

Evaluation of the Effect of Water-Based Therapy (Hydrotherapy) on Pain Intensity in Patients with Low Back Pain (LBP): Literature Review

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ABSTRACT

Low Back Pain (LBP) is a burdensome global health issue, particularly in the elderly, and while water-based therapy is a promising intervention, its application remains limited. This literature review aimed to evaluate the effectiveness of water-based interventions in reducing pain and improving physical function in elderly patients with LBP, analysing six articles sourced from PubMed and Google Scholar (2015–2023). The results demonstrate that water-based interventions are significantly effective in reducing pain intensity and disability, and enhancing physical function (including posture and balance). Furthermore, a higher frequency of swimming was correlated with lower LBP pain levels. Consequently, water-based therapy is highly recommended as an effective complementary therapy for LBP in the elderly, largely due to the effect of water buoyancy; however, further studies are necessary due to the limited number of reviewed literature

Keywords: Low back pain (LBP), hydrotherapy, water-based therapy, elderly

INTRODUCTION

Low Back Pain (LBP) is a global health challenge and the leading cause of disability worldwide. According to the *Global Burden of Disease* data, LBP ranks first in Years Lived with Disability (YLD) and sixth in total health burden as measured by Disability Adjusted Life Years (DALY) ^{1 2}. Globally, it is estimated that 80% of the population will experience LBP at least once in their lifetime, with incidence rates peaking between the ages of 35 and 55 ^{3 1}. In Indonesia, data from the Indonesian Neurological Association (PERDOSSI) indicates that approximately 35.86% of patients visiting pain management services suffer from LBP, with a majority being women in the productive and elderly age groups (41–60 years) ^{1 4}.

The impact of LBP extends beyond physical impairment, encompassing significant psychosocial and economic burdens for both individuals and communities ^{5 6}. Patients often experience limitations in daily activities and work, leading to high demand for medical rehabilitation services to achieve rapid functional recovery and pain reduction ^{6 7}. While various therapeutic modalities exist, effective LBP

management requires an approach that minimises joint pressure while simultaneously strengthening the spinal supporting muscles⁸. Hydrotherapy is a physical treatment increasingly recognised for its effectiveness in managing chronic LBP. It utilises the unique physical characteristics of water, such as buoyancy, resistance, and turbulence, to allow movements that are difficult or impossible to perform on land due to gravity^{6 9}. Water's buoyancy reduces the load on aching joints, while its natural resistance provides a medium for muscle strengthening without high trauma risk, making it an ideal option for elderly patients or those with muscle weakness^{6 10}.

In clinical practice, the McKenzie and Williams Flexion approaches are standard therapeutic exercises used to improve spinal mobility and stability¹¹. However, psychological barriers, such as exercise boredom, and physical constraints due to gravity often hinder patient compliance. Integrating McKenzie and Williams methods into an aquatic environment (hydrotherapy) is expected to create a safer, well-tolerated, and more enjoyable form of exercise for LBP patients⁶.

Clinical observations in hospital settings reveal that current LBP management is still dominated by pharmacological therapy and simple warm compresses. The implementation of hydrotherapy by healthcare professionals, particularly nurses, remains limited due to the lack of specialised facilities, such as temperature-controlled pools and physical monitoring equipment. Nevertheless, in archipelagic regions like Maluku, where the water area exceeds the land mass, the potential for water-based therapy is highly relevant both geographically and functionally. Based on these considerations, this study aims to evaluate the effectiveness of McKenzie and Williams hydrotherapy protocols in reducing pain intensity and disability levels among patients with chronic LBP.

MATERIAL AND METHOD

This study is a literature review conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The literature search was conducted in PubMed and Google Scholar for articles published between January 2015 and December 2024. The search was executed using the following keywords: "*Low Back Pain*" AND "*Hydrotherapy*" AND "*Elderly*". The inclusion criteria for this review were defined as follows; Population: Elderly patients diagnosed with Low Back Pain (LBP), Intervention: Hydrotherapy or aquatic exercise, Study Design: Quantitative studies (e.g., Randomized Controlled Trials or

Quasi-experimental studies), Outcomes: Studies measuring pain intensity, disability levels, or functional mobility, Language: Publications in English or Indonesian, Publication Year: Studies published between 2015 and 2024 to ensure current clinical relevance. To minimise selection bias, the screening process was conducted independently by two reviewers. Any discrepancies regarding a study's eligibility were resolved through discussion and consensus. The methodological quality of the included studies was evaluated using the Joanna Briggs Institute (JBI) Critical Appraisal Tools. This assessment ensured that only studies with robust methodology were included in the final synthesis.

