



Effectiveness of Hydrotherapy in Knee Arthrosis

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Abstract

Introduction: Osteoarthritis (OA) currently represents the most common type of arthritis around the world.

Objective: To review the effectiveness of hydrotherapy in knee osteoarthritis based on the systematic review of the available literature.

Materials and Methods: Systematic review based on clinical trials and randomized clinical trials. The search, identification, selection, screening and inclusion of the studies included in this review were carried out under the criteria of the PRISMA Declaration. The data was extracted from the Zotero reference processor and the data were discriminated in a Microsoft Excel data matrix. The evaluation of the methodological quality and the risk of bias was carried out from the PEDro scale for the methodological evaluation of clinical trials.

Results: 1650 titles were initially identified in PMC, Pubmed, ScienceDirect, Hinari, and Dialnet; 9 clinical trials and randomized clinical trials were finally included. The results show the efficacy and safety of interventions based on hydrotherapy as a therapeutic method in the rehabilitation of pain, function, muscle mass, gait, psychological function and health-related quality of life in patients with osteoarthritis of the knee.

Conclusions: The results of this review consider hydrotherapy as an effective and safe intervention in patients with osteoarthritis of the knees; hydrotherapy seems to be an intervention that generates greater adherence in the long term and with greater effects after a follow-up of up to 12 months.

Keywords: Hydrotherapy; Rehabilitation; Knee Joint

Introduction

Osteoarthritis (OA) currently represents the most common type of arthritis around the world. OA is usually a progressive and disabling rheumatologic condition that usually presents initially asymptotically and leads to progressive loss of function [1].

According to the *Centers for Disease Control and Prevention* of the *National Center for Chronic Disease Prevention and Health Promotion* (CDC) In the United States, OA affects about 33 million people in this country alone [2]. Osteoarthritis is a serious disease, according to the CDC, affecting 1 in 4 adults in the United States; it is estimated that by 2040 there will be 70 million people with OA in this country [3]. In contrast, according to the *Osteoarthritis Action Alliance* (OAAA), 43% of people with OA are older than 65 years, and in some countries up to 88% of people with OA are older than 45 years. On the other hand, due to gender, 62% of these people with this condition are female and up to 78% of people with osteoarthritis are non-Hispanic whites [3].

Osteoarthritis is a progressive and degenerative disease of the joints. The main causes of OA include mechanical stress factors and other factors of abnormal joint mechanics. From this, there is an invasion of proinflammatory markers and proteases at the joint level that promotes its destruction [4]. The modifications and structural changes in osteoarthritis usually affect the articular cartilage, which is usually affected by superficial fibrillation and focal erosions; these erosions usually fenestrate or invade the bone tissue, which continually involves the joints with greater dominance [5].

Injuries at the cartilage level promote damage to the collagen matrix, which implies that chondrocytes proliferate, generate cartilage hypertrophy with ossification and forming osteophytes; To the extent that damage to the collagen matrix is generated, the chondrocytes undergo apoptosis. When a dysfunctional collagen mineralizes as a result of OA, thickening of the subchondral bone is generated. Within OA, the most compromised joints include the knees, hands and hips, among others [6].

Based on the chronicity and severity of osteoarthritis on the functionality of people, there are multiple surgical and non-surgical treatments to resolve this disease. There are multiple non-surgical treatments that have been shown to be effective in reducing pain and disability, improving functionality and quality of life, however, they do not reverse the damage generated [7].

Within the standard treatment in the care of patients with symptomatic knee osteoarthritis, physical therapy and patient education are included. Different studies have shown that the combination of supervised exercises and exercise at home generates beneficial results in patients with OA, likewise, the American Academy of Orthopedic Surgeons (AAOS) recommends this treatment [8].

In accordance with the above, international clinical practice guidelines establish that a rehabilitation program accompanied by patient education is the best effective treatment proposal for patients with OA. In contrast, currently multiple studies have shown that interventions with water therapy or hydrotherapy contribute with different benefits in patients with knee osteoarthritis, as well as providing greater safety and generating fewer complications associated with treatment [9,10].

Finally, multiple studies propose hydrotherapy as an intervention strategy that offers multiple physiological and biomechanical benefits. Thus, hypothetically it is defined that interventions in water increase muscle strengthening, active mobilization and reduce pain. Likewise, the aquatic environment provides an ideal environment to work, taking into account the hydraulic and buoyancy principles [11,12]. Taking into account the above, this study aims to review the effectiveness of hydrotherapy in knee osteoarthritis based on the systematic review of the available literature.

