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The impact of aquatic therapy on quality of life in individuals with Low Back Pain: a systematic review

O impacto da terapia aquática na qualidade de vida de indivíduos com dor lombar: uma revisão sistemática

El impacto de la terapia acuática en la calidad de vida de personas con dolor lumbar: una revisión sistemática

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ABSTRACT: PURPOSE: To review the effects of aquatic therapy on the management of Low Back Pain (LBP), thereby aiding clinical decision-making and improving the Quality of Life of these patients. MATERIALS AND METHODS: This systematic review followed PRISMA guidelines and included randomized clinical trials from PubMed, PEDro, Medline, The Cochrane Library, and Scopus, without time restrictions, assessing the effects of aquatic therapy on quality of life in individuals with LBP. RESULTS: Seven studies met the eligibility criteria. Aquatic therapy demonstrated significant benefits for chronic LBP, functionality, and quality of life. Interventions delivered in standardized aquatic environments showed greater efficacy than land-based exercises and also improved body composition, physical fitness, sleep, anxiety, and depression. The consistency of results reinforces the therapeutic relevance of this modality, particularly in higher-frequency and longer programs. CONCLUSION: Aquatic therapy is an effective and safe intervention for chronic LBP, promoting improvements in pain, function, quality of life, and psychosocial outcomes. Protocols performed at least three times per week for eight or more weeks appear more effective, supporting their integration into clinical practice and health policies.

Keywords: hydrotherapy, aquatic therapy, Low Back Pain, lumbago, quality of life.

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RESUMO: OBJETIVO: Revisar os efeitos da terapia aquática no tratamento da dor lombar (DL), auxiliando assim na tomada de decisões clínicas e melhorando a qualidade de vida desses pacientes. MATERIAIS E MÉTODOS: Esta revisão sistemática seguiu as diretrizes PRISMA e incluiu ensaios clínicos randomizados do PubMed, PEDro, Medline, Cochrane Library e Scopus, sem restrições de data, que avaliaram os efeitos da terapia aquática na qualidade de vida de indivíduos com DL. RESULTADOS: Sete estudos atenderam aos critérios de elegibilidade. A terapia aquática demonstrou benefícios significativos para a DL crônica, funcionalidade e qualidade de vida. Intervenções realizadas em ambientes aquáticos padronizados mostraram maior eficácia do que exercícios em terra e também melhoraram a composição corporal, o condicionamento físico, o sono, a ansiedade e a depressão. A consistência dos resultados reforça a relevância terapêutica dessa modalidade, particularmente em programas de maior frequência e duração. CONCLUSÃO: A terapia aquática é uma intervenção eficaz e segura para a DL crônica, promovendo melhorias na dor, na função, na qualidade de vida e nos desfechos psicossociais. Protocolos realizados pelo menos três vezes por semana, durante oito semanas ou mais, parecem ser mais eficazes, o que justifica sua integração na prática clínica e nas políticas de saúde.

Palavras-chave: hidroterapia, terapia aquática, dor lombar, lumbago, qualidade de vida.

RESUMEN: OBJETIVO: Revisar los efectos de la terapia acuática en el manejo del dolor lumbar (LBP), facilitando así la toma de decisiones clínicas y mejorando la calidad de vida de estos pacientes. MATERIALES Y MÉTODOS: Esta revisión sistemática siguió las directrices PRISMA e incluyó ensayos clínicos aleatorizados de PubMed, PEDro, Medline, The Cochrane Library y Scopus, sin restricciones de tiempo, que evaluaron los efectos de la terapia acuática en la calidad de vida de personas con LBP. RESULTADOS: Siete estudios cumplieron los criterios de elegibilidad. La terapia acuática demostró beneficios significativos para el LBP crónico, la funcionalidad y la calidad de vida. Las intervenciones realizadas en entornos acuáticos estandarizados mostraron mayor eficacia que los ejercicios en tierra y también mejoraron la composición corporal, la condición física, el sueño, la ansiedad y la depresión. La consistencia de los resultados refuerza la relevancia terapéutica de esta modalidad, especialmente en programas de mayor frecuencia y duración. CONCLUSIÓN: La terapia acuática es una intervención eficaz y segura para el LBP crónico, que promueve mejoras en el dolor, la función, la calidad de vida y los resultados psicosociales. Los protocolos realizados al menos tres veces por semana durante ocho semanas o más parecen más eficaces, lo que respalda su integración en la práctica clínica y las políticas de salud.

