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Effects of using hydrotherapy on chronic knee osteoarthritis

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Millions of people around the world suffer from chronic knee osteoarthritis, also known as degenerative joint disease. There is a breakdown of cartilage and bone in the knee joint due to this degenerative disorder.

This bachelor's thesis aims to investigate the effects of hydrotherapy on chronic knee osteoarthritis.

The methodology for this bachelor's thesis was based on a literature review. It follows the key tenets of systematic search. PubMed, ScienceDirect, Wiley Library, and manual search were all thoroughly used. For this thesis, seven articles were selected, including randomized controlled trials, meta-analyses of randomized trials, and prospective intervention studies that met the inclusion criteria.

According to the relevant results, hydrotherapy has been proven to be an effective treatment for chronic knee osteoarthritis. At the end of the follow-up period of four to eight weeks, hydrotherapy reduces knee pain and increases the quality of life, muscle strength, muscle power, and muscle resistance, which leads to maintaining long-term effectiveness.

Based on the findings of this bachelor's thesis, hydrotherapy appears to have a positive effect on individuals with chronic knee osteoarthritis. In addition to decreasing knee discomfort, these exercises also increase muscle strength, power, and endurance. Medical professionals may suggest hydrotherapy as a potential treatment option for patients with chronic knee osteoarthritis.

Key Words	Knee, Osteoarthritis, Hydrotherapy, Physiotherapy, Aquatic therapy, Exercise, Physical Therapy, Chronic

Contents

1. Introduction

Osteoarthritis is one of the persistent conditions that causes pain, discomfort, and joint movement restrictions. People with chronic knee osteoarthritis have trouble standing up from a sitting position, climbing stairs, and walking long distances. These functional restrictions significantly impact their daily lives in general. Thus, the only available treatments are those that address the patient's symptoms and those that stop the disease from progressing further. (Hunter, Schofield & Callander, 2014.)

Aquatic physical therapy is a vital primary intervention method for many rehabilitation programs. Currently, the researchers itself involved in doing a hydrotherapeutic study which ensures that all the aspects including pain or discomfort and physical function must be taken into account to enhance the success of treatment. Also, they must evaluate outcomes in light of the latest suggestions. Also to enhance the potential advantages of hydrotherapy for patients suffering from osteoarthritis of the knee, it is better if future investigations prioritize improving water's hydrostatic and hydrodynamic properties. (Ma et al., 2022.)

Osteoarthritis is a debilitating condition that affects people's ‘quality of life’. It generally consumes significant healthcare resources and increases socioeconomic expenses. Moreover, due to the combined effects of aging, increasing obesity rates, and rising joint injury rates the prevalence of this disease is on the rise. Over 250 million people worldwide are affected by osteoarthritis, according to statistics. (Hunter, Schofield & Callander, 2014.)

Moreover, hydrotherapy is commonly used in rehabilitation programs for various medical conditions such as rheumatoid arthritis, fibromyalgia, stroke, and Parkinson's disease, as reported (Bidonde et al.2014). It is vital to investigate ways to stop the disease from progressing further. Hydrotherapy would be the exercise for osteoarthritis patients. The temperature and compression of water can improve blood circulation and reduce joint distress and stiffness due to the water’s resilience, thereby reducing the pressure on joints, bones, and muscles. Aquatic physical therapy produces higher treatment compliance than other types of therapy and doesn't worsen joint problems. (Park et al., 2011.)

2. Background

2.1 Chronic knee osteoarthritis

The most prevalent sign of knee osteoarthritis is pain, which is also a key contributor to chronic impairment and disability directly related to osteoarthritis (Alshami, 2014). Complex causes of osteoarthritis result from the interaction of systemic and local components. All ages, from young to old, are affected by osteoarthritis. The origin of this severe condition has multiple genes associated with its occurrence. Adolescent athletes have an increased tendency to get early-onset osteoarthritis if they participate in sports, sustain joint injuries, are overweight, or have a genetic susceptibility. (Blagojevic et al., 2010.)

Three common symptoms are advised for knee osteoarthritis: persistent knee discomfort, minimal morning stiffness, and decreased function (Alshami, 2014). Various factors influence joint osteoarthritis, including age, gender (with females being more prone), obesity, knee injuries, joint laxity, bone density, muscle weakness, and repetitive joint movements. By recognizing risk factors, especially in weight-bearing joints, and implementing the appropriate therapy, osteoarthritis can be minimized, as can future pain and impairment. (Zhang & Jordan., 2010). Mechanical forces on the joints, which are influenced by body mass index, significantly increase osteoarthritis. This risk factor is modifiable. (Lementowski & Zelicof, 2008.)