Materials and Methods

Design

A descriptive systematic review study was developed from available clinical trials and randomized clinical trials. This study was developed taking into account the ethical and bioethical considerations described in the World Medical Declaration in Helsinki.

Search strategy

The search, identification, selection, screening and inclusion of the studies included in this review were carried out under the criteria of the PRISMA Declaration [12] (Transparent Reporting Items for Systematic Reviews and Meta-Analyses) for the construction and development of systematic reviews no meta-analysis.

The search strategy combined with the boolean operators AND and OR was as follows

("hydrotherapy"[MeSH Terms] OR "hydrotherapy"[All Fields]) AND ("osteoarthritis, knee"[MeSH Terms] OR "osteoarthritis"[All

Fields] AND “knee”[All Fields]) OR “knee osteoarthritis”[All Fields] OR (“knee”[All Fields] AND “osteoarthritis”[All Fields]))

Selection of studies

For the selection of the studies included in the systematic review, each one of the authors was in charge of carrying out this process, and the different studies selected by title were listed and identified at first through the Zotero reference processor, which was synchronized between all researchers.

After searching and selecting studies by title, one author (JC, QG) reviewed each of the included titles and the feasibility of inclusion in the systematic review. Two other authors (AM, GS; AY, HM) were responsible for applying the eligibility criteria for the inclusion of these studies in the systematic review. A fourth and fifth author (Y, HM; ML, GM) were designated responsible for the background review of each of the studies selected for full text analysis.

Selection criteria

Eligibility criteria included scientific studies published in journals indexed in databases in any language, clinical trial type and randomized clinical trial, study with conclusive results, studies with human beings greater than or equal to 18 years, and studies with statement of considerations ethics and bioethics. On the other hand, duplicate studies were excluded, with a methodological design different from clinical trials and randomized clinical trials, studies in children under 18 years of age and in case of financial or ethical conflicts of interest.

Collection and extraction

The data was extracted from the *Zotero reference processor* and the data were discriminated in a *Microsoft Excel* data matrix; data were discriminated based on the name of the main author, year of publication, sample size (*n*), diagnosis, intervention and control groups, intervention methodology, findings and final considerations.

Quality evaluation

The evaluation of the methodological quality and the risk of bias of the studies finally included was carried out based on the scale for the methodological evaluation of clinical trials included in PEDro systematic reviews [14] (*Physiotherapy Evidence Database*). This Scale, developed from the Delphi list prepared by Verhagen., *et al.*

(1998) [14], includes 10 items that assess internal validity [2-9] and statistical information from clinical trials [10-11]; The PEDro Scale assigns 1 point for the fulfillment of each item that is evaluated.

In this process, two authors (JC, QG., Y, HM) evaluated the methodological quality of the studies. Each of the authors applied the PEDro Scale independently for each of the included clinical studies. In case there was any difference on the points assigned in the PEDro scale, a third author (AM, GS) would make an assessment of the application of the scale.

Participants

Subjects of both genders with an age equal to or greater than 18 years of age, from different regions of the world with a diagnosis of OA and included in a rehabilitation program through water therapy or hydrotherapy were included.

Results

Study selection results

Initially 1650 titles were identified after the initial search of documents in the databases PMC: (*n* = 595), Pubmed: (*n* = 161), ScienceDirect: (*n* = 655), Hinari: (*n* = 234) and Dialnet: (*n* = 5). Next, 736 studies were excluded because they were white literature (*n* = 5), gray literature (*n* = 626), had designs other than clinical trials (*n* = 97), because they included a population <18 years of age; there were no animal studies or studies with financial or ethical conflicts of interest. Finally, 90 studies were included for the full text review, of which 27 studies remained for the analysis of met objectives and conclusive findings, which finally left a total of 9 clinical trials and randomized clinical trials included in the systematic review (Figure 1).

Results of the evaluation of the quality of the evidence

According to the previous description, 9 clinical trials and randomized clinical trials were included for the development of this study. The investigations included in this systematic review were subjected to a methodological evaluation to determine the methodological quality of the available evidence and the selection bias, according to the PEDro considerations. The results of this evaluation finally determined a mean of 9.33 for the PEDro Scale with a qualifier of “Good”, according to the criteria of Cashin., *et al.* [13] for the quality of the evidence of the studies included in this research (Table 1 and 2).