RESULTS AND DISCUSSION

The search in 2 databases yielded 732 articles, including 1 from PubMed. 461 publications were excluded because they were not full-text and were not from the last 10 years, leaving 271 articles. The articles were then screened again against the inclusion criteria, and 259 were excluded, leaving 12 articles. However, 8 of these were excluded because they were not journals or quantitative studies. After several screening stages, 4 journals were obtained from PubMed. Meanwhile, 1 Google Scholar database yielded 26,400 articles, of which 22,310 publications were excluded because they were not full-text publications from the last 3 years, leaving 4,090 articles. The articles were then screened again against the inclusion criteria, and 4,085 were excluded, leaving 17 articles. However, 15 of these were excluded because they were not journals or quantitative studies. After several screening stages, 2 journals were obtained from Google Scholar. Combined, there were 6 articles meeting the journal inclusion criteria suitable for the purpose of this literature review. The selected articles are described in

Tabel 1. Evaluation of the Effect of Water-Based Therapy (Hydrotherapy) on Pain Intensity in Patients With Low Back Pain (LBP).

No	Author & Year	Sample Size	Study Design	Intervention	Outcome Measure	Main Findings
1.	Mirmoezzi, Masoud Irandoust, Khadijeh H'mida, Cyrine Taheri, Morteza	Twenty-eight participants (16 men and 12 women)	semi-experimental pretest-posttest with a control group.	Hydrotherapy incorporating the McKenzie and Williams methods	Numeric Pain Rating Scale (NPRS), Roland-Morris Disability	This study proves that a McKenzie and Williams-based

<p>Trabelsi, Khaled Ammar, Achraf Paryab, Nesa Nikolaidis, Pantelis T. Knechtle, Beat Chtourou, Hamdi (2020)</p>	<p>Questionnaire (RMDQ), Straight Leg Raise Test (SLRT)</p>	<p>hydrotherapy program significantly reduces pain and disability in chronic low back pain patients within 10 sessions. The treatment effectively improves NPRS and RMDQ scores while increasing leg range of motion (SLRT), which indicates reduced nerve root irritation. Utilizing water's buoyancy and resistance, this method provides a safer alternative to land-based exercise, with additional</p>
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						sessions serving to stabilize and maintain functional improvements
2.	Mariya Gramatikova, Stamenka Mitova, Nasko Valchev (2020)	30 subjects, including 22 males and 8 females.	Experimental Group	Hydrotherapy combined with magnetotherapy and underwater jet massage	Visual Analogue Scale (VAS), Laseg Test (Straight Leg Raise), Antropometri, Variational and Statistical Significance Testing	Research on 30 subjects (athletes and non-athletes) demonstrates that a one-month combination of hydrotherapy and magnetotherapy effectively and significantly relieves chronic lumbar pain. The main results recorded a reduction in pain scores (VAS) from severe to mild and an increase in hip joint range of

					<p>motion (Laseg Test) in both groups ($P < 0.01$). This therapy is proven to reduce muscle spasms and restore the function of the <i>n.ischiadicus</i> nerve.</p>	
3.	<p>Irاندoust, Khadijeh Taheri, Morteza. (2015)</p>	<p>32 subjects, all of whom were males aged 65 or older</p>	<p>Randomized Controlled Trial (RCT) or True Experimental Design</p>	<p>(<i>Aquatic Exercise</i>).</p>	<p>Body Composition and Low Back Pain</p>	<p>Twelve weeks of aquatic exercise significantly improved the body composition of elderly males by decreasing BMI, WHR, and body fat (PBF), while increasing trunk muscle mass by 4.1%. These improvements were accompanied by a drastic</p>

						reduction in physical pain scores (from 7 to 3) and psychological symptoms (from 4 to 1) within the intervention group. Conversely, no significant changes were observed in the control group regarding pain levels or body composition
4.	Irاندoust, Khadijeh Taheri, Morteza Mirmoezzi, Masoud H'mida, Cyrine Chtourou, Hamdi Trabelsi, Khaled Ammar, Achraf Nikolaidis, Pantelis Theodoros Rosemann, Thomas	65 older adults (30 males and 35 females)	Pre-test/Post-test	Water-based Exercise compared with Land-based Exercise.	Postural Mobility, Somatotype, Body Composition, Physical Readiness	The study found that an eight-week aquatic exercise program significantly improved postural mobility and reduced fall risk in older adults with an endomorphic

