = 2.88, df = 1 (P = 0.09), I^2 =65%							

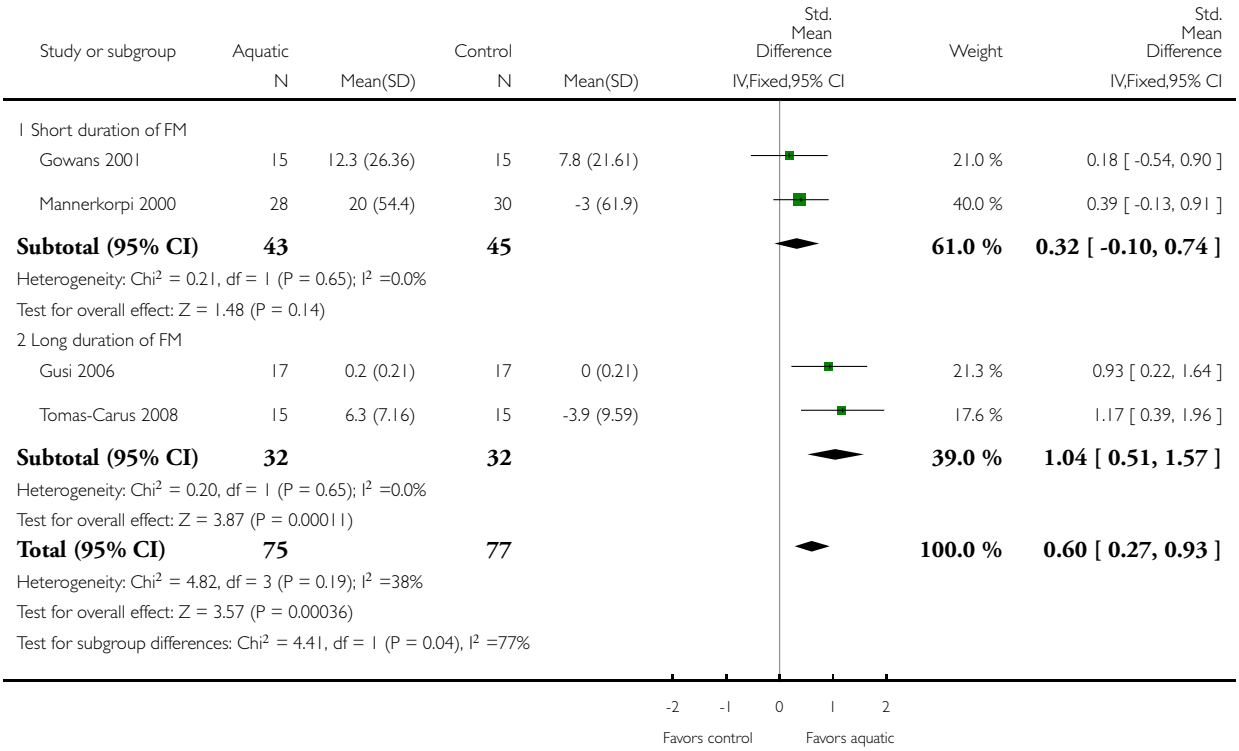


Analysis 5.3. Comparison 5 Subgroup analysis: disease duration (short versus long), Outcome 3 Strength (short versus long duration).

Review: Aquatic exercise training for fibromyalgia

Comparison: 5 Subgroup analysis: disease duration (short versus long)

Outcome: 3 Strength (short versus long duration)



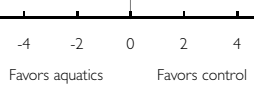
Analysis 6.1. Comparison 6 Subgroup analysis: low versus high impact of disease at baseline, Outcome 1 Multidimensional function (low versus high disease impact at baseline.

Review: Aquatic exercise training for fibromyalgia

Comparison: 6 Subgroup analysis: low versus high impact of disease at baseline

Outcome: 1 Multidimensional function (low versus high disease impact at baseline

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Low impact at baseline							
Mannerkorpi 2000	28	-9 (13)	29	0 (14)		18.4 %	-0.66 [-1.19, -0.12]
Mannerkorpi 2009	57	-3.39 (11.49)	54	-1.38 (9.86)		37.6 %	-0.19 [-0.56, 0.19]
Munguia-Izquierdo 2007	34	-4.8 (9.81)	24	-0.9 (9.74)		18.8 %	-0.39 [-0.92, 0.13]
Subtotal (95% CI)	**119**		**107**			**74.8 %**	**-0.35 [-0.62, -0.09]**
Heterogeneity: Chi^2 = 2.03, df = 2 (P = 0.36); I^2 =2%							
Test for overall effect: Z = 2.62 (P = 0.0088)							
2 High impact at baseline							
Altan 2004	24	-14.29 (11.88)	22	-7.3 (7.47)		14.7 %	-0.69 [-1.28, -0.09]
Gowans 2001	15	-2.4 (8.21)	16	-1 (7.62)		10.5 %	-0.17 [-0.88, 0.53]
Subtotal (95% CI)	**39**		**38**			**25.2 %**	**-0.47 [-0.93, -0.02]**
Heterogeneity: Chi^2 = 1.18, df = 1 (P = 0.28); I^2 =16%							
Test for overall effect: Z = 2.03 (P = 0.043)							
Total (95% CI)	**158**		**145**			**100.0 %**	**-0.38 [-0.61, -0.15]**
Heterogeneity: Chi^2 = 3.41, df = 4 (P = 0.49); I^2 =0.0%							
Test for overall effect: Z = 3.28 (P = 0.0010)							
Test for subgroup differences: Chi^2 = 0.19, df = 1 (P = 0.66), I^2 =0.0%							

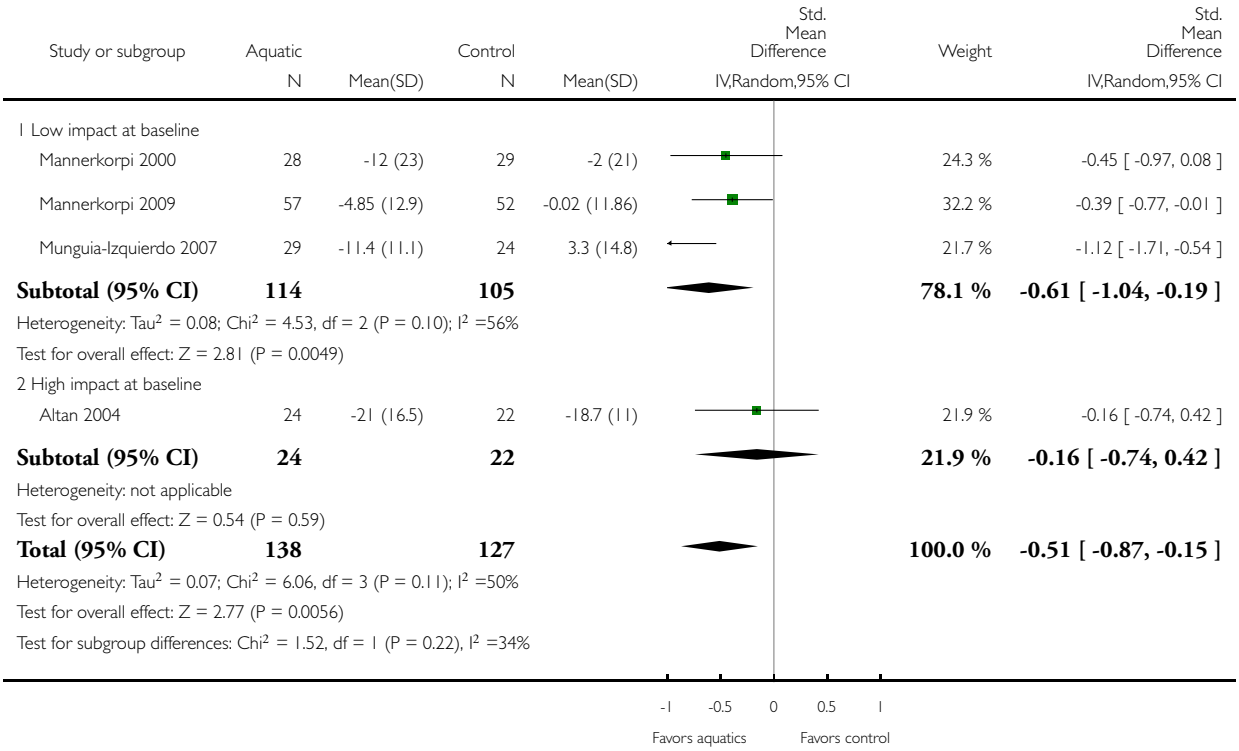


Analysis 6.2. Comparison 6 Subgroup analysis: low versus high impact of disease at baseline, Outcome 2 Pain (low versus high baseline impact).

Review: Aquatic exercise training for fibromyalgia

Comparison: 6 Subgroup analysis: low versus high impact of disease at baseline

Outcome: 2 Pain (low versus high baseline impact)



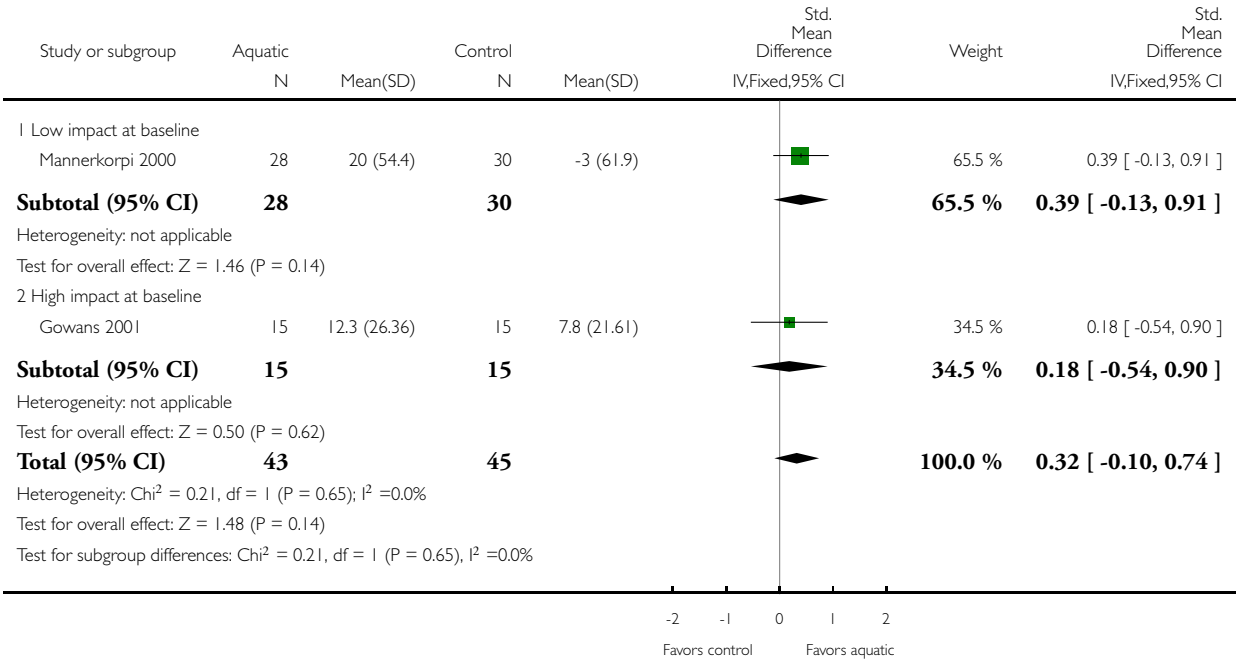
Analysis 6.3. Comparison 6 Subgroup analysis: low versus high impact of disease at baseline, Outcome 3 Strength (low versus high disease impact at baseline multidimensional function).

Review: Aquatic exercise training for fibromyalgia

Comparison: 6 Subgroup analysis: low versus high impact of disease at baseline

Outcome: 3 Strength (low versus high disease impact at baseline multidimensional function)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Low impact at baseline							
Mannerkorpi 2000	28	20 (54.4)	30	-3 (61.9)		65.5 %	0.39 [-0.13, 0.91]
Subtotal (95% CI)	**28**		**30**			**65.5 %**	**0.39 [-0.13, 0.91]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.46 (P = 0.14)							
2 High impact at baseline							
Gowans 2001	15	12.3 (26.36)	15	7.8 (21.61)		34.5 %	0.18 [-0.54, 0.90]
Subtotal (95% CI)	**15**		**15**			**34.5 %**	**0.18 [-0.54, 0.90]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.50 (P = 0.62)							
Total (95% CI)	**43**		**45**			**100.0 %**	**0.32 [-0.10, 0.74]**
Heterogeneity: Chi^2 = 0.21, df = 1 (P = 0.65); I^2 =0.0%							
Test for overall effect: Z = 1.48 (P = 0.14)							
Test for subgroup differences: Chi^2 = 0.21, df = 1 (P = 0.65), I^2 =0.0%							



Analysis 7.1. Comparison 7 Subgroup analysis: low versus high baseline pain, Outcome 1 Multidimensional function (low versus high baseline pain).