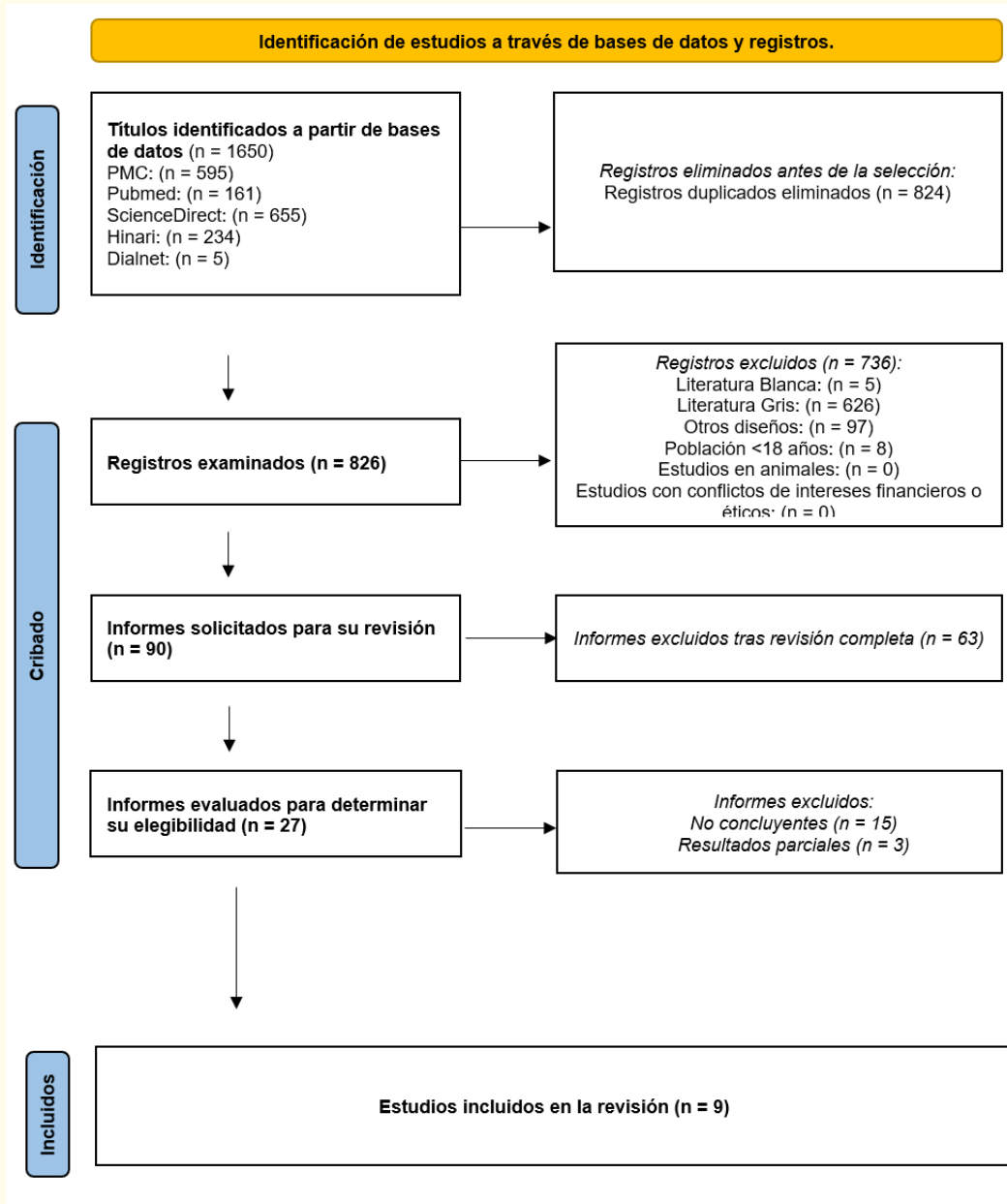


Figure 1: PRISM diagram.