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5.	Sutanta. (2021)	31 respond ents.	analytical survey	Swimming (as a retrospectivel y observed variable to see its relationship with pain).	Pain Level, Swimming Frequency , Muscle Strength, and Responde nt Characteri stics	A study of 31 elderly responde nts shows a significan t correlatio n between swimmin g frequency and the reduction of low back pain (LBP) levels, with a p- value of 0.0003. The correlatio n coefficien t of -0.610 indicates that the more regularly a responde nt swims, the more their perceived pain decrease s. Most responde nts who swam irregularly experienc ed severe pain (60%) , while those
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						who swam regularly tended to experience mild pain. Swimming is effective in reducing pain because it strengthens the muscles around the spine and relieves pressure on back structures.
6.	Rakhi Sadanand Sawant, Sandeep Babasaheb Shinde. (2019)	30 patients	Experimental study	(Hydrotherapy-Based Exercises) compared to other interventions (possibly conventional therapy).	VAS (<i>Visual Analogue Scale</i>), ROM (<i>Range of Motion</i>), MMT (<i>Manual Muscle Testing</i>), and MODI (<i>Modified Oswestry Disability Index</i>)	The study concludes that while both conventional therapy and hydrotherapy are effective in improving patient conditions, hydrotherapy is significantly superior in reducing

pain intensity (VAS) compared to conventional therapy. However, for aspects such as Range of Motion (ROM), Manual Muscle Testing (MMT), and disability levels (MODI), both methods yielded comparable results with no significant difference

Analysis of the six selected studies demonstrates that hydrotherapy consistently reduces pain intensity in patients with Low Back Pain (LBP). Assessments using pain scales such as the NPRS and VAS showed significant improvements, particularly between the 10th and 20th sessions^{6 12}. The frequency of exercise proved to be a crucial factor, evidenced by a strong negative correlation ($r = -0.610$) between swimming frequency and pain levels; the more regularly patients engaged in aquatic activities, the lower the pain intensity experienced¹³. This suggests that hydrotherapy is effective both as a structured clinical intervention and as a therapeutic recreational activity¹. In conjunction with pain reduction, physical function and patient disability levels also showed meaningful improvement. The decrease in disability scores, as measured by the RMDQ and MODI questionnaires, reflects an enhanced ability of

patients to perform daily activities independently ^{6 14}. Among the elderly population, this functional recovery was further supported by changes in body composition, including reductions in Body Mass Index (BMI) and body fat percentage ¹⁰. This reduction in body weight mechanically alleviates stress on spinal structures, thereby contributing to long-term recovery ¹⁵.

Regarding mobility and balance, hydrotherapy offers distinct advantages over dry-land exercise. The aquatic environment significantly improves postural mobility and gait scores, particularly in elderly individuals with an endomorph somatotype ¹⁶. Improvements in the neurodynamics of the sciatic nerve and range of motion (ROM) occur because water provides a medium that allows nerve mobilisation exercises to be performed with minimal resistance ^{15 14}. Furthermore, the physical properties of water provide a sense of security that reduces the fear of falling (FOF), encouraging patients to perform extremity movements more confidently and to their full extent ¹⁷.

The primary mechanism underlying this effectiveness lies in the property of buoyancy, which reduces compressive forces on the intervertebral discs and gravitational loading on the spine ¹⁰. This property allows for the strengthening of core muscles without triggering acute pain. Additionally, combining hydrotherapy with mechanical stimulation, such as underwater jet massage and magnetotherapy, helps relax neural tension and improve blood circulation in the lumbar region. The strengthening of paraspinal muscles during swimming also functions as a natural brace, maintaining both flexibility and spinal stability ¹. Despite these promising results, several limitations in the studies gathered must be noted. Significant variation in intervention duration, ranging from 4 to 12 weeks, poses a challenge in establishing an optimal standardised protocol ^{15 10}. Moreover, some studies utilised relatively small sample sizes and convenience sampling techniques, which may not fully represent the general population; thus, the generalisation of these results should be approached with caution ^{13 14}.

The clinical implications for the nursing field are significant. Nurses can integrate hydrotherapy as an independent non-pharmacological intervention in the care plans of chronic LBP patients to reduce reliance on analgesics. In their role as educators, nurses can emphasize the importance of regular aquatic exercise to maintain mobility and prevent muscle stiffness ¹³. Specifically in gerontological nursing, this therapy can be prioritized as a safe rehabilitation method to improve balance and quality of life for the elderly without a high risk of physical injury ¹⁷.