Palabras clave: hidroterapia, terapia acuática, dor lombar, lumbago, calidad de vida.

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1. INTRODUCTION

Low back pain (LBP) is a ubiquitous condition within the general population. Clinically, it is divided into acute, subacute, and chronic LBP. Acute LBP refers to symptoms lasting less than 4 weeks, while subacute extends from 4 to 12 weeks (Qaseem *et al*., 2017). Chronic LBP is described as persistent pain in the lumbar region, with or without radiation to the legs, lasting more than 12 weeks, located between the lower ribs and the upper gluteal folds. It is a common musculoskeletal condition with increasing global incidence (Ma *et al*., 2022).

The classification and treatment of LBP are often based on the duration of symptoms, possible causes, the presence or absence of radicular symptoms, and correspondence with anatomical or radiographic abnormalities (Qaseem *et al*., 2017).

Radicular LBP, which results from nerve root compression, manifests as pain in the lower limbs, paresthesia, and/or weakness. Studies indicate that up to one-third of patients suffering from LBP report persistence of moderate to severe pain for at least one year after an acute episode, with one in five of these patients experiencing substantial limitations in Activities of Daily Living (ADLs) (Qaseem *et al*., 2017).

LBP not only detrimentally affects quality of life (QoL) but also imposes a substantial socioeconomic burden, representing a significant challenge for health systems (Zhou *et al*., 2024). This impact is evidenced financially by the excessive use of imaging exams, hospitalization prescriptions, the use of opioids and injections, and other invasive procedures of questionable efficacy. Paradoxically to the indication of these methods, which show little or no efficacy, their effects can delay the recovery period and potentially increase the risk of long-term disability, raising the risk of potential complications from this condition (GBD, 2021).

All interventions aimed at rehabilitating LBP share a common goal: pain control, prevention/reduction of disabilities, and return to daily and work activities. Among the various therapies available are: medication prescription, laser therapy, ozone therapy, land-based exercises, ultrasound, chiropractic, aquatic therapy, and, in more severe cases,

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surgery (Mirmoezzi *et al*., 2021). Although exercise is recognized as the best approach for treating chronic LBP, many physical therapists traditionally still prefer passive treatments, such as electrotherapy (TENS and therapeutic ultrasound) and acupuncture, just as many physicians predominantly base their practices on medication prescription (Bailly *et al*., 2021; WHO, 2023).

Among the available therapeutic exercise modalities for this pathology, aquatic therapy has proven to be a relevant and promising approach, gaining popularity as a therapeutic option. Aquatic therapy refers to exercises performed in water, an environment that offers ideal conditions for the execution of active exercise programs due to its specific properties, such as buoyancy, density, thermal capacity, and conductivity (Peng *et al*., 2022). Studies indicate that the hydrostatic effect of aquatic exercises can facilitate pain relief through the reduction of peripheral edema and inhibition of sympathetic nervous system activity (Shi *et al*., 2018).

Furthermore, aquatic therapy provides an ideal environment for performing aerobic exercises, allowing patients to achieve higher exertion intensities than would be possible on land, due to reduced joint load. Water also contributes to muscle relaxation, pain reduction, increased joint flexibility, and improved functional capacity. This therapeutic modality is generally considered safe, well-tolerated, and associated with high levels of patient satisfaction (Dundar *et al*., 2009). Other important findings on the use of the aquatic environment as an intervention for improving QoL showed improvements in the lipid and anthropometric profile of the elderly (Moura *et al*., 2020); and in the reduction of diastolic blood pressure in postmenopausal women (de Andrade Barboza *et al*., 2020).

Comparative studies analyzing exercises performed on land and in water have demonstrated that the efficacy of therapeutic aquatic exercise and the degree of pain relief provided by this modality are superior to those observed with land-based exercises (Dundar *et al*., 2009; Psycharakis *et al*., 2019). Patients with chronic LBP who performed therapeutic aquatic exercises showed greater improvement in terms of function, pain reduction, QoL, sleep quality, and mental state compared to those undergoing

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conventional physical therapy modalities (Peng *et al*., 2022). A meta-analysis reinforces these findings, indicating a statistically significant reduction in pain and disability in patients treated with aquatic therapy compared to those treated with land-based therapy (Shi *et al.,* 2018).

Although traditional pharmacological approaches are widely used, they have limitations, such as only temporarily interrupting symptoms and an inability to prevent recurrences. Other literature reviews focus on the assessment of pain and functionality, not addressing QoL in depth, making further research necessary to elucidate this theme.