Although clinical signs and a physical examination can usually diagnose knee osteoarthritis, joint damage must be identified to confirm the diagnosis and determine the level of joint involvement. Conventional plain radiography is typically the first step in the diagnostic process to demonstrate the relationship between structure and pain in knee osteoarthritis. The symptoms of osteoarthritis include inflammation, stiffness, crepitus, limited mobility, and joint pain, affecting wrists, hips, knees, backs, and necks. As a result of the disease mechanism, the entire joint system is affected, including articular cartilage, ligaments, synovial membranes, capsules, subchondral bones, and periarticular muscles. In epidemiological studies, osteoarthritis is the most common musculoskeletal ailment that causes disability, sick days, and difficulty walking and climbing stairs. (Wenham & Conaghan, 2009; Bartels et al., 2016.)

Articular cartilage mainly consists of proteoglycans, type II collagen, chondrocytes, and water.

Each component of articular cartilage must always be in balance with one another for any cartilage deterioration to be countered by synthesis. As collagen and proteoglycans are reduced in osteoarthritis, degradative enzymes, such as matrix metalloproteases (MMPs), are overexpressed, altering the equilibrium. Early in osteoarthritis, chondrocytes secrete matrix metalloproteinases inhibitors that promote proteoglycan production and control degradation. Yet this corrective action falls short. Although more proteoglycans are synthesized and water content increases, the collagen pattern becomes disorganized, and the equilibrium is disrupted. This causes a flexibility reduction in the relevant articular cartilage somehow and a decrease in the number of proteoglycans. (Houard, Goldring & Berenbaum, 2013; Kisand et al., 2018.)

A decrease in chondrocyte quantity and type, the activation of catabolic and hypertrophic differentiation, and the eventual loss of cartilage are all indications of osteoarthritis. Vascular channels should make chemical communication easier for the bone and cartilage. When stimulated repeatedly, chondrocytes alter their phenotypic and express a certain group of genes. These mediators enter the synovial fluid and stimulate synovial macrophages and fibroblasts, leading to an inflammatory response. Although knee osteoarthritis and aging are closely associated, it's crucial to remember that knee osteoarthritis is a disease in and of itself. Osteoarthritis and aging are associated with variations in cartilage. Additionally, whereas normal aging cartilage expresses cartilage-degrading enzymes at normal levels, knee osteoarthritis exhibits increased levels of these enzymes. (Hsu & Siwiec, 2019; Houard, Goldring & Berenbaum, 2013.)

2.2 Hydrotherapy

Aquatic therapy involves physical activities or manual therapies done in water. The unique benefit of this type of therapy is that it provides effective exercise without causing discomfort. Hydrotherapy has been shown to benefit several physiological systems, such as the circulatory, pulmonary, metabolic, and musculoskeletal systems. Aquatic therapy involves a variety of techniques, including in aquatic therapy, including passive submersion in mineral, hot, or cold water. Exercise therapy, saunas, and spas may also be included. In aquatic exercise, hydrostatics and hydrodynamics are used to design obstacles that encourage physical activity for better health. The health benefits of aquatic exercise can be attributed to the qualities of water, such as its warmth, which eases pain and muscular spasms. (Mooventhan& Nivethitha, 2014; Silva et al., 2008.)

Balance exercises can be safely performed in water before they can be performed on land. By increasing metabolism, water resistance accelerates weight loss and increases muscle mass.

The benefits of gradually increasing weight bearing are added to underwater treadmill work. The therapist has the flexibility to instantly alter the tread speed as necessary. The water is usually heated between 32°C and 36°C. Osteoarthritis patients may benefit from water exercise. Hot water is supposed to help arthritis patients feel less pain and stiffness in their muscles and skeletal system and relax their muscles. Therefore, aquatic exercise may be more advantageous than comparable training on land as the first phase of exercise therapy for arthritis patients. Exercise therapy is intended to help persons with osteoarthritis gain better strength and control over their knee joints. This will enhance their sensorimotor control and lead to compensatory functional stability. (Chiquoine et al., 2018; Bartels et al., 2016.)

Aquatic physical therapy does not exacerbate joint problems compared to other types of interventions (Lund et al., 2008). Hydrotherapy or aquatic therapy is a non-drug therapy that has recently gained attention for treating osteoarthritis. Hydrotherapy may be the initial therapeutic option for patients with knee osteoarthritis, as it provides short-term benefits and makes joint movement easier due to water's weight-relieving properties. Aquatic therapy is a common treatment method for musculoskeletal disorders and its effectiveness is assessed using functional tests and surveys. Despite the use of functional tests in aquatic therapy, it remains a popular choice for treating these conditions. (Cuesta-Vargas et al., 2020.)

