Applying Ai Chi to Improve Pain, Postural Control, and Quality of Life in Those With Neurological Conditions: A Systematic Review

Eliza Ericson, DPT; Ryan Kulawy, DPT; Joslyn Phalen, DPT; Alyssa Winberg, DPT; Gabriele Moriello, PT, PhD

Department of Physical Therapy, Utica University, Utica, New York (Drs Ericson, Kulawy, Phalen, and Winberg); and Department of Physical Therapy, Tufts University, Medford, Massachusetts (Dr Moriello).

Background and Purpose: Individuals with neurological conditions often experience pain, deficits in postural control, and reduced quality of life. Ai Chi, a form of aquatic therapy and a mindfulness practice, may impact these impairments. This systematic review aimed to synthesize evidence on the effectiveness of Ai Chi on postural control, pain, and quality of life in adults with neurological disorders.

Methods: A comprehensive search was conducted using 4 databases (CINAHL, PubMed, MEDLINE, and Physiotherapy Evidence Database) and 2 gray literature databases (WorldCat and Center for Research Libraries Library Catalog). Only randomized controlled trials were utilized in this review. The researchers completed title, abstract, and full-text screening individually and then in pairs using the selection criteria. Data were synthesized descriptively, and effect sizes were calculated. The Physiotherapy Evidence Database (PEDro) Scale was used to assess the quality of the final articles.

Results: Eight studies were included in this systematic review, ranging in score from 6 to 8 on the PEDro Scale, indicating they were of good quality. Ai Chi, or a combination of Ai Chi and dry land exercise, resulted in greater improvements in postural control, pain, or quality of life, as compared to dry land exercises in individuals with Parkinson disease, stroke, and multiple sclerosis. Treatment effects were largest for pain.

Discussion: These findings support the contention that Ai Chi is more effective than land-based exercises in the neurological population. There is strong evidence showing the benefits of Ai Chi on pain, postural control, and quality of life for individuals with Parkinson disease, stroke, and multiple sclerosis.

Conclusion: Physical therapists could consider Ai Chi as an intervention for individuals with neurological diagnoses, especially when the goal is to address impairments in pain, postural control, and quality of life. (J Aquat Phys Ther 2025;33(3):33–44)

Key words: Ai Chi, aquatic therapy, neurological diagnoses

Living with a neurological disorder can significantly affect a person's physical well-being, mental health, and quality of life, limiting participation in valued activities.[1] Individuals with neurological disorders may face impairments with motor, sensory, and vestibular systems, which can impair postural control and increase the risk of falls.[2] People with neurological conditions are 3 times more likely to fall than those without, with the highest risk among individuals diagnosed with Parkinson disease and stroke.[3] Additionally, about 36% of people with neurological conditions experience chronic pain, which is twice as prevalent as in the general population.[4]

Journal of Aquatic Physical Therapy

Correspondence: Gabriele Moriello, PT, PhD, Department of Physical Therapy, Tufts University, 200 Boston Ave, Medford MA 02155 (Gabriele.Moriello@tufts.edu).

The authors have no conflicts of interest or disclosures to report.

DOI: 10.1097/PXT.0000000000000051

Individuals with neurological diagnoses are at higher risk for mental health disorders, with depression and anxiety reported in anywhere from 10% to 45% of cases.[1,5] Anxiety and depression can occur due to frustration from reduced independence, chronic pain, social isolation, as well as biological changes caused by the disease itself.[1,6-9] Both physical and mental impairments can lead to difficulties with daily activities.

Growing evidence suggests that mindfulness activities can help individuals better manage their conditions by reducing physical and psychological symptoms and improving quality of life.[10,11] Ai Chi, a mindfulness practice similar to Tai Chi, combines slow, deliberate movements, deep breathing, and visualization techniques, all performed in the calming environment of water.[12] Ai Chi fosters mindfulness by encouraging intentional practice, connecting breath work with movement, and enhancing body awareness. It also incorporates a spiritual aspect by balancing yin and yang through hand movements. Practicing Ai Chi in shoulder height water provides buoyancy, reducing body weight significantly. Water-based settings offer a warm, distracting environment from pain and can be

enjoyable and social in groups. Additionally, the fear of falling is minimized in water, boosting confidence when compared to land-based activities.[12,13]

Ai Chi consists of 19 choreographed patterns of movement, or katas, that are designed to enhance the mind-body connection, improve physical and mental health, and promote overall well-being. The core elements of Ai Chi integrate deep breathing with slow continuous arm, trunk, and leg movements, which progress in complexity over time.[12] The purpose of these movements is to balance energy by stretching specific meridians, which are channels that allow energy, or qi, to flow.[12-14] See Table 1 for a more detailed description of each of the 19 katas.

Research shows that individuals with neurological diagnoses who participate in Ai Chi, or a combination of Ai Chi and dry land exercise, experience improvements in postural control, pain, and quality of life compared to strictly dry land exercises.[15] Paced breathing techniques, when paired with rhythmic muscle contractions, enhance parasympathetic activity, thereby reducing sympathetic tone and limiting the biological stress response.[16] Intentional movement is crucial for postural control as it requires individuals to act against gravity during complex movements and maintain their center of mass during static and dynamic movements.[17] This is vital for transfers, walking, daily activities, fall prevention, and other functional and recreational activities.

TABLE 1
Description of Ai CHi Katas[12]