This study objectively synthesizes the most current available scientific evidence, aiming to provide the scientific community with a greater understanding of the role of aquatic therapy in the management of LBP to thereby assist in clinical decision-making and improve the QoL of these patients.

2. MATERIALS AND METHODS

This systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol, ensuring transparency and rigor in the selection and analysis of the included studies. Clinical trials investigating the effects of aquatic therapy on individuals with LBP were considered. The search was performed in the following databases: PubMed, PEDro, Medline, The Cochrane Library, and Scopus; using the following English descriptors: "(Hydrotherapy) OR (Aquatic Therapy) OR (Pool Therapy) OR (Ai Chi Therapy) OR (Ai Chi Therapies) OR (Water Tai Chi Therapy) OR (Aquatic Exercise Therapy) OR (Water Exercise Therapy) AND (Low back pain) OR (Low back pains) OR (Low back ache) OR (Low back aches) OR (Lower back pain) OR (Lower back pains) OR (Lumbago) OR (Mechanical Low Back Pain) OR (Posterior Compartment Low Back Pain) OR (Postural Low Back Pain) OR (Recurrent Low Back Pain) AND (Quality of life)". These terms were combined with Boolean operators to maximize search comprehensiveness. The search was performed without time or language filters.

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The study screening and selection process was conducted independently by two reviewers who conducted the article selection in two stages: initially, titles and abstracts were reviewed, followed by the full reading of potentially eligible texts. The inclusion criteria were rigorously defined to ensure the relevance of the selected studies. Studies that met the following criteria were included: exclusively assessed aquatic therapy; involved individuals with pain in the lumbar spine; were randomized clinical trials; presented as a primary outcome the results of this intervention involving the QoL of these volunteers, potentially encompassing adjacent items such as pain, functionality, and sleep. The exclusion criteria involved: studies without an aquatic therapy intervention; research still in development; aquatic interventions combined with other therapies; pregnant volunteers; articles that were not clinical trials, such as reviews or meta-analyses; research not conducted with humans; publications without open access through the institutional agreements where the searches were conducted; and outcomes not related to QoL.

Any discrepancies regarding study inclusion were resolved by consensus or, when necessary, by adjudication from a third reviewer was requested to break the tie. This systematic process ensured the inclusion of highly relevant studies with adequate methodological quality, suitable for answering the research questions of this review.