Patients with osteoarthritis may benefit from water therapy, as the resilience of water reduces the weight that joints, bones, and muscles must support (Biscarini and Cerulli, 2007). It is recommended for the treatment of knee and hip osteoarthritis and other well-known conditions such as fibromyalgia. The 'Hubbard bath' is used for cleansing and debridement of burns or skin, and the treatment of musculoskeletal pain and osteoarthritis. The surrounding water relieves the pressure on the bones and joints and often relieves swelling and edema by massaging, as well as reducing muscle spasms and spasms. (Soto-Quijano & Grabois, 2011.)

There are many techniques and tactics used in hydrotherapy, and many of them use water as a medium to promote thermoregulatory responses. Although it took some time for the physiological mechanisms behind these advantages to become fully understood, the therapeutic effects have long been acknowledged. Practitioners concentrated particularly on the use of heat and cold therapies to produce "profound reflex responses," such as vasodilation and vasoconstriction, as physiologists' understanding of physiological processes expanded. Physiological mechanisms like thermoregulation, which are now reasonably well understood and support hydrotherapy practice, affect blood flow and related metabolic processes. Along with changing

blood pressure, one may change blood flow throughout the body by tightening or relaxing certain arterioles in the skeletal muscles, skin, and abdominal region. (Lin et al., 2014.)

2.3 Treatment effects of using hydrotherapy for chronic knee osteoarthritis

Aquatic physiotherapy, which involves immersion in warm water, is the basis of the safest and often most effective methods for osteoarthritis of the knee. Most hydrotherapy programs tend to enhance functional capacity as well as pain threshold and 'quality of life' in elderly individuals suffering from osteoarthritis of the knee. Examining the impact of hydrotherapy on chronic knee osteoarthritis is the goal of this bachelor's thesis. This 'Randomized Controlled Trial' determined the effects of aquatic therapy on elderly patients with osteoarthritis of the knee. Clinical experience supports the use of water rehabilitation activities in a scientific study. The intended outcomes are believed to be the result of a well-designed training regimen in addition to the usual physical and other physiological effects of immersion in warm water. Depending on their placement in the aquatic intervention group, volunteers will either get the intervention, be put in a control group, or receive no intervention at all. By the administration of nociceptive stimuli at four anatomical locations of the knee, pain perception was measured using a well-known visual analog scale. Less severe pain, more flexibility, increased functional ability, and expected improved quality of life were all reported by aquatic intervention group participants. Knee osteoarthritis treatment seeks to improve patient functioning, slow the expected progression of the illness, and enhance and carry the patient's quality of life. This is done by managing discomfort, stiffness, and other relevant symptoms. (Alcalde et al., 2017; Ickinger & Tikly, 2010.)

In terms of minimizing joint loading, lowering the risk of injury, and significantly lessening pain, hydrotherapeutic or aquatic exercises may be better for patients with osteoarthritis than land-based physical activity programs (Vaile et al., 2007). During a 4-week hydrotherapy treatment, this was done to look out at the patient's self-perceived functional status and level of discomfort in their knee osteoarthritis. The participants had to complete a 4-week hydrotherapeutic program which was guided by a physiotherapist. The 4-week hydrotherapy treatment, per the results, significantly reduced discomfort and significantly improved each participant's perception of their functional status. The study found that patients with knee osteoarthritis who received the 4-week hydrotherapy treatment reported reduced pain in extremities and improved self-perceived physical function levels. Also, the outcomes that were received showed that the ability to do each of the participant's particular daily tasks has been improved, with reduced knee discomfort and greater function as well. The clinical implications show that four weeks of twice-weekly hydrotherapy exercises in a well-heated pool may reduce the pain up to expectations

and enhance the expected functional status in those knee osteoarthritis patients as well. (Sekome & Maddocks, 2019.)

A meta-analysis that combined the results of 11 studies conducted on patients suffering from osteoarthritis in the knee and hip joints has shown that aquatic exercises have positive effects on reducing pain, and unusual stiffness, enhancing physical function, and also the quality of life (Waller et al., 2014). To evaluate the immediate and long-term benefits of a well-designed, 8-week holistic rehabilitation approach on functioning, physical activity, and overall health status in women who have long-term knee osteoarthritis, a "systematic review" with "meta-analysis of Randomized Controlled Trials" was carried out. Individual comprehensive rehabilitation or aqua training groups for females with recurrent osteoarthritis of the knee were selected at random. The results of the research show that the 8-week individualized holistic rehabilitation program improved functional, physical activity, and overall health status in women who have severe knee osteoarthritis compared to an aquatic training program. (Song & Oh, 2022.)

