

Balneotherapy and Hydrotherapy in Neurological Disorders of the Aging Population: A Literature Review

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Disclosure statement

I have no actual or potential conflict of interest in relation to this program/presentation.

Context

Life expectancy reported to be 73.3 years as of 2024^[1];

General consensus → **geriatric patients** classified as 65 years of age or older

Parkinson's Disease usually begins around 60–65^[2];

Multiple Sclerosis typically diagnosed between 20 and 50 years old^[3];

Dementia typically begins after age 65^[4];

Stroke → first stroke occurs at around 70 on average^[5];

Aim: Evaluating the impact of hydrotherapy and balneotherapy in neurological disorders closely related to aging:

**Stroke,
Parkinson's Disease,
Multiple Sclerosis,
Dementia.**

analyzing

**Activities of daily living (ADL),
Balance,
Gait and functional mobility,
Quality of life (QoL).**

Figure 1. Scope of this review – effects of water based therapies on functional parameters in neurological disorders associated with aging

[1] United Nations Department of Economic and Social Affairs Population Division, World Population Prospects (2024)

[2] Parkinson's Disease | National Institute of Neurological Disorders and Stroke n.d. <https://www.ninds.nih.gov/health-information/disorders/parkinsons-disease> (accessed April 11, 2026)

[3] Empowering people affected by MS to live their best lives. National Multiple Sclerosis Society n.d. <https://www.nationalmssociety.org> (accessed April 11, 2026)

[4] What Are the Signs of Alzheimer's Disease? National Institute on Aging 2022. <https://www.nia.nih.gov/health/alzheimers-symptoms-and-signs/what-are-signs-alzheimers-disease> (accessed April 11, 2026)

[5] Trends in Age of First-Ever Stroke Following Increased Incidence and Life Expectancy in a Low-Income Chinese Population | Stroke n.d. <https://www.ahajournals.org/doi/10.1161/strokeaha.115.012400> (accessed April 11, 2026)

Materials and Methods (I)

Literature research:

Study Inclusion:

Water-based rehabilitation interventions;
Neurological disorders of aging;
Functional and quality-of-life outcomes;
Reviews, meta-analyses, RCTs, and key clinical studies;
English-language articles.

Study Exclusion:

Non-neurological populations;
Non-aquatic interventions;
No relevant rehabilitation outcomes;
Duplicates/overlapping reports;
Non-English or inaccessible studies.

Final Studies Included: 15 articles.

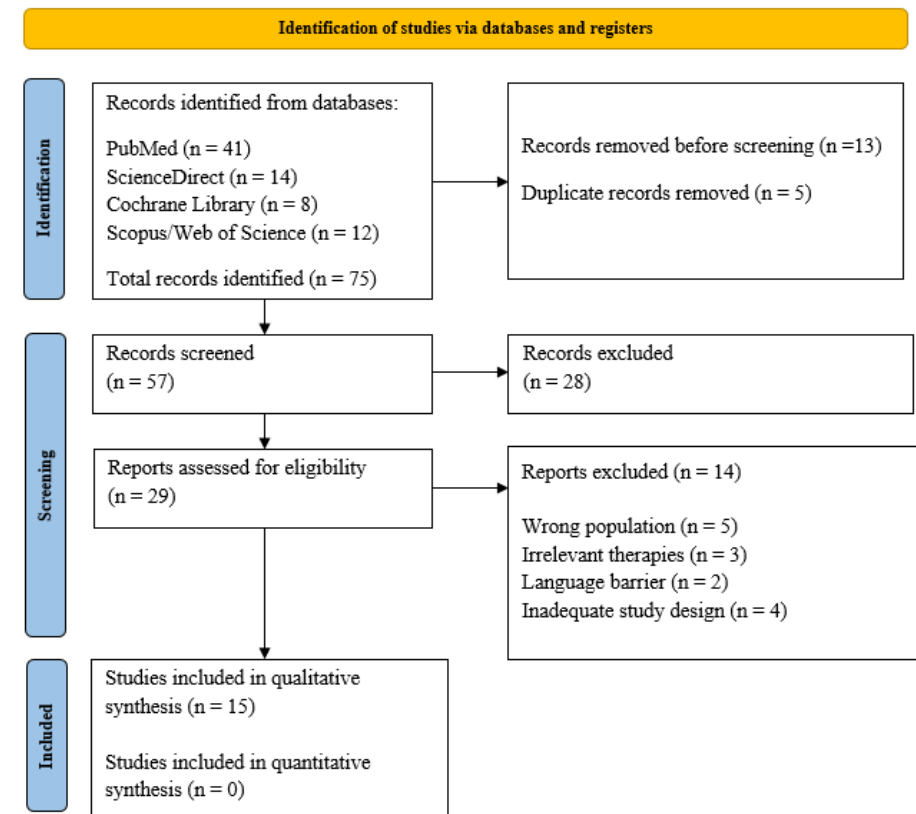


Figure 2. PRISMA diagram illustrating the study selection process

Materials and Methods (II)