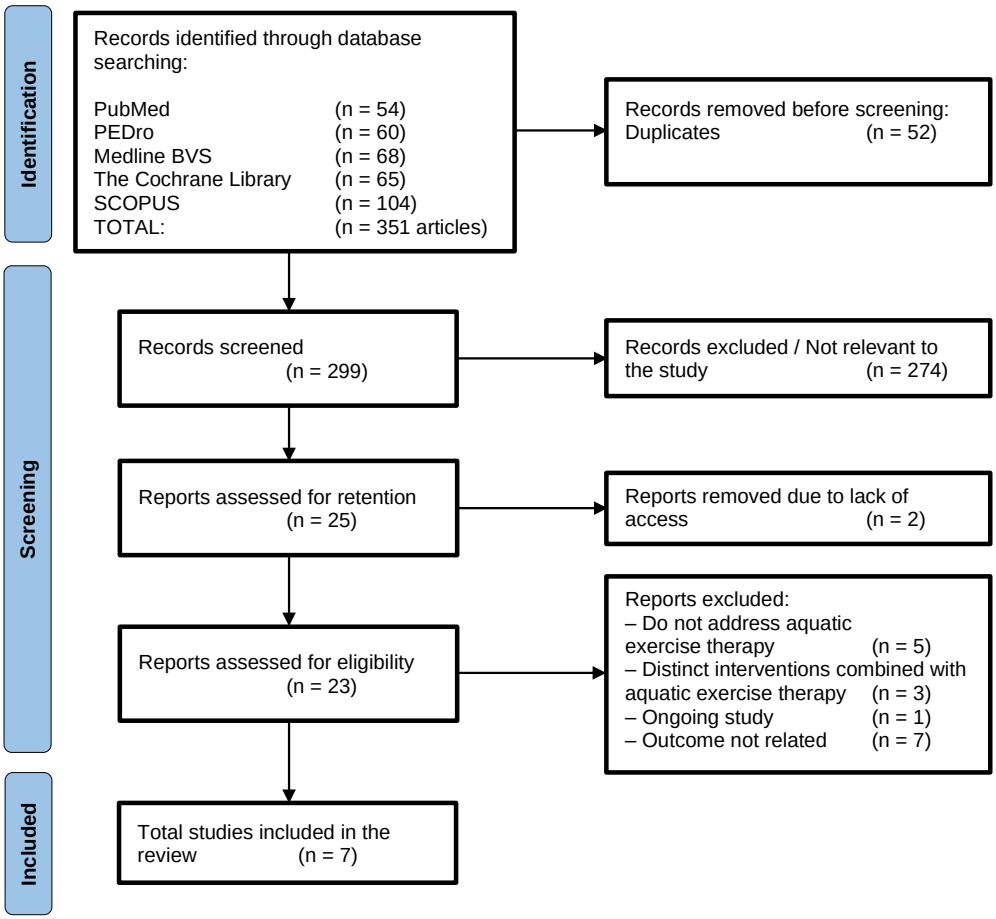
3. RESULTS AND DISCUSSION

The search strategy in the PubMed, PEDro, Medline, The Cochrane Library, and SCOPUS databases resulted in 351 initial records. After the exclusion of duplicates (n = 52), 299 studies were submitted to title and abstract screening. Of these, 274 did not meet the research criteria and were eliminated due to thematic irrelevance. The 25 potentially eligible articles proceeded to full-text reading, but two were discarded due to unavailability of the full text. In the final assessment stage, 16 publications were excluded for various reasons, such as: not addressing aquatic exercise therapy (n = 5), using different interventions (n = 3), being ongoing (n = 1), or presenting outcomes unrelated

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to the review's objective (n = 7). Thus, a total of seven studies were included in the final analysis of this systematic review (Figure 1).

Figure 1. PRISMA flowchart for the selection of articles in the systematic review.



Source: Prepared by the authors.

The seven studies rigorously met the eligibility criteria, totaling a heterogeneous sample composed of individuals with chronic LBP, mostly sedentary adults of both sexes. All studies exclusively assessed the effects of aquatic therapy on LBP and its functional, physical, and psychosocial repercussions.

The methodological designs included four randomized clinical trials and two non-randomized controlled studies, published between 2013 and 2022, with samples ranging from 49 to 113 participants. The predominant age range was between 30 and 65 years,

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reflecting the profile most affected by chronic LBP. Of the seven studies, three were conducted in Spain, and the other investigations were in Canada, China, Italy, and Turkey.

Regarding the interventions, all were performed in an aquatic environment with standardized characteristics: heated pools at approximately 30 °C, sessions of 55 to 60 minutes, frequency of 2 to 5 times per week, and duration between 4 and 12 weeks. The programs included aerobic exercises, resistance training, stretching, relaxation, and functional movements adapted to water buoyancy and resistance. The characteristics of the studies included in the review are shown in Table 1.

Table 1. Characterization of the studies included in the systematic review.

Author (Year)	Study Type and Groups	Sample and Intervention	Outcomes Assessed and Instruments	Main Results
Baena-Beato *et al.* (2013)	Non-randomized comparative. **Groups:** Aquatic physical therapy **2x/week**; Aquatic physical therapy **3x/week** and **control**: waiting list	54 adults with chronic low back pain. Frequency: 2 or 3x/week (comparison between groups), each session 60 min. for 2 months.	Pain (VAS); Functional disability (Oswestry); QoL (SF-36); Body composition (BMI), *curl-up* test, *sit-and-reach* test*, Hand dynamometer (handgrip strength) and Aerobic capacity (1-mile walk test).	Significant reduction in pain and functional disability and increased physical fitness, with greater effect at 3x/week. There was also a greater improvement in QoL in the higher frequency group.
Baena-Beato *et al.* (2014a)	Controlled clinical trial. **Intervention group**: Aquatic physical therapy and **Control group**: waiting list	49 sedentary adults with chronic low back pain. Frequency: 5x/week, each session 60 min. for 2 months.	Pain (VAS); Functional disability (ODI); QoL (SF-36); Body composition (BMI), *curl-up* test, *sit-and-reach* test*, Hand dynamometer (handgrip strength) and Aerobic capacity (1-mile walk test).	Significant reduction in low back pain and disability, in addition to improvement in physical QoL, body composition, and physical fitness. The authors highlight the efficacy of high-frequency programs for this population. The control group showed no significant changes.
Baena-Beato *et al.* (2014b)	Prospective Observational (non-randomized). **Single group**: Aquatic physical therapy 2 to 5x/week\ *(no control group).*	60 sedentary adults with chronic low back pain. Frequency: 2 to 5x/week (personal availability), each session of 55 to 60 min. for 8 weeks.	Pain (VAS); Functional disability (ODI); QoL (SF-36); Body composition (BMI), *curl-up* test, *sit-and-reach* test*, Hand dynamometer (handgrip strength) and Resting HR	The main predictors of disability reduction (ODI) after aquatic physical therapy were pain reduction and increased abdominal endurance. There was a significant association with handgrip strength