The majority of the six journals reviewed discuss the effects of water-based interventions, such as hydrotherapy, aquatic exercise, or swimming, on health and physical condition. Five of the six journals specifically target the problem of lower back pain, especially chronic, non-specific pain. The fourth journal focuses on healthy elderly people, but also discusses the benefits of aquatic exercise.

All journals that tested interventions one through four and six, or analysed relationships (Journal five), indicate that water-based interventions have a positive impact or a significant relationship on the measured outcomes, such as pain reduction, improved physical function, or increased mobility and body composition. Three out of the six journals (Journals three, four, and five) explicitly mention that the elderly was the study group, showing particular attention to the benefits of aquatic therapy for old age. Although all journals focus on water therapy for musculoskeletal problems, the type of interventions used differ, ranging from pure exercise to a combination of tools. The first journal focuses on McKenzie and Williams-based hydrotherapy, which are structured physiotherapy methods. Meanwhile, the third and fourth journals use aquatic exercise with different focuses, namely Body Composition and Postural Mobility. The most distinct is the second journal, as it combines hydrotherapy with magnetotherapy and hydromassage, making it the most complex intervention. On the other hand, the fifth journal is different because it is not an intervention trial but a retrospective correlational study linking swimming frequency to pain levels.

The key differences in sample characteristics are clear from their age groups and health conditions. The third, fourth, and fifth journals explicitly targeted the elderly, especially the fourth, which focused on healthy elderly individuals with an endomorphic body type. Meanwhile, the first and sixth journals focused on patients with chronic non-specific low back pain (NSLBP), and the second journal divided the sample into two groups: athletes and non-athletes experiencing back pain. The duration of the intervention programs also varied, ranging from 1 month (second journal) to 20 sessions (first journal), with the longest reaching 12 weeks (third journal).

In terms of effectiveness, the first and fourth journals demonstrated that aquatic therapy yielded significantly better results compared to the control or land-based intervention groups, both in reducing pain and disability and in improving postural mobility. These results were statistically significant. The sixth journal also showed that water-based therapy was better, although it was only shown to reduce pain (measured

by the VAS scale) compared to other variables. Meanwhile, the fifth journal found that the more frequently a person swam, the more their pain decreased.

Hydrotherapy and aquatic exercises, such as Willermark and Islind, are recognised as promising intervention methods for managing chronic low back pain (LBP) and related conditions. In general, hydrotherapy protocols show significantly positive effects on patients' perceived pain and disability levels, based on health indicators, after 10 and 20 sessions compared to the baseline condition before treatment began⁶. The study shows that aquatic therapy has a positive impact on pain levels and functional ability in patients with nonspecific low back pain (NSLBP) after 10 and 20 therapy sessions. These findings support the idea that water-based interventions are effective in managing and treating low back pain, consistent with the results of several meta-analyses on exercise and aquatic therapy.⁶

In addition to alleviating pain and reducing functional impairment, the hydrotherapy protocol can increase the range of motion (ROM) on the Straight Leg Raise Test (SLRT). This reduces irritation of the nerve roots in the lower spinal area. The increase in ROM indicates that the mechanism of neural tissue movement is better, and its sensitivity to pressure or compression on the lower spinal nerve roots is also improved. Although a hypothesis suggests that continuing exercise treatment for up to 20 sessions would yield better results in reducing low back pain, the research findings do not support this hypothesis. No significant difference was found between the results at the 10th session and the 20th session in terms of treatment, which indicates that a significant impact was already achieved in the early stages of treatment.⁶

The lack of a significant difference between the 10th and 20th sessions suggests that a 10-session training program might already be sufficient to achieve most of the benefits in reducing pain and disability. The subsequent sessions likely help in adjusting and maintaining the patient's good posture, as well as keeping the pain and disability levels low, thereby highlighting the importance of continuing to train to maintain that condition⁶. Wilmarth and Islind play an important role in the effectiveness of hydrotherapy. Immersion in water, or water immersion, helps reduce the load on the spine. With the effect of buoyancy, movements that are usually difficult or impossible to perform on land can be done more easily.⁶ Buoyancy helps alleviate stress on joints and muscles, allowing for a wider range of motion by distributing body

weight evenly. Furthermore, warm water makes muscles work more efficiently and helps reduce feelings of fatigue and stress.⁶