Kata	Explanation of Kata	Description of Movement
Contemplating	Begin with a calm and focused mind, preparing for the practice.	Symmetrical trunk position with a wide stance, while fixating visually on a point. The center of gravity (COG) is not moving, and the arms move symmetrically. Focus is on breathing.
Floating	Gentle movements that create a sense of buoyancy and relaxation.	Similar to contemplating but the focus is on buoyancy where the arms mimic floating on water.
Uplifting	Raising the arms to enhance energy flow and promote positivity.	Symmetrical trunk position with a wide stance, while fixating visually on a point. COG is not moving, and the arms move upward symmetrically, as if lifting something light.
Enclosing	Bringing the arms inward to create a sense of protection and self-awareness.	Symmetrical trunk position with a wide stance, while fixating visually on a point. COG is not moving, and the arms move to enclose the body symmetrically.
Folding	Movements that involve bending and flexing to improve flexibility.	Symmetrical trunk position with a wide stance, while fixating visually on a point. COG is not moving, and the arms fold symmetrically.
Soothing	Gentle, calming movements to reduce stress and promote tranquility.	Symmetrical trunk position with a wide stance, while fixating visually on a point. COG is not moving, and the arms move asymmetrically to calm the body.
Gathering	Bringing energy inward, focusing on internal strength and balance.	Symmetrical trunk position in tandem stance with asymmetrical arm movements toward and away from the body, as in a gathering motion.
Freeing	Movements that release tension and promote freedom of motion.	Trunk rotations in tandem stance with asymmetrical arm movements; eyes follow hands.
Shifting	Changing positions to improve balance and coordination.	With a wide symmetrical base, rotations between the thorax and pelvis with continuous shifting of COG in the coronal place. Eyes follow the moving hand as the arms move asymmetrically.
Accepting	Embracing the present moment and the body's capabilities.	In tandem stance, the trunk moves symmetrically, while continuously shifting the COG in the sagittal plane and visually fixating on a point. Focus is on balance.
Accepting with grace	Performing movements with elegance and mindfulness.	Arms move symmetrically close to the body, then move away, with either the front or back leg lifted during a breath cycle while visually fixating on a point.
Rounding	Circular movements to enhance fluidity and continuity.	Arms move symmetrically close to the body, then move away, with either the front or back leg lifted during a breath cycle while visually fixating on a point. Adding a rounding motion.
Balancing	Focused movements to improve stability and equilibrium.	Maintaining balance while arms move symmetrically with either the front or back leg lifted during 3 breath cycles.
Flowing	Smooth, continuous movements that promote harmony and ease.	Arms move symmetrically, smoothly, and continuously while walking laterally, cross stepping and pivoting, while visually fixating on a point.
Reflecting	Contemplative movements that encourage self-awareness and introspection.	Arms move symmetrically and reflectively while walking laterally, cross stepping and pivoting, while visually fixating on a point.
Suspending	Holding positions to build strength and concentration.	Arms move symmetrically with a body turn and a floating phase, without a visual fixation point.
Encircling	Circular movements that create a sense of unity and completeness.	Arms move symmetrically in a full circular movement. Symmetrical stance and continuous movement of the COG, following the hand with the eyes.
Surrounding	Movements that encompass the body, promoting protection and wholeness.	Arms move symmetrically in a Tai Chi manner, as if you are pushing away and then pulling in toward your body. Symmetrical stance and continuous movement of the COG, following the hand with your eyes.
Nurturing	Gentle, caring movements that promote healing and well-being.	Arms move symmetrically in a Tai Chi manner, as if you are pushing away and then pulling in toward your body. Symmetrical stance and continuous movement of the COG, following the hand with your eyes.

A scoping review by Dunlap et al[15] examined the effects of Ai Chi on balance, pain, functional mobility, and quality of life in healthy adults and those with various painful and neurological medical conditions. All studies examining the impact of Ai Chi on balance reported greater improvements with Ai Chi compared to land-based exercises, and most studies indicated more significant pain reduction and found enhanced functional mobility in the Ai Chi group. However, the studies investigating quality of life yielded mixed results.

Limitations of the scoping review included a low number of high-quality studies; potential data duplication and the review included some non-land-based comparison interventions like acupuncture, alternative aquatic therapy, and spa thermal treatment. This current systematic review will update the scoping review and address these limitations by focusing solely on neurological diagnoses, excluding non-land-based comparison interventions, and including only high-quality studies. Additionally, the aim of a scoping review is to provide an overview of the research landscape and identify areas for further exploration rather than offering a detailed synthesis of evidence. Therefore, the purpose of this systematic review was to collect, assess, and synthesize existing evidence on the effectiveness of Ai Chi on postural control, pain, and quality of life in individuals with neurological disorders. Understanding the impact of Ai Chi on individuals with neurological disorders can contribute to better patient outcomes and community functioning.

METHODS

Data Sources and Searches

A thorough search was conducted across multiple databases, including CINAHL, PubMed, MEDLINE, and Physiotherapy Evidence Database (PEDro), for studies published between 2010 and 2025. Throughout the search process, a reference librarian was consulted. The search term "Ai Chi" AND (pain OR postur* OR "quality of life") yielded 55 results in CINAHL and 62 results in MEDLINE. In PubMed and WorldCat, the query "Ai Chi" NOT "Tai Chi" produced 60 and 6 results, respectively. In PEDro, searching for "Ai Chi" under "hydrotherapy, balneotherapy" and the neurology subdiscipline yielded 8 results. Attempts to search the gray literature using WorldCat and the Center for Research Libraries Library Catalog did not yield any additional results for "Ai Chi." Reference lists of identified articles were reviewed to locate any additional studies. Furthermore, an expert in aquatic therapy was consulted for recommendations and guidance.

Study Selection

Studies were included if they met the following criteria: (1) participants were adults with neurological diagnoses; (2) the intervention was Ai Chi, Ai Chi Ne, or Wall Ai Chi; (3) the study design was a randomized controlled trial or a pilot randomized controlled trial; (4) at least 1 outcome measure assessed postural control, pain, and/or quality of life; (5) the article was published between 2010 and 2025; and (6) the article was written in either English or German.

Studies were excluded if (1) the intervention was general aquatic therapy with no mention of Ai Chi, (2) the intervention performed was Tai Chi or Qi Gong, (3) participants had a psychological or intellectual disorder without a neurological condition, or (4) there was no comparison of a land-based intervention.

All sources were imported into RefWorks and subsequently transferred to the latest version of Covidence to facilitate the screening process by removing duplicates and enabling the screening of titles and abstracts. Four assessors (E.E., R.K., J. P., and A.W.) independently reviewed the titles and abstracts of 65 articles individually, then in pairs, followed by a group discussion of the findings. The fifth assessor (G.M.) served as a tiebreaker for any conflicts. After the initial search, 226 articles were imported, with 97 duplicates removed. Of the 129 articles screened, 21 qualified for a full-text review. The full-text review was conducted by 4 assessors (E.E., R.K., J.P., and A.W.) independently and then in pairs, with the fifth assessor (G.M.) acting as a tiebreaker. The full-text review excluded 13 articles, leaving 8 articles for data extraction.

Data Extraction and Quality Assessment

To summarize the information from all the articles, a data extraction table was created, detailing author/year, intervention and control group characteristics, participant characteristics, and study outcomes. A primary and secondary assessor independently collected data from each article and then discussed their findings to ensure consistency (Table 2). For quality assessment, the PEDro) Scale was used to evaluate the internal validity of the included articles. The process for collecting scores mirrored that of the data extraction. Differences in assessment were discussed among the assessors, and if consensus could not be reached, the fifth assessor (G.M.) acted as a tiebreaker. All PEDro Scores were compared to those in the PEDro database, and any discrepancies were discussed among all researchers.