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				and lumbar/hamstring flexibility.
Costantino *et al.* (2014)	Randomized clinical trial. **Group A**: Back school and **Group B**: Aquatic physical therapy.	56 elderly with nonspecific chronic low back pain. Frequency: 2x/week, each session 60 min. for 12 weeks.	Pain (SF-36 - pain domain); Functional disability (RMDQ); QoL (SF-36).	Both groups (aquatic therapy and Back School) were effective, but aquatic physical therapy had a greater impact on reducing disability and improving QoL. This therapy should be considered especially for the elderly, due to its efficacy and safety.
Dundar *et al.* (2009)	Randomized clinical trial. **Intervention group**: Aquatic physical therapy and **Control group**: Home exercises (land).	65 adults with chronic low back pain. Frequency: 5x/week, each session 60 min. for 4 weeks.	Pain (VAS); Functional disability (ODI); Quality of Life (QoL) (SF-36); Spinal mobility.	Aquatic therapy superior to land exercise in improving disability (ODI) and QoL (SF-36).
Peng *et al.* (2022)	Blinded randomized clinical trial. **Intervention group**: Aquatic physical therapy and\ **Control group**: TENS + Infrared	113 adults with chronic low back pain. Frequency: 2x/week, each session 60 min. for 12 weeks.	Pain (NRS); Functional disability (RMDQ); QoL (SF-36); Sleep (PSQI), Anxiety and depression (HADS), Kinesiophobia (TSK).	Aquatic physical therapy was significantly more effective in reducing pain and disability, in addition to promoting improvement in the other assessed outcomes. The effects were maintained for up to 12 months.
Rosenstein *et al.* (2025)	Randomized clinical trial. **Intervention group** (aquatic exercises) and **Control group** (care at a physical therapy clinic)	34 adults with chronic low back pain. Frequency: 2x/week, each session 60 min. for 10 weeks.	QoL (SF-12); Pain (NRS); Functional disability (ODI); Strength of lumbar extensor muscles (standardized isometric test); Anxiety and depression (HADS); Sleep (ISI); Muscle morphology (MRI).	The intervention group showed improvements in the muscle volume of the multifidus and erector spinae, in addition to improved QoL, reduced anxiety and depression, and improved sleep quality. There was also a significant improvement in lumbar extensor strength in both groups, but without statistical difference between them. The study highlights that muscle morphological changes

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				were moderately correlated with clinical and psychosocial outcomes.

Legend: QoL (Quality of Life); VAS (Visual Analogue Scale); ODI (Oswestry Disability Index); SF-36 (Short Form Health Survey -- 36 items); BMI (Body Mass Index); HR (Heart Rate); RMDQ (Roland-Morris Disability Questionnaire); TENS (Transcutaneous Electrical Nerve Stimulation); NRS (Numeric Rating Scale); PSQI (Pittsburgh Sleep Quality Index); HADS (Hospital Anxiety and Depression Scale); TSK (Tampa Scale for Kinesiophobia); SF-12 (Short Form Health Survey -- 12 items); MRI (Magnetic Resonance Imaging). Three main outcomes were recurrent in all studies: low back pain intensity, level of functional disability, and quality of life. Source: Prepared by the authors.

LBP was measured mainly by the Visual Analogue Scale (VAS) and Numeric Rating Scale (NRS). In all studies that used these scales, there was a statistically significant reduction in pain after the aquatic intervention. For example, Baena-Beato (2014) reported an average reduction of 3.83 mm on the VAS, while Peng *et al*. (2022) identified a reduction greater than 2 points on the NRS in 70% of patients after 3 months of aquatic treatment – an effect maintained after 12 months.

Functional disability was assessed using the Oswestry Disability Index (ODI) and the Roland Morris Disability Questionnaire (RMDQ). The studies demonstrated a significant improvement in the scores of these instruments, indicating greater functional autonomy of the participants after the program. In the study by Dundar *et al*. (2009), the aquatic therapy group obtained superior results compared to the land-based exercise group, demonstrating a relevant differential effect of water immersion on functionality. In the study by Rosenstein *et al*. (2025), although the aquatic group did not show significant changes in the ODI relative to the control group, moderate correlations were observed between increased lumbar muscle strength and self-reported functional improvement.

