

## SYSTEMATIC REVIEW

**EFFECTIVENESS OF AQUATIC EXERCISES FOR THE MANAGEMENT OF KNEE OSTEOARTHRITIS: A SYSTEMATIC REVIEW**

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**ABSTRACT**

**Introduction:** Knee osteoarthritis (OA) is one of the commonest problems in general population that is more likely to increase in future as the population ages. Aquatic exercises are advanced non-invasive techniques used in the management of knee OA. This research aims to provide evidence regarding effects of aquatic exercises and its general feasibility in reducing pain, improve body function and quality of life (QOL).

**Material & Methods:** A systematic review was conducted following PRISMA guidelines. Literature search was done using PubMed and PEDro database. Randomized Controlled Trials using different mesh terms related to knee OA and aquatic intervention were included. The main outcome parameters were pain, range of motion, power and QOL.

**Results:** We identified a total of 32 studies for this systematic review. After screening, 15 articles were included. All studies showed that aquatic exercises may decrease pain and increase ROM. The result suggests that aquatic exercises are effective in decreasing pain and increasing ROM, muscles power and QOL.

**Conclusion:** Aquatic exercises are effective for the patients with knee OA. Aquatic exercises decrease knee joint pain, reduce joint stiffness and enhance walking speed, range of motion, muscle power and QOL.

**Key Words:** aquatic exercise, knee osteoarthritis, quality of life, range of motion

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**INTRODUCTION**

Knee Osteo Arthritis (OA) is a persistent deteriorating disorder of knee joint.<sup>1</sup> Individuals with OA complain of joint pain, loss of activity and muscle weakness leading towards poor health and QOL. Additionally, loss of productivity and personal economic stress are related with ongoing disease.<sup>2</sup>

Frequency of knee OA is about 7-33% in general population.<sup>3</sup> Approximately 40% of people older than 75 years suffer from knee OA.<sup>4</sup> Therapeutic exercise is considered as a useful intervention technique and is recommended in various guidelines as a non-pharmacologic treatment technique for knee

OA.<sup>5</sup> Evidence is present regarding transient impact of aquatic exercises in aged people with knee OA.<sup>6</sup> A 12-week session of reasonable intensity may increase joint flexibility, muscle power and aerobic capability.<sup>7</sup> Different properties of water, utilized by aquatic exercises helps promote and restore health. Hydrotherapy has a long therapeutic history and is gaining more attention lately.<sup>8</sup> Properties of water such as buoyancy helps reduce weight bearing and its heating effect has reported to release contractures, reduce pain, and ease muscle spasms.<sup>9</sup> It improves muscle strengthening because water acts as resistance and much greater muscle power is required.<sup>10</sup> Aquatic exercises are comfortable, easier for the body and is more enjoyable for the patient.<sup>11</sup> Aquatic exercises have been used as a treatment technique for more than 18 years.<sup>12</sup> The practice of hydrotherapy feels better and appears to enhance QOL.<sup>13</sup> Many previous studies have assessed effectiveness of hydrotherapy in general population including patients with chronic diseases.<sup>12</sup> However, comprehensive research is needed for specific implications as knee OA in middle and aged patients. Recent existing clinical practice guidelines strongly recommend hydrotherapy or other aquatic exercises to be used as a treatment protocol for knee OA especially.<sup>13</sup> Exercise is a comprehensive concept that includes many forms such as resistance, isokinetic and aerobic exercises. All types of exercises show remarkable improvement in knee OA symptoms but aquatic exercises especially help enhance functional mobility and QOL significantly.<sup>14</sup> Aquatic exercises have many advantages compared to land-based exercises.<sup>15</sup> Numerous studies in Pakistan have used aquatic therapy to treat conditions like ankle sprains, cerebral palsy, and autism, demonstrating its effectiveness and feasibility. However, no such study has been conducted for knee osteoarthritis using aquatic therapy, promoting its efficacy and benefits. Therefore, this systematic review seeks to evaluate the efficacy of aquatic exercises for people with knee OA.