The PEDro Scale includes 11 criteria: eligibility criteria, randomization, concealment of allocation, similar prognostic indicators, blinding of subjects, blinding of therapists, blinding of outcome assessors, attrition, intention-to-treat analysis, between-group statistical comparison, and point measures and measures of variability. Criteria 2 to 11 were used to calculate the score, with a possible maximum score of 10. A total PEDro Score of 0 to 3 was considered "poor," 4 to 5 was considered "fair," 6 to 8 was considered "good," and 9 to 10 was considered "excellent".[18] The reliability of the total PEDro Scale score has been found to be moderate, with an ICC of 0.56 (95% CI: 0.47-0.65) for individual ratings and an ICC of 0.68 (95% CI: 0.57-0.76) for consensus ratings.[19] Construct validity supports the use of the total PEDro Score to differentiate between higher quality and lower quality studies.[18]

Data Synthesis and Analysis

After each assessor examined their respective articles, the data extraction and quality results were compiled into tables on

TABLE 2
Data Extraction Table

Author & Year	PEDro Score	Ai Chi Group & Dry Land Therapy (DLT) Group Characteristics	Participant Characteristics	Study Outcomes: Clinical Significance (Cohen's *d*)	Study Outcomes: Statistical Significance
Castro-Sánchez et al, 2012	8	**Ai Chi group (n = 36)**: 60 minutes, twice weekly for 20 weeks. **DLT group (n = 35)**: 60 minutes of relaxation exercise, twice weekly for 20 weeks.	**Diagnosis**: Multiple sclerosis **Ages**: 18-75 years	**Pain VAS**: Significant differences at weeks 20 ($P < .044$) and 24 ($P < .049$) but not week 30. **MPQ PRI**: Significant differences at weeks 20 ($P < 0.044$) and 24 ($P < 0.031$) but not week 30. **MSIS-29 Psychological**: Significant differences at weeks 20 ($P < .023$), 24 ($P < .027$), and 30 ($P < .038$). **MSIS-29 Physical**: Significant differences at weeks 20 ($P < .014$), 24 ($P < .019$), and 30 ($P < .027$). **Beck Depression Inventory II**: Significant differences at weeks 20 ($P < .031$) and 24 ($P < .039$).	**Pain VAS**: Treatment effects were large ($d = 1.30$) post treatment and small ($d = 0.41$) 10 weeks later. **MPQ PRI**: Treatment effects were medium ($d = 0.78$) post treatment and small ($d = 0.27$) 10 weeks later. **MSIS-29 Psychological**: Treatment effects were small ($d = 0.23$ post treatment and $d = 0.30$ 10 weeks later). **MSIS-29 Physical**: Treatment effects were small ($d = 0.27$) post treatment and trivial ($d = 0.14$) 10 weeks later. **Beck Depression Inventory II**: Treatment effects were large ($d = 1.68$) post treatment and small ($d = 0.40$) 10 weeks later.
Kurt et al, 2018	7	**Ai Chi group (n = 20)**: 5 times a week, 60-minute sessions, total of 25 sessions (5 weeks). **DLT group (n = 20)**: 5 times a week, 60-minute sessions, total of 25 sessions (5 weeks).	**Diagnosis**: Parkinson disease, Hoehn and Yahr Stages 2-3 **Mean age**: 63.03 ± 6.90 years	**Dynamic Balance**: Significant differences favoring Ai Chi in anteroposterior index ($P < .05$), mediolateral index ($P < .05$), and overall balance index ($P < .05$). **BBS**: Significant differences favoring Ai Chi ($P < .05$). **TUG**: Significant differences favoring Ai Chi ($P = .05$) in the Ai Chi group. **PDQ-39**: Significant differences favoring Ai Chi ($P < .05$).	**Dynamic balance**: Treatment effects were trivial to small ($d = 0.08$-0.33). **BBS**: Treatment effect was trivial ($d = 0.08$). **TUG**: Treatment effect was trivial ($d = 0.14$). **PDQ-39**: Treatment effect was small ($d = 0.25$).
Pérez-de la Cruz, 2017	7	**Ai Chi group (n = 15)**: 20 twice-weekly 45-minute sessions. **DLT group (n = 15)**: 20 twice-weekly 45-minute sessions.	**Diagnosis**: Parkinson disease, Hoehn and Yahr Stages 1-3 **Ages**: 52-80 years	**Pain VAS**: Significant differences favoring Ai Chi ($P = .005$) post treatment. Results were maintained 1 month later. **BBS**: Significant differences favoring Ai Chi ($P < .001$) post treatment. Results were maintained 1 month later. **TGUG**: Significant differences favoring Ai Chi ($P < .001$) post treatment. Results were maintained 1 month later. **UPDRS Section 4**: Significant differences favoring the Ai Chi group ($P = .001$) post treatment. Results were maintained 1 month later.	**Pain VAS**: Treatment effects were large ($d = 1.03$ post treatment and $d = 1.47$ 1 month later). **BBS**: Treatment effects were medium ($d = 0.57$) post treatment and large ($d = 1.20$) 1 month later. **TGUG**: Treatment effects were large ($d = 0.81$ post treatment and $d = 1.04$ 1 month later). **UPDRS Total**: Treatment effects were trivial ($d = 0.03$) post treatment and small ($d = 0.35$) 1 month later.

(*continues*)

TABLE 2

Data Extraction Table (*Continued*)

