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REVIEW ARTICLE (META-ANALYSIS)

Effectiveness of Aquatic Exercise for Musculoskeletal Conditions: A Meta-Analysis

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Abstract

Objective: To investigate the effectiveness of aquatic exercise in the management of musculoskeletal conditions.

Data Sources: A systematic review was conducted using Ovid MEDLINE, Cumulative Index to Nursing and Allied Health Literature, Embase, and The Cochrane Central Register of Controlled Trials from earliest record to May 2013.

Study Selection: We searched for randomized controlled trials (RCTs) and quasi-RCTs evaluating aquatic exercise for adults with musculoskeletal conditions compared with no exercise or land-based exercise. Outcomes of interest were pain, physical function, and quality of life. The electronic search identified 1199 potential studies. Of these, 1136 studies were excluded based on title and abstract. A further 36 studies were excluded after full text review, and the remaining 26 studies were included in this review.

Data Extraction: Two reviewers independently extracted demographic data and intervention characteristics from included trials. Outcome data, including mean scores and SDs, were also extracted.

Data Synthesis: The Physiotherapy Evidence Database (PEDro) Scale identified 20 studies with high methodologic quality (PEDro score $\geq$6). Compared with no exercise, aquatic exercise achieved moderate improvements in pain (standardized mean difference [SMD] = −.37; 95% confidence interval [CI], −.56 to −.18), physical function (SMD = .32; 95% CI, .13−.51), and quality of life (SMD = .39; 95% CI, .06−.73). No significant differences were observed between the effects of aquatic and land-based exercise on pain (SMD = −.11; 95% CI, −.27 to .04), physical function (SMD = −.03; 95% CI, −.19 to .12), or quality of life (SMD = −.10; 95% CI, −.29 to .09).

Conclusions: The evidence suggests that aquatic exercise has moderate beneficial effects on pain, physical function, and quality of life in adults with musculoskeletal conditions. These benefits appear comparable across conditions and with those achieved with land-based exercise. Further research is needed to understand the characteristics of aquatic exercise programs that provide the most benefit.

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Musculoskeletal conditions are widespread and among the world's leading causes of chronic pain, disability, and reduced health-related quality of life.[1] A recent report on global burden of disease highlighted that musculoskeletal conditions account for 7% of total disability-adjusted life years, with low back pain accounting for nearly half, and osteoarthritis accounting for almost 10% of this burden.[2] Musculoskeletal conditions are also the most common cause for using health care resources.[3] This burden, reflected by endorsement of the Bone and Joint Decade 2000−2010 by the United Nations and World Health Organization, is predicted to rise because of the aging population.[4] As such, identifying and promoting effective management strategies for these conditions has been flagged as a public health priority.[5]

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There is a growing body of evidence that suggests that aquatic exercise can decrease the disease burden of musculoskeletal conditions.[6-9] The benefits of aquatic exercise arise from the physiological effects of immersion and hydrodynamic principles of exercise in the aquatic environment.[10] Buoyancy decreases compressive weight-bearing stresses on joints and allows functional exercise with lessened gravitational load, improving both strength and range of movement.[11] Additionally, immersion in thermoneutral water (34°C) decreases sympathetic nervous system activity, which in combination with the compressive effects of hydrostatic pressure can reduce swelling and perception of pain in people with musculoskeletal conditions.[10] The aquatic environment can allow higher-intensity exercises to be undertaken, with lower cardiovascular stress than is possible on land.[12]

Despite the increasing number of randomized controlled trials (RCTs) being undertaken, the most recent Cochrane systematic review published in 2007, limited to osteoarthritis studies, concluded that there remains a lack of high-quality studies in this area.[13] The meta-analysis included data from 6 RCTs and identified that aquatic exercise had a small-to-moderate short-term effect on pain, function, and quality of life compared with no intervention.[13] A more recent meta-analysis published in 2011 focused only on function, mobility, and pooled health outcomes in people with osteoarthritis or rheumatoid arthritis.[8] This review included 10 RCTs and concluded that aquatic exercise had comparable effects with land-based exercise. This review again highlighted the variability in methodologic quality of included studies, hindering the identification of true differences between the 2 modes of exercise. Reviews completed on the effects of aquatic exercise for people with fibromyalgia[6,14] and low back pain[7] have also reported positive impacts with aquatic exercise; however, they were cautious in their conclusions because of variable study quality.