Reference	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	Total
Foley A. (2003) [15]	+	+	+	+	-	-	-	+	+	+	+	8
Fransen M. (2007) [16]	+	+	+	+	+	-	+	+	+	+	+	10
Silva LE. (2008) [17]	+	+	+	+	-	-	+	+	+	+	+	9
Gill SD. (2009) [18]	+	+	+	+	-	-	+	+	+	+	+	9
Valtonen A. (2010) [19]	+	+	+	+	-	-	+	+	+	+	+	9
Waller B. (2017) [20]	+	+	+	+	-	+	+	+	+	+	+	10
Dias JM. (2017) [21]	+	+	+	+	+	+	+	+	+	+	+	eleven
Taglietti M. (2018) [22]	+	+	+	+	-	-	+	+	+	+	+	10
Alonso-Rodríguez AM., (2021) [23]	+	+	+	+	-	-	-	+	+	+	+	8

Table 1: Evaluation of the methodological quality of clinical trials (n = 14).

PEdRo (Physiotherapy Evidence Database): + Yes; - No.

P1: Selection criteria; P2: random assignment; P3: Allocation concealment; P4: Similar groups at baseline; P5: Blinding of participants; P6: Blinding of therapists; P7: Assessor blinding; P8: Dropouts < 15%; P9: analysis by intention to treat; P10: Reported differences between groups; P11: Estimated point and reported variability.

Author	n	Participants	groups	Intervention	Findings	Conclusions
Foley A., (2003) [15]	105	Participants aged 50 years or older with clinical OA of the hip or knee.	GE1: Hydrotherapy GE2: Gymnastics CG: Control	The two exercise groups had three exercise sessions per week for 6 weeks. At 6 weeks, all outcome assessments (muscle strength dynamometry, 6-minute walk test, WOMAC OA index, total medications, SF-12 quality of life, activity profile) were performed by an independent physical therapist who was blinded to treatment assignment. Adelaide and Arthritis Self-Efficacy Scale).	The hydrotherapy group increased left quadriceps strength only at follow-up. The hydrotherapy group was significantly different from the control group in the distance walked and the physical component of the SF-12. Compliance rates were similar for both exercise groups, with 84% hydrotherapy and 75% attended gym sessions.	Functional gains were achieved with both exercise programs compared to the control group.
Fransen M., (2007) [16]	152	Older participants with symptomatic chronic osteoarthritis of the hip or knee.	GE1: Hydrotherapy GE2: Tai Chi CG: Control	Participants were randomly assigned for 12 weeks to hydrotherapy classes, Tai Chi classes, or a wait-list control group. Outcomes were assessed 12 and 24 weeks after randomization and included pain and physical function, general health status, psychological well-being, wellness and performance.	Participants assigned to hydrotherapy classes demonstrated mean improvements in pain and physical function scores. Assignments to both classes achieved significant improvements in the physical component total score, but only assignment to hydrotherapy achieved significant improvements in measures of physical performance. All significant improvements were maintained at 24 weeks. Class attendance was higher for hydrotherapy.	Hydrotherapy or Tai Chi interventions can provide significant and sustained improvements in physical function for many sedentary older people with chronic hip or knee osteoarthritis.

Silva LE., (2008) [17]	74	Participants with knee osteoarthritis.	GE1: Water therapy GE2: Therapy on land	Outcome measures included a VAS for pain in the previous week, the WOMAC, pain during walking assessed by a VAS at rest and immediately after a 50-foot (15.24-m) run.) walk test (50FWT), walking time measured at fast and comfortable paces during the 50FWT, and the Lequesne index. Measurements were recorded by a blinded investigator at baseline and at 9 and 18 weeks after starting the intervention.	The 2 groups were homogeneous in all parameters at the start of the study. Reductions in pain and improvements in WOMAC and Lequesne index scores were similar between groups. Pain before and after 50FWT decreased significantly over time in both groups. However, the water exercise group experienced a significantly greater decrease in pain than the land exercise group before and after 50FWT at week 18 of follow-up.	Hydrotherapy was superior to exercise on land in relieving pain before and after walking at last follow-up. Water exercises are a suitable and effective alternative for managing knee OA.
Gill SD., (2009) [18]	82	Participants awaiting elective hip or knee joint replacement surgery.	GE1: Hydrotherapy GE2: The rapist on the ground GC: Control	participants were evaluated immediately before and after the 6-week intervention, then 8 weeks later. Primary outcomes were self-reported pain and function and patient global assessment. Secondary outcomes were performance-based measures and psychosocial status.	Although both interventions were effective in reducing pain and improving function, there were no post-intervention differences between groups for primary and secondary outcomes. However, the hydrotherapy group felt less pain immediately after the exercise classes.	The water intervention appears to have a more favorable effect on pain immediately after exercise classes.
Valtonen A., (2010) [19]	fifty	Participants 4 to 18 months after unilateral knee replacement	SG: Hydrotherapy GC: Control	12-week progressive aquatic strength training or no intervention. Mobility limitation assessed by gait speed and stair climbing time, and self-reported physical functional difficulty, pain, and stiffness assessed using the WOMAC questionnaire. Knee extensor strength and knee flexor strength.	Habitual walking speed increased and stair-climbing time decreased in the aquatic training group. There was no significant difference between groups in WOMAC scores. Training increased knee extensor power in the operated leg, knee flexor power.	Progressive aquatic resistance training had favorable effects on mobility limitation by increasing gait speed and decreasing stair-climbing time. In addition, the training increased muscle power in the lower limbs.
Waller B., (2017) [20]	87	Postmenopausal female participants with mild knee osteoarthritis	SG: Hydrotherapy GC: Control	The intervention group participated in 48 supervised intensive aquatic resistance training sessions over 4 months. Body composition was measured with DXA. 2 km walking speed and knee injury and osteoarthritis outcome score were measured.	After the 4-month intervention there was a significant decrease in fat mass and an increase in walking speed in favor of the intervention group. Body composition returned to baseline after 12 months. In contrast, the increase in walking speed was maintained.	High-intensity aquatic resistance training decreases fat mass and improves gait speed in postmenopausal women with mild knee osteoarthritis.