Yet another Randomized Controlled Trial was conducted to examine the safety as well as the effectiveness of aquatic exercise therapy for the management of knee and hip osteoarthritis. Two review authors simultaneously selected trials for inclusion, assessed the internal validity of the trials, and obtained information from the research. The acquired data were examined using standardized mean differences. By the end of therapy for combined knee and hip osteoarthritis, there was a low-to-moderate influence on the “quality of life” and a slight-to-moderate impact on function. The discomfort was shown to have a minimal effect with a 3% absolute reduction and a 6.6% relative collapse from baseline. Shortly after the therapy concluded, there was no change in the patient's capacity to walk or degree of stiffness. Just one experiment compared land-based exercise with aquatic exercise and only participants with knee osteoarthritis. Very quickly, there was a noticeable decrease in discomfort, but there was no evidence that the therapy had any effect on stiffness or mobility. It seems that various kinds of Aquatic exercises have some expected beneficial short-term benefits for patients who have suffered from “hip and/or knee osteoarthritis” but couldn’t find any longer-term benefits as expected. So it suggests that those who have osteoarthritis may choose to start a lengthier fitness regimen that includes water training. (Bartels et al., 2016.)

3. Aim and Methods

3.1 Aim

The purpose of this bachelor's thesis is to investigate the effects of hydrotherapy on chronic knee osteoarthritis.

3.2 Search Strategy

Using pre-set search strategies that combined keywords, all kinds of study methods were used as the strategy for collecting data. This literature review focused on publications that were published after the year 2010. To maintain the standard of the research used the most recent research articles, due to improvements and new techniques of hydrotherapy that occurred. Inclusion and exclusion criteria are briefly described in Table 1. Databases including PubMed, Wiley Library, Science Direct, and manual search were used to have the desired results. The searches were conducted between December 2022 and April 2023. English was used as the publication language and all the other languages were excluded. In Figure 1 the thesis's flow chart is shown.

Search words: "chronic knee osteoarthritis" AND hydrotherapy OR "aquatic exercises", "chronic knee osteoarthritis" AND physiotherapy OR "physical therapy" AND "aquatic exercises", "chronic knee osteoarthritis" AND "aquatic therapy" OR "water exercises"

Table 1: Inclusion and Exclusion criteria that are used in this thesis

	Inclusion criteria	Exclusion criteria
Publication Date	Research articles published after the year 2010	Research articles published before the year 2010
Publication language	Results articles published in English	Articles that are not published in English
Method	"Randomized controlled trials", "Meta-analyses of randomized trials", and "prospective intervention studies"	All the other study methods were excluded.
Contents	Hydrotherapy or aquatic/water exercises used in physiotherapy, Chronic knee osteoarthritis,	Articles that are not related to Chronic knee osteoarthritis. Articles that used a different treatment method instead of hydrotherapy.