Author & Year	PEDro Score	Ai Chi Group & Dry Land Therapy (DLT) Group Characteristics	Participant Characteristics	Study Outcomes: Clinical Significance (Cohen's *d*)	Study Outcomes: Statistical Significance
Pérez-de la Cruz, 2018	7	**Ai Chi group (n = 14)**: 44 sessions over 11 weeks, each lasting 45 minutes. **DLT group (n = 15)**: 44 sessions over 11 weeks, each lasting 45 minutes. Strength and aerobic activities.	**Diagnosis**: Parkinson disease, Hoehn and Yahr Stages 1-3 **Mean age**: 66.3 ± 6.1 years	**Pain VAS**: Significant differences favoring Ai Chi (P = .005). **TGUG**: Significant differences favoring Ai Chi (P < .001). **PDQ-39**: No differences between groups.	**Pain VAS**: Treatment effects were large (d = 0.96 post treatment and d = 1.49 1 month later). **TGUG**: Treatment effects were medium (d = 0.44) post treatment and large (d = 1.02) 1 month later.
Pérez-de la Cruz, 2019	7	**Ai Chi group (n = 15)**: 20 sessions, twice a week for 45 minutes for 10 weeks. **DLT group (n = 15)**: 20 sessions, twice a week for 45 minutes for 10 weeks. Strength training and aerobic exercises.	**Diagnosis**: Parkinson disease, Hoehn and Yahr Stages 1-3 **Mean age**: 67.5 ± 9.9 years	**Pain VAS**: Significant differences favoring the Ai Chi group (P = .005) post treatment. Results were maintained 1 month later. **Geriatric Depression Scale**: Significant differences favoring the Ai Chi group (P = .002) post treatment. Results were maintained 1 month later. **SF-36 Standardized Physical Component Scale:** Significant differences favoring the Ai Chi group (P < .001) post treatment. Results were maintained 1 month later.	**Pain VAS**: Treatment effects were large (d = 0.96 post treatment and d = 1.2 1 month later). **SF-36 Standardized Physical Component Scale:** Treatment effects were trivial (d = 0.03 post treatment and d = 0.15 1 month later). **Geriatric Depression Scale**: Treatment effects were trivial (d = 0.08) post treatment and medium (d = 0.60) 1 month later.
Pérez-de la Cruz, 2020a	6	**Ai Chi group (n = 13)**: 45-minute group sessions, twice a week for 12 weeks. **DLT group (n = 14)**: 24 sessions, twice a week for 12 weeks. **Ai Chi + DLT group (n = 13)**: 45-minute group sessions, twice a week for 12 weeks.	**Diagnosis**: Chronic stroke **Mean age**: 56.8 ± 5.2 years	**Pain VAS**: Significant differences favoring the Ai Chi and the combined AI Chi + DLT groups (P = .001) post treatment. Results were maintained 1 month later. **Tinetti**: Significant differences favoring the Ai Chi and the combined AI Chi + DLT groups (P = .011) post treatment. Results were maintained 1 month later.	**Pain VAS:** (1) Ai Chi vs Ai Chi + DLT: Treatment effects were small favoring Ai Chi (d = 0.43) post treatment and medium (d = 0.54) 1 month later. (2) Ai Chi vs DLT: Treatment effects were large favoring Ai Chi (d = 2.07 post treatment and d = 2.6 1 month later). (3) Ai Chi + DLT vs DLT: Treatment effects favoring Ai Chi + DLT were large (d = 1.78 post treatment and d = 2.35 1 month later). **Tinetti**: (1) Ai Chi vs Ai Chi + DLT: Treatment effects favoring Ai Chi + DLT were trivial (d = 0.18) post treatment and small (d = 0.33) 1 month later. (2) Ai Chi vs DLT: Treatment effects favoring Ai Chi were medium (d = 0.70 post treatment and d = 0.78 1 month later). (3) Ai Chi + DLT vs DLT: Treatment effects favoring Ai Chi + DLT were large (d = 0.95 post treatment and d = 1.20 1 month later).

(*continues*)

TABLE 2

Data Extraction Table (*Continued*)

Author & Year	PEDro Score	Ai Chi Group & Dry Land Therapy (DLT) Group Characteristics	Participant Characteristics	Study Outcomes: Clinical Significance (Cohen's *d*)	Study Outcomes: Statistical Significance
Pérez-de la Cruz, 2020b	7	**Ai Chi group (n = 13)**: twice-weekly 45-minute sessions, total of 24 sessions (12 weeks). **DLT group (n = 15)**: twice-weekly 45-minute sessions, total of 24 sessions (12 weeks). **Ai Chi + DLT group (n = 13)**: twice-weekly 45-minute sessions, total of 24 sessions (12 weeks).	**Diagnosis**: Chronic stroke **Mean age**: Ai Chi group: 63.8 ± 13.6 years Ai Chi + DLT group: 61.4 ± 13.9 years DLT group: 62.7 ± 13.4 years	**Pain VAS**: Significant differences favoring the Ai Chi and the combined AI Chi + DLT groups ($P < .001$) post treatment. Results were maintained 1 month later. **SF-36**: Significant differences favoring the Ai Chi and the combined AI Chi + DLT groups on all items except the social category post treatment. Results were maintained 1 month later.	**Pain VAS:** (1) Ai Chi vs Ai Chi + DLT: Treatment effects favoring AI Chi only were medium ($d = 0.50$) post treatment and small ($d = 0.38$) 1 month later. (2) Ai Chi vs DLT: Treatment effects favoring Ai Chi were large ($d = 2.34$ post treatment and $d = 3.01$ 1 month later. (3) Ai Chi + DLT vs DLT: Treatment effects favoring Ai Chi + DLT were large ($d = 2.37$ post treatment and $d = 2.79$ 1 month later). **SF-36 (physical components)**: (1) Ai Chi vs Ai Chi + DLT: Treatment effects favoring Ai Chi only were trivial to medium ($d = 0.02$ for physical role, $d = 0.38$ for physical function, and $d = 0.74$ for general health). Treatment effects favoring Ai Chi + DLT were small for bodily pain ($d = 0.29$). (2) Ai Chi vs DLT: Treatment effects favoring Ai Chi were small to large (ranging from $d = 0.32$ for general health to $d = 3.33$ for bodily pain). (3) Ai Chi + DLT vs DLT: Treatment effects favoring Ai Chi + DLT were large ($d = 1.55$ for physical function, $d = 1.67$ for physical role, and $d = 2.96$ for body pain). Treatment effects favoring DLT were medium for general health ($d = 0.40$). **SF-36 (mental component):** (1) Ai Chi vs Ai Chi + DLT: Treatment effects favoring Ai Chi only were trivial to large ($d = 0.16$ for vitality, $d = 0.77$ for emotional role, and $d = 1.0$ for mental health). (2) Ai Chi vs DLT: Treatment effects favoring Ai Chi were large ($d = 1.52$ for mental health and $d = 2.09$ for emotional role). Treatment effects for vitality favoring the DLT group were medium ($d = 0.80$). (3) Ai Chi + DLT vs DLT: Treatment effects favoring Ai Chi + DLT were trivial ($d = 0.17$) for mental health and medium ($d = 0.78$) for emotional role. Treatment effects favoring DLT were medium for vitality ($d = 0.79$).

(*continues*)

TABLE 2

Data Extraction Table (*Continued*)

Author & Year	PEDro Score	Ai Chi Group & Dry Land Therapy (DLT) Group Characteristics	Participant Characteristics	Study Outcomes: Clinical Significance (Cohen's *d*)	Study Outcomes: Statistical Significance
Pérez-de la Cruz, 2021	8	**Ai Chi group (n = 13)**: twice-weekly 45-minute sessions, total of 24 sessions (12 weeks). **DLT group (n = 15)**: twice-weekly 45-minute sessions, total of 24 sessions (12 weeks). **Ai Chi + DLT group (n = 13)**: twice-weekly 45-minute sessions, total of 24 sessions (12 weeks).	**Diagnosis**: Chronic stroke **Mean age**: 52.7 ± 13.3 years	**BBS and TUG**: Significant differences from pretest to posttest ($P < .001$) and then maintained at the 1 month follow-up.	**BBS:** (1) Ai Chi vs Ai Chi + DLT: Treatment effects were large favoring Ai Chi ($d = 1.15$ post treatment and $d = 1.06$ 2 months later). (2) Ai Chi vs DLT: Treatment effects were large favoring Ai Chi ($d = 2.06$ post treatment and $d = 2.22$ 2 months later). (3) Ai Chi + DLT vs DLT: Treatment effects favoring Ai Chi + DLT were medium ($d = 0.62$ post treatment and $d = 0.78$ 2 months later). **TUG**: (1) Ai Chi vs Ai Chi + DLT: Treatment effects favoring Ai Chi only were trivial ($d = 0.11$) post treatment and small ($d = 0.25$) 2 months later. (2) Ai Chi vs DLT: Treatment effects favoring Ai Chi were medium ($d = 1.3$ post treatment and $d = 1.73$ 2 months later). (3) Ai Chi + DLT vs DLT: Treatment effects favoring Ai Chi + DLT were large ($d = 1.39$ post treatment and $d = 1.53$ 2 months later).