The pressure from the water and the depth make it easier for patients to perform exercises. On the other hand, the viscous nature of the water and its surface create resistance to every active movement, which helps strengthen the muscles. The desired exercise intensity can be adjusted by changing the speed of movement in the water.⁶ Physical activity performed in the water helps improve balance and body coordination while stimulating the visual system, inner ear balance, and perception.¹⁹ By utilizing the characteristic properties of water such as buoyancy, resistance, flow, and turbulent current, exercise programs can be created gradually and adjusted to the needs and function of the patient.⁶

Water exercises help relieve stress on painful joints, improve spinal flexibility and range of motion, and reduce back pressure by counteracting gravitational stress. The floating position, both horizontally and vertically, makes patients more relaxed and reduces excessive load, which impacts postural correction and a more neutral spinal position⁶. Allegedly, aquatic exercise can improve range of motion and core stabilizer muscle function by enhancing coordination between co-working muscles and muscles that inhibit movement. Isotonic movements using weighted ankle cuffs and a noodle on the arms can help the core muscles release better and become stronger. The placement of the weight cuffs and noodle helps decompress the spine well, which specifically relieves pressure on the discs, the thecal sac space, and the nerve roots, as well as creating proper spacing between the vertebrae⁶. The recommended therapeutic aquatic exercises for reducing pain and improving function in chronic low back pain include core stabilisation exercises, unloading treatment, and flexibility exercises, which are also referred to as neurodynamic treatment for low back pain.⁶

Water-based therapy is often considered in the rehabilitation process due to its unique physical properties and lower risk, which facilitates various types of interventions such as stretching, muscle strengthening, joint mobilisation, balance training, gait training, and endurance exercises, all of which can help alleviate back pain. Hydrotherapy benefits include the ability to reduce the load on painful joints while providing resistance for exercise, increasing muscle strength, flexibility, and spinal range of motion, as well as improving balance and coordination, which collectively alleviate pressure on back pain.²⁰ Some previous studies indicate that exercising in water provides a better improvement in daily activity capacity and quality of life

compared to land-based exercise. Nevertheless, other studies show that both (the hydrotherapy group and the land-based exercise group) experienced significant improvements in functional ability and pain reduction. However, there is also research suggesting that the benefits of hydrotherapy may not be long-lasting, thereby proposing the need for continuous sessions to maintain better mobility and reduce pain. Generally, this intervention aims to relieve pain, improve range of motion, strengthen muscles, and enhance quality of life.¹⁴

Additional research utilising a specialised method with magnetotherapy and hydromassage showed a statistically significant improvement in patients with chronic lower back pain, including both athletes and non-athletes.¹⁸ The protocol successfully reduced pain, improved the neurodynamics of the sciatic nerve, increased the range of motion of the hip joint, and reduced muscle stiffness in the spinal area in both study groups, which confirms the positive benefits of underwater warm-water massage on neuromuscular function and muscle pain¹⁸. Patients with chronic LBP who are physically active are less likely to experience more severe disability. LBP and disability also have an impact on the decrease in hip range of motion.⁶

Water-based exercise is also evaluated for its effects on body composition and LBP in elderly men. This study aims to see the effect of 12 weeks of water-based exercise on BMI, body fat percentage, waist-to-hip ratio, muscle mass, and LBP. The results showed that WHR, PBF, BMI, muscle mass, and LBP (both physical and psychological symptoms) increased significantly after exercise. This improvement in body composition is considered one of the causes of the improvement in LBP symptoms. Research indicates that excess body weight and body fat negatively affect lower back pain, and low abdominal muscle strength is considered a contributing factor. Therefore, increasing muscle volume and strength, as evidenced by a 12-week increase of up to 4.1%, could be an effective way to address the problem. Water-based exercises have the advantage of allowing movements that engage both the upper and lower body with an optimal range of motion, while simultaneously reducing stress on the joints.¹⁰

Therefore, this exercise can help improve body composition and reduce non-specific lower back pain. Another focus of exercises in water is its ability to increase postural mobility in healthy elderly individuals with endomorphic body types, with the goal of reducing the risk of falls.¹⁷ Aquatic exercise can help reduce the risk of falls in the elderly by improving postural mobility through low dynamic movements that

integrate flexibility, muscle strength, balance, and resistance training. Aquatic exercise groups can reduce the risk of falling from moderate to low.¹⁷ Melakukan aktivitas di dalam air memungkinkan lansia menerima *feedback* tubuh yang tepat tanpa takut jatuh (*Fear of Falling / FOF*), karena gerakan dapat dideteksi dan dikoreksi dengan lebih baik, sehingga sistem kontrol tubuh menjadi lebih efektif. *FOF* sendiri dapat menghambat aktivitas sehari-hari lansia, menurunkan kinerja fisik, serta mengurangi kemandirian sosial mereka.¹⁷