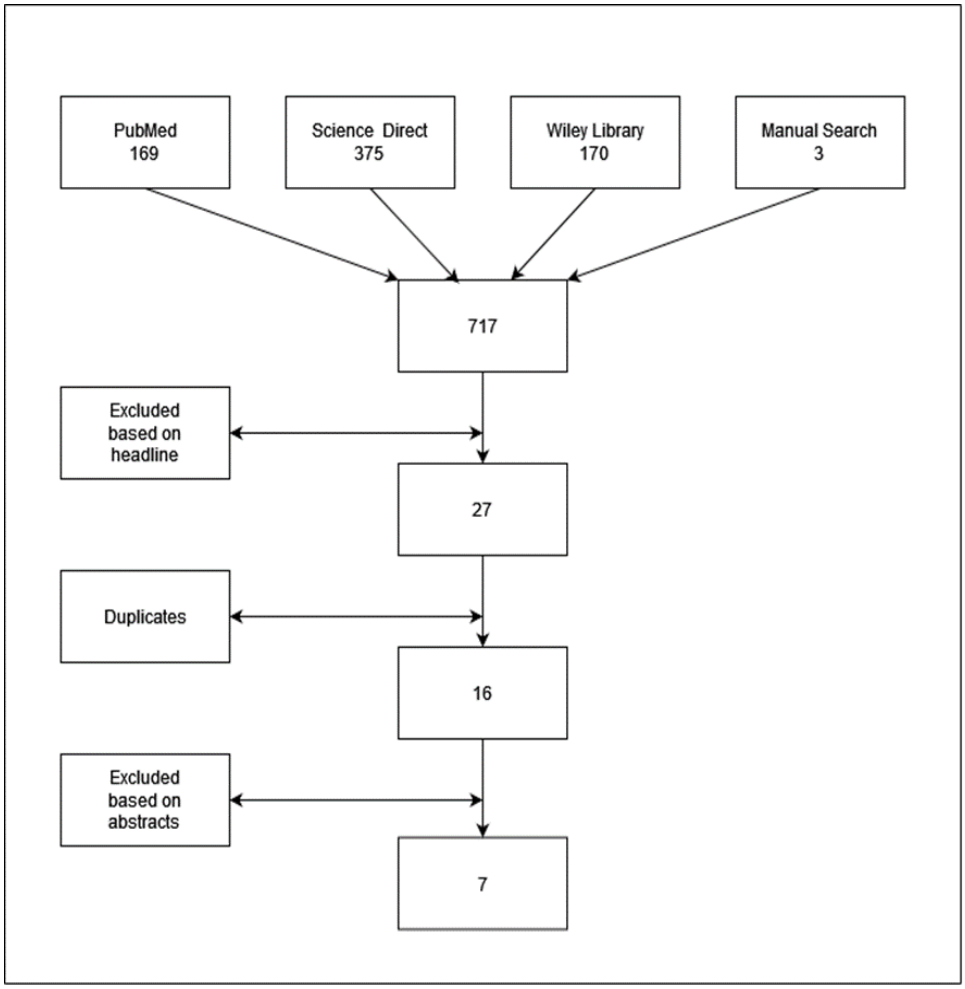

Figure 1: Thesis flowchart of the process

When searching the databases selection was able to locate a larger number of articles including 717 but most of those are not even related to chronic knee osteoarthritis. So, by reading the headlines, we excluded all of those and were able to reduce the amount to 27. Then we excluded the duplicates that were found and reduced it to 16. Considering the abstract, we excluded 8 of 15, because those articles didn't follow up the relevant exact criteria. Eventually, considered only 7 articles eligible.

4. Results

Seven research publications were chosen for analysis, and all different types of study methods were included by the inclusion and exclusion criteria. Three publications from a manual search

and four articles from PubMed were used in this thesis.

Authors, Year, and place	**Purpose of the study**	**Methods**	**Participants**	**Intervention**	**Results and conclusion**
(Bartels et al., 2016)	To compare the effects of aquatic exercise to no intervention for those who have osteoarthritis in their knees, hips, or both.	”Randomized controlled trials”	Most (75%) were women, with a mean age of 68 years and ages between 62 and 74.	The people included in the study did therapy, indoor swimming, and any form of exercise, such as medication, other treatments, or lifestyle transition.	Both disability and pain were lowered by five points, and “quality of life” was increased by seven points. This was compared to the control group, which showed a reduction in pain, disability, and also “quality of life”.
(Sekome & Maddocks, 2019)	A 4-week hydrotherapy treatment enhanced self-perceived functional status and discomfort in people with knee osteoarthritis.	”Randomized controlled trials”	The physiotherapist provided a 4–8-week hydrotherapeutic intervention to 18 patients with chronic knee osteoarthritis.	60-minute strength training sessions twice a week, including a warm-up and a cool-down.	Patients with knee osteoarthritis reported reduced pain and improved physical function after a 4-week hydrotherapy session, with reduced knee pain and improved ability to perform daily tasks.
(Dias et al., 2017)	To find out whether Hydrotherapy can improve muscle function, pain, and also function, in older women who	”Randomized controlled trials”	This involved 73 elderly women who have “knee osteoarthritis”.	Divided into three sections: a warm-up, strengthening exercises, and a cool-down session (5 min). During the six weeks, progressive	A well-planned six-week hydrotherapy program combined with an educational program resulted in greater short-term improvements in both function and pain in

	have “knee osteoarthritis”.			workouts were done twice a week.	those women with “knee osteoarthritis” than in an educational program alone.
(Ma et al.,2022)	“To find out the advantages of using aquatic physical therapy as a rehabilitation plan for people with knee osteoarthritis.”	Meta-analysis of Randomized Trials and Systematic Review	There were 883 participants have included in it.	Pain, physical function, and “quality of life” were assessed using “Western Ontario and McMaster University pain”, “Visual analog scale score”, and “Knee injury and osteoarthritis outcome score scales”.	Aquatic physical therapy engages in enhancing pain, physical function, knee extension strength of muscles, and walking capacity in patients with osteoarthritis in the knee. The Meta-analyses showed that aquatic physical treatment significantly improved Western Ontario and McMaster University’s physical function.
(Azizi et al., 2019)	“To evaluate the impact of aquatic exercise on older individuals with knee osteoarthritis in terms of pain, gait, and balance.”	Randomized Controlled Trials	32 Male patients with knee osteoarthritis who were less than 60 years old.	Participants in the intervention group performed 24 sessions of an aquatic exercise program for 8 weeks, lasting 60 minutes each session with a warm-up, strength training, and cool-down.	Comparing the group intervention to the group control, there was a significant reduction in pain. Patients who attended group sessions had better balance and walking.
(Mary et al., 2014)	“To identify the feasibility and efficacy of a	Prospective Intervention Study	Twenty elders above 65 years	Professional physiotherapists delivered group	Also, Aquatic exercise has been shown to re-