Definitions and therapeutic rationale:

Balneotherapy:

Therapeutic use of **mineral or thermal waters**;

May include **bathing, physiotherapy in thermal water, massage, and spa-based procedures.**

Hydrotherapy:

Broader therapeutic use of **water in rehabilitation**;

Usually involves **pool-based exercise, immersion, or therapist-guided movement.**

Aquatic therapy:

Structured rehabilitation exercise performed in water;

Most common term used in modern **neurological rehabilitation studies.**



Figure 3. Water based rehabilitation: Balneoherapy (A), Hydrotherapy (B), Aquatic Exercise (C)

Materials and Methods (III)

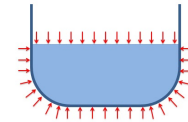
Buoyancy:

- Reduces effective body weight;
- Facilitates movement in patients with **weakness, pain, or fear of falling**.



Hydrostatic pressure:

- Enhances **sensory input and postural support**;
- Helps with stability and body awareness.



Viscosity / water resistance:

- Provides **graded resistance** for strengthening and motor control;
- Allows safer practice of balance and movement tasks.



Warm water:

- Promotes **muscle relaxation**;
- Reduces pain and improves exercise tolerance.



Clinical result:

- Supports training of **balance, gait, functional mobility, endurance, and participation**^[6];
- Particularly useful when land-based therapy is limited by **pain, deconditioning, or fear of falling**^[7].

[6] Matsumoto S. Evaluation of the Role of Balneotherapy in Rehabilitation Medicine. J Nippon Med Sch 2018;85:196–203. <https://doi.org/10.1272/jnms.2018.85.30>.

[7] Campos DM, Ferreira DL, Gonçalves GH, Farche ACS, De Oliveira JC, Ansai JH. Effects of aquatic physical exercise on neuropsychological factors in older people: A systematic review. Archives of Gerontology and Geriatrics 2021;96:104435. <https://doi.org/10.1016/j.archger.2021.104435>.

Materials and Methods (IV)

Scales used:

Activities of daily living (ADL) / functional independence:

Mainly assessed with **Barthel Index (BI)**, **Modified Barthel Index (MBI)**, and **Functional Independence Measure (FIM)**.

Balance / postural control:

Most common tools: **Berg Balance Scale (BBS)**, **3-level BBS (BBS-3L)**, **Functional Reach Test (FRT)**, **Functional Reach (FR)**, **Community Balance and Mobility Test (CBM)**, **Trunk Impairment Scale (TIS)**.

Gait and functional mobility:

Frequently measured with **Timed Up and Go (TUG)**, **2-Minute Walk Test (2MWT)**, **Functional Ambulation Categories (FAC)**, **Rivermead Mobility Index (RMI)**, timed walking tests, and sit-to-stand / transfer tasks
In **Parkinson's disease**, pooled walking outcomes were mainly reported through **TUG-type measures**.

Quality of life (QoL):

Assessed with **PDQ-39** in Parkinson's disease, **SF-36**, **EQ-5D**, and disease-specific **physical and mental QoL composite scores** in multiple sclerosis.

Materials and Methods (V)

Balance and postural control:

Scale	Full name	What it measures	Structure / content	How to interpret it
BBS	Berg Balance Scale	Static balance and fall risk during functional tasks	14 items , each scored 0–4 ; total score 0–56 . It assesses standing balance, transfers, reaching, turning, and stepping tasks.	Higher score = better balance ; lower scores indicate greater balance impairment and higher fall risk.
BBS-3L	3-Level Berg Balance Scale	Simplified balance assessment derived from the Berg Balance Scale	A reduced-level version of the Berg scoring system using 3 response levels rather than the standard 5-point format; intended to simplify scoring while retaining clinical utility in stroke/balance assessment.	Higher score = better balance / task performance.
FRT	Functional Reach Test	Dynamic balance and margin of stability in standing	Measures the maximum distance a person can reach forward while standing without losing balance or stepping.	Longer reach distance = better dynamic balance ; shorter reach suggests impaired balance and higher fall risk.
FR	Functional Reach	Forward-reaching capacity as a marker of dynamic standing balance	In rehabilitation studies, FR is generally reported as the practical forward reach distance achieved in standing, similar in concept to the Functional Reach Test.	Greater reach = better balance control.
CBM / CB&M	Community Balance and Mobility Scale	Higher-level balance and mobility needed for community ambulation	13 tasks , with 6 performed bilaterally ; items scored 0–5 , total score up to 96 . It captures more challenging balance and mobility tasks than basic bedside tests.	Higher score = better community-level balance and mobility.
TIS	Trunk Impairment Scale	Trunk control and sitting balance	Evaluates static sitting balance , dynamic sitting balance , and trunk coordination ; total score ranges from 0 to 23 .	Higher score = better trunk performance and postural control.