Review: Aquatic exercise training for fibromyalgia

Comparison: 7 Subgroup analysis: low versus high baseline pain

Outcome: 1 Multidimensional function (low versus high baseline pain)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Low pain at baseline							
Gusi 2006	17	-11 (12.36)	17	1 (10.47)		14.3 %	-1.02 [-1.74, -0.30]
Tomas-Carus 2008	15	-9 (9.633)	15	2 (7.81)		12.0 %	-1.22 [-2.01, -0.43]
Subtotal (95% CI)	**32**		**32**			**26.3 %**	**-1.11 [-1.64, -0.58]**
Heterogeneity: Chi^2 = 0.13, df = 1 (P = 0.72); I^2 =0.0%							
Test for overall effect: Z = 4.10 (P = 0.000041)							
2 High pain at baseline							
Altan 2004	24	-14.29 (11.88)	22	-7.3 (7.47)		20.9 %	-0.69 [-1.28, -0.09]
Mannerkorpi 2000	28	-9 (13)	29	0 (14)		26.1 %	-0.66 [-1.19, -0.12]
Munguia-Izquierdo 2007	34	-4.8 (9.81)	24	-0.9 (9.74)		26.7 %	-0.39 [-0.92, 0.13]
Subtotal (95% CI)	**86**		**75**			**73.7 %**	**-0.57 [-0.89, -0.25]**
Heterogeneity: Chi^2 = 0.68, df = 2 (P = 0.71); I^2 =0.0%							
Test for overall effect: Z = 3.51 (P = 0.00044)							
Total (95% CI)	**118**		**107**			**100.0 %**	**-0.71 [-0.99, -0.44]**
Heterogeneity: Chi^2 = 3.76, df = 4 (P = 0.44); I^2 =0.0%							
Test for overall effect: Z = 5.12 (P < 0.00001)							
Test for subgroup differences: Chi^2 = 2.95, df = 1 (P = 0.09), I^2 =66%							

Analysis 7.2. Comparison 7 Subgroup analysis: low versus high baseline pain, Outcome 2 Pain (low versus high baseline pain).

Review: Aquatic exercise training for fibromyalgia

Comparison: 7 Subgroup analysis: low versus high baseline pain

Outcome: 2 Pain (low versus high baseline pain)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 Low baseline pain							
Arcos-Carmona 2011	27	-2.81 (3.86)	26	-0.58 (3.6)		19.1 %	-0.59 [-1.14, -0.04]
Gusi 2006	17	-18.4 (27.55)	17	1 (17.24)		12.9 %	-0.82 [-1.53, -0.12]
Tomas-Carus 2008	15	-3 (11.46)	15	2 (13.06)		12.3 %	-0.40 [-1.12, 0.33]
Subtotal (95% CI)	**59**		**58**			**44.3 %**	**-0.60 [-0.98, -0.23]**
Heterogeneity: Tau² = 0.0; Chi² = 0.70, df = 2 (P = 0.71); I² =0.0%							
Test for overall effect: Z = 3.18 (P = 0.0015)							
2 High baseline pain							
Altan 2004	24	-21 (16.5)	22	-18.7 (11)		17.7 %	-0.16 [-0.74, 0.42]
Mannerkorpi 2000	28	-12 (23)	29	-2 (21)		20.5 %	-0.45 [-0.97, 0.08]
Munguia-Izquierdo 2007	29	-11.4 (11.1)	24	3.3 (14.8)		17.5 %	-1.12 [-1.71, -0.54]
Subtotal (95% CI)	**81**		**75**			**55.7 %**	**-0.57 [-1.11, -0.03]**
Heterogeneity: Tau² = 0.15; Chi² = 5.56, df = 2 (P = 0.06); I² =64%							
Test for overall effect: Z = 2.07 (P = 0.038)							
Total (95% CI)	**140**		**133**			**100.0 %**	**-0.58 [-0.86, -0.31]**
Heterogeneity: Tau² = 0.02; Chi² = 6.28, df = 5 (P = 0.28); I² =20%							
Test for overall effect: Z = 4.15 (P = 0.000033)							
Test for subgroup differences: Chi² = 0.01, df = 1 (P = 0.93), I² =0.0%							

Analysis 7.3. Comparison 7 Subgroup analysis: low versus high baseline pain, Outcome 3 Strength (low versus high baseline pain).

Review: Aquatic exercise training for fibromyalgia

Comparison: 7 Subgroup analysis: low versus high baseline pain

Outcome: 3 Strength (low versus high baseline pain)

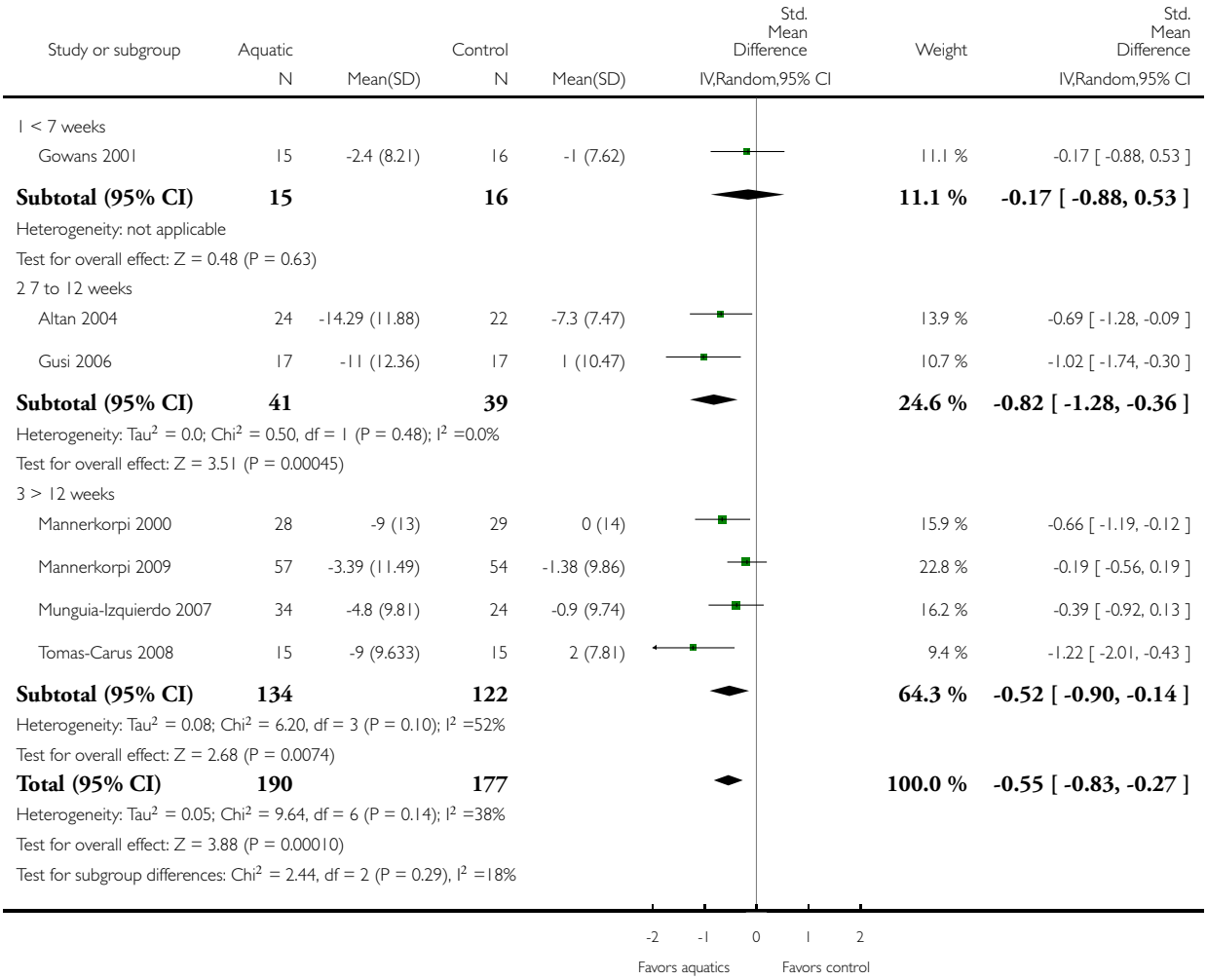
Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Low baseline pain							
Gusi 2006	17	0.2 (0.21)	17	0 (0.21)		27.0 %	0.93 [0.22, 1.64]
Tomas-Carus 2008	15	6.3 (7.16)	15	-3.9 (9.59)		22.3 %	1.17 [0.39, 1.96]
Subtotal (95% CI)	**32**		**32**			**49.4 %**	**1.04 [0.51, 1.57]**
Heterogeneity: Chi^2 = 0.20, df = 1 (P = 0.65); I^2 =0.0%							
Test for overall effect: Z = 3.87 (P = 0.00011)							
2 High baseline pain							
Mannerkorpi 2000	28	20 (54.4)	30	-3 (61.9)		50.6 %	0.39 [-0.13, 0.91]
Subtotal (95% CI)	**28**		**30**			**50.6 %**	**0.39 [-0.13, 0.91]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.46 (P = 0.14)							
Total (95% CI)	**60**		**62**			**100.0 %**	**0.71 [0.34, 1.08]**
Heterogeneity: Chi^2 = 3.17, df = 2 (P = 0.20); I^2 =37%							
Test for overall effect: Z = 3.76 (P = 0.00017)							
Test for subgroup differences: Chi^2 = 2.97, df = 1 (P = 0.08), I^2 =66%							

Analysis 8.1. Comparison 8 Subgroup analysis: length of program, Outcome 1 Multidimensional function (length of program).

Review: Aquatic exercise training for fibromyalgia

Comparison: 8 Subgroup analysis: length of program

Outcome: 1 Multidimensional function (length of program)

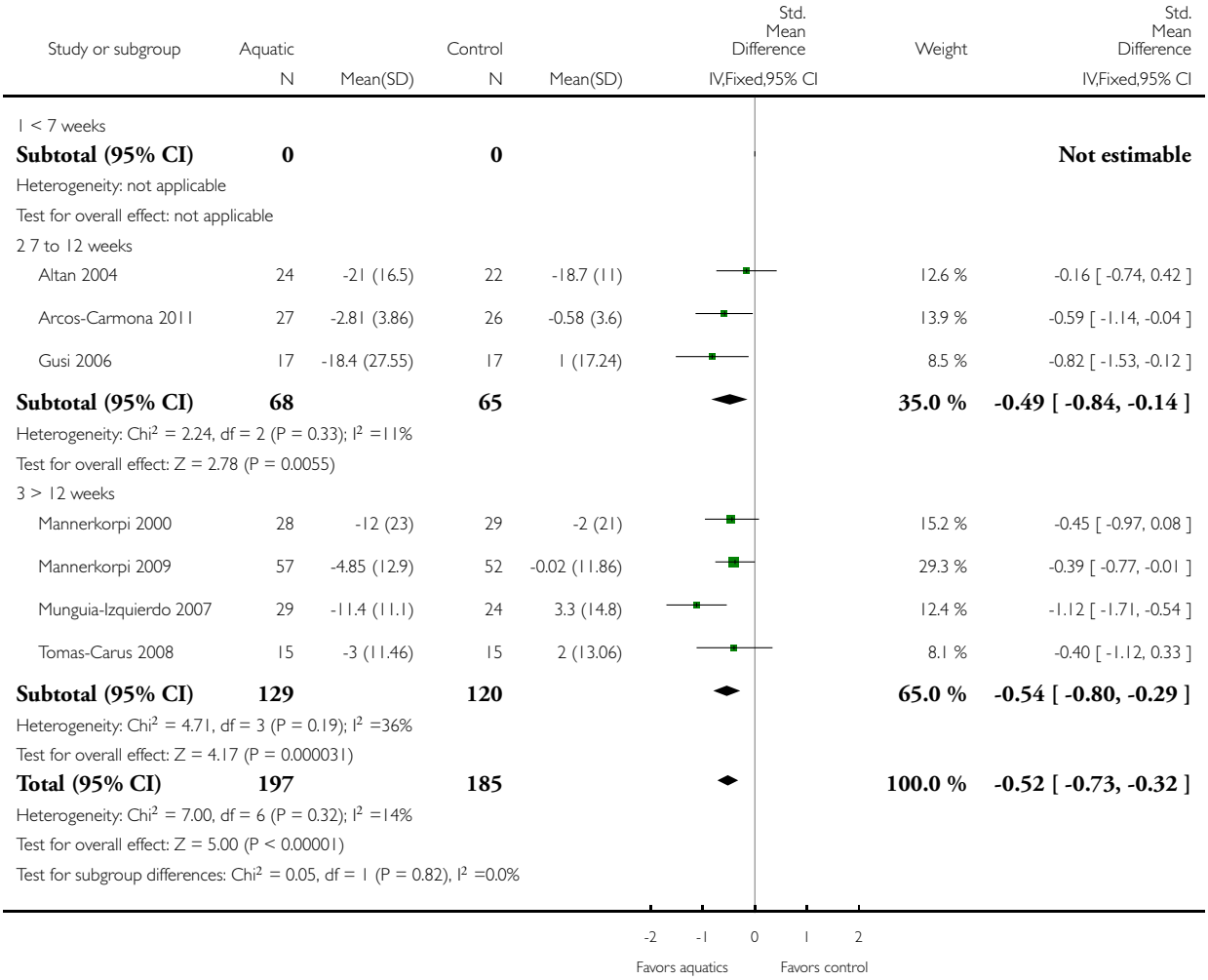


Analysis 8.2. Comparison 8 Subgroup analysis: length of program, Outcome 2 Pain (length of program).