QoL was, in most studies, measured with the SF-36, with improvement mainly in the physical component (functional capacity, bodily pain, and general health). In five of the seven studies, the authors reported significant improvements in the physical domains, and two of these studies also observed improvements in the mental component (vitality, emotional health, and social), although with lesser magnitude. Rosenstein *et al*. (2025), using the SF-12, reported a significant improvement in physical QoL and identified a

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positive correlation between the increase in multifidus muscle volume and the physical component of the SF-12.

In addition to the three central outcomes, the studies addressed additional variables that broadened the understanding of the impact of aquatic therapy, namely body composition, health-related physical fitness, and sleep, anxiety, and depression.

Body composition was assessed in three studies (Baena-Beato 2013, 2014a and 2014b), which indicated improvement in BMI, reduction of body fat, and increase in skeletal muscle mass, although this effect was less consistent among the studies. When present, it was more evident in programs with higher frequency (≥3 times per week).

Health-related physical fitness was assessed through tests such as: handgrip strength, sit-and-reach, push-ups, and the 1-mile walk test (*Rockport 1-Mile Walk Test*). The data indicated that the improvement in this fitness positively impacted the reduction of functional disability, as evidenced by Baena-Beato (2014), who identified abdominal muscle endurance as a significant predictor of functional improvement. This finding was reinforced by Rosenstein *et al*. (2025), who verified improvement in lumbar extensor strength, measured by an isokinetic dynamometer, after the aquatic intervention, strengthening the relationship between muscle strength gain and functional recovery.

Sleep, anxiety, and depression were assessed in the study by Peng *et al*. (2022), which showed significant improvement in these domains in the aquatic therapy group, with a sustained impact up to the 12-month follow-up. Similarly, Rosenstein *et al*. (2025) observed moderate correlations between improvement in sleep quality, anxiety, and depression and gains in muscle morphology. These findings suggest that the effects of aquatic physical therapy extend beyond physical aspects, also promoting emotional balance and improvement in psychosocial well-being.

The consistency of findings across diverse contexts, populations, and methodologies underscores the robustness of the available evidence. Pain reduction was the most rapidly noticeable outcome, directly reflecting the improvement in functionality and physical QoL of the participants. Furthermore, programs with higher weekly frequency (three or more sessions) and longer duration (minimum of 8 weeks)

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demonstrated a greater magnitude of effect, indicating a positive dose-response relationship.

This systematic review gathered seven studies that investigated the effects of aquatic physical therapy on individuals with chronic LBP, assessing outcomes such as pain, functional disability, QoL, body composition, health-related physical fitness, and psychosocial factors. Although there are variations in intervention protocols and sample characteristics among the studies, all pointed out that aquatic therapy was effective, safe, and capable of promoting relevant physical and psychosocial benefits. The analysis reveals a high degree of consistency in the findings pertaining to the benefits of aquatic therapy for individuals with LBP can be observed.

Regarding pain, all seven studies reported a significant reduction in patients undergoing hydrotherapy. In particular, the study by Peng *et al*. (2022) demonstrated that individuals allocated to the aquatic therapy group showed greater pain reduction, measured by the NRS, compared to the group undergoing traditional physical therapy, with a 12-month follow-up. These findings are in line with the meta-analysis conducted by Shi *et al*. (2018), which analyzed eight randomized clinical trials and concluded that hydrotherapy is effective in reducing pain intensity in patients with chronic LBP. Similar results were observed by Baena-Beato *et al*. (2013; 2014), who reported significant improvements after eight weeks of aquatic intervention with five weekly sessions.

The adequate use of validated and practical pain scales, as suggested by Karcioglu *et al.* (2018), allows for greater comparability between clinical studies and more evidence-based clinical decision-making. The authors emphasize that VAS and NRS are simple yet highly effective instruments for assessing pain intensity, applicable in different health contexts, including aquatic physical therapy. This methodological standardization contributes to the robustness of the data observed in this systematic review. Therefore, the consistent pain reduction observed in aquatic interventions constitutes a central element for the functional improvement of individuals with LBP.