Abbreviations: BBS, Berg Balance Scale; MPQ PRI, Pain Rating Index of the McGill Pain Questionnaire; MSIS-29, Multiple Sclerosis Impact Scale; PDQ-39, 39-Item Parkinson's Disease Questionnaire; SF-36, Short Form-36 Health Survey; TGUG, Get Up and Go; TUG, Timed Up and Go; UPDRS, Unified Parkinson's Disease Rating Scale; VAS, visual analog scale.

Covidence. The assessors then conducted a consensus process to compare the similarities and differences between the reviews of each article. During this comparison, the most important components were identified through descriptive analysis. Articles were classified into 3 categories based on the type of outcome measure: pain, postural control, and quality of life. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines[20] were thoroughly examined and implemented throughout this review and were integrated with the quality assessment.

Effect sizes using Cohen *d* were calculated to determine the magnitude of between-group treatment effects. An effect size of 0.20 indicated a small effect, 0.50 indicated a medium effect, and 0.80 indicated a large effect.[21] Once each effect size was obtained or calculated, they were categorized into 3 focus areas for this review: pain, postural control, and quality of life. Trends were identified to determine where Ai Chi provided the most benefits.

RESULTS

Identification of Studies

The literature search yielded 226 studies, which were imported into Covidence for screening. Covidence identified 94 duplicates and an additional 3 were found manually, leaving 129 studies for abstract screening. Of these, 108 studies were deemed irrelevant, resulting in 21 studies for full-text review. After the full-text review, 13 studies were excluded due to wrong study design (n = 6), incorrect patient population (n = 5), or incorrect comparator (n = 2), leaving 8 studies to be included in this review. See Figure 1 for the PRISMA diagram illustrating this process.

Description of Included Studies

All included studies were randomized controlled trials with sample sizes ranging from 29 to 73 individuals with neurological diagnoses for a total sample size of 352 participants.[22-29] Out of the 8 studies, 1 was completed in Turkey[23] and the other 7 in Spain.[22,24-29]

PEDro Scores

The studies scored between 6 and 8 on the PEDro Scale, indicating they were all good-quality studies. In all studies, groups were randomly assigned, allocation was concealed, a key outcome measure was obtained from 85% or more of the subjects, there was no attrition or an intention-to-treat analysis was performed if attrition occurred, and point measures and measures of variability were used for at least 1 key outcome measure. None of the studies were able to blind the subjects or the therapists. Prognostic indicators were similar at baseline in 37.5% of the studies. In 87.5% of the studies, the assessor was blinded when applying the outcome measure, and the results of between-group statistical comparisons were reported for at least 1 key outcome.

Description of Participants

Three studies included adults over the age of 40,[24-26] 1 study included adults over the age of 35,[27] and the remaining 4 studies included adults over the age of 18.[22,23,28,29] Four studies focused on individuals with Parkinson disease, with 3 including participants classified as Hoehn and Yahr Stages 1 to 3,[24-26] and 1 including participants classified as Hoehn and Yahr Stages 2 to 3.[23] Three studies included individuals with chronic stroke,[27-29] and 1 study included individuals diagnosed with multiple sclerosis (MS).[22]

Interventions

All 8 studies examined Ai Chi as an aquatic intervention compared to dry land therapy (DLT).[22-29] Five studies compared an Ai Chi group to a dry land group,[22-26] while the other 3 included a third combined group (Ai Chi plus dry land) for comparison.[27-29] Dry land exercises included resistance training and therapeutic exercise, which were not specified, but classified as traditional exercises.

All 8 studies[22-29] performed the exercises in group classes. In 3 studies,[25,26,29] participants performed Ai Chi exercises in a pool with a temperature of 30°C, with variations of less than 0.5°C. One study[24] had a pool temperature of 30°C with variations of less than 1.5°C. Four other studies used water temperatures of 32°C,[22] 34°C,[27] and 36°C,[22] with 1 study not specifying the temperature.[28] Ai Chi exercises were performed for 60 minutes in 2 studies,[22,23] and for 45 minutes in the remaining 6 studies.[24-29]

Outcomes

Postural Control

Five studies examined postural control using outcome measures such as the Berg Balance Scale, Timed Up and Go, and Tinetti Total.[22,24,25,27,29] All 5 studies found significant improvements favoring the Ai Chi or combined Ai Chi/dry land group. Overall, there is strong evidence that Ai Chi is more effective than traditional land-based therapies for improving postural control in adults with neurological diagnoses.

Pain

Six studies examined the effect of Ai Chi on pain and found significant improvements favoring the Ai Chi group compared to DLT.[22,24-28] All 6 studies used the visual analog scale (VAS), with some also using the McGill Pain Questionnaire Pain Rating Index and the McGill Pain Questionnaire Present Pain Rating. Overall, there is strong evidence that Ai Chi is more effective than traditional land-based therapies for reducing pain in adults with neurological diagnoses.

Quality of Life

Six studies examined quality of life and found significant improvements favoring the Ai Chi group or combined Ai Chi/dry land group over DLT alone.[22-26,28] Different outcome measures

were used based on the neurological condition studied. For Parkinson disease, the Parkinson's Disease Questionnaire 39 and Unified Parkinson's Disease Rating Scale III were used. For MS, the Multiple Sclerosis Impact Scale 29 was used; and for stroke, the Short Form Survey-36 was used. Overall, there is strong evidence that Ai Chi is more effective than traditional land-based therapies for improving quality of life in adults with neurological diagnoses.

Effect Sizes

The overall treatment effect of Ai Chi on pain was large in all 6 studies, which used pain as an outcome measure.[22,24-28] Values from all 3 patient populations (Parkinson disease, MS, and stroke) ranged from Cohen $d = 0.96$[25,26] to $d = 2.34$[28] on the VAS, and in all but 1 study,[22] these large treatment effects were maintained at follow-up. In 2 of the studies,[27,29] the author added a third group (Ai Chi + DLT), which allowed for comparison of combined therapy to Ai Chi only and DLT only. Treatment effects for pain were largest in the Ai Chi only group. For postural control, treatment effects were not as strong as with pain and varied from medium to large,[24,25,27,29] except in 1 study where the effects were trivial to small.[23] Regarding quality of life, treatment effects were not consistent and varied from trivial to large. See Table 2 for specific Cohen *d* values for each study.