Review: Aquatic exercise training for fibromyalgia

Comparison: 8 Subgroup analysis: length of program

Outcome: 2 Pain (length of program)

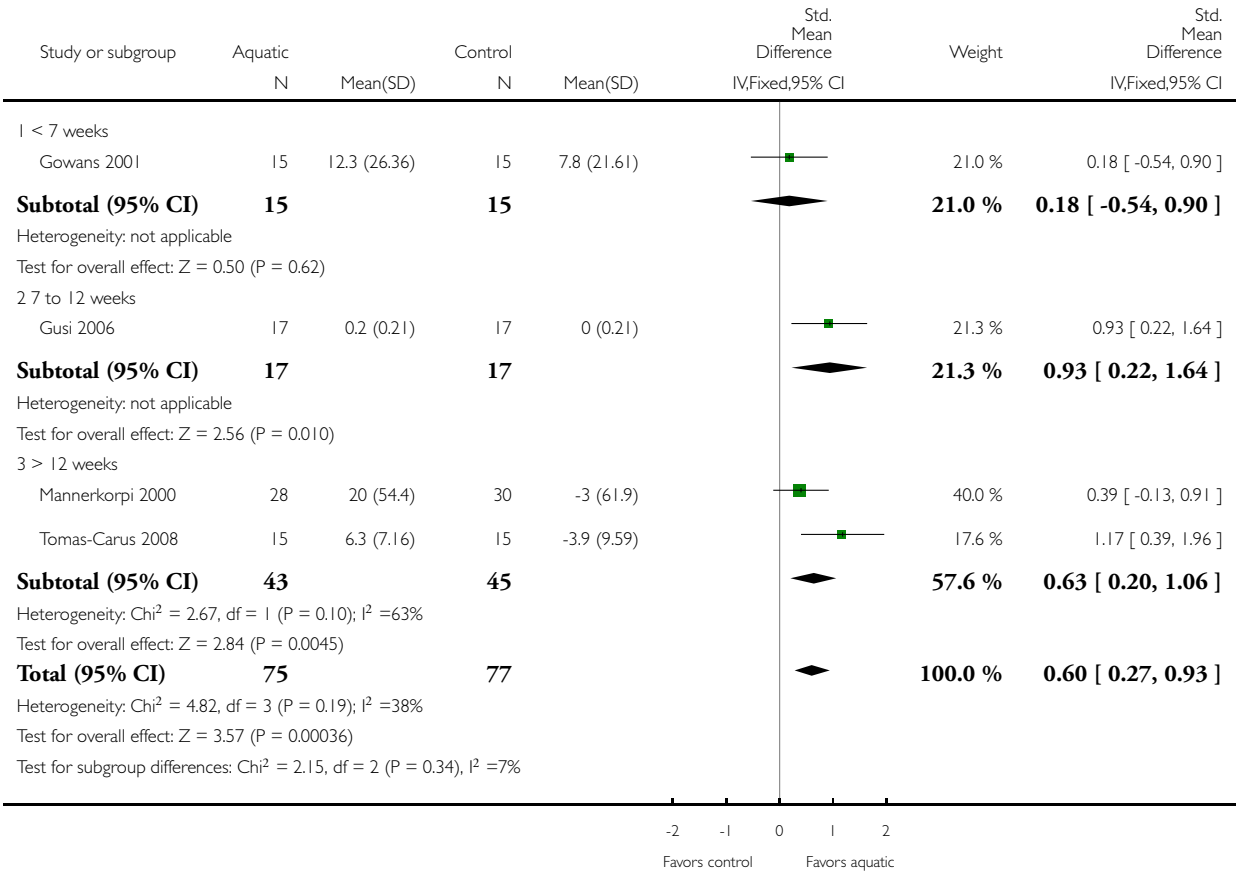


Analysis 8.3. Comparison 8 Subgroup analysis: length of program, Outcome 3 Strength (length of program).

Review: Aquatic exercise training for fibromyalgia

Comparison: 8 Subgroup analysis: length of program

Outcome: 3 Strength (length of program)



Analysis 9.1. Comparison 9 Subgroup analysis: accumulated time in the pool, Outcome 1 Multidimensional function (accumulated time in the pool).

Review: Aquatic exercise training for fibromyalgia

Comparison: 9 Subgroup analysis: accumulated time in the pool

Outcome: 1 Multidimensional function (accumulated time in the pool)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 < 1000 min in pool							
Gowans 2001	15	-2.4 (8.21)	16	-1 (7.62)		8.9 %	-0.17 [-0.88, 0.53]
Mannerkorpi 2000	28	-9 (13)	29	0 (14)		15.5 %	-0.66 [-1.19, -0.12]
Subtotal (95% CI)	**43**		**45**			**24.4 %**	**-0.48 [-0.91, -0.05]**
Heterogeneity: Chi^2 = 1.15, df = 1 (P = 0.28); I^2 =13%							
Test for overall effect: Z = 2.21 (P = 0.027)							
2 1000 to 2000 min in pool							
Altan 2004	24	-14.29 (11.88)	22	-7.3 (7.47)		12.4 %	-0.69 [-1.28, -0.09]
Mannerkorpi 2009	57	-3.39 (11.49)	54	-1.38 (9.86)		31.8 %	-0.19 [-0.56, 0.19]
Subtotal (95% CI)	**81**		**76**			**44.2 %**	**-0.33 [-0.64, -0.01]**
Heterogeneity: Chi^2 = 1.94, df = 1 (P = 0.16); I^2 =48%							
Test for overall effect: Z = 2.02 (P = 0.043)							
3 > 2000 min in pool							
Gusi 2006	17	-11 (12.36)	17	1 (10.47)		8.5 %	-1.02 [-1.74, -0.30]
Munguia-Izquierdo 2007	34	-4.8 (9.81)	24	-0.9 (9.74)		15.9 %	-0.39 [-0.92, 0.13]
Tomas-Carus 2008	15	-9 (9.633)	15	2 (7.81)		7.1 %	-1.22 [-2.01, -0.43]
Subtotal (95% CI)	**66**		**56**			**31.5 %**	**-0.75 [-1.12, -0.38]**
Heterogeneity: Chi^2 = 3.67, df = 2 (P = 0.16); I^2 =46%							
Test for overall effect: Z = 3.93 (P = 0.000087)							
Total (95% CI)	**190**		**177**			**100.0 %**	**-0.50 [-0.71, -0.29]**
Heterogeneity: Chi^2 = 9.64, df = 6 (P = 0.14); I^2 =38%							
Test for overall effect: Z = 4.64 (P < 0.00001)							
Test for subgroup differences: Chi^2 = 2.88, df = 2 (P = 0.24), I^2 =31%							

Analysis 9.2. Comparison 9 Subgroup analysis: accumulated time in the pool, Outcome 2 Pain (accumulated time in the pool).

Review: Aquatic exercise training for fibromyalgia

Comparison: 9 Subgroup analysis: accumulated time in the pool

Outcome: 2 Pain (accumulated time in the pool)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 < 1000 min in pool							
Arcos-Carmona 2011	27	-2.81 (3.86)	26	-0.58 (3.6)		14.3 %	-0.59 [-1.14, -0.04]
Mannerkorpi 2000	28	-12 (23)	29	-2 (21)		15.5 %	-0.45 [-0.97, 0.08]
Subtotal (95% CI)	**55**		**55**			**29.8 %**	**-0.52 [-0.90, -0.13]**
Heterogeneity: Tau^2 = 0.0; Chi^2 = 0.13, df = 1 (P = 0.72); I^2 =0.0%							
Test for overall effect: Z = 2.65 (P = 0.0080)							
2 1000 to 2000 min in pool							
Altan 2004	24	-21 (16.5)	22	-18.7 (11)		13.1 %	-0.16 [-0.74, 0.42]
Mannerkorpi 2009	57	-4.85 (12.9)	52	-0.02 (11.86)		26.0 %	-0.39 [-0.77, -0.01]
Subtotal (95% CI)	**81**		**74**			**39.2 %**	**-0.32 [-0.64, 0.00]**
Heterogeneity: Tau^2 = 0.0; Chi^2 = 0.41, df = 1 (P = 0.52); I^2 =0.0%							
Test for overall effect: Z = 1.97 (P = 0.049)							
3 >2000 min in pool							
Gusi 2006	17	-18.4 (27.55)	17	1 (17.24)		9.3 %	-0.82 [-1.53, -0.12]
Munguia-Izquierdo 2007	29	-11.4 (11.1)	24	3.3 (14.8)		12.9 %	-1.12 [-1.71, -0.54]
Tomas-Carus 2008	15	-3 (11.46)	15	2 (13.06)		8.8 %	-0.40 [-1.12, 0.33]
Subtotal (95% CI)	**61**		**56**			**31.1 %**	**-0.82 [-1.24, -0.41]**
Heterogeneity: Tau^2 = 0.02; Chi^2 = 2.34, df = 2 (P = 0.31); I^2 =15%							
Test for overall effect: Z = 3.89 (P = 0.00010)							
Total (95% CI)	**197**		**185**			**100.0 %**	**-0.53 [-0.76, -0.31]**
Heterogeneity: Tau^2 = 0.01; Chi^2 = 7.00, df = 6 (P = 0.32); I^2 =14%							
Test for overall effect: Z = 4.63 (P < 0.00001)							
Test for subgroup differences: Chi^2 = 3.60, df = 2 (P = 0.17), I^2 =44%							

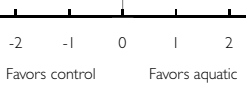
Analysis 9.3. Comparison 9 Subgroup analysis: accumulated time in the pool, Outcome 3 Strength (accumulated time in the pool).

Review: Aquatic exercise training for fibromyalgia

Comparison: 9 Subgroup analysis: accumulated time in the pool

Outcome: 3 Strength (accumulated time in the pool)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 < 1000 min in pool							
Gowans 2001	15	12.3 (26.36)	15	7.8 (21.61)		21.0 %	0.18 [-0.54, 0.90]
Mannerkorpi 2000	28	20 (54.4)	30	-3 (61.9)		40.0 %	0.39 [-0.13, 0.91]
Subtotal (95% CI)	**43**		**45**			**61.0 %**	**0.32 [-0.10, 0.74]**
Heterogeneity: Chi^2 = 0.21, df = 1 (P = 0.65); I^2 =0.0%							
Test for overall effect: Z = 1.48 (P = 0.14)							
2 1000 to 2000 min in pool							
Subtotal (95% CI)	**0**		**0**				**Not estimable**
Heterogeneity: not applicable							
Test for overall effect: not applicable							
3 > 2000 min in pool							
Gusi 2006	17	0.2 (0.21)	17	0 (0.21)		21.3 %	0.93 [0.22, 1.64]
Tomas-Carus 2008	15	6.3 (7.16)	15	-3.9 (9.59)		17.6 %	1.17 [0.39, 1.96]
Subtotal (95% CI)	**32**		**32**			**39.0 %**	**1.04 [0.51, 1.57]**
Heterogeneity: Chi^2 = 0.20, df = 1 (P = 0.65); I^2 =0.0%							
Test for overall effect: Z = 3.87 (P = 0.00011)							
Total (95% CI)	**75**		**77**			**100.0 %**	**0.60 [0.27, 0.93]**
Heterogeneity: Chi^2 = 4.82, df = 3 (P = 0.19); I^2 =38%							
Test for overall effect: Z = 3.57 (P = 0.00036)							
Test for subgroup differences: Chi^2 = 4.41, df = 1 (P = 0.04), I^2 =77%							



Analysis 10.1. Comparison 10 Subgroup analysis: exercise frequency, Outcome 1 Multidimensional function (exercise frequency).