Although there is evidence that aquatic exercise is an effective strategy in the management of a number of musculoskeletal conditions, the relative benefits across conditions have not been reported because previous reviews have only focused on individual conditions. Therefore, the aims of this review were (1) to systematically examine the effect of aquatic exercise on pain, physical function, and quality of life in people with musculoskeletal conditions when compared with both no exercise and land-based exercise; and (2) investigate the relative effectiveness of aquatic exercise for individual musculoskeletal conditions, including osteoarthritis, rheumatoid arthritis, fibromyalgia, low back pain, and osteoporosis.

Methods

Literature search

A systematic search of literature was conducted until May 2013. Ovid MEDLINE, Cumulative Index to Nursing and Allied Health Literature, Embase, and The Cochrane Central Register of Controlled Trials were searched to identify published research. A sensitive search strategy was developed using medical subject heading search terms and keywords (appendix 1) and translated for each database as appropriate. The references of included studies were also reviewed for further relevant literature.

List of abbreviations:

CI	confidence interval
PEDro	Physiotherapy Evidence Database
RCT	randomized controlled trial
SMD	standardized mean difference

Eligibility criteria

Study selection

Two reviewers (A.L.B. and J.T.) independently screened and excluded studies based on title and abstracts. For articles not excluded by this process, full text was obtained and assessed independently by both reviewers against the inclusion and exclusion criteria. If a decision could not be reached between the 2 reviewers, a third reviewer (R.T.M.) was called for the final decision.

Types of studies and participants

Studies were included if they were conducted as an RCT or quasi-RCT. Participants had to be diagnosed with at least 1 musculoskeletal condition using accepted arthritis and musculoskeletal diagnostic criteria. Studies with participants <18 years of age or who had recently had surgery (eg, arthroplasty, spinal surgery) were excluded.

Interventions

Studies must have included 1 group that participated in aquatic exercise and a comparison group that participated in no exercise (including nonactive activities [eg, education]) or land-based exercise. Aquatic exercise interventions were defined as any type of endurance, flexibility, strength, resistance, or aerobic exercise conducted in a pool. Other hydrotherapy methods, such as turbulent spa therapy and balneotherapy (immersion in mineralized water), were excluded because these approaches do not usually include an active exercise component.

Outcomes

Outcomes of interest were pain, physical function, and quality of life. To be included in this review, studies had to have reported outcome measures known to be responsive for measuring change in pain, physical function, or quality of life in people with musculoskeletal conditions. When 2 outcome measures were available for the same outcome, only 1 was included in the meta-analysis. Generic (nondisease) outcome measures were prioritized for inclusion in the meta-analysis followed by disease-specific measures based on priority lists defined by a prior Cochrane systematic review.[13] Outcome measures were also required to be scored on a 0 to 100 scale or have the capability to be converted to this scale. The list of outcome measures that met the inclusion criteria is shown in table 1 in descending order of priority.

Methodologic quality assessment

All included studies were assessed for methodologic quality independently by 2 reviewers (J.T. and A.L.B.) using the Physiotherapy Evidence Database (PEDro) Scale.[15] This scale rates 11 aspects of methodologic quality of RCTs as being either absent or present (appendix 2). Because the first item (eligibility criteria) is not scored, the total score ranges from 0 to 10. Studies that obtain a score of <6 points are considered low quality, whereas those with a score ≥6 points are considered high quality.[16] A third reviewer (R.T.M.) was called if consensus could not be reached.

Data extraction

Two reviewers (A.L.B. and J.T.) independently extracted data for the included studies. Demographic data (age, sex, musculoskeletal condition) and intervention characteristics (exercise components,