## **MATERIAL AND METHODS**

A systematic review was conducted through PRISMA guidelines. Evaluation of each study was done using eligibility criteria. Literature was searched through PEDro and PubMed

database. Additional search was done using Google Scholar. Articles were searched from 15th August 2000 to 27th August 2020. Two reviewers individually searched titles, abstracts and full text articles using the search strategy; (“aquatic exercise” OR “hydrotherapy” OR “water exercises” OR “water aerobics” OR “aquatic fitness”) AND (“knee osteoarthritis” OR “knee arthritis” OR “arthritis” OR “degenerative joint disease” OR “knee degenerative joint disease”). Initially 217988 articles were retrieved from both databases. Randomized Control Trials published in English language were included only. We included articles which assessed effectiveness of aquatic exercises in people with knee OA. Other studies such as systematic review, cross sectional surveys, observational studies, editorials, short communication and conference papers were excluded. Detail methodology of inclusion and exclusion criteria is explained in the form of PRISMA flow chart in figure 1.

## **RESULTS**

We identified a total of 217988 studies for this systematic review. Initially searched articles identified through PubMed were 215559 while 2429 studies were identified through PEDro. After duplicate removal, we excluded 214988 studies. Titles and abstracts of the rest of articles were screened, out of which 2971 studies were excluded because they were reviews or non-English articles or the intervention used in those studies were other than aquatic exercise. Articles were screened according to our eligibility criteria. Finally, 15 articles were selected for this review (Figure 1). The selected articles were published from 2000-2020. Out of total studies, 15 Randomized Controlled Trails met our eligibility criteria for our systematic review. Selected 15 articles in this systematic review included 948 participants and majority of the articles studied the effects of aquatic exercises in patients with knee OA. The selected RCTs showed good parameter, prognosis, relief from pain, improvement in QOL as well as enhancing physical performance and aerobic capacity. Few studies showed that aquatic exercises decreased leg tiredness and enhanced cardio respiratory capability. Other studies suggested that the use of aquatic exercises was a good choice for patients with knee OA and also increased knee joint ROM. On the other

hand, studies highlighted that land based exercises were painful for these patients. Total resistance water exercise increased walking speed and decreased knee stiffness. Each study was scored according to PEDro scale as shown in table 2, except those who did not have adequate information to be scored in accordance with PEDro scale guidelines also shown in table 2.

## DISCUSSION

This study involves systematic literature review of RCTs focusing on Effects of Aquatic exercise on the management of knee OA in terms of reducing pain, improving body function and quality of life (QOL). Fifteen studies were filtered on the basis of inclusion and exclusion criteria. Overall, the findings imply that exercise had a favourable impact on at least one outcome variable in the trials that were analysed. Additionally, exercise appears to be an efficient method of controlling knee OA, bringing about favourable physical and functional results.

Aquatic exercises have beneficial effects for patients with knee OA. Aquatic training is one of the main non-pharmaceutical interventions suggested for lower limb OA, however, evidence regarding strength of most favourable training is uncertain. Among fifteen studies, seven studies reported that Hydrotherapy sessions help in reducing knee joint pain while Yazigi et al reported hydrotherapy exercises reduces knee symptoms including pain associated with knee OA.

The most prominent variable studied in our study was Pain which showed significant improvement after aquatic exercises regime similarly the same phenomena has been explained in several studies supporting the effects of exercises in OA patients' knee pain reduction earlier reviews.<sup>16</sup> Similarly, 4 studies have advocated for aquatic exercises in terms of increase in ROM for knee flexion and extension. Whereas according to international studies there were no significant changes in joint ROM of knee extension and knee flexion in the aquatic group compared to the group receiving no aquatic physical treatment. Studies using joint ROM of knee extension revealed high heterogeneity, but knee flexion showed moderate variability.<sup>17</sup> Aqua-cycling is used to enhance knee ROM, lower limb muscle power and aerobic ability in all populations,