Review: Aquatic exercise training for fibromyalgia

Comparison: 10 Subgroup analysis: exercise frequency

Outcome: 1 Multidimensional function (exercise frequency)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 One pool session per week							
Mannerkorpi 2000	28	-9 (13)	29	0 (14)		15.5 %	-0.66 [-1.19, -0.12]
Mannerkorpi 2009	57	-3.39 (11.49)	54	-1.38 (9.86)		31.8 %	-0.19 [-0.56, 0.19]
Subtotal (95% CI)	**85**		**83**			**47.2 %**	**-0.34 [-0.65, -0.03]**
Heterogeneity: Chi² = 2.00, df = 1 (P = 0.16); I² =50%							
Test for overall effect: Z = 2.18 (P = 0.029)							
2 Three pool sessions per week							
Altan 2004	24	-14.29 (11.88)	22	-7.3 (7.47)		12.4 %	-0.69 [-1.28, -0.09]
Gowans 2001	15	-2.4 (8.21)	16	-1 (7.62)		8.9 %	-0.17 [-0.88, 0.53]
Gusi 2006	17	-11 (12.36)	17	1 (10.47)		8.5 %	-1.02 [-1.74, -0.30]
Munguia-Izquierdo 2007	34	-4.8 (9.81)	24	-0.9 (9.74)		15.9 %	-0.39 [-0.92, 0.13]
Tomas-Carus 2008	15	-9 (9.633)	15	2 (7.81)		7.1 %	-1.22 [-2.01, -0.43]
Subtotal (95% CI)	**105**		**94**			**52.8 %**	**-0.64 [-0.93, -0.35]**
Heterogeneity: Chi² = 5.71, df = 4 (P = 0.22); I² =30%							
Test for overall effect: Z = 4.32 (P = 0.000016)							
Total (95% CI)	**190**		**177**			**100.0 %**	**-0.50 [-0.71, -0.29]**
Heterogeneity: Chi² = 9.64, df = 6 (P = 0.14); I² =38%							
Test for overall effect: Z = 4.64 (P < 0.00001)							
Test for subgroup differences: Chi² = 1.92, df = 1 (P = 0.17), I² =48%							

Analysis 10.2. Comparison 10 Subgroup analysis: exercise frequency, Outcome 2 Pain (exercise frequency).

Review: Aquatic exercise training for fibromyalgia

Comparison: 10 Subgroup analysis: exercise frequency

Outcome: 2 Pain (exercise frequency)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 One pool session per week							
Mannerkorpi 2009	57	-4.85 (12.9)	52	-0.02 (11.86)		23.2 %	-0.39 [-0.77, -0.01]
Mannerkorpi 2009	57	-4.85 (12.9)	52	-0.02 (11.86)		23.2 %	-0.39 [-0.77, -0.01]
Subtotal (95% CI)	**114**		**104**			**46.4 %**	**-0.39 [-0.65, -0.12]**
Heterogeneity: $Tau^2 = 0.0$; $Chi^2 = 0.0$, df = 1 (P = 1.00); $I^2 = 0.0\%$							
Test for overall effect: Z = 2.82 (P = 0.0048)							
2 Two pool sessions per week							
Arcos-Carmona 2011	27	-2.81 (3.86)	26	-0.58 (3.6)		13.1 %	-0.59 [-1.14, -0.04]
Subtotal (95% CI)	**27**		**26**			**13.1 %**	**-0.59 [-1.14, -0.04]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.09 (P = 0.036)							
3 Three pool sessions per week							
Altan 2004	24	-21 (16.5)	22	-18.7 (11)		12.0 %	-0.16 [-0.74, 0.42]
Gusi 2006	17	-18.4 (27.55)	17	1 (17.24)		8.6 %	-0.82 [-1.53, -0.12]
Munguia-Izquierdo 2007	29	-11.4 (11.1)	24	3.3 (14.8)		11.8 %	-1.12 [-1.71, -0.54]
Tomas-Carus 2008	15	-3 (11.46)	15	2 (13.06)		8.1 %	-0.40 [-1.12, 0.33]
Subtotal (95% CI)	**85**		**78**			**40.5 %**	**-0.63 [-1.08, -0.17]**
Heterogeneity: $Tau^2 = 0.11$; $Chi^2 = 5.95$, df = 3 (P = 0.11); $I^2 = 50\%$							
Test for overall effect: Z = 2.72 (P = 0.0066)							
Total (95% CI)	**226**		**208**			**100.0 %**	**-0.51 [-0.73, -0.29]**
Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 7.36$, df = 6 (P = 0.29); $I^2 = 19\%$							
Test for overall effect: Z = 4.58 (P < 0.00001)							
Test for subgroup differences: $Chi^2 = 1.02$, df = 2 (P = 0.60), $I^2 = 0.0\%$							

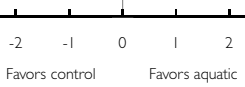
Analysis 10.3. Comparison 10 Subgroup analysis: exercise frequency, Outcome 3 Strength (exercise frequency).

Review: Aquatic exercise training for fibromyalgia

Comparison: 10 Subgroup analysis: exercise frequency

Outcome: 3 Strength (exercise frequency)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 One pool session per week							
Mannerkorpi 2000	28	20 (54.4)	30	-3 (61.9)		40.0 %	0.39 [-0.13, 0.91]
Subtotal (95% CI)	**28**		**30**			**40.0 %**	**0.39 [-0.13, 0.91]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.46 (P = 0.14)							
2 Two pool sessions per week							
Subtotal (95% CI)	**0**		**0**				**Not estimable**
Heterogeneity: not applicable							
Test for overall effect: not applicable							
3 Three pool sessions per week							
Gowans 2001	15	12.3 (26.36)	15	7.8 (21.61)		21.0 %	0.18 [-0.54, 0.90]
Gusi 2006	17	0.2 (0.21)	17	0 (0.21)		21.3 %	0.93 [0.22, 1.64]
Tomas-Carus 2008	15	6.3 (7.16)	15	-3.9 (9.59)		17.6 %	1.17 [0.39, 1.96]
Subtotal (95% CI)	**47**		**47**			**60.0 %**	**0.74 [0.31, 1.16]**
Heterogeneity: Chi^2 = 3.77, df = 2 (P = 0.15); I^2 =47%							
Test for overall effect: Z = 3.41 (P = 0.00065)							
Total (95% CI)	**75**		**77**			**100.0 %**	**0.60 [0.27, 0.93]**
Heterogeneity: Chi^2 = 4.82, df = 3 (P = 0.19); I^2 =38%							
Test for overall effect: Z = 3.57 (P = 0.00036)							
Test for subgroup differences: Chi^2 = 1.05, df = 1 (P = 0.31), I^2 =4%							

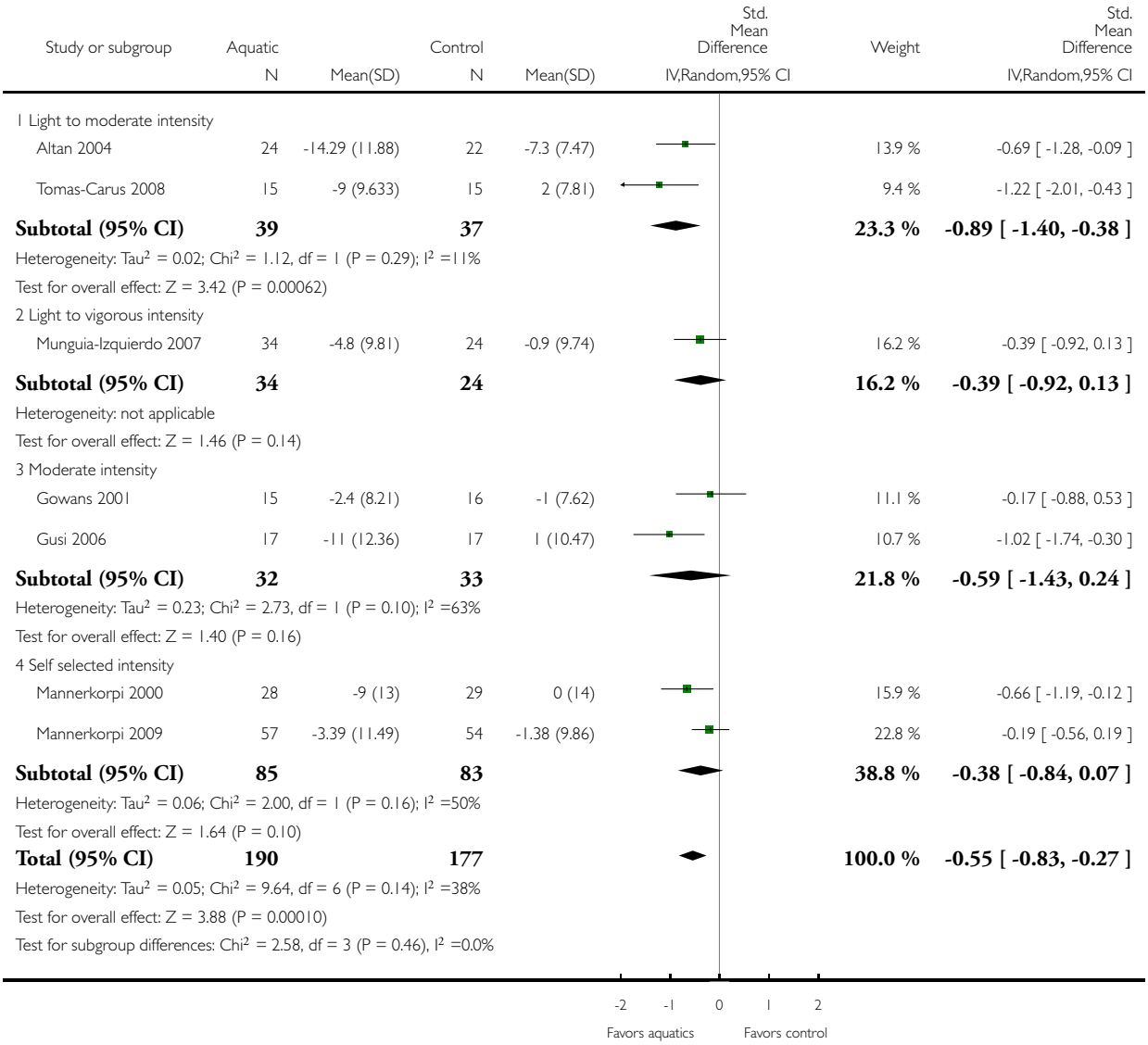


Analysis 11.1. Comparison 11 Subgroup analysis: exercise intensity, Outcome 1 Multidimensional function (exercise intensity).