Dias JM., (2017) [21]	73	Female participants aged 65 years or older with knee osteoarthritis	SG: Hydrotherapy GC: Control	The hydrotherapy group received the intervention program in a heated pool twice a week for 6 weeks and an educational protocol. Primary outcomes were pain intensity assessed with the WOMAC questionnaire. Secondary outcomes were knee flexor and extensor muscle performance.	The hydrotherapy group had better results for pain and function. Patients who received hydrotherapy had better performance in knee flexor and knee extensor strength, knee flexor power, and knee extensor endurance.	Older women with knee osteoarthritis may benefit from a course of hydrotherapy exercises.
Taglietti M., (2018) [22]	60	Older participants with knee osteoarthritis.	SG: Hydrotherapy GC: Control	An eight-week aquatic exercise treatment protocol of 16 individual sessions, twice a week. Pain, function, quality of life, functional mobility and depression were taken as main measures.	WOMAC functional capacity values were reduced in favor of the exercise group. No differences were found for the outcomes functional mobility or depression.	Aquatic exercise improved pain and function after eight weeks, and function at three months follow-up compared with the patient education program.
Alonso-Rodríguez AM., (2021) [23]	115	Older participants with total knee arthroplasty	SG: Hydrotherapy GC: Control	The TKA patients received a first rehabilitation phase of 15 sessions of 60 minutes in the gym. In the second phase, 15 sessions of 40 minutes, one group performed physiotherapy in a gym and another in a swimming pool. Different variables were evaluated: functional capacity, pain and stiffness with the WOMAC index, joint balance with a goniometer; muscle strength with Lovett scale, and 6-minute walk test result.	After the second phase of rehabilitation, greater clinical improvements were observed in the pool group, with statistically significant differences in pain, stiffness, joint balance, and muscle strength in the operated knee, and in the result of the 6-hour walk test. minutes.	In patients with TKA, hydrotherapy during the second phase of rehabilitation treatment was more effective than physical therapy in the gym in terms of improvement of pain, stiffness, joint balance, muscle strength and gait tests.

Table 2: Observational and experimental studies included (n = 14).

CG: Control Group; EG: Experimental Group; VAS: Visual Analog Scale; WOMAC: Western Ontario and McMaster University Osteoarthritis Index; CSA: Muscle Cross-Sectional Area; DXA: Dual Energy X-Ray Absorptiometry; TKA: Total Knee Arthroplasty.

Analysis of the information

Characterization

The total of studies finally selected included a total of 798 patients with mild, moderate and severe osteoarthritis of the knee with an age from 45 years to over 80 years of age. Some studies included participants with total knee replacement or awaiting surgery. Interventions included hydrotherapy with comparators such as: Tai-chi, gym, educational program or no control intervention; Interventions with water therapy were performed for a period be-

tween 6 weeks and 12 weeks, at a frequency of 2 to 3 times per week.

Primary measures included: muscle strength dynamometry, 6-minute walk test, WOMAC OA index, total medications, SF-12 quality of life, Adelaide activity profile, arthritis self-efficacy scale, visual analog scale, gait (50FWT), Lequesne index, dual X-ray densitometry, joint balance with goniometer, and muscle strength with Lovett scale.