Table 1. Balance and postural control scales used across studies included in this review

[8] Berg Balance Scale (BBS) – Strokengine n.d. <https://strokengine.ca/en/assessments/berg-balance-scale-bbs/> (accessed April 14, 2026).

[9] Physiopedia contributors, "Community Balance and Mobility Scale," Physiopedia, , https://www.physio-pedia.com/index.php?title=Community_Balance_and_Mobility_Scale&oldid=364939 (accessed April 14, 2026).

[10] Physiopedia contributors, "Trunk Impairment Scale," Physiopedia, , https://www.physio-pedia.com/index.php?title=Trunk_Impairment_Scale&oldid=375477 (accessed April 14, 2026).

Materials and Methods (VI)

Timed Up and Go (TUG) – measured in seconds:



Figure 4. Timed up and Go action sequence

Quality of Life – Short Form–36 Health Survey (SF–36) and EuroQol 5 Dimensions (EQ–5D):

Scale	Full Name	Domains Assessed	Scoring Method	PM&R application
SF–36	Short Form–36 Health Survey	Physical functioning, role limitations, bodily pain, general health, vitality, social functioning, emotional well-being, mental health	Scores range from 0 to 100 per domain (higher = better health)	Comprehensive QoL tracking tool; captures physical and emotional recovery
EQ–5D	EuroQol 5 Dimensions	Mobility, self-care, usual activities, pain/discomfort, anxiety/depression	Index score from utility weights (0 = death, 1 = full health), plus a VAS 0–100	Brief yet standardized tool for economic evaluations and broad QoL changes
PDQ–39	Parkinson's Disease Questionnaire–39	Disease-specific health-related quality of life in Parkinson's disease; captures the impact of PD on functioning and well-being.	39 items across 8 domains (higher scores indicate worse quality of life)	Useful for tracking the broader impact of Parkinson's disease on daily life and for detecting changes after treatment or rehabilitation interventions.

Table 2. Quality of Life scales according to Ware, J. E., & Sherbourne, C. D. (1992) and EuroQol Group. (1990) and Parkinson's Disease Society of the United Kingdom (1997)

[11] Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992 Jun;30(6):473-83. PMID: 1593914

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Results (I)

Disorder centered results:

Parkinson's disease:

ADL: functional benefit reported, although not summarized by a single pooled ADL value^[14,15,16];
QoL: PDQ-39 improved by 5.057 points^[16];
Balance: improved by 2.234 points^[16];
Gait: walking / TUG-type outcomes improved by 0.911 units^[16];
Functional mobility: consistently favored aquatic therapy in review-level analyses^[14,15].