Review: Aquatic exercise training for fibromyalgia

Comparison: 11 Subgroup analysis: exercise intensity

Outcome: 1 Multidimensional function (exercise intensity)

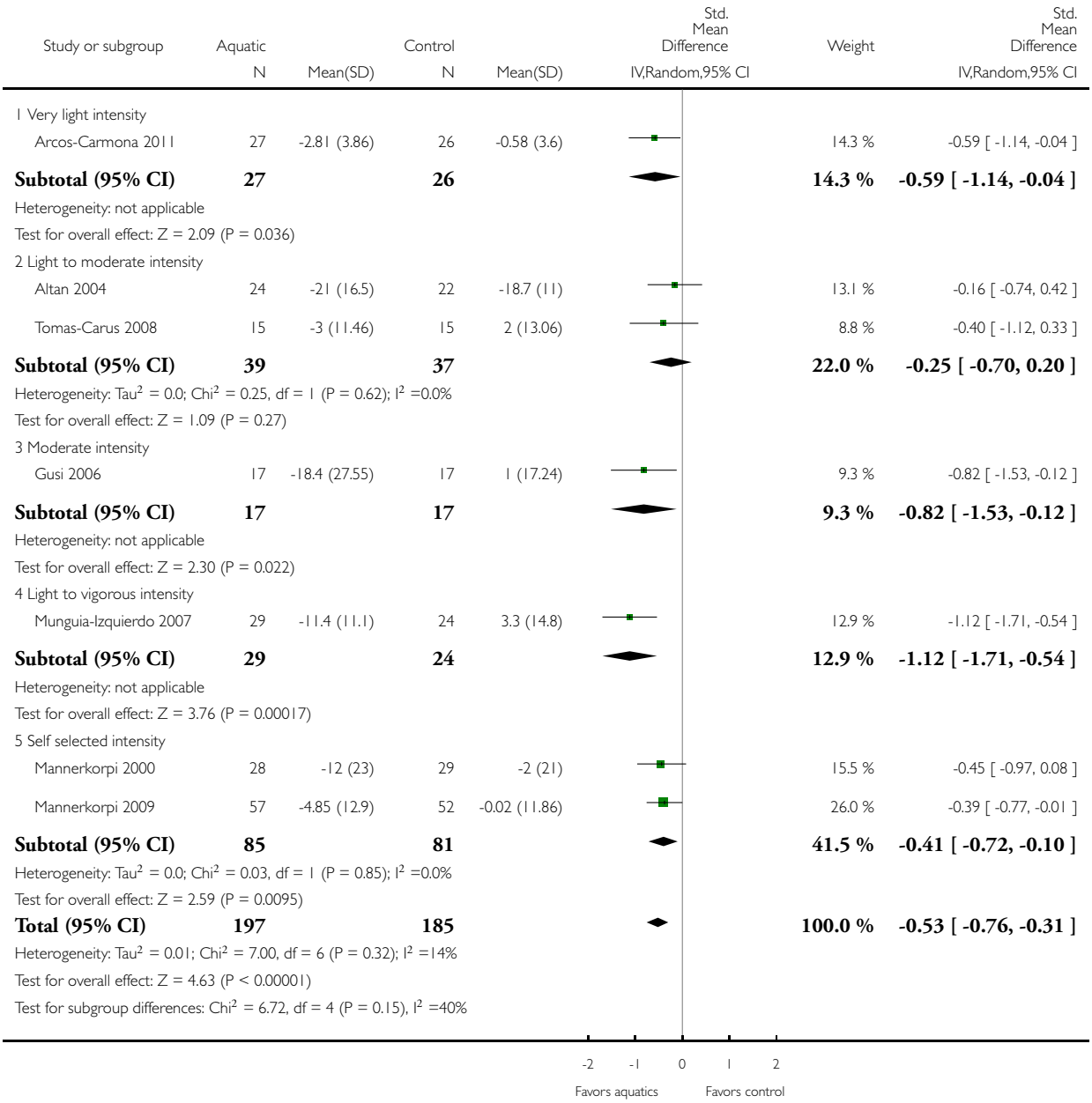


Analysis 11.2. Comparison 11 Subgroup analysis: exercise intensity, Outcome 2 Pain (exercise intensity).

Review: Aquatic exercise training for fibromyalgia

Comparison: 11 Subgroup analysis: exercise intensity

Outcome: 2 Pain (exercise intensity)



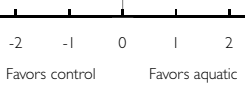
Analysis 11.3. Comparison 11 Subgroup analysis: exercise intensity, Outcome 3 Strength (exercise intensity).

Review: Aquatic exercise training for fibromyalgia

Comparison: 11 Subgroup analysis: exercise intensity

Outcome: 3 Strength (exercise intensity)

Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Light to moderate intensity							
Tomas-Carus 2008	15	6.3 (7.16)	15	-3.9 (9.59)		17.6 %	1.17 [0.39, 1.96]
Subtotal (95% CI)	**15**		**15**			**17.6 %**	**1.17 [0.39, 1.96]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.93 (P = 0.0033)							
2 Moderate intensity							
Gowans 2001	15	12.3 (26.36)	15	7.8 (21.61)		21.0 %	0.18 [-0.54, 0.90]
Gusi 2006	17	0.2 (0.21)	17	0 (0.21)		21.3 %	0.93 [0.22, 1.64]
Subtotal (95% CI)	**32**		**32**			**42.4 %**	**0.56 [0.05, 1.06]**
Heterogeneity: Chi^2 = 2.10, df = 1 (P = 0.15); I^2 =52%							
Test for overall effect: Z = 2.17 (P = 0.030)							
3 Self selected intensity							
Mannerkorpi 2000	28	20 (54.4)	30	-3 (61.9)		40.0 %	0.39 [-0.13, 0.91]
Subtotal (95% CI)	**28**		**30**			**40.0 %**	**0.39 [-0.13, 0.91]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.46 (P = 0.14)							
Total (95% CI)	**75**		**77**			**100.0 %**	**0.60 [0.27, 0.93]**
Heterogeneity: Chi^2 = 4.82, df = 3 (P = 0.19); I^2 =38%							
Test for overall effect: Z = 3.57 (P = 0.00036)							
Test for subgroup differences: Chi^2 = 2.71, df = 2 (P = 0.26), I^2 =26%							



Analysis 12.1. Comparison 12 Subgroup analysis: pool temperature - cool, temperate, warm, Outcome 1 Multidimensional function (pool temperature).

Review: Aquatic exercise training for fibromyalgia

Comparison: 12 Subgroup analysis: pool temperature - cool, temperate, warm

Outcome: 1 Multidimensional function (pool temperature)

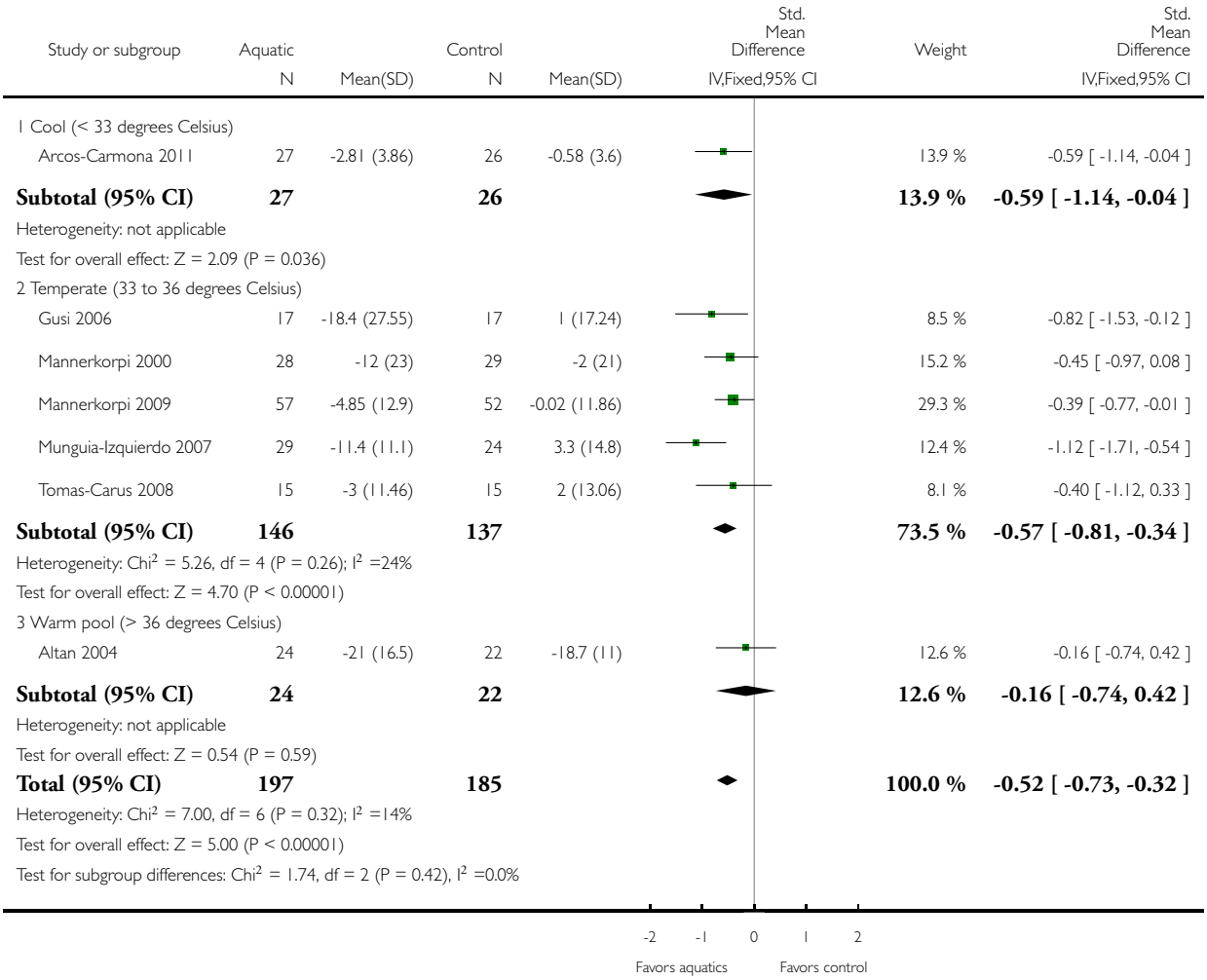
Study or subgroup	Aquatic N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 Cool (27 to 32 degrees Celsius)							
Subtotal (95% CI)	**0**		**0**				**Not estimable**
Heterogeneity: not applicable							
Test for overall effect: not applicable							
2 Temperate (33 to 36 degrees Celsius)							
Gusi 2006	17	-11 (12.36)	17	1 (10.47)		10.7 %	-1.02 [-1.74, -0.30]
Mannerkorpi 2000	28	-9 (13)	29	0 (14)		15.9 %	-0.66 [-1.19, -0.12]
Mannerkorpi 2009	57	-3.39 (11.49)	54	-1.38 (9.86)		22.8 %	-0.19 [-0.56, 0.19]
Munguia-Izquierdo 2007	34	-4.8 (9.81)	24	-0.9 (9.74)		16.2 %	-0.39 [-0.92, 0.13]
Tomas-Carus 2008	15	-9 (9.633)	15	2 (7.81)		9.4 %	-1.22 [-2.01, -0.43]
Subtotal (95% CI)	**151**		**139**			**75.1 %**	**-0.60 [-0.97, -0.24]**
Heterogeneity: $Tau^2 = 0.09$; $Chi^2 = 8.44$, df = 4 (P = 0.08); $I^2 = 53\%$							
Test for overall effect: Z = 3.25 (P = 0.0012)							
3 Warm (> 36 degrees Celsius)							
Altan 2004	24	-14.29 (11.88)	22	-7.3 (7.47)		13.9 %	-0.69 [-1.28, -0.09]
Gowans 2001	15	-2.4 (8.21)	16	-1 (7.62)		11.1 %	-0.17 [-0.88, 0.53]
Subtotal (95% CI)	**39**		**38**			**24.9 %**	**-0.47 [-0.96, 0.03]**
Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 1.18$, df = 1 (P = 0.28); $I^2 = 16\%$							
Test for overall effect: Z = 1.83 (P = 0.067)							
Total (95% CI)	**190**		**177**			**100.0 %**	**-0.55 [-0.83, -0.27]**
Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 9.64$, df = 6 (P = 0.14); $I^2 = 38\%$							
Test for overall effect: Z = 3.88 (P = 0.00010)							
Test for subgroup differences: $Chi^2 = 0.19$, df = 1 (P = 0.66), $I^2 = 0.0\%$							

Analysis 12.2. Comparison 12 Subgroup analysis: pool temperature - cool, temperate, warm, Outcome 2 Pain (pool temperature).