Effectiveness of interventions with hydrotherapy in knee osteoarthritis

A study by Foley, A., *et al.* [15], sought to compare the effects of a hydrotherapy resistance exercise program with a gym resistance exercise program on strength and function in the treatment of osteoarthritis. The population was randomly divided into three groups: hydrotherapy (n = 35), gym (n = 35) or control (n = 35). The two exercise groups had 3 exercise sessions per week for 6 weeks. In the gym group, both the left and right quadriceps increased significantly in strength compared to the control group. The hydrotherapy group was significantly better than the control group in the distance walked and the physical component of the SF-12. The gym group was significantly better than the control group in terms of walking speed and satisfaction with self-efficacy. Compliance rates were similar for both exercise groups, with 84% hydrotherapy and 75% attended gym sessions. There were no differences in drug use between the groups during the study period.

Another study conducted by Fransen, M., *et al.* [16], sought to determine whether Tai-Chi or hydrotherapy classes for people with symptomatic chronic osteoarthritis (OA) of the hip or knee generate measurable clinical benefits. In this investigation, a randomized controlled trial was conducted with 152 elderly people with symptomatic chronic osteoarthritis of the hip or knee. Participants were randomized for 12 weeks to hydrotherapy sessions (n = 55), Tai Chi sessions (n = 56), or a waiting list control group (n = 41). Outcomes were assessed at 12 and 24 weeks after randomization and included pain and physical function (Western Ontario and McMaster Universities Osteoarthritis Index), general health status (Short Form Health Survey-12 of the Medical Outcomes Study [SF-12], version 2), psychological well-being, well-being and physical performance (*Up and Go test*, 50-step walk time, timed stair climbing). At 12 weeks, compared to controls, participants assigned to hydrotherapy classes demonstrated improvements in pain and physical function scores. Both intervention assignments achieved significant improvements in the SF-12 physical component total score, but only hydrotherapy achieved significant improvements in measures of physical performance. All significant improvements were maintained at 24 weeks; class attendance was higher for hydrotherapy at 81% compared to 61% for Tai Chi.

However, in a study by Silva, LE., *et al.* [17], the effectiveness of hydrotherapy and exercises on land was evaluated in subjects with knee OA; 64 subjects were randomly assigned to 1 of 2 groups

that exercised for 18 weeks. Outcome measures included a visual analog scale (VAS) for pain in the previous week, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), pain during walking assessed by a VAS at rest and immediately after of a 50-foot (15.24-m) run, walk test, time, and Lequesne's index. Within outcomes, reductions in pain and improvements in WOMAC and Lequesne index scores were similar between groups. Pain before and after 50FWT decreased significantly over time in both groups. However, the hydrotherapy group experienced a significantly greater decrease in pain than the exercise group.

In another context, Gill, SD., *et al.* [18], compared the preoperative effects of multidimensional exercise programs on land (n = 40) and hydrotherapy (n = 42) for people awaiting hip joint replacement surgery or knee. Each 6-week program included an educational session, exercise classes twice a week, and an occupational therapy home evaluation. Participants were evaluated immediately before and after the 6-week intervention, and then 8 weeks later. Primary outcomes were self-reported pain and function (Western Ontario and McMaster Universities Osteoarthritis Index) and patient global assessment. Secondary outcomes were performance-based measures (timed walk and chair standing) and psychosocial status (36-item short-form health survey mental component score). Pain was also measured before and after each exercise class on a 7-point verbal rating scale. Although both interventions were effective in reducing pain and improving function, there were no post-intervention differences between groups for primary and secondary outcomes. However, the hydrotherapy group had less pain immediately after the interventions.

Accordingly, Valtonen, A., *et al.* [19] studied the effects of aquatic resistance training on mobility, muscle strength, and quadriceps cross-sectional area; 50 participants aged 55 to 75 years 4 to 18 months after unilateral knee replacement were included. A 12-week progressive aquatic strength training was applied, and self-reported gait speed and stair climbing time, physical functional difficulty, pain and stiffness assessed using the Western Ontario Questionnaire and WOMAC were assessed. Knee extensor strength and knee flexor strength were assessed isokinetically, and thigh muscle cross-sectional area by computed tomography. Compared to the control group, habitual walking speed increased by 9% and stair-climbing time decreased by 15% in the hydrotherapy group. Training increased knee extensor power by 32% in the operated leg and 10% in the non-operative leg, and knee flexor power by

48% in the operated leg and 8% in the non-operative leg compared to controls. The mean increase in CSA of the thigh muscle of the operated leg was 3% and that of the non-operated leg was 2% after training compared to controls; there was no significant difference in WOMAC scores.