where land-based exercises are uncomfortable for certain individuals.<sup>6</sup> Vigorous water resistance exercises are useful in reducing fat mass as well as refine walking velocity in post-menopausal women with mild knee OA.<sup>5</sup> In Contrast to no treatment, a 6-week agenda of water physical therapy resulted in a lesser amount of pain and better physical activity, increased power, and improved QOL.<sup>2</sup> When assessing a 12 week follow up, individuals engaged in hydrotherapy had better outcomes such as improved functional activity level and QOL.<sup>18</sup>

Clinically, muscular strength is crucial because it helps to protect joints by acting as a shock absorber and a joint stabilizer.<sup>16</sup> In our review 5 studies have favoured aquatic exercises for enhancing muscular strength while one of the recent review published has also supported our regarding increase in knee extensors muscles while on the other hand aquatic exercises, showed no effect on other major muscle groups, possibly due to insufficient intervention intensity or duration to cause physiological changes in muscle structure.<sup>19</sup> Out of fifteen included studies, only two of the studies have favoured increase in QOL of patient with knee OA while previously published systematic reviews have shown contradictions in their results projecting both, improvement and no significant effects associated with QOL in knee OA.<sup>20</sup>

We suppose that water exercise, can raise the balance among forces in the lower-limb joints (adduction/abduction and flexion/extension moments at knee and hip joints) in all direction, hence improving walking pattern.<sup>21</sup> Adjacent to the profit of land-based work out, aquatic exercises might also enhance QOL as well as psychological well being in overweight patients with knee OA.<sup>12</sup> When compared aquatic exercises to general exercise, the decrease in symptoms and increased mobility were observed as 92% for aquatic and 85% for other land based work out.<sup>22</sup> Events related to water based treatment due to its cohesive property can be very effective for muscle reinforcement, hydrostatic stress which chains and stabilizes the clients and increase balance to execute workout without any fear, warm water can direct to decrease pain and muscle stiffness, buoyancy which reduce loading of joints, and the solitary aspects of water-based work out

which may allow patients to workout easily which they would be not able to carry out on ground.<sup>23</sup>

## CONCLUSION

We conclude that aquatic exercises are effective in patients with knee OA. Aquatic exercises decrease knee joint pain, reduce joint stiffness and enhance walking speed, ROM of the knee, power and QOL.