Review: Aquatic exercise training for fibromyalgia

Comparison: 12 Subgroup analysis: pool temperature - cool, temperate, warm

Outcome: 2 Pain (pool temperature)

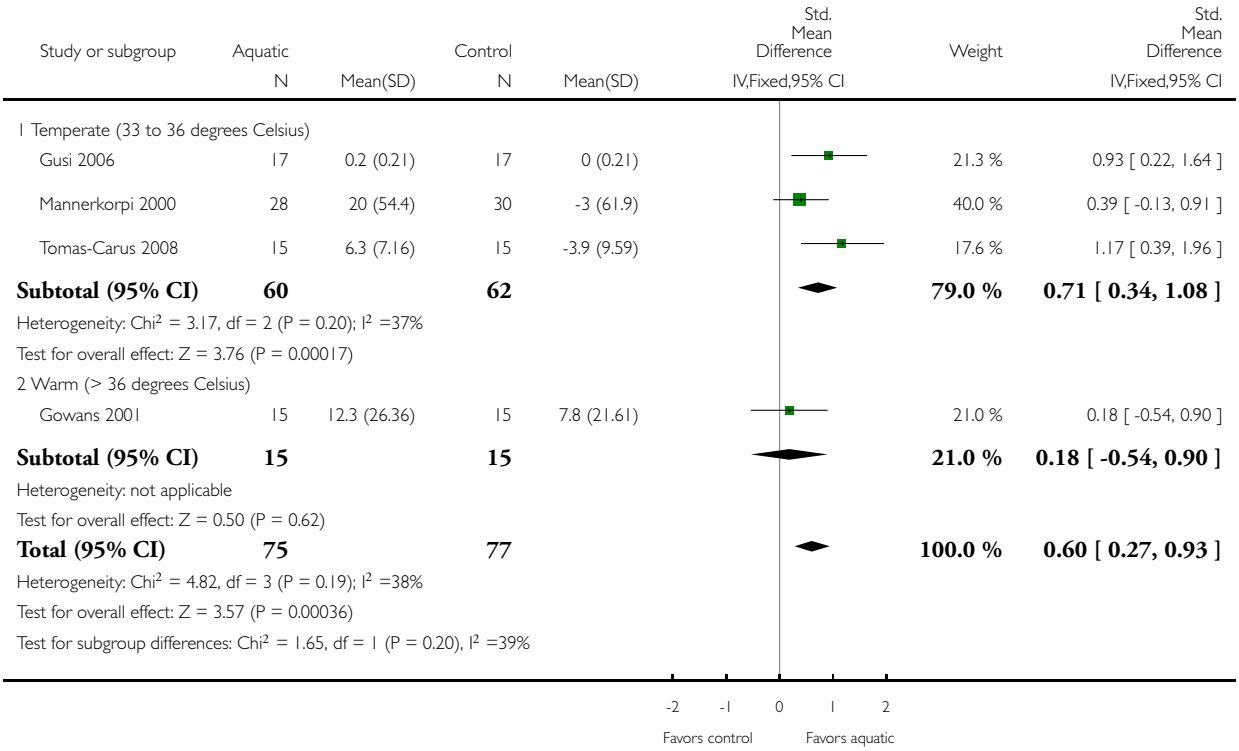


Analysis 12.3. Comparison 12 Subgroup analysis: pool temperature - cool, temperate, warm, Outcome 3 Strength (pool temperature).

Review: Aquatic exercise training for fibromyalgia

Comparison: 12 Subgroup analysis: pool temperature - cool, temperate, warm

Outcome: 3 Strength (pool temperature)



ADDITIONAL TABLES

Table 1. Glossary of terms

Term	Definition
Balneotherapy	The term derived from the Latin word balneum which means bath. Balneotherapy involves bathing in mineral or thermal water, and sometimes exercise. Usually the natural spring or welled water is 20 °C or higher
Biomarkers	In medicine, a biomarker is a term often used to refer to measurable characteristics that reflects the severity or presence of some disease state. It is often an indicator of a particular disease state or some other psychological state of an organism

Table 1. Glossary of terms (*Continued*)

Detraining	Losing the physical and health effects gained during exercise training by stopping exercise
Exercise	Physical activity that is planned, structured, and repetitive and [that] has as a final or intermediate objective the improvement or maintenance of physical fitness (Garber 2011)
Exercise training	Program that is designed to meet individual health and physical fitness goals; a single exercise session should include a warm-up, stretching, conditioning and cool-down components. The rate of progression depends on the individual's health status and exercise tolerance
Hydrotherapy	A warm water (above 30 °C) exercise intervention in which participants immerse at waist or shoulder height
Mental health	The individual's level of psychological well-being or an absence of a mental disorder. It may include the ability to enjoy life or adapt to different circumstances and demands
Multidimensional function	A single score derived from either a general health questionnaire (e.g., SF-36, EuroQol 5d) or a disease-specific questionnaire (Fibromyalgia Impact Questionnaire) that attempts to summarize the many components of health
Muscle endurance	The ability to produce force repetitively
Muscle strength	A physical test of the amount of force a muscle can generate
OMERACT	OMERACT (Outcome Measures in Rheumatology) is an independent initiative of international health professionals interested in outcome measures in rheumatology. Over the last 20 years, OMERACT has served a critical role in the development and validation of clinical and radiographic outcome measures in rheumatoid arthritis, osteoarthritis, psoriatic arthritis, fibromyalgia, and other rheumatic diseases (www.omeract.org). OMERACT is linked to the Cochrane Collaboration Musculoskeletal Review Group where the outcomes endorsed by OMERACT are recommended for use in Cochrane Systematic Reviews
Physical activity	Any bodily movement produced by skeletal muscles that results in energy expenditure above resting (basal) levels. Physical activity broadly encompasses exercise, sports, and physical activities done as part of daily living, occupation, leisure, and active transportation (Garber 2011)
Physical fitness	The ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy [leisure] pursuits and to meet unforeseen emergencies. Physical fitness is operationalized as "[a set of] measurable health and skill-related attributes"
Physical function	The capacity of an individual to carry out the physical activities of daily living. Physical function reflects motor function and control, physical fitness, and habitual physical activity and is an independent predictor of functional independence, disability, and morbidity
PWC-170	Test that measures aerobic fitness. PWC stands for physical work capacity. PWC-170 estimates the working capacity at a heart rate of 170 beats per minute. A cycle ergometer, clock, and/or hear rate monitor are needed

Table 1. Glossary of terms (*Continued*)

Skewness	Not every distribution of data is symmetric - sets of data that are not symmetric are said to be asymmetric. The measure of how asymmetric a distribution can be is called skewness
Sleep disturbance	A score derived from a questionnaire that measures sleep quantity and quality. The Medical Outcomes Survey Sleep Scale measures 6 dimensions of sleep (initiation, staying asleep, quantity, adequacy, drowsiness, shortness of breath, snoring)
Symptoms	Patients' perceptions of an 'abnormal' physical, emotional, or cognitive state
Tenderness	Pain evoked by tactile pressure
Thalassotherapy	A combination of bathing in sea water in a marine climate with solar radiation and exercise

Table 2. Physical activity RCTs screened out

A. Physical activity interventions having an aquatic component, which did not meet the inclusion criteria		**A. Physical acti**
Article	***Number of groups***	***Interventions***
Burckhardt 1994	3	Comp (Ed + MX (LD-AE, AQ-AE + FX)); Educ control (delayed treatment)
Cedraschi 2004	2	Comp (AQ + LD AE; Relax; Educ); control
Da Costa 2005	2	AQ + LD MX (AQ-AE + Land-AE + ST); control (care as usual)
Gowans 1999	2	Control (wait list control); Comp (AQ-AE + Educ)
King 2002	4	AE (AQ + /or LD); Educ; Comp AE (AQ + /or LD) + Educ; control
Rivera Redondo 2004	2	AQ + LD MX (AE + FX + ST); CBT
van Koulil 2010	2	Comp CBT1 + AQ/LD (AE + ST + FX + Hydro); Comp CBT2 + AQ/LD (AE + ST + FX + Hydro)
B. Physical activity interventions without an aquatic component		**B. Physical acti**
Article	***Number of groups***	***Interventions***
Alentorn-Geli 2008	3	MX (AE + FX + Relax); Comp (VIB + MX (AE + FX + Relax)); control
Altan 2009	2	MX (ST + FX) (Pilates); Relax + FX
Astin 2003	2	Mindfulness meditation

Table 2. Physical activity RCTs screened out (*Continued*)

Baptista 2012	2	Dance; wait list control
Bircan 2008	2	AE; ST
Bojner 2006	2	Dance/movement; control
Bressan 2008	2	FX; AE
Buckelew 1998	4	Biof + Relax; MX (AE + ST + FX + posture + biomechanics); Comp (Biof + Relax + MX (AE + ST + FX + posture + biomechanics)); control (Educ/attention)
Carson 2010; Carson 2012	2	Comp (yoga + meditation + breathing exercises + Educ); wait list control
Demir-Gocmen 2013	2	MX (FX + Co-ord)//HPrg (FX)
Field 2003	2	COMP (self massage + FX); Relax
Fontaine 2007	2	LPA (likely mostly aerobic); Educ
Fontaine 2010; Fontaine 2011	2	LPA (likely mostly aerobic); Educ (fibro education - non ex group)
Garcia-Martinez 2011	2	Mx (AE + ST + FX); control
Genc 2002	2	MX (ST + FX + posture); non ex intervention + remedial ex (Relax + Mobil)
Gusi 2010; Olivares 2011; Adsuar 2012	2	VIB; control TAU
Hakkinen 2001; Hakkinen 2002	3	ST (fibromyalgia); ST (healthy); control (fibromyalgia)
Hammond 2006	2	COMP (Educ + SMP + MX (AE + Tai Chi + ST + FX)); Relax
Hooten 2012	2	COMP (MX (ST + FX) + program)
Hunt 2000	2	MX (AE + ST + FX); control
Isomeri 1993	3	AE; ST + Meds; AE + Meds
Jones 2002	2	ST; FX
Jones 2007; Jones 2008	4	Comp; Meds + MX (AE + ST + FX + Relax); Meds + placebo (diet recall); placebo med + MX (AE + ST + FX + Relax); Control: placebo Meds + placebo diet recall
Jones 2012	2	Tai Chi; Educ

Table 2. Physical activity RCTs screened out (*Continued*)

Joshi 2009	2	MX; Med
Kayo 2011	3	AE; ST; control
Keel 1998	2	Comp (MX (AE + FX) + Educ; Relax, group discussion); Relax
Lemstra 2005	2	Comp (MX (AE + FX + STR) + Educ + SM + SMP + massage); control
Liu 2012	2	Qi Gong//sham Qi Gong
Lynch 2012	2	Qi Gong//wait list control
Mannerkorpi 2010	2	AE (moderate intensity); AE (low intensity)
Martin 1996	2	MX (AE + FX + ST); Relax
Martin-Nogueras 2012	2	MX (FX + FX + Relax)//control
Matsutani 2007	2	Comp (Educ + laser + FX); Comp (Educ + FX)
Matsutani 2012	2	AE; FX
McCain 1988	2	AE; FX
Mengshoel 1992; Mengshoel 1993	2	AE - dance; control
Nichols 1994	2	AE; control
Norregaard 1997	3	AE; MX (AE + FX); thermotherapy
Ramsay 2000	2	AE; AE (CV)
Richards 2002	2	AE; Comp Relax + FX
Rooks 2007	4	MX (AE + FX); MX (ST + AE + FX); SMP; SMP + MX (ST + AE + FX)
Sañudo 2010a	2	MX (AE + ST + FX); Comp (MX (AE + FX + ST) + VIB)
Sañudo 2010b	3	AE; MX (AE + ST + FX); control (TAU)
Sañudo 2010c	2	AE; control
Sañudo 2011	2	MX (AE + ST); control (TAU, AAU)
Sañudo 2012	2	MX (VIB + AE + ST + FX); MX (AE + ST + FX)

Table 2. Physical activity RCTs screened out (*Continued*)

Schachter 2003	3	AE - long bout; AE - short bout; control (TAU)
Schmidt 2011	3	Comp (meditation + yoga); Comp (Relax + FX); control (wait list)
Sencan 2004	3	AE; Meds; control
Valencia 2009	2	Comp; (Relax + MX (AE + FX); FX (Mézières method)
Valim 2003	2	AE; FX
Valkeinen 2004, Valkeinen 2005	3	ST (fibromyalgia); ST (healthy); control (fibromyalgia)
Valkeinen 2008	2	MX (ST + AE); C (AAU)
van Santen 2002a	3	MX (AE + FX + ST); biofeedback; control
van Santen 2002b	2	MX (AE + FX + ST) (self selected intensity); AE (moderate to vigorous intensity)
Verstappen 1997	2	MX (AE + FX + ST + co-ordination); control
Wang 2010	2	Tai Chi; Comp (FX + Educ)
Wigers 1996	3	AE; SMT; control (TAU)
Yuruk 2008	2	MX (calisthenic AE + FX); MX (ST + FX + posture)

Key: AAU = activity as usual, AE = aerobics, AQ = aquatics, Biof = biofeedback, spa = balneotherapy, CBT = cognitive behavior therapy, Comp = composite, Educ = education, FX = flexibility, HPrg = Home program, LD = land, LPA = leisure time physical activity, LifePA = lifestyle physical activity, Meds = medication, Multi = multidisciplinary program, ~ = not, or non, MX = mixed exercise, Relax = relaxation, SMP = self management program, SMT: self management treatment, ST = strength, SM = stress management, Spa = thalassotherapy, TENS = transcutaneous electrical stimulation, TAU = treatment as usual, VIB = whole body vibration

Table 3. Outcome measure listing for included studies

Outcome	Number of studies	Measures (commonly) used
Pain	14	Current pain VAS (cm) FIQ pain SF-36 bodily pain
Fatigue	13	VAS (10 cm) FIQ fatigue SF-36 vitality