Waller, B., *et al.* [20] investigated the effects of 4-month intensive aquatic resistance training on body composition and gait speed in postmenopausal women with mild knee osteoarthritis (OA), post-intervention and postoperatively. 12-month follow-up. This randomized clinical trial assigned eighty-seven postmenopausal female volunteers to an intervention group (n = 43) of 48 intensive sessions of aquatic resistance training and a control group (n = 44). Body composition was measured with dual-energy X-ray absorptiometry (DXA). 2 km walking speed and knee injury and osteoarthritis outcome score (KOOS) were measured. After the 4-month intervention there was a significant decrease in fat mass and an increase in walking speed in favor of the intervention group. Body composition returned to baseline after 12 months, in contrast, the increase in gait speed was maintained. No changes in lean mass or KOOS were observed.

Consistent with previous studies, Dias, JM., *et al.* [21], evaluated the impact of hydrotherapy on pain, function, and muscle function in older women with knee osteoarthritis. Seventy-three women aged 65 years or older were randomized to hydrotherapy (n = 36) or a control group (n = 37). The hydrotherapy group received the intervention program in a heated pool twice a week for 6 weeks and an educational protocol. Primary outcomes were pain intensity and function assessed with the WOMAC questionnaire. Secondary outcomes were knee flexor and extensor muscle performance assessed using an isokinetic dynamometer. The hydrotherapy group had better results for pain and function. Patients who received hydrotherapy had better performance in knee flexor and knee extensor strength, knee flexor power, and knee extensor endurance.

Like the previous study, Taglietti, M., *et al.* [22] compared the effectiveness of aquatic exercises in people with knee osteoarthritis. They included a total of 60 patients aged 68.3 years with clinical symptoms and knee osteoarthritis. An 8-week treatment protocol of twice-weekly aquatic exercise (n = 31) and an educational program (n = 29). Pain, function, quality of life, functional mobility, and depression were assessed. At the end of treatment, WOMAC func-

tional capacity values were reduced in favor of the aquatic exercise group for both the total score. The total score was also reduced at 12-month follow-up. No differences were found for the outcomes functional mobility or depression. On the other hand, Alonso-Rodríguez, AM., (2021) [23], evaluated the efficacy of hydrotherapy versus hydrotherapy in patients with knee OA. The patients received a first phase of rehabilitation (15 sessions of 60 minutes) in the gym. In the second phase (15 sessions of 40 minutes), one group underwent physiotherapy in a gym and another in a swimming pool. Different were evaluated: functional capacity, pain and stiffness with WOMAC index, joint balance with goniometer; muscle strength with Lovett scale, and 6-minute walk test result. After the second phase of rehabilitation, greater clinical improvements were observed in the hydrotherapy group with statistically significant differences in pain, stiffness, joint balance and muscle strength in the knee and in the result of the 6-minute walk test.

Discussion

The results of this review, which included 9 randomized clinical trials, show the efficacy and safety of interventions based on hydrotherapy as a therapeutic method in the rehabilitation of pain, function, muscle mass, gait, psychological function and quality of life. health-related life in patients with OA of the knees. However, some studies show that there is no significant difference between interventions in water versus interventions on land, but the effects of the inherent rehabilitation of the modality are ratified.

In a study by Batterham, *et al.* [24] the effects of aquatic exercise compared to land exercise on function, mobility, or perception of participants in arthritis programs were investigated; included ten randomized controlled clinical trials comparing terrestrial with aquatic exercise for adults with arthritis. No differences in outcomes were observed for the two rehabilitation strategies in the meta-analysis. There was considerable variability between trials in key program features, including exercises prescribed and quality of design. Most trials poorly reported the components of the exercise programs. This study suggests that post-aquatic exercise for adults with arthritis appears comparable to post-exercise on land. When people are unable to exercise on land, or find it difficult to exercise on land, aquatic programs provide a favorable alternative strategy. As in our review, this review defines that there are multiple studies that show similar results between rehabilitation on land and in water in patients with knee OA, but they also confirm that there

is a greater integration of the patient in the wet environment having taking into account patient safety and the low risk of adverse events.