DISCUSSION

The aim of this systematic review was to investigate the effects of Ai Chi on postural control, pain, and quality of life in individuals with neurological diagnoses. All 8 studies included in this review demonstrated that Ai Chi, or a combination of Ai Chi and dry land exercise, led to greater improvements in postural control, pain, and/or quality of life, compared to dry land exercises alone in individuals with Parkinson disease, stroke, and MS. This review builds upon the scoping review by Dunlap et al[15] by refining the population criteria for greater homogeneity, calculating treatment effects, and incorporating 3 studies which include a third intervention group (Ai Chi and DLT) as well as individuals with stroke. There is strong evidence showing the benefits of Ai Chi on pain, postural control, and quality of life for individuals with Parkinson disease, stroke, and MS.

The findings of this systematic review align closely with the scoping review by Dunlap et al,[15] which also reported improvements in pain and postural control. However, while Dunlap et al[15] observed mixed results regarding quality of life, the current review found all positive outcomes in this area. The difference could be attributed to the fact that the current review was more homogeneous in terms of population, comparison interventions, and included only high-quality studies.

The largest treatment effects across all 3 populations were observed in pain reduction. Water-based exercises relieve pain through the combined effects of exercise, warm water, and buoyancy on thermal and mechanoreceptors, which block nociceptors. Additionally, the hydrostatic pressure, viscosity, and temperature of the water enhance proprioceptive feedback, increase motor unit synchronization, and improve blood flow and oxygen supply, reducing pain-related signal molecules.[30-32] The buoyancy of water enables individuals to perform movements that might be challenging on land, alleviating stress on muscles and joints.[33,34] Additionally, Ai Chi's gentle, flowing movements help relax muscles and reduce tension, further alleviating pain.

As compared to the scoping review by Dunlap et al,[15] the current systematic review incorporated several articles which included a second comparison group combining Ai Chi with DLT in those with stroke.[27-29] Though not statistically significant, small to medium treatment effects ($d = 0.38$-0.54) were noted with pain when Ai Chi was compared to a combination of Ai Chi and dry land exercises.[27,28] Physical therapists might take this into consideration when recommending Ai Chi for those who have had a stroke, since additional DLT might not be necessary in this population if the goal is to reduce pain.

In all studies evaluating Ai Chi's impact on postural control,[23-25,27,29] participants who engaged in Ai Chi—either alone or in combination with DLT—showed improvements in group mean scores that reached or closely approached the established cut-off values for minimal fall risk. Ai Chi incorporates various standing positions and demands continuous control and shifting of the center of gravity, making it excellent for enhancing balance and preventing falls. The buoyancy and hydrostatic pressure of water enable individuals to push their boundaries beyond what is comfortable on land, improving balance and weight shifting, further reducing the risk of falls.[35]

Chronic pain significantly affects quality of life by limiting physical activity, causing emotional distress, and reducing overall well-being. Good postural control is essential for performing daily activities safely and independently. Impaired postural control can limit mobility and increase the risk of falls, negatively impacting quality of life. Addressing pain and improving postural control can lead to better overall quality of life, so it is not surprising that quality of life improves following Ai Chi. Ai Chi also incorporates mindfulness, which has been found to alleviate symptoms of depression, stress, and anxiety,[10,11] all common in those with neuromuscular diagnoses. Additionally, the psychological effects of regular exercise have been shown to improve mood, reduce anxiety and depression, and relieve stress.[36,37]

In all the studies included in this systematic review, Ai Chi was conducted as a group intervention. Group exercises have been shown to reduce stress and enhance emotional, physical, and mental quality of life.[38] Additionally, group exercise improves adherence to exercise routines and boosts self-esteem, most likely due to the social relationships formed during these activities.[39]

Based on these results, the authors recommend that therapists consider Ai Chi for their patients with stroke, Parkinson disease, and MS, especially when the goal is to reduce pain. Some hospitals and rehabilitation centers offer clinical Ai Chi as part of the rehabilitation process. Therapists interested in incorporating Ai Chi into their practice can take certification courses and workshops available across the US and abroad. The clinical practice guidelines for Parkinson disease[40] and