Table 3. Outcome measure listing for included studies (*Continued*)

Sleep disturbances	8	Pittsburgh Sleep Quality Index Hamilton Depression Scale - sleep items Total sleep time (average hours/day over 21 days)
Stiffness	7	VAS (10 cm) FIQ stiffness
Tenderness	11	Tender points count Dolorimeter count
Multidimensional	12	FIQ total EQ-5D SF-12
Patient-rated global	1	VAS (10 cm)
Self reported physical function	9	SF-36 physical functioning FIQ physical function SF-12
Muscle function - strength	5	Dynamic leg extension-isokinetic knee ext concentric at 60 deg/s Hand grip
Muscle function - endurance	4	LE dynamic endurance chair test - total repetitions Sit to stand chair test Grip at 10 sec UE static endurance in seconds
Muscle function - flexibility	2	Sit and reach (cm) Shoulder motion
Maximal cardiorespiratory function	3	Canadian Aerobic Fitness Test $VO2_{max}$ Cycle ergometry
Submaximal cardiorespiratory function	5	6-minute walk test Anaerobic threshold 100 m walk test
Mental health	10	SF-36 mental health sub-scale SF-12 mental health summary
Anxiety	11	Hamilton Anxiety Score FIQ anxiety State Anxiety Inventory Arthritis Impact Measurement Scale Mental Health Inventory - sub-scale anxiety Hospital Anxiety and Depression Questionnaire - anxiety

Table 3. Outcome measure listing for included studies (*Continued*)

Depression	13	FIQ Depression Beck Depression Inventory Arthritis Impact Measurement Scale Mental Health Inventory Hospital Anxiety and Depression Questionnaire
Self esteem	2	ASES (function)

ASES: Arthritis Self Efficacy Scales
FIQ: Fibromyalgia Impact Questionnaire
LE: lower extremity
VAS: visual analog scale
UE: upper extremity

Table 4. Comparison of heterogeneity in the meta-analyses with Ide 2008 included versus excluded

	With Ide 2008 included in meta-analysis	**With Ide 2008 excluded from meta-analysis**	**Difference in I^2**
Multidimensional function	Tau^2 = 0.53; Chi^2 = 45.24, df = 7 (P value < 0.00001); I^2 = 85%	Tau^2 = 0.68; Chi^2 = 18.71, df = 6 (P value = 0.005); I^2 = 68%	17% less
Self reported function	Tau^2 = 0.20; Chi^2 = 16.86, df = 5 (P value = 0.005); I^2 = 70%	Tau^2 = 0.06; Chi^2 = 6.98, df = 4 (P value = 0.14); I^2 = 43%	27% less
Pain	Tau^2 = 0.34; Chi^2 = 34.03, df = 7 (P value < 0.0001); I^2 = 79%	Tau^2 = 0.02; Chi^2 = 7.15, df = 6 (P value = 0.31); I^2 = 16%	63% less
Tenderness	Tau^2 = 0.52; Chi^2 = 30.26, df = 7 (P value < 0.0001); I^2 = 77%	Tau^2 = 0.12; Chi^2 = 14.25, df = 6 (P value = 0.03); I^2 = 58%	19% less
Fatigue	Tau^2 = 0.97; Chi^2 = 67.94, df = 6 (P value < 0.00001); I^2 = 91%	Tau^2 = 0.21; Chi^2 = 18.17, df = 5 (P value = 0.003); I^2 = 72%	19% less
Stiffness	Tau^2 = 1.28; Chi^2 = 18.92, df = 4 (P value = 0.0008); I^2 = 79%	Tau^2 = 0.59; Chi^2 = 22.65, df = 3 (P value < 0.0001); I^2 = 87%	8% more
Mental health	Tau^2 = 0.40; Chi^2 = 23.57, df = 4 (P value < 0.0001); I^2 = 83%	Tau^2 = 0.13; Chi^2 = 8.44, df = 3 (P value = 0.04); I^2 = 64%	19% less
Sleep	Tau^2 = 1.87; Chi^2 = 30.70, df = 2 (P value < 0.00001); I^2 = 93%	Tau^2 = 0.04; Chi^2 = 1.47, df = 1 (P value = 0.22); I^2 = 32%	61% less
Depression	Tau^2 = 0.48; Chi^2 = 43.27, df = 7 (P value < 0.00001); I^2 = 84%	Tau^2 = 0.16; Chi^2 = 17.04, df = 6 (P value = 0.009); I^2 = 65%	19% less

Table 4. Comparison of heterogeneity in the meta-analyses with Ide 2008 included versus excluded (*Continued*)

Anxiety	Tau² = 0.07; Chi² = 12.85, df = 7 (P value = 0.08); I² = 46%	Tau² = 0.00; Chi² = 6.34, df = 6 (P value = 0.39); I² = 5%	41% less

Table 5. Primary wellness outcomes in aquatic versus aquatic RCTs (SMDs, 95% CIs)[a]

Study	Intervention 1	Intervention 2	Multidimensional function[b]	Self reported physical function[b]
Calandre 2010	Aquatic flexibility	Ai Chi (aquatic Tai Chi)	SMD -0.35 (95% CI -0.79 to 0.09)	n/a
De Andrade 2008	Aquatic aerobic	Aquatic aerobic training in sea water	SMD -0.17 (95% CI -0.81 to 0.47)	SMD -0.26 (95% CI -0.90 to 0.38)

[a] Random-effects model.
[b] Negative numbers mean the results favor intervention 1.
CI: confidence interval; SMD: standardized mean difference

Table 6. Primary symptoms outcomes in aquatic versus aquatic RCTs (SMDs, 95% CIs)[a]

Study	Intervention 1	Intervention 2	Pain[b]	Stiffness[b]
Calandre 2010	Aquatic flexibility	Ai Chi (aquatic Tai Chi)	SMD -0.37 (95% CI -0.81 to 0.07)	SMD -0.62 (95% CI -1.07 to -0.17)
De Andrade 2008	Aquatic aerobic	Aquatic aerobic in sea water	SMD -0.06 (95% CI -0.07 to 0.58)	n/a

[a] Random-effects model.
[b] Negative numbers mean the results favor intervention 1.
CI: confidence interval; SMD: standardized mean difference

Table 7. Primary fitness outcomes in aquatic versus aquatic RCTs (SMDs, 95% CIs)[a]

Study	Intervention 1	Intervention 2	Strength	Submaximal cardiorespiratory function
Calandre 2010	Aquatic flexibility	Ai Chi (aquatic Tai Chi)	n/a	n/a
De Andrade 2008	Aquatic aerobic	Aquatic aerobic training in sea water	n/a	n/a

[a] Random-effects model.
[b] Negative numbers mean the results favor intervention 1.
CI: confidence interval; SMD: standardized mean difference

Table 8. Subgroups based on participant-related characteristics

Subgroup	Study	N	Mean	90% CI LL	90% CI UL	
Younger versus older age						**Younger versus**
YOUNGER	Altan 2004	46	43.5	42.00	45.02	
YOUNGER	Arcos-Carmona 2011	53	44.0	42.29	45.64	
YOUNGER	Mannerkorpi 2009	132	45.64	44.59	46.69	
---	Mannerkorpi 2000	57	46.0	43.87	48.17	
---	Gowans 2001	31	47.3	44.97	49.60	
OLDER	Munguia-Izquierdo 2007	53	48.2	46.52	49.85	
OLDER	Tomas-Carus 2008	30	50.8	48.19	53.41	
OLDER	Gusi 2006	34	51.0	48.37	53.63	
Short versus long disease duration						**Short versus lon**
SHORT	Gowans 2001	31	8.9	6.4	11.5	
SHORT	Mannerkorpi 2000	57	8.7	7.2	10.1	
SHORT	Mannerkorpi 2009	132	5.1	4.4	5.9	
---	Arcos-Carmona 2011	53	9.5	8.0	11.1	
LONG	Gusi 2006	34	21.5	19.1	23.9	
LONG	Munguia-Izquierdo 2007	53	14.0	11.9	16.1	
LONG	Tomas-Carus 2008	30	19.8	17.6	21.9	
Low versus high impact of fibromyalgia at baseline						**Low versus high**
LOW	Gowans 2001	31	55.7	52.4	59.1	
LOW	Altan 2004	46	60.1	57.2	63.1	
---	Gusi 2006	34	61.0	56.0	66.0	
---	Tomas-Carus 2008	30	62.0	58.3	65.7	

Table 8. Subgroups based on participant-related characteristics (*Continued*)

HIGH	Mannerkorpi 2009	132	65.5	63.2	67.8
HIGH	Munguia-Izquierdo 2007	53	66.0	62.8	69.3
HIGH	Mannerkorpi 2000	57	68.0	65.6	70.4
Low versus high pain at baseline					**Low versus high**
LOW	Arcos-Carmona 2011	53	57.5	56.3	58.8
LOW	Tomas-Carus 2008	30	60.0	53.8	66.2
LOW	Gusi 2006	34	63.5	56.4	70.6
---	Mannerkorpi 2009	132	70.9	68.3	73.5
HIGH	Mannerkorpi 2000	57	75.5	71	79.9
HIGH	Munguia-Izquierdo 2007	53	75.7	70.9	80.5
HIGH	Altan 2004	46	77.1	72.8	81.5

CI: confidence interval, LL: lower limit, UL: upper limit

APPENDICES

Appendix 1. 2011 ACSM Position Stand: Guidance for prescribing exercise

The following recommendations are from Garber 2011.

Recommendations for cardiorespiratory fitness

- Moderate intensity cardiorespiratory exercise training for ≥ 30 minutes/day on ≥ 5 days per week for a total of ≥ 150 minutes per week, vigorous intensity cardiorespiratory exercise training for ≥ 20 minutes/day on ≥ 3 days per week (≥ 75 minutes/week), or a combination of moderate and vigorous intensity exercise to achieve a total energy expenditure of ≥ 500 to 1000 MET min/week.

Recommendations for muscular fitness

- On two to three days per week, adults should also perform resistance exercises for each of the major muscle groups, and neuromotor exercise involving balance, agility, and co-ordination.
- Two to four sets of resistance exercise per muscle group are recommended but even a single set of exercise may significantly improve muscle strength and size.

- Rest interval between sets if more than one set is performed: two to three minutes
- Resistance equivalent of 60% to 80% of one repetition max (1RM) effort. For novices 60% to 70% of 1RM is recommended, for experienced exercises ≥ 80% may be appropriate.
- The selected resistance should permit the completion of 8 to 12 repetitions per set or the number needed to induce muscle fatigue but not exhaustion.
- For people who wish to focus on improving muscular endurance, a lower intensity (< 50% of 1RM) can be used with 15 to 25 repetitions in no more than 2 sets.

Recommendations for flexibility

- A series of flexibility exercises for each major muscle-tendon groups with a total of 60 seconds per exercise on ≥ 2 days per week is recommended. A series of exercises targeting the major muscle-tendon units of the shoulder girdle, chest, neck, trunk, lower back, hips, posterior and anterior legs, and ankles are recommended. For most individuals, this routine can be completed within 10 minutes.
- Stretches should be held for 1 to 30 seconds at the point of tightness or slight discomfort. Older persons may realize greater improvements in range of motion with longer stretching durations (30 to 60 seconds). A 20% to 75% maximum contraction held for three to six seconds followed by a 10- to 30-second assisted stretch is recommended for PNF techniques.
- Repeating each flexibility exercise two to four times is effective.