	community-based aquatic exercise program for elderly people with knee osteoarthritis."		old (average age, 72 years)	and individual exercises twice weekly for 10 weeks.	duce knee pain, improve body balance, and improve psychological health for older persons with arthritic knees, even without weight-bearing activities.
(Tirza & Natalia, 2018)	"To find out whether aquatic exercise can improve cardiorespiratory endurance and quality of life in obese patients with knee osteoarthritis."	"Randomized controlled trials"	Conducted on thirty-three obese patients with knee osteoarthritis.	Exercises for aerobic fitness and knee strength were offered, and also cardiorespiratory endurance was measured using the Borg Scale.	Emotional problems, energy/fatigue, and pain/discomfort parameters were enhanced mostly in the "land-based exercise group', while leg fatigue, energy/fatigue, "emotional well-being", and "general health metrics" improved in aquatic exercise.

The above articles mostly focused on investigating outcomes such as muscle strength/power/resistance, "knee pain", and "quality of life". Also, a few of the article's joint symptoms, physical function, walking ability, and body composition were among the outcomes that were investigated.

Knee pain: Out of 7 articles, 6 articles have indicated that knee pain has been reduced (Bartels et al., 2016, Mary et al., 2014, Sekome & Maddocks, 2019, Dias et al., 2017, Ma et al., 2022, Azizi et al., 2019). Bartels et al. (2016) observed that compared to a control group, aquatic exercise only marginally improved both pain and disability over the short term "(SMD 0.31, 95% CI 0.47 to 0.15; 12 trials, 1076 participants)". Based on the evidence of intermediate quality, individuals who participated in the aquatic exercise had mean pain and mean disability scores that were five points lower on a scale of 0 to 100. More than half of the respondents, according to Mary et al., 2014, treated their knee pain with analgesic ointment or patches before having an

aquatic exercise program created by a physiotherapist. Only one patient exercised expressly to reduce knee pain and stiffness in addition to taking medication. After the Physiotherapist designed the aquatic exercise program, fewer participants (19 vs. 4; P=0.004) were taking medications, and fewer (from four to one) were depending on oral analgesics, indicating that knee pain has been significantly reduced.

According to Sekome & Maddocks (2019), the results of the investigation suggest that participants who stick with a two-time per a week aquatic exercise schedule for a period of four weeks may have a statistically significant decrease in pain and stiffness as well as an improvement in their functional skills. Those individuals reported improved performance on their regular tasks every day, a decrease in knee discomfort, and improved function. Aquatic therapy inside a pool that is heated appears to be a useful and efficient treatment for osteoarthritis of the knee joint, regardless of whether it's employed as a short-term intervention. The mean Visual Analog Scale scores were decreased by 3.72 (2.45), which is statistically significant “(p 0.05)” and have a “95%” confidence range of “2.506 to 4.938”. The impact size was significant at 0.71. The “Western Ontario and McMaster University Osteoarthritis Index scores” decreased by 29.5 (15.51), which is statistically significant. The effect magnitude was significant at 0.79. For the three stated “Western Ontario and McMaster University Osteoarthritis Index subscales (pain, stiffness, and activities of daily living)”, the standard error of the mean and mean differences are also shown.

Individuals in the intervention group had substantially less knee discomfort and more function than those in the control group, according to the analysis of correlation. Ma et al. (2022) noted that 11 studies that evaluated pain as an outcome were integrated into the meta-analysis. The pain was examined using the “Western Ontario and McMaster University Osteoarthritis Index pain “measures, the “Knee Injury and Osteoarthritis Outcome Score”, and the “Visual Analog Scale”. The “Western Ontario and McMaster University osteoarthritis index pain” and the “Visual analog scale” comparing the aquatic physical treatment group with the control group revealed two clinically significant differences, but not the pain associated with the “Knee injury and osteoarthritis outcome score” (SMD = 0.31, 95%CI: 2.12, 2.75, p = 0.80). It was clear from the conclusion that the knee discomfort had subsided.