In another study, Al-Qubaeissy, *et al.* [25] evaluated the effectiveness of hydrotherapy in the management of patients with RA; included six randomized controlled clinical trials. Most studies reported favorable results for a hydrotherapy intervention compared to no treatment or other interventions for people with osteoarthritis (OA) of the knee. Improvement was particularly noted in reduced pain, joint tenderness, mood symptoms and tension, and increased grip strength and patient satisfaction with short-term hydrotherapy treatment. This study finds that hydrotherapy has a positive role in reducing pain and improving the health status of RA patients compared to no or other short-term interventions. In contrast to our research, the results indicating that the results with short-term hydrotherapy are evident and are prolonged over time are also reinforced.

Compared to the previous study, Waller B., *et al.* [26] performed a systematic review with meta-analysis to determine the effect of hydrotherapy on symptoms and function associated with lower extremity OA; 11 studies met the inclusion criteria and were included in the synthesis and meta-analysis. Meta-analysis showed a significant effect of hydrotherapy on pain, self-reported function, and physical functioning. In addition, a significant effect on stiffness and quality of life was observed. Like our review, this systematic review and meta-analysis indicate that hydrotherapy is effective in managing symptoms associated with lower limb OA.

Facing the effectiveness of aquatic exercise for the treatment of knee osteoarthritis (OA), Lu M., *et al.* [27] reviewed included six RCTs (398 participants) in a systematic review. This study, like our review, showed that there is moderate evidence of a moderate effect on physical function in favor of aquatic exercise immediately after the intervention, however, in this study it is defined that there is no evidence of pain reduction or improvement in QoL (quality of life) when aquatic exercise was compared to no exercise. Only one trial reported 3 months of follow-up measurements, which showed limited evidence of pain improvement with aquatic exercise and no evidence of QoL or physical function when aquatic exercise was compared with no exercise. Based on these results, this review concludes that aquatic exercise is effective and safe and can

be considered as an adjunctive treatment for patients with knee osteoarthritis but contradicts our findings by considering that it is not effective in reducing pain and improving quality of life. life in general.

Years later, Dong., *et al.* [28] systematically reviewed the effectiveness of aquatic exercise (AQE) compared to land exercise (LBE) in the treatment of knee osteoarthritis (OA); Eight RCTs were included, with a total of 579 patients. The meta-analysis showed that there were no significant differences between hydrotherapy and land-based exercise for pain relief, physical function, and improvement in quality of life, for both short-term and long-term interventions, in patients with osteoarthritis of the knee. However, the level of adherence and satisfaction for hydrotherapy was higher than for exercise on land. Compared with no intervention, hydrotherapy showed a modest effect in elevating activities of daily living. Hydrotherapy is comparable to exercise on land for the treatment of knee OA. In contrast, Song., *et al.* [29] reviewed more recent articles not included in earlier studies to assess the effect size of aquatic exercise-based interventions on pain, quality of life, and joint dysfunction in patients with osteoarthritis. This review including 20 randomized clinical trials showed that aquatic exercise produced a reduction in pain compared to a control group, and aquatic exercise was effective in reducing pain compared to a land exercise group. The meta-analysis showed that aquatic exercise produces an improvement in quality of life and a reduction in joint dysfunction compared to a control group. Thus, this review and meta-analysis concludes that, for patients with osteoarthritis, aquatic exercise-based interventions are effective in reducing joint pain and dysfunction and improving quality of life. These last two recent reviews [28,29] coincide with our results when considering hydrotherapy as an effective intervention to improve quality of life, physical function, pain, and contribute to improving the levels of adherence to rehabilitation interventions.

According to the available scientific literature, there is scientific evidence that can show the effectiveness and safety of interventions through water therapy in patients with knee OA, however, the size of the effect in multiple studies after months of follow-up decreases. Different systematic reviews and meta-analyses reinforce the evidence of the effectiveness of hydrotherapy in these patients, however, recent clinical trials are encouraged.

Conclusions

The results of this review consider hydrotherapy to be an effective and safe intervention in patients with osteoarthritis of the knees, similar to therapy on land. On the other hand, hydrotherapy seems to be an intervention that generates greater adherence in the long term and with greater effects after a follow-up of up to 12 months. New clinical trials are needed to establish the effectiveness of hydrotherapy as a rehabilitation intervention compared to other conventional treatment modalities in knee osteoarthritis.

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