Appendix 2. The Cochrane Library (Wiley) search strategy

#1 MeSH descriptor Fibromyalgia explode all trees
#2 fibromyalgia
#3 fibrositis
#4 (#1 OR #2 OR #3)
#5 MeSH descriptor Exercise explode all trees
#6 MeSH descriptor Physical Exertion explode all trees
#7 MeSH descriptor Physical Fitness explode all trees
#8 MeSH descriptor Exercise Tolerance explode all trees
#9 MeSH descriptor Sports explode all trees
#10 MeSH descriptor Pliability explode all trees
#11 exertion*
#12 exercis*
#13 sport*
#14 (physical or motion) near/5 (fitness or therapy or therapies)
#15 physical* near/2 endur*
#16 manipulat*
#17 skate* or skating
#18 jog*
#19 swim*
#20 bicycl*
#21 cycle*
#22 walk*
#23 row or rows or rowing
#24 weight next train*
#25 muscle next strength*
#26 MeSH descriptor Yoga explode all trees
#27 yoga
#28 tai chi
#29 MeSH descriptor Tai Ji explode all trees
#30 MeSH descriptor Vibration explode all trees
#31 vibration

#32 pilates
#33 (#5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR # 20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR (# AND 27) OR #28 OR #29 OR #30 OR #31 OR #32)
#34 (#33 AND #4)

Appendix 3. MEDLINE (OVID) search strategy

1. Fibromyalgia/
2. Fibromyalgi$.tw.
3. fibrositis.tw.
4. or/1-3
5. exp Exercise/
6. Physical Exertion/
7. Physical Fitness/
8. exp Physical Endurance/
9. exp Sports/
10. Pliability/
11. exertion$.tw.
12. exercis$.tw.
13. sport$.tw.
14. ((physical or motion) adj5 (fitness or therapy or therapies)).tw.
15. (physical$ adj2 endur$).tw.
16. manipulat$.tw.
17. (skate$ or skating).tw.
18. jog$.tw.
19. swim$.tw.
20. bicycl$.tw.
21. (cycle$ or cycling).tw.
22. walk$.tw.
23. (row or rows or rowing).tw.
24. weight train$.tw.
25. muscle strength$.tw.
26. exp Yoga/
27. yoga.tw.
28. exp Tai Ji/
29. tai chi.tw.
30. Ai Chi.tw.
31. exp Vibration/
32. vibration.tw.
33. pilates.tw.
34. or/5-33
35. 4 and 34

Appendix 4. EMBASE (OVID) search strategy

1. FIBROMYALGIA/
2. fibromyalgi$.tw.
3. fibrositis.tw.
4. or/1-3
5. exp exercise/
6. fitness/
7. exercise tolerance/
8. exp sport/
9. pliability/
10. exertion$.tw.
11. exercis$.tw.
12. sport$.tw.
13. ((physical or motion) adj5 (fitness or therapy or therapies)).tw.
14. (physical$ adj2 endur$).tw.
15. manipulat$.tw.
16. (skate$ or skating).tw.
17. jog$.tw.
18. swim$.tw.
19. bicycl$.tw.
20. (cycle$ or cycling).tw.
21. walk$.tw.
22. (row or rows or rowing).tw.
23. weight train$.tw.
24. muscle strength$.tw.

Appendix 5. CINAHL (EBSCO host) search strategy

S1 (MH "Fibromyalgia")
S2 TI fibromyalgia or AB fibromyalgia
S3 TI fibrositis or AB fibrositis
S4 (MH "Exercise+")
S5 (MH "Exertion+")
S6 (MH "Physical Fitness")
S7 (MH "Exercise Test+")
S8 (MH "Sports+")
S9 (MH "Pliability")
S10 (MH "Physical Endurance+")
S11 TI exertion* or AB exertion*
S12 TI exercis* or AB exercis*
S13 TI sport* or AB sport*
S14 TI physical N5 fitness or TI physical N5 therapy or TI physical N5 therapies or AB physical N5 fitness or AB physical N5 therapy or AB physical N5 therapies
S15 TI motion N5 fitness or TI motion N5 therapy or TI motion N5 therapies or AB motion N5 fitness or AB motion N5 therapy or AB motion N5 therapies
S16 TI physical* N2 endur* or AB physical* N2 endur*
S17 (skate* or skating) or AB (skate* or skating)
S18 jog* or AB jog*
S19 TI swim* or AB swim*
S20 TI bicycl* or AB bicycl*
S21 TI ((cycle* or cycling)) or AB ((cycle* or cycling))
S22 TI walk* or AB walk*

S23 TI (row or rows or rowing) or AB (row or rows or rowing)
S24 TI weight train* or AB weight train*
S25 TI muscle strength* or AB muscle strength*
S26 TI manipulat* or AB manipulat*
S27 S1 or S2 or S3
S28 S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24 or S25 or S26
S29 S27 and S28
S30 S27 and S28
S31 (MH "Yoga Pose") OR (MH "Yoga")
S32 TX yoga
S33 TX tai chi
S34 (MM "Tai Chi")
S35 TX tai ji
S36 TX pilates
S37 (MH "Pilates") OR "pilates"
S38 (MH "Vibration")
S39 TX vibration
S40 S31 or S32 or S33 or S34 or S35 or S36 or S37 or S38 or S39
S41 (S27 and (S28 or S40)

Appendix 6. PEDro Physiotherapy Evidence Database (http://www.pedro.org.au/) search strategy

Terms searched:

- fibromyalg* AND fitness training
- fibromyalg* AND strength training
- fibrositis

Appendix 7. Dissertation Abstracts (ProQuest) terms

Terms searched:

- fibromyalg* or fibrositis (in citation or abstract)

Appendix 8. Current Controlled Trials (http://www.controlled-trials.com/) search strategy

Terms searched fibromyalg* or fibrositis

Appendix 9. WHO International Clinical Trials Registry Platform (http://www.who.int/ictrp/en/) search strategy

Terms searched fibromyalg* or fibrositis in Condition

Appendix 10. AMED (OVID) Allied and Complementary Medicine search strategy

OVID AMED (Allied and Complementary Medicine) <1985 to Jan 2012>
Search strategy:

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1 Fibromyalgia/ (1453)
2 Fibromyalgi$.tw. (1626)
3 fibrositis.tw. (20)
4 or/1-3 (1631)
5 exp Exercise/ (7293)
6 Physical Fitness/ (1655)
7 exp Physical Endurance/ (747)
8 exp Sports/ (3576)
9 Pliability/ (32)
10 exertion$.tw. (1129)
11 exercis$.tw. (18675)
12 sport$.tw. (4952)
13 ((physical or motion) adj5 (fitness or therapy or therapies)).tw. (8773)
14 (physical$ adj2 endur$).tw. (629)
15 manipulat$.tw. (4038)
16 (skate$ or skating).tw. (81)
17 jog$.tw. (158)
18 swim$.tw. (552)
19 bicycl$.tw. (972)
20 (cycle$ or cycling).tw. (3530)
21 walk$.tw. (7139)
22 (row or rows or rowing).tw. (174)
23 weight train$.tw. (149)
24 muscle strength$.tw. (5651)
25 exp pilates/ (22)
26 exp Yoga/ (345)
27 exp Tai chi/ (204)
28 Tai ji.tw. (6)
29 yoga.tw. (448)
30 (hatha or kundalini or ashtunga or bikram).tw. (26)
31 pilates.tw. (62)
32 exp Exercise therapy/ (4945)
33 or/5-32 (43624)
34 4 and 33 (328)

Appendix 11. Selection criteria

Level One screen

Based solely on the title of the report:

1. Does the study deal exclusively with fibromyalgia? No - exclude, Yes or uncertain - go to step two
2. Does it include exercise? No - exclude, Yes or uncertain - go to step three
3. Does the study deal exclusively with adults? No - exclude, Yes or uncertain - go to step four
4. Is it a RCT? No - exclude, Yes or uncertain - Include

Level Two screen

Based solely on the abstract of the report:

1. Does the study deal exclusively with fibromyalgia? No - exclude, Yes or uncertain - go to step two
2. Does it include exercise? No - exclude, Yes or uncertain - go to step three
3. Does the study deal exclusively with adults? No - exclude, Yes or uncertain - go to step four

4. Is it a RCT? No - exclude, Yes or uncertain - Include

Level Three screen

Based on the full text of the report:

1. Does the study deal exclusively with fibromyalgia? No - exclude,Yes - go to step two, Uncertain - add to list of questions for author and proceed to step two
2. Is the diagnosis of fibromyalgia based on published criteria? No - exclude, Yes - go to step three, Uncertain - add to list of questions for author and proceed to step 3
3. Does the study deal exclusively with adults? No - exclude, Yes - go onto step 4, Uncertain - add to list of questions for author and proceed to step 4
4. Is it a RCT? (the study uses terms such as "random", "randomized", "RCT", or "randomization" to describe the study design or assignment of subjects to groups) No - exclude, Yes - go onto step 5, Uncertain - add to list of questions for author and proceed to step 5
5. Does it include exercise (the study involves at least one intervention that includes exercise)? No - exclude, Yes - go on to step 6, Uncertain - add to list of questions for author and proceed to step 6
6. Is between-group data provided for the outcomes? No (the study contains ONLY FM, or b) results are reported such that effects on FM cannot be isolated - **exclude,** Yes - **include** the study, Yes but uncertain about one or more of steps 1 to 5 reserve judgement until authors are contacted

Level Four screen (classification of the study using team's intervention listing)

1. Classification of design
   i) Number of interventions
   ii) Type of comparisons:
      a) Head to head comparison?
      b) Exercise to control?
      c) Composite to control?
2. Control group
      a) Classify type of control
3. Exercise
   i) Enter the type of exercise interventions used in the study
   ii) Complete the naming of the intervention groups

WHAT'S NEW

Last assessed as up-to-date: 24 October 2013.

Date	Event	Description
3 October 2013	Amended	Update and restructuring of the 'Exercise for treating fibromyalgia syndrome' review. This review has been split into several reviews, each focusing on a particular type of exercise training or physical activity. This review addresses aquatic exercise training The others are: • 'Aerobic exercise for fibromyalgia' (in process); • 'Composite exercise for fibromyalgia' (in process); • 'Flexibility exercise for fibromyalgia' (in process); • 'Mixed exercise for fibromyalgia' (in process); • 'Resistance training for fibromyalgia' (published in *The Cochrane Library* 2013, Issue 12).

HISTORY

Review first published: Issue 10, 2014

Date	Event	Description
14 June 2008	Amended	Converted to new review format. CMSG ID C036-R
17 August 2007	New citation required and conclusions have changed	Substantive amendment. See published notes for details

CONTRIBUTIONS OF AUTHORS

AJB: designing and reviewing protocol for review, screening data extraction, methodological analysis, writing and reviewing manuscript.

JB: participating in discussion regarding methods, screening studies, data extraction, methodological analysis, writing and reviewing manuscript and approving the final manuscript.

CLS: designing and reviewing protocol for review, screening studies, data extraction, providing expert opinion on exercise physiology, reviewing drafts and approving the final draft of the manuscript.

SCW: participating in discussion regarding methods, screening studies, data extraction, methodological analysis, writing and reviewing drafts, and approving the final draft of the manuscript.

RR: participating in discussion regarding methods, screening studies, data extraction, methodological analysis, writing and reviewing manuscript.

AD: participating in discussion regarding methods, screening studies, data extraction, methodological analysis, writing and reviewing drafts and approving the final draft of the manuscript.

TR: performing the literature search, participating in discussion regarding methods, writing and reviewing drafts and approving the final draft of the manuscript.

TO: designing and reviewing protocol for review, screening studies, data extraction, providing expert opinion on exercise physiology, reviewing drafts and approving the final draft of the manuscript.

DECLARATIONS OF INTEREST

We confirm that any present or past affiliations or other involvement in any organization or entity with an interest in the review, which might lead me/us to have a real or perceived conflict of interest, are listed below.

- Julia Bidonde: none known
- Angela J Busch: none known
- Sandra C Webber: none known
- Candice L Schachter: none known
- Adrienne Danyliw: none known
- Tom J Overend: none known
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- Tamara Rader: none known

SOURCES OF SUPPORT

Internal sources

- School of Physical Therapy, University of Saskatchewan, Canada.
- Department of Medicine, University of Saskatchewan, Canada.
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- Institute for Work and Health, Canada.

External sources

- No sources of support supplied

NOTES

This review is one of a major update of the previous reviews completed in 2002 and 2007 on exercise and fibromyalgia. Given the growth in the literature the review has this time been split into several reviews (i.e., resistance, aquatic, mixed, aerobic, flexibility, and vibration). Methodological differences between the 2007 review and this update included the following:

- Small revisions to the search terms.
- Changes in the membership of the review team (addition of new review authors and two consumers).
- Use of the 'Risk of bias' tool (Higgins 2011b) to assess the quality of the evidence instead of van Tulder 2003.
- Methodological criteria that were used in the earlier version of the review.
- Revisions to Cochrane methods described in version 5.1.0 of the *Cochrane Handbook for Systematic Reviews of interventions* (Higgins 2011b), including 'Summary of Findings' (GRADE).
- Use of electronic data extraction methods (Google Docs) as opposed to paper-based methods used in earlier versions of the review.
- Subgroup analyses (using patient and intervention characteristics).
- Post hoc sensitivity analysis.

INDEX TERMS

Medical Subject Headings (MeSH)

Exercise Therapy [adverse effects; *methods]; Fibromyalgia [*therapy]; Hydrotherapy [adverse effects; *methods]; Muscle Strength; Randomized Controlled Trials as Topic; Treatment Outcome

MeSH check words

Adult; Female; Humans; Male