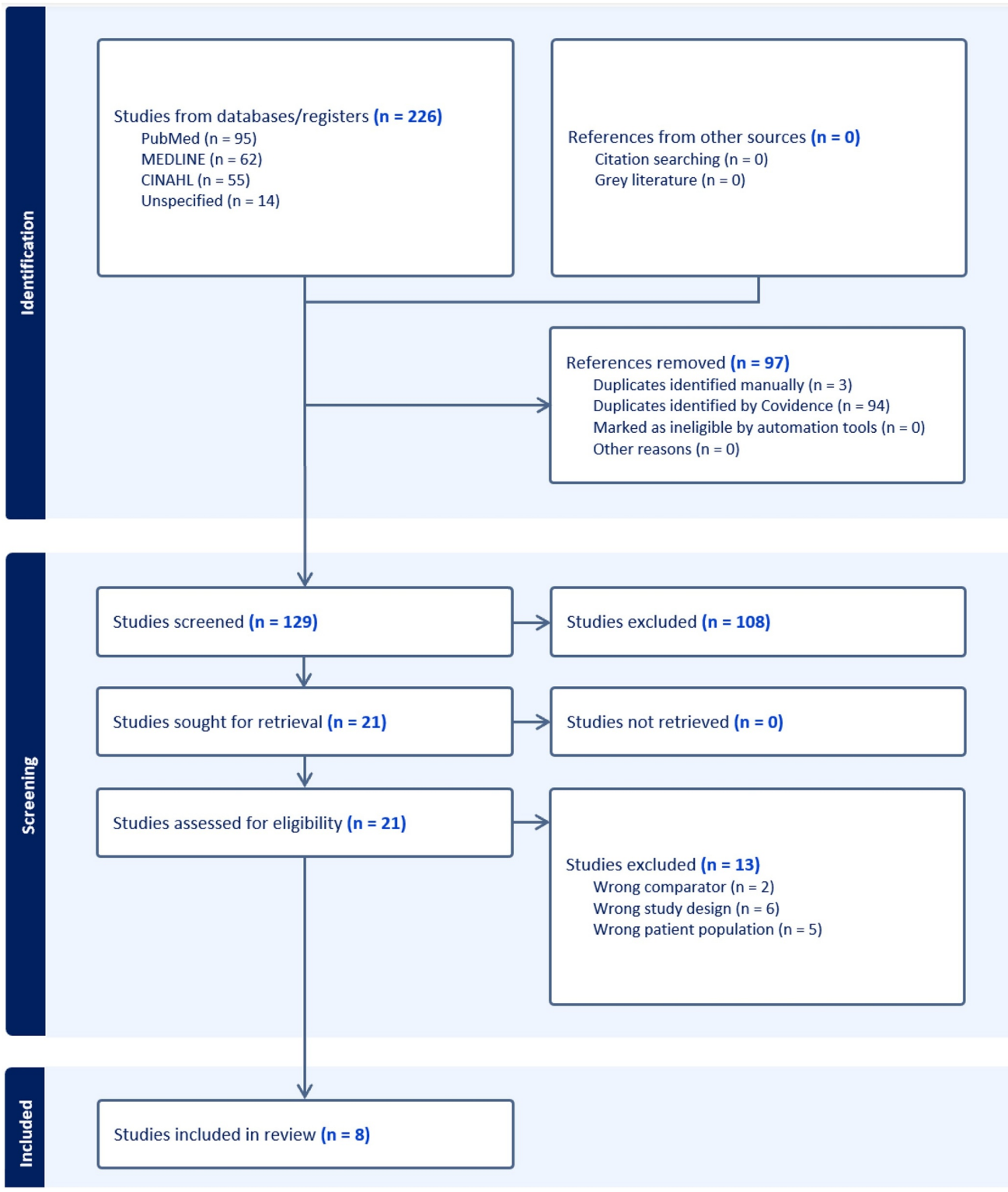

Fig. PRISMA diagram

stroke[41] recommend referring patients to community-based exercise classes to maintain an active lifestyle and continue their recovery process. Physical therapists also have a role in secondary prevention to help minimize the severity of impairments and long-term complications.[42] These authors suggest that therapists consider Ai Chi when referring patients to community-based classes. Local Young Men's Christian Associations and local aquatic centers often offer Ai Chi classes.

There are several limitations to this systematic review. First, a meta-analysis was not performed. The studies did not have

comparable study designs since they evaluated the effects of Ai Chi on three different populations. If data were pooled based on those three different populations, there would not be a substantial number of relevant studies in each category to provide meaningful data. The second limitation was that only three neurological diagnoses were included, and the results cannot be generalized to people with all neurological conditions. Another possible limitation is that two of the studies[24,26] had the same number of participants and the same inclusion criteria, meaning they could have used the same subjects for both studies. Future research should be conducted to examine longer follow-up periods to determine how long the effects of Ai Chi last and should include other diagnoses. Additionally, it would be beneficial to find an optimized dosage of Ai Chi for maximal therapeutic effect.

CONCLUSION

These findings suggest that Ai Chi is a highly effective intervention for improving postural control, reducing pain, and enhancing quality of life in adults with Parkinson disease, stroke, and MS. The consistent positive outcomes across various measures and populations highlight the potential of Ai Chi as a valuable therapeutic approach in clinical settings. These authors recommend this approach in these three populations when the goal is to reduce pain, improve postural control, or enhance quality of life. Future research should continue to explore the long-term benefits and mechanisms of Ai Chi, as well as its applicability to other neurological conditions.