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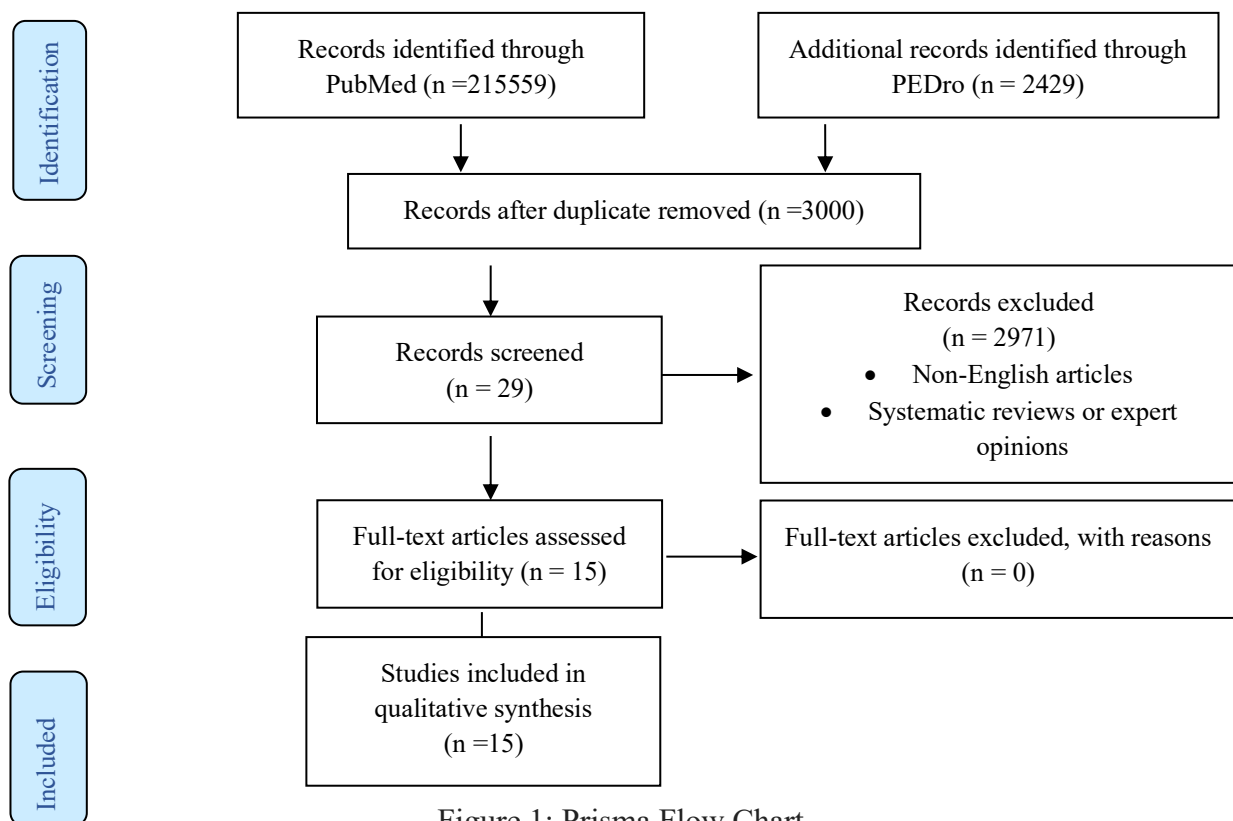


Figure 1: Prisma Flow Chart



Table 1: details of the studies included in this review

Author/Year	Interventional Group	Control Group	Interventional Group Regime	Results
Tirza Z.Tamin Et Al (2018)	Exercise Group=15, Control Group=18	Control Group=18	Aquatic Exercise Session For 6 Weeks	For overweight patients with sub-acute pain, hydrotherapy sessions results in decreased lower limb fatigue along with preventing lower limb injury, enhancing cardio respiratory capacity and improve general and psychological health.
Marcelo Taglietti Et Al (2018)	Exercise=31 Control Group=29	Control Group=29	Aquatic Exercise Session For 8 Weeks And 3 Month Follow-Up	Water based exercise help in reducing pain, increasing physical activity after 8 weeks regime while also improves balance after 3 months of follow-up.
Shirin Assar Et Al (2020)	Exercise Group=12 Control Group=12	Control Group=12	Aquatic Total Resistance Exercise For 12 Month Follow-Up Session	Total resistance exercise could be suggested by physical therapists as a suitable protocol for patients with knee OA it increases quadriceps power, knee flexion rom and decrease stiffness of knee OA.
Stefanie Rewald Et Al (2020)	Exercise Group=55 Control Group=47	Control Group=47	Aquatic Exercises Given For 12 Weeks Of Hydrotherapy Session	Hydrotherapy exercise agenda decreased self-reported knee pain and enhanced physical performance in patients with mild to moderate knee OA.
Tsae-Jyy Et Al (2006)	Exercise Group=20 Control Group=18	Control Group=18	Aquatic Exercises Given For 12 Weeks Of Hydrotherapy Session	Hydrotherapy session of reasonable intensity may progress joint flexibility, lower limb muscles power and aerobic capability.