Regarding functional disability, the studies by Baena-Beato *et al*. (2013, 2014), Peng *et al*. (2022), and Dundar *et al*. (2009) used validated scales such as the RMDQ and

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ODI and found a significant reduction in disability after the aquatic intervention. In particular, Dundar *et al.* (2009) observed that participants submitted to a program of aquatic exercises five times per week for four weeks showed greater functional improvement compared to those who performed home exercises. The authors posit that aquatic therapy may be particularly advantageous during the initial phases of rehabilitation, especially for patients with greater disability levels. Furthermore, Rosenstein *et al*. (2025) found that increased lumbar extensor strength, measured by an isokinetic dynamometer, was positively associated with self-reported functional improvement, reinforcing the relationship between physical gains and functional recovery.

The correlation between outcomes was also evidenced in the functional prediction analyses (Baena-Beato *et al*., 2014), where pain improvement and increased muscle endurance significantly explained the reduction in disability. This finding is consistent with the principles of functional rehabilitation, which point to movement as a therapeutic pillar in LBP.

In line with these results, studies such as those by Waller, Lambeck, and Daly (2009) and Olson *et al*. (2013) reinforce that aquatic programs produce consistent positive effects on functionality, especially when performed with adequate frequency and under professional supervision. Both studies used the ODI to demonstrate significant improvements in the ability to perform daily activities.

Olson *et al*. (2013), in particular, draw attention to the benefits of aquatic physical therapy in individuals with higher degrees of functional disability – those who have relevant restrictions for walking short distances, climbing stairs, or even dressing. These patients, often affected by fear of movement and a higher risk of physical inactivity, tend to avoid activities for fear of pain. In this context, the aquatic environment offers support and safety for performing exercises with less impact and pain, which favors adherence, improves self-confidence, and amplifies functional gains even among the most severe cases.

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QoL was consistently measured by instruments such as the SF-36 and SF-12, with a predominance of improvement in the physical domains (functional capacity, bodily pain, and general health) reported in five of the seven studies. In two studies, improvements in the mental component (vitality, emotional health, and social relations) were also observed, albeit to a lesser extent. The study by Rosenstein *et al*. (2025) observed a positive correlation between the increase in multifidus muscle volume and the physical component of the SF-12, reinforcing the link between muscle function and QoL perception. Ariyoshi *et al*. (1999), even without a control group, reported that patients who participated in aquatic exercises two or more times per week over six months presented more consistent improvements in physical QoL scores, suggesting the importance of frequency in the intervention's effectiveness.

Both Waller *et al*. (2009) and Olson *et al.* (2013) also reinforce that aquatic programs bring positive impacts on the QoL of individuals with chronic LBP, particularly in the physical domains of the SF-36. Olson *et al.* (2013) highlight that these benefits are amplified when programs include professional supervision and individualized approaches, while Waller *et al*. (2009) point out that the improvement in QoL may be related to the feeling of support, safety, and pleasure provided by the aquatic environment.

The interaction between chronic pain, disability, and mental health also deserves emphasis, since symptoms such as anxiety and depression can compromise both adherence and the results of physiotherapeutic interventions. The study by Peng *et al*. (2022) was the only one to simultaneously assess sleep (PSQI), anxiety and depression (HADS), and kinesiophobia (TSK), identifying significant improvements in all domains after the aquatic intervention. These findings are consistent with the biopsychosocial model of chronic pain, in which emotional and behavioral aspects are considered mediators of the therapeutic response (Pincus *et al*., 2006; Liddle; Baxter; Gracey, 2007). Studies such as that by Almeida *et al*. (2016) also indicate that the practice of exercises in an aquatic environment, as it occurs in a more welcoming, playful, and interactive setting, contributes to the reduction of anxiety and depression symptoms.

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Complementing these data, the study by Peng *et al*. (2022) demonstrated a significant reduction in symptoms of anxiety, depression, and kinesiophobia after 12 months of aquatic intervention, assessed by instruments such as PSQI, HADS, and TSK. The literature indicates that chronic pain is often associated with muscle stiffness, physical deconditioning, postural changes, and emotional distress, which impairs QoL (Pittler *et al*., 2006; Childs *et al*., 2008). Other research discusses that psychological distress acts as a mediator of persistent pain, influenced by affective and cognitive factors. Thus, the beneficial effects of aquatic therapy on mental health have important implications for the patient's integral recovery (Pincus *et al*., 2006; Liddle; Baxter; Gracey, 2007).