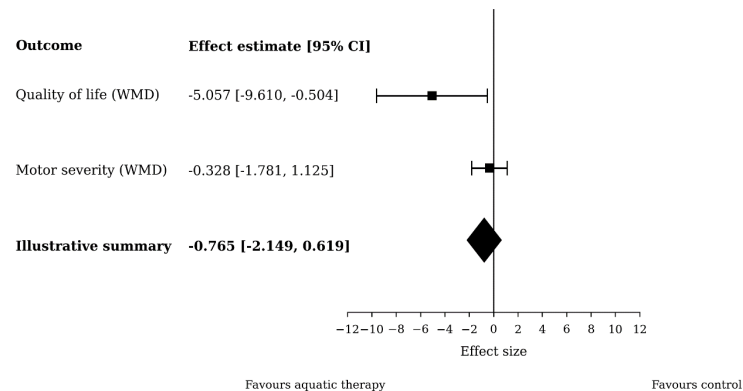


Figure 5. Quality of life and symptom burden in Parkinson's Disease

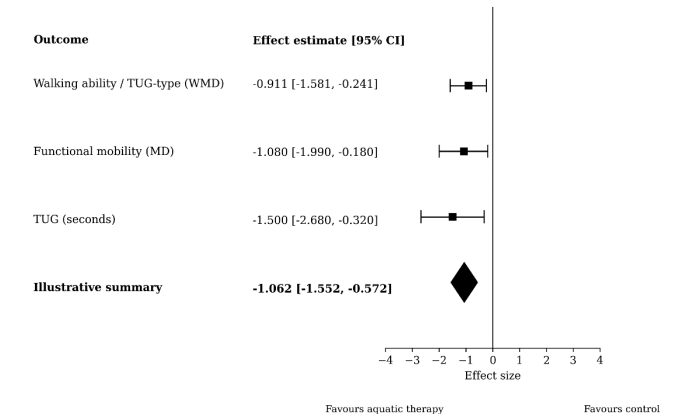


Figure 6. Gait and functional mobility in Parkinson's Disease

[14] Pinto C, Salazar AP, Marchese RR, Stein C, Pagnussat AS. The Effects of Hydrotherapy on Balance, Functional Mobility, Motor Status, and Quality of Life in Patients with Parkinson Disease: A Systematic Review and Meta-analysis. PM&R 2019;11:278-91. <https://doi.org/10.1016/j.pmrj.2018.05.011>.

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Results (II)

Disorder centered results:

Stroke:

ADL: Modified Barthel Index +9.49^[17];
QoL: improved in review-level evidence^[18];
Balance: BBS +3.56 / +7.01^[17];
Gait: TUG -3.79 s^[17];
Functional mobility: FRT +4.19 units^[17].

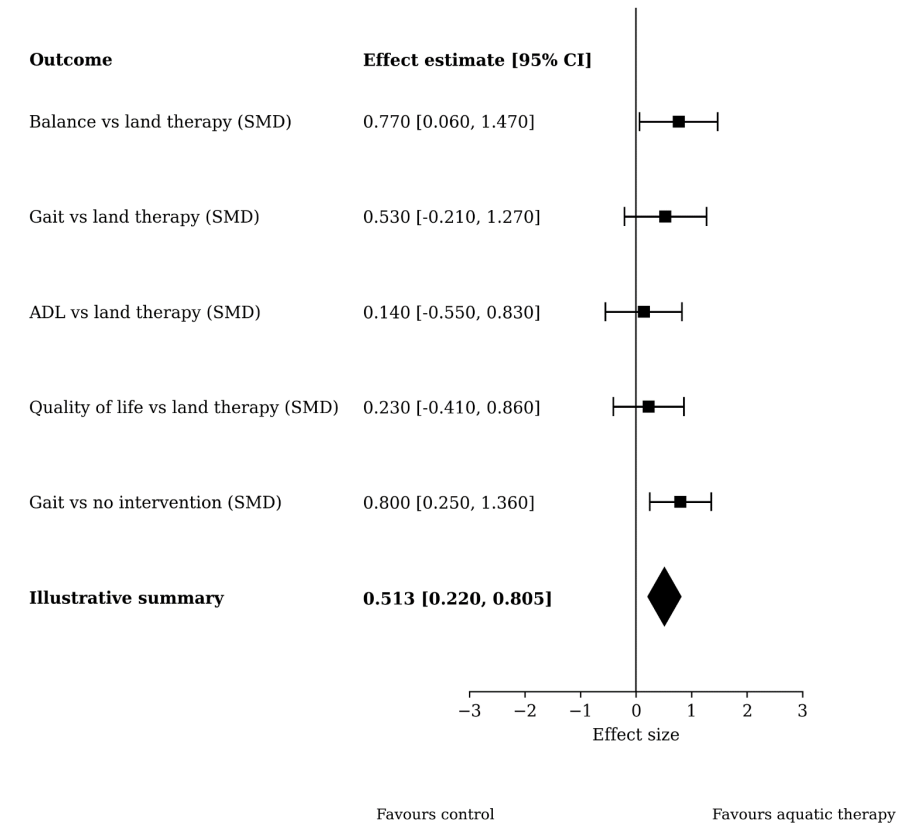


Figure 7. Stroke – Balance, gait, ADL, QoL vs control

[17] Giurati S, Servadio A, Temperoni G, Curcio A, Valente D, Galeoto G. The effect of aquatic physical therapy in patients with stroke: A systematic review and meta-analysis. Topics in Stroke Rehabilitation 2021;28:19–32. <https://doi.org/10.1080/10749657.2020.1755811>.