Rewald Et Al (2016)	Alcalde Et Al (2017)	Benjamin Waller Et Al (2013)	Hans Lund Et Al (2008)	Rana S Hinman Et Al (2007)	Jesus Casilda Lopez Et Al (2017)
Exercise Group = 84	Exercise Group=15,	Exercise Group =35	Exercise Group=27	Exercise Group=36,	Exercise Group=17
Control Group =84	Control Group=15	Control Group =35	Control Group=27	Control Group=35	Control Group=17
Hydrotherapy Session For 12 Weeks Follow-Up	Hydrotherapy Session For 12 Weeks	Hydrotherapy Session Of 4 Months Intervention And 12 Month	Hydrotherapy Program For 8 Weeks And 3 Months Follow-Up	Hydrotherapy Session For 42 Days	Hydrotherapy Session For 2 Months
Aqua cycling improves rom of the knee, increase lower extremity strength and aerobic capacity.	The use of hydrotherapy is an efficient tool in the recovery of motor skills in patient with knee OA. There is solid evidence that aquatic exercises are effective in reducing pain and improving functional activities.	Aquatic exercise can mildly reduce knee and can cause slight improvement in function, strength and ROM.	The observation of current study was 92% adequate for hydrotherapy and 85% for basic exercise, with all targeted population when engaged in exercise session.	Hydrotherapy sessions result in reduced pain and better physical activity, power and quality of daily living.	Aquatic dance-based exercise program considerably enhanced task level, cardio respiratory ability, decreased post exercise heart rate and muscular fatigue.

Mohammed Alkattan Et Al (2016)	Yazigi Et Al (2013)	Jae-Young Lim Et Al (2010)	B. Waller Et Al (2017)
Exercise Group =24	Exercise Group = 25	Exercise Group=26	Exercise Group=43,
Control Group =24	Control Group = 25	Control Group=24,	Control Group=44
Hydrotherapy For 12 Sessions For 12 Weeks	Hydrotherapy Session For 12 Weeks	Hydrotherapy Session 3 Times A Week For 8 Weeks	Hydrotherapy Session For 12 Months Follow-Up
Daily swimming exercises decrease joint pain and rigidity related with knee OA and facilitate muscle power, functional level in middle and older aged patients with knee OA.	The PICO agenda associated with this study promotes awareness about effectiveness of aquatic exercise scheme in reducing knee OA by reducing symptoms and upgrade quality of life.	Aquatic exercise decreases the amount of pain interfering with physical functions and ADLS, thus aquatic exercise may be efficient for obese individuals having trouble with traditional exercises because of pain associated with knee OA.	Short duration and high strengthening aquatic resistance training program reduce fat mass and enhance walking speed in post-menopausal women with light knee OA, only walking speed were sustained for 12 months follow-up.



Table 2: PEDro Scale Scores for Individual Study

<i>PEDro Scale Scores for Individual Study</i>											
Study	1	2	3	4	5	6	7	8	9	10	Total
Tsae-Jyy et al 2006	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6/10
Stefanie Rewald et al 2020	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7/10
Shirin Assar et al 2020 RCT	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	8/10
Marcelo Taglietti et al 2018 RCT	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7/10
Tirza Z.Tamin et al 2018 RCT	Yes	No	Yes	No	No	No	No	No	Yes	Yes	4/10
Jesus Casilda Lopez et al 2017 RCT	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8/10
Rana S Hinman et al 2007 RCT	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8/10
Hans Lund et al 2008 RCT	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8/10
Benjamin Waller et al 2013 RCT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alcalde et al 2017 RCT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rewald et al 2016 RCT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B.Waller et al 2017 RCT	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6/10
Jae-Young Lim et al 2010 RCT	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7/10

Yazigi et al 2013 RCT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mohammed Alkatan et al 2016	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	7/10
<p>PEDro: Physiotherapy Evidence Database                      1 random allocation, 2 concealed allocation, 3 baseline comparability, 4 blinding of subject,                      5 blinding of therapists, 6 blinding of assessors, 7 more than 85% follow-up, 8 intention-                      to-treat analysis, 9 reporting of between-group statistical comparisons, 10 reporting of                      point measures and measures of variability</p>											