Aquatic exercise is very suitable for seniors experiencing obesity, osteoarthritis, lower back pain, or knee pain. This is because exercise in water is more appropriate than traditional land-based exercise, especially for seniors with an endomorphic body type, particularly those who are overweight or obese, who have a higher risk of falling.¹⁷ When a person stands in waist-deep water, about 50% of their body weight is lost. This makes gravity feel lighter and reduces the risk of falling. With this condition, seniors can move more freely in the water, having a wider range of motion, allowing them to try various movement variations and gain more movement experience. Aerobic exercise also improves balance due to neural adaptations induced by the aquatic exercise, such as the more efficient use of cortical somatosensory neural reorganisation and an increase in synaptic connection efficiency.¹⁷

A study on the relationship between swimming frequency and muscle strength levels in elderly individuals with Low Back Pain (LBP) shows that most LBP patients undergoing swimming therapy are women. This aligns with the fact that LBP is more common in women than in men, as women's muscle strength physiologically tends to be lower than men's.¹ The majority of people who experience LBP (Low Back Pain) are seniors aged 61 to 70 years, a time when muscles begin to lose density. The ability of muscles to work decreases with age, and the older a person gets, the greater the risk of bones losing their elasticity, which can lead to the appearance of low back pain symptoms¹.

Sports such as swimming are recommended because they can strengthen the muscles around the spine and help maintain flexibility. Furthermore, research results show that people with a BMI in the overweight or obese category are more susceptible to experiencing LBP (Low Back Pain) compared to people with a normal BMI, which supports the theory that excessive body weight can cause LBP by putting additional pressure on the lower spine.¹

Some drawbacks in research on the benefits of hydrotherapy include insufficient exercise duration, lack of long-term effect monitoring, and a relatively small number of participants. Furthermore, the participants' confidentiality was not maintained, which might have influenced how they reported their results. The testing methods used were also self-administered by the participants. ^{6 17}

Factors such as social and demographic factors, as well as psychological factors like fear, anxiety, stress, and depression, which can influence the outcome, were not investigated in some studies. In the future, it is suggested to include measures of psychological factors and other habits, such as sleep patterns, and to conduct truly supportive research to ensure effectiveness and reliability. Overall, the evidence from the six journals collectively supports the use of hydrotherapy and aquatic exercise as an effective way to reduce chronic pain, decrease disability, and improve physical function and mobility in people with low back pain, especially in the elderly and those who are overweight. The advantages are supported by the natural properties of water, which have specific benefits.

CONCLUSION

Hydrotherapy significantly reduces pain and disability in elderly patients with Low Back Pain (LBP) by utilizing water buoyancy to minimize joint loading. The McKenzie and Williams aquatic methods effectively improve nerve mobility within 10 sessions, while general aquatic exercises enhance body composition and balance to prevent fall risks. However, long-term effectiveness remains limited by variations in program duration and small study sample sizes. Consequently, further Randomized Controlled Trials (RCTs) with larger samples and longer follow-up periods are required. Clinically, nurses can integrate hydrotherapy into elderly rehabilitation programs as a safe, non-pharmacological intervention to improve functional independence.

AUTHORS' CONTRIBUTIONS

Zainal Khalid Tharob : Conceptualisation, Writing –reviewing& editing, Writing – original draft. **Sitti Johri Nasela** : Writing –review & editing, Methodology, Writing – original draft preparation. **Martini Tidore** : Writing –review & editing, Methodology, Investigation. **Abdul Rivai S. Dunggio** : Writing –review & editing, Writing –original draft, Software, Visualisation, Validation.

DISCLOSURE STATEMENT

The authors declare that they have no financial conflicts of interest or personal relationships that could have influenced the results reported in this paper. The data were obtained from PubMed and Google Scholar databases. The authors acknowledge that although they have used these data for academic research purposes, they do not claim any ownership rights to them. All authors contributed to the conception and design of the study, literature collection, analysis, and interpretation of the results. The authors confirm that the manuscript has been read and approved by all named authors. The authors confirm that this manuscript is an original work that has not been published elsewhere and is not currently under consideration for publication elsewhere.

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