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Results (III)

Disorder centered results:

Multiple Sclerosis:

ADL: functional benefit described across studies, especially in mobility and participation^[19,20,21];
QoL: 43.9→65.4 / 44.4→70.2^[21];
Balance: positive balance effects reported across review-level evidence^[20];
Gait: walking and mobility outcomes improved in review-level evidence^[19];
Functional mobility / fatigue: MFIS 42.1→32.3 units vs 45.6→60.8 units^[21].

Dementia:

ADL: functional and participation-related benefits reported^[7,22,23];
QoL: improved psychological well-being^[7,22];
Balance: functional gains reported, though balance was not the main quantified endpoint^[22,23];
Gait: mobility-related outcomes described positively^[22,23];
Functional mobility / participation: improved engagement and psychosocial outcomes^[7,22,23].

[19] Amedoro A, Berardi A, Conte A, Pelosin E, Valente D, Maggi G, et al. The effect of aquatic physical therapy on patients with multiple sclerosis: A systematic review and meta-analysis. Multiple Sclerosis and Related Disorders 2020;41:102022. <https://doi.org/10.1016/j.msdis.2020.102022>.

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Results (IV)

Cross-disorder synthesis by outcome:

ADL	Balance	Gait / mobility	QoL	Symptom burden
• PD: functional benefit reported^[14,15,16]; • Stroke: MBI +9.49^[17]; • MS: functional benefit described^[19,20,21]; • Dementia: participation-related benefit reported^[7,22,23].	• PD: +2.234^[16]; • Stroke: BBS +3.56 / +7.01^[17]; • MS: positive balance effects reported^[19,20]; • Dementia: functional gains reported^[22,23].	• PD: -0.911^[16]; • Stroke: TUG -3.79 s; FRT +4.19^[14]; • MS: gait improved in review-level evidence^[19]; • Dementia: mobility outcomes described positively^[22,23].	• PD: PDQ-39 -5.057^[16]; • Stroke: improved in review-level evidence^[18]; • MS: 43.9→65.4 / 44.4→70.2^[21]; • Dementia / older adults: improved well-being and QoL-related outcomes^[7,22,23].	• PD: mobility-linked symptom relief; global motor severity NS^[16]; • Stroke: emotional status / spasticity improved^[18]; • MS: MFIS 42.1→32.3 vs 45.6→60.8^[21]; • Dementia: better behavioral and psychological well-being^[22,23].

Table 3. Outcome centered analysis showing the effect of aquatic interventions

Discussion (I)

Clinical implications for PM&R:

Water-based therapies are **adjuncts to conventional neurorehabilitation**, not replacements for land-based therapy

They appear particularly useful in older neurological patients whose land-based exercise is limited by:

Pain;

Fear of falling;

Poor balance;

Deconditioning;

Musculoskeletal comorbidity.

The most defensible clinical targets are:

balance and postural control;

gait / functional mobility;

quality of life.

In PM&R practice, their main value lies in supporting **safer movement, better rehabilitation tolerance, and clinically meaningful functional gains.**

Discussion (II)

Future directions and practice outlook:

Aquatic therapy already has enough promise to support use in **selected PM&R patients**.

The key question now is:

who benefits most?

which outcomes respond best?

which protocols should be standardized?



Future studies should focus on:

geriatric-specific randomized trials;

standardized protocols, terminology, and dosage;

clearer reporting of ADL, participation, fear of falling, and long-term benefit;

comparison with land-based rehabilitation;

more balneotherapy-specific neurological evidence.

Bottom line: stronger evidence could support broader integration into **neurorehabilitation and multidisciplinary PM&R care**.

Discussion (III)

Strengths of the review:

- Covers the main neurological disorders of aging;
- Combines qualitative and quantitative evidence;
- Structured by pathology and by outcome;
- Focused on clinically meaningful PM&R endpoints.

Limitations of the review:

- Heterogeneous terminology, protocols, and outcome measures;
- Uneven evidence across disorders;
- Small samples and short follow-up in many studies;
- Balneotherapy evidence weaker than aquatic-exercise evidence.

Take away messages

Water changes rehabilitation

Aquatic therapy creates a safer environment for movement, balance training, and functional recovery.

The strongest gains are visible

The most consistent improvements were in **balance, gait / mobility, and quality of life.**

The benefit is multidimensional

Aquatic therapy improves not only physical function, but also **fatigue, confidence, and well-being.**

The right patients benefit most

It is particularly useful in older neurological patients limited by **pain, deconditioning, or fear of falling.**

Time for clinical integration

Water-based therapies should be seen not as optional extras, but as **meaningful PM&R tools in Neurorehabilitation.**

Thank you!



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