According to Azizi et al. (2019), during the start of the trial, there was no statistically significant variance in the mean visual analog scale for pain between the aquatic and control groups [74.1 (11.5) and 74.2 (24.1), respectively; p = 0.564], but it was crucial at the conclusion [64.3 (19.0)

and 74.1 (38.3), respectively; p = 0.010]. Analysis revealed that the group intervention drastically decreased the mean pain score “(p = 0.019)”, but in the control group, it didn’t (p = 0.493). No participant mentioned any physical activity in the water having any particularly detrimental consequences.

“Muscle strength, power, and resistance”: Dias et al. (2017), Mary et al. (2014), and Ma et al. (2022) assessed the strength of the muscles, power, and resistance considering both knee flexors and extensors. The covariance analysis showed that the hydrotherapy group showed larger gains in all muscle parameters. Women undergoing hydrotherapy showed a substantial increase in the strength of their knee flexor muscles as compared to the education-only group. In comparison to the control group, hydrotherapy did result in significant differences in the strength of the knee flexor muscles “(mean difference = 5.0; 95% CI: 0.3-9)” and the resistance of the knee extensor muscles “(mean difference = 4.8; 95% CI: 0.3-9)” in the treatment groups. These outcomes are beneficial from a therapeutic perspective because stronger muscles serve as joint stabilizers and stress absorbers, protecting the injured joint.

According to Mary et al. (2014), physiotherapists also noticed that all the participants with knee swelling had reduced (10 versus 0 knees; P=0.002). Despite a significant gain in muscular strength, the girth of the thigh decreased from a mean of 40 cm (about 1.31 ft) to 39 cm (measured at 5 cm (about 1.97 in) above the base of the patella in both the right and left knees) (P0.001). The median quadriceps strength increased from “9 kg to 21 kg” as the median knee flexion range increased from 115° to 125° (P0.001) (P0.01). Also, the functional reach test's median score improved from 10 to 14 repeats, and also the median score of the sit-to-stand test increased from “20 to 28 cm”, respectively “(P 0.001)”. Moreover, mobility (P0.01), trunk walking and bending capabilities (P0.05), pain levels (P0.01), and mood (P0.01) all increased (P0.01).

Six studies that looked at muscular strength as a consequence are included in the meta-analysis, according to Ma et al. (2022). The muscles tested to gauge muscular strength were hip abduction, knee flexion, and knee extension. An analysis of subgroups should be carried out in research on hip abduction to determine the differences in muscle strength between the left and right sides. While knee extension muscular strength “(p = 0.14, I2 = 41%)” and considering hip abduction strength of the muscle “(left p = 0.75, I2 = 0%, and right p = 0.84, I2 = 0%)” did not exhibit any evidence of heterogeneity, knee flexion muscle strength did “(p 0.01, I2 = 71%)”. The increase in the level of knee flexion muscular strength did not vary drastically much between both “(MD = 2.46, 95%CI 0.98, 5.90, p = 0.16; right: MD = 2.14, 95%CI 6.91, 2.63)”, according to the findings of a combined analysis (p = 0.16). But there was a substantial variance

in the muscular strength of the knee extension between the two groups “(MD = 2.11, 95%CI: 0.02, 4.20, p = 0.05)”.

Quality of Life: Three articles examined the “quality of life” and mentioned it (Bartels et al., 2016; Ma et al., 2022; Tirza & Natalia, 2018). Bartels et al. (2016) found that ten trials had a modestly positive effect on the “quality of life” “(SMD = 0.25; 95% CI = 0.49 to 0.01; ten trials, 971 subjects)”. The mean “quality of life” score increased by seven points “(95% CI 0 to 13 points)” in comparison to the control group “(scale of 0 to 100)”. None of the trials on the list had their radiographic results evaluated. In the studies that were taken into account, aquatic exercise had no major negative effects.

Also, the “Knee Injury and Osteoarthritis” Outcome Score and “quality of life” were reportedly utilized in four studies to evaluate the quality of life Ma et al. (2022). The meta-analysis “(MD = 0.07, 95 %CI 2.67, 2.81, p = 0.96)” found no obvious difference between the two groups in the improvement of “quality of life”, and the quality-of-life analyses did not disclose any heterogeneity (p = 0.6, I2 = 0%). The group of individuals that engaged in land-based exercise demonstrated a substantial improvement in the Short Form-36 quality of life assessment after eight weeks, Tirza & Natalia (2018). Improvements in the hydrotherapy group were seen in “EF (p=0.025)”, “EWB (p0.001)”, and “GH (p=0.045)” domains accordingly. There were no noticeably significant variations in the improvement of quality of life among the groups that exercised on land and in the water.

The findings of the Group analyses for gait and walking measurements were published by Azizi et al.(2019), and they showed that the advantages of aquatic training were greatly enhanced in terms of “static and dynamic balance, step length, stride length, and cadence”. Considering the step width or duration the two groups didn’t have many differences as well.