REFERENCES

1. Prisnie J, Sajobi T, Wang M, et al. Effects of Depression and Anxiety on Quality of Life in Five Common Neurological Disorders. *Gen Hosp Psychiatry*. 2018;52:58–63. doi:10.1016/j.genhosppsych.2018.03.009.
2. Cronin C, Archad Q, Seemungal B. Vestibular Deficits in Neurodegenerative Disorders: Balance, Dizziness, and Spatial Disorientation. *Front Neurol*. 2017;8:538. doi:10.3389/fneur.2017.00538.
3. Homann B, Plaschg A, Grundner M, et al. The Impact of Neurological Disorders on the Risk for Falls in the Community Dwelling Elderly: a Case-Controlled Study. *BMJ Open*. 2013;3(11):e003367. doi:10.1136/bmjopen-2013-003367.
4. Cragg J, Warner F, Shupler M, et al. Prevalence of Chronic Pain among Individuals with Neurological Conditions. *Health Rep*. 2018;29 (3):11–16.
5. Rickards H. Depression in Neurological Disorders: Parkinson's Disease, Multiple Sclerosis, and Stroke. *J Neuro Neurosurg Psychiatry*. 2005;76 (Suppl 1):i48–i52. doi:10.1136/jnnp.2004.060426.
6. Boeschoten R, Braamse A, Beekman A, et al. Prevalence of Depression and Anxiety in Multiple Sclerosis: a Systematic Review and Meta-Analysis. *J Neurol Sci*. 2017;372:331–341. doi:10.1016/j.jns.2016.11.067.
7. Yang Y, Wang C, Xiang Y, Lu J, Penzel T. Editorial: Mental Disorders Associated with Neurological Diseases. *Front Psychiatry*. 2020;11:196. doi:10.3389/fpsyt.2020.00196.
8. McDonald S, Mickens M, Goldberg-Looney L, Mutchler B, Ellwood M, Castillo T. Mental Disorder Prevalence among U.S. Department of Veterans Affairs Outpatients with Spinal Cord Injuries. *J Spinal Cord Med*. 2018;41(6):691–702. doi:10.1080/10790268.2017.1293868.
9. Văcăraş V, Văcăraş V, Nistor C, et al. The Influence of Depression and Anxiety on Neurological Disability in Multiple Sclerosis Patients. *Behav Neurol*. 2020;6738645:8. doi:10.1155/2020/6738645.
10. Hearn JH, Cross A. Mindfulness for Pain, Depression, Anxiety and Quality of Life in People with Spinal Cord Injury: a Systematic Review. *BMC Neurol*. 2020;201:1–11. doi:10.1186/s12883-020-1619-5.
11. Smart CM, Ali JI, Viczko J, Silveira K. Systematic Review of the Efficacy of Mindfulness-Based Interventions as a Form of Neuropsychological Rehabilitation. *Mindfulness*. 2022;13(2):301–317. doi:10.1007/s12671-021-01779-2.
12. Lambeck J, Bommer A. Clinical Ai Chi®: Applications in Clinical Practice. In: Becker BE and BE CAJ, eds.. *Comprehensive Aquatic Therapy*. 3rd ed. Washington State University Publishing; 2010:1–22.
13. Clinical Ai Chi Subgroup of the International Aquatic Therapy Faculty. *Clinical Ai Chi*. Accessed April 24, 2025. https://clinicalaichi.org
14. Sova R, Konno J. *Ai Chi: Balance, Harmony & Healing*. DSL, Ltd; 1999.
15. Dunlap E, Lambeck J, Ku P, Gobert D. Ai Chi for Balance, Pain, Functional Mobility, and Quality of Life in Adults: a Scoping Review. *J Aquat Phys Ther*. 2021;29(1):14–28. doi:10.1097/japt-d-20-00014.
16. Chin MS, Kales SN. Understanding Mind-Body Disciplines: a Pilot Study of Paced Breathing and Dynamic Muscle Contraction on Autonomic Nervous System Reactivity. *Stress Health*. 2019;35(4):542–548. doi:10.1002/smi.2887.
17. Le Mouel C, Brette R. Mobility as the Purpose of Postural Control. *Front Computat Neurosci*. 2017;11(67). doi:10.3389/fncom.2017.00067.
18. Cashin A, McAuley J. Clinimetrics: Physiotherapy Evidence Database (PEDro) Scale. *J Physiother*. 2020;66(1):59. doi:10.1016/j.jphys.2019.08.005.
19. Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro Scale for Rating Quality of Randomized Controlled Trials. *Phys Ther*. 2003;83(8):713–721. doi:10.1093/ptj/83.8.713.
20. Page M, McKenzie J, Bossuyt P, et al. The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. *PloS Med*. 2021;18(3):1–15. doi:10.1136/bmj.n71.
21. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. Lawrence Erlbaum; 1988.
22. Castro-Sánchez A, Matarán-Peñarrocha G, Lara-Palomo I, Saavedra-Hernández M, Arroyo-Morales M, Moreno-Lorenzo C. Hydrotherapy for the Treatment of Pain in People with Multiple Sclerosis: a Randomized Controlled Trial. *Evid Based Complement Alternat Medicine*. 2012;2012:473963. doi:10.1155/2012/473963.
23. Kurt E, Büyükturan B, Büyükturan Ö, Erdem H, Tuncay F. Effects of Ai Chi on Balance, Quality of Life, Functional Mobility, and Motor Impairment in Patients with Parkinson's Disease. *Disabil Rehabil*. 2018;40 (7):797. doi:10.1080/09638288.2016.1276972.
24. Pérez de la Cruz S. Effectiveness of Aquatic Therapy for the Control of Pain and Increased Functionality in People with Parkinson's Disease: a Randomized Clinical Trial. *Eur J Phys Rehabil Med*. 2017;53 (6):825–832. doi:10.23736/S1973-9087.17.04647-0.
25. Pérez-de la Cruz S. A Bicentric Controlled Study on the Effects of Aquatic Ai Chi in Parkinson Disease. *Complement Ther Med*. 2018;36:147–153. doi:10.1016/j.ctim.2017.12.001.
26. Pérez-de la Cruz S. Mental Health in Parkinson's Disease after Receiving Aquatic Therapy: a Clinical Trial. *Acta Neurol Belg*. 2019;119 (2):193–200. doi:10.1007/s13760-018-1034-5.
27. Pérez-de la Cruz S. Comparison of Aquatic Therapy Vs. Dry Land Therapy to Improve Mobility of Chronic Stroke Patients. *Int J Environ Res Public Health*. 2020a;17(13):4728. doi:10.3390/ijerph17134728.
28. Pérez-de la Cruz S. Influence of an Aquatic Therapy Program on Perceived Pain, Stress, and Quality of Life in Chronic Stroke Patients: a Randomized Trial. *Int J Environ Res Public Health*. 2020b;17(13):4796. doi:10.3390/ijerph17134796.
29. Pérez-de la Cruz S. Comparison between Three Therapeutic Options for the Treatment of Balance and Gait in Stroke: a Randomized Controlled Trial. *Int J Environ Res Public Health*. 2021;18(2):426. doi:10.3390/ijerph18020426.
30. Becker BE. Aquatic Therapy: Scientific Foundations and Clinical Rehabilitation Applications. *PM R*. 2009;1(9):859–872. doi:10.1016/j.pmrj.2009.05.017.
31. Zamunér A, Andrade C, Arca E, Avila M. Impact of Water Therapy on Pain Management in Patients with Fibromyalgia: Current Perspectives. *J Pain Res*. 2019;12:1971–2007. doi:10.2147/jpr.s161494.

32. Mooventhan A, Nivethitha L. Scientific Evidence-Based Effects of Hydrotherapy on Various Systems of the Body. *N Am J Med Sci*. 2014;6 (5):199–209. doi:10.4103/1947-2714.132935.
33. Carayannopoulos A, Han A, Burdenko I. The Benefits of Combining and Land Based Exercises. *J Exerc Rehabil*. 2020;16(1):20–26. doi:10.12965/jer.1938742.371.
34. Siega J, Iucksch D, Israel V. Multicomponent Aquatic Training (MAT) Program for People with Parkinson's Disease: a Protocol for a Controlled Study. *Int J Environ Res Public Health*. 2022;19(3):1727. doi:10.3390/ijerph19031727.
35. Ku P, Chen S, Yang Y, Lai T, Wang R. The Effects of Ai Chi for Balance in Individuals with Chronic Stroke: a Randomized Controlled Trial. *Sci Rep*. 2020;10(1):1201. doi:10.1038/s41598-020-58098-0.
36. Salihu D, Kwan R, Wong E. The Effect of Dancing Interventions on Depression, Anxiety, and Stress in Adults without Musculoskeletal Disorders: an Integrative Review and Meta-Analysis. *Complement Ther Clin Practice*. 2021;45:101467. doi:10.1016/J.CTCP.2021.101467.
37. Mahindru A, Patil P, Agrawal V. Role of Physical Therapy on Mental Health and Well-Being: a Review. *Cureus*. 2023;15(1):e33475. doi:10.7759/cureus.33475.
38. Yorks D, Frothingham C, Schuenke M. Effects of Group Fitness Classes on Stress and Quality of Life of Medical Students. *J Am Osteopath Assoc*. 2017;117(11):e17–e25. doi:10.7556/jaoa.2017.140.
39. Kanamori S, Takamiya T, Inoue S, Kai Y, Kawachi I, Kondo K. Exercising Alone versus with Others and Associations with Subjective Health Status in Older Japanese: the JAGES Cohort Study. *Sci Rep*. 2016;6 (1):39151. doi:10.1038/srep39151.
40. Osborne J, Botkin R, Colon-Semenza C, et al. Physical Therapist Management of Parkinson's Disease: a Clinical Practice Guideline from the American Physical Therapy Association. *Phys Ther*. 2022;102(4): pzab302. doi:10.1093/ptj/pzab302.
41. Winstein C, Stein J, Arena R, et al. Guidelines for Adult Stroke Rehabilitation and Recovery. A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association. *Stroke*. 2016;47(6):e98–e169. doi:10.1161/STR.0000000000000098.
42. Quinn L, Morgan D. From Disease to Health: Physical Therapy Health Promotion Practices for Secondary Prevention in Adult and Pediatric Neurologic Populations. *J Neurol Phys Ther*. 2018;41:S46–S54. doi:10.1097/NPT.