Another relevant aspect concerns surgical interventions, which, although indicated in specific cases, present a higher risk of complications, prolonged recovery time, and the possibility of pain recurrence (Wang *et al*., 2017). In this scenario, aquatic therapy stands out as a first-line, effective, and less invasive strategy, aligned with the recommendations of clinical guidelines (Airaksinen *et al*., 2006; Qaseem *et al.,* 2017; Miyamoto *et al*., 2018). The possibility of promoting functional, physical, and psychosocial gains safely reinforces its applicability in both outpatient and Primary Care contexts.

Regarding body composition, Baena-Beato *et al*. (2013, 2014) observed a significant reduction in body mass index (BMI) and body fat percentage, especially in the group submitted to the aquatic intervention. These results are attributed to the cardiorespiratory and resistance nature of aquatic exercises, which favor caloric expenditure, global muscle activation, and reduction of adiposity.

The improvement in health-related physical fitness, observed in the studies by Baena-Beato *et al*. (2013, 2014), may be directly associated with the reduction of functional disability. Fitness was assessed through tests such as handgrip strength, sit-and-reach, push-ups, and the 1-mile walk test, reflecting an increase in muscle endurance, flexibility, and aerobic capacity. Abdominal endurance, in particular, proved to be a significant predictor of functional improvement, as pointed out in previous analyses (Hodges *et al*., 2003; Barr; Griggs; Cadby, 2007;). This suggests that aquatic interventions

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that promote muscle gain and global conditioning not only relieve pain but also restore functionality in a sustainable way.

Among the mechanisms explaining the results, the importance of abdominal muscle endurance as one of the main physical determinants of functional disability stands out (Hodges *et al*., 2003; Barr; Griggs; Cadby, 2007;). Low endurance leads to restrictions in daily activities (Weiner *et al*., 2003), lower levels of physical activity (Lin *et al*., 2011), and worsening pain (Kovacs *et al*., 2004; Hall *et al*., 2011). Mannion *et al*. (2001) suggest that fear, pain, and psychological distress explain a significant part of functional disability. Rainville *et al*. (2004) emphasize that pain reduction, associated with abdominal strengthening, directly contributes to functional improvement.

Finally, the comparison with pharmacological interventions reinforces the role of physical therapy as a primary approach. Although medications such as palmitoylethanolamide can relieve pain (Scturro *et al*., 2020), their prolonged use is associated with risks of dependence (Yabuki *et al*., 2019). Thus, therapeutic exercises, particularly in an aquatic environment, remain recommended by international guidelines as first-choice treatment (Airaksinen *et al*., 2006; Qaseem *et al*., 2017; Miyamoto *et al*., 2018).

This systematic review presents important strengths. The inclusion of studies with good methodological quality, with a predominance of randomized clinical trials, increases the robustness of the gathered evidence. Another differential was the multidimensional analysis of the effects of aquatic physical therapy, encompassing physical, functional, and psychosocial outcomes – including pain, functional disability, QoL, body composition, physical fitness, and mental health. Additionally, the comparative analysis of the frequencies and durations of the interventions allowed for the discussion of dose-response relationships, providing subsidies for the practical application of aquatic therapy in different clinical contexts.

Despite these contributions, some limitations must be acknowledged. The small number of included studies (n = 7) restricts the generalization of the findings. The heterogeneity between the protocols used (different types of exercises, frequencies,

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durations, and assessment methods) compromises the direct comparison of results. Furthermore, few studies included long-term follow-up, making it difficult to assess the durability of the effects. The absence of data on cost-effectiveness was also observed, a fundamental aspect for guiding decisions in public health, especially in contexts with limited resources. Therefore, it is recommended that future research conduct randomized clinical trials with a larger number of participants and standardized protocols, including longitudinal follow-up (≥ 12 months) to assess the maintenance of clinical gains.

4. CONCLUSION

This systematic review demonstrated that aquatic physical therapy is an effective, safe, and multifactorial intervention in the treatment of chronic LBP. The analyzed studies revealed consistent positive effects on pain, functional disability, and quality of life, especially in the physical domains. Furthermore, a potential impact on body composition, physical fitness, and psychosocial indicators, such as sleep, anxiety, and depression, was observed, mainly when the programs were applied with a frequency equal to or greater than three times per week, for at least eight weeks. Consequently, the integration of aquatic therapy should be expanded within clinical practice and public health policies, especially in contexts with adequate infrastructure and trained professionals. Its implementation can significantly contribute to the promotion of functionality, autonomy, and quality of life of individuals affected by this prevalent and disabling condition.

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