Tirza & Natalia (2018) discovered that assessments of “leg fatigue (p=0.016)”, “energy/fatigue (p=0.025)”, “emotional well-being (p0.001)”, and ‘overall health (p=0.045)” all improved substantially during the aquatic exercise. This research discovered that exercising in the water lessened physical exhaustion. Aquatic exercise has been reported to improve orthopedic issues because it lessens the stress that weight-bearing places on the skeletal joints.

5. Discussion

This thesis looked at the effects of using hydrotherapy on chronic knee osteoarthritis. In terms of minimizing joint overload, lowering the risk of injury, and significantly lessening pain, hydrotherapeutic or aquatic exercises may be better for patients with osteoarthritis than land-based physical activity programs (Vaile et al., 2007).

“Randomized controlled trials”, “meta-analyses of randomized trials”, and “prospective intervention studies” were selected to determine the superiority of one treatment over another. This clearly explains how to choose the most effective therapy options.

Most of the individuals with both “knee and hip osteoarthritis” express a minor, short-term clinically meaningful impact on “pain, disability, and quality of life” after completing a Hydrotherapy program. Despite a broad respondent group with a mix of “knee and hip osteoarthritis”, overall assessments of the immediate impacts of water-based exercise show an exact and foreseeable result. (Bartels et al., 2016.)

Following a 4-week hydrotherapy session, patients with knee osteoarthritis reported less severe pain and greater levels of self-perceived physical function. The particular daily tasks performance was described by those participants as being enhanced, with reduction of knee pain and better function. Hydrotherapy in a heated pool appears to be a good and successful treatment for osteoarthritis of the knee joint, regardless of whether it's utilized as a short-term alternative. (Sekome & Maddocks, 2019.)

After a well-planned six-week aquatic therapy program in addition to an educational program, women with knee osteoarthritis reported larger short-term gains in pain and function than following the educational program alone, according to the findings of this randomized controlled experiment. The function of the knee muscles, in particular strength of the knee flexor and extensor, power of the knee flexors, and resistance of the knee extensors, were also impacted more positively in women with “knee osteoarthritis” who had hydrotherapy. (Dias et al., 2017.)

According to the study’s findings, aquatic physical therapy considerably improved knee osteoarthritis patients' “pain, physical function, knee extension muscle strength, and walking capacity”. According to meta-analyses, aquatic physical therapy substantially enhanced physical function as well. By the way, the “quality of life, flexibility, or body composition” of patients with knee osteoarthritis did not improve. During water physical treatment, just the knee extension muscle's strength may be boosted. During aquatic physical therapy, a substantial reduction in walking ability was also observed on the Timed-Up-and-Go Test. (Ma et al., 2022.)

This randomized controlled trial demonstrates that, compared to the group control and group intervention, the pain was dramatically reduced. Additionally, it was discovered that patients who participated in group therapy had improved balance and gait. They improved from water training in terms of “static and dynamic balance, stride and step lengths, and cadence”. The results did not show that exercise increased step width or time. Patients with osteoarthritis who exercise in the water report less subjective pain. The patient’s gait and balance have improved considerably. (Azizi et al., 2019.)

According to research, swimming may have considerable positive effects on knee function, body balance, and psychological well-being, even in elderly non-swimmers with arthritic knees. Regardless of whether weight-bearing activities contributed to their symptoms, populations with arthritic knee issues improved from aquatic exercise. According to the findings, making a long-term investment in water exercise sessions can help older people manage their chronic knee osteoarthritis more effectively. (Mary et al., 2014.)

Another randomized controlled study compared land-based exercise to aquatic exercise to help obese individuals with knee osteoarthritis improve their efficiency amount of “cardiorespiratory endurance” and also the “quality of life”. Furthermore, these research findings indicate that all general health metrics were significantly improved by water exercise. According to the results of this study, patients should commence undertaking an aquatic exercise to increase their general health and vitality and lessen leg tiredness. After that, physical activity might be maintained on land to enhance cardiorespiratory endurance and quality of life. (Tirza & Natalia, 2018.)

Most of the articles chosen for this thesis fit the objectives of the bachelor's thesis. All different kinds of studies were covered in the research publications. The chosen articles also showed a variety of hydrotherapy-related effects on chronic osteoarthritis of the knee. The difficulty in finding the precise relevant articles as intended was a major weakness. Only seven articles were chosen as a result. This bachelor’s thesis demonstrates the positive effects of using hydrotherapy on people with chronic osteoarthritis of the knee, including reduced knee pain and improved muscle strength, power, and resistance. Healthcare providers might recommend hydrotherapy to patients with knee osteoarthritis.

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