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Physical therapy interventions to manage pain in Parkinson's disease: a systematic review

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review paper
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ABSTRACT
Purpose. Pain is a common non-motor symptom in Parkinson's disease (PD), affecting about 40% of this population. Non-drug treatments and physical exercises, including physical therapy, are recommended options to ease PD pain. However, there are gaps in the literature regarding the treatment of this symptom, as well as few clinical trials assessing possible physical therapy interventions to manage PD pain. Hence, the objective of this study was to verify and analyse the physical therapy treatments available in the literature to manage pain in PD patients.
Methods. A systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), searching the PEDro, PubMed, SciELO, and Science Direct databases.
Results. After applying the eligibility criteria, nine clinical trials remained, whose total sample comprised 242 individuals with PD (Hoehn and Yahr stage 1 to 4), submitted to physical therapy resources and methods such as hydrotherapy, physical therapy exercises, gait training with body weight support, electroacupuncture, and massage.
Conclusions. All the articles had positive physical therapy results in treating pain in people with PD. It is concluded that land and aquatic physical therapy methods improve the levels of pain in PD patients. However, further studies are needed with larger samples, who should be followed up to verify the duration of the effects.
Key words: movement disorder, pain management, exercise, hydrotherapy

Introduction

Parkinson's disease (PD) is a neurodegenerative disease characterised by the loss of dopaminergic neurons in the substantia nigra. It is more prevalent in older adults and clinically recognised by its four cardinal signs: bradykinesia, tremor at rest, muscle stiffness, and postural instability [1]. Moreover, PD patients are also affected by non-motor symptoms such as pain, which is very common in this population, affecting 40% to 85% of patients [2]. Its onset varies in relation to motor symptoms, either preceding them or appearing only in more advanced stages of the disease [2]. However, despite the high prevalence rates of pain related to PD or resulting from secondary causes (such as musculoskeletal, visceral, or other pains), about 25% to 50% of PD patients do not receive any treatment for pain [3, 4].

PD pain is classified into five domains: musculoskeletal pain, radicular/neuropathic pain, dystonia-related pain, akathisia-related pain/discomfort (restlessness), and central pain [2]. Musculoskeletal pain is the most common of these, with a prevalence of 40% to 75% of painful PD patients [2]. Pain is a biopsychosocial experience that includes sensitive/discriminative, emotional/motivational, cognitive, behavioural, spiritual, cultural, and developmental elements. It is associated with impaired sleep, depression, and reduced quality of life, and is reported as one of the most worrying symptoms experienced by people with PD. In addition, pain negatively interferes with functional capacity (FC), which is referred to as the ability to perform activities that enable an individual to take care of himself or herself and live independently [5, 6]. Hence, pain requires comprehensive and multiprofessional assessment with validated and reliable instru-

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ments, ensuring patients have the right to the best treatment possible [7].

Drug treatment and physical therapy are recommended strategies to ease PD pain [8]. Nevertheless, there are gaps in the literature regarding pain treatment, as well as a scarcity of clinical trials assessing possible physical therapy interventions to manage PD pain. This may be due to the underdiagnosis of the different types of pain. Thus, the objective of this review was to verify and analyse the physical therapy treatments available to manage pain in people with PD and its repercussion on functional capacity. The following research questions were used in this article:

1. Which physical therapy techniques are available to manage PD pain?
2. How effective is physical therapy in managing PD pain?
3. What are the repercussions of the physical therapy techniques available for pain management in PD on the functional capacity?

Material and methods

This review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [9], and its protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) (ID CRD42022371042).

Search strategies

This systematic review of the literature searched four databases (Science Direct, SciELO, PubMed, and PEDro), including studies from January 2012 to September 15, 2022. After consulting the health sciences descriptors in DeCS/MeSH, the following keywords were used: 'Parkinson's disease', 'pain', 'physical therapy', 'hydrotherapy', 'aquatic therapy', and 'pain management'. The descriptors were combined with the Boolean operators 'AND' and 'OR'. Thus, the titles and abstracts of potentially eligible studies were selected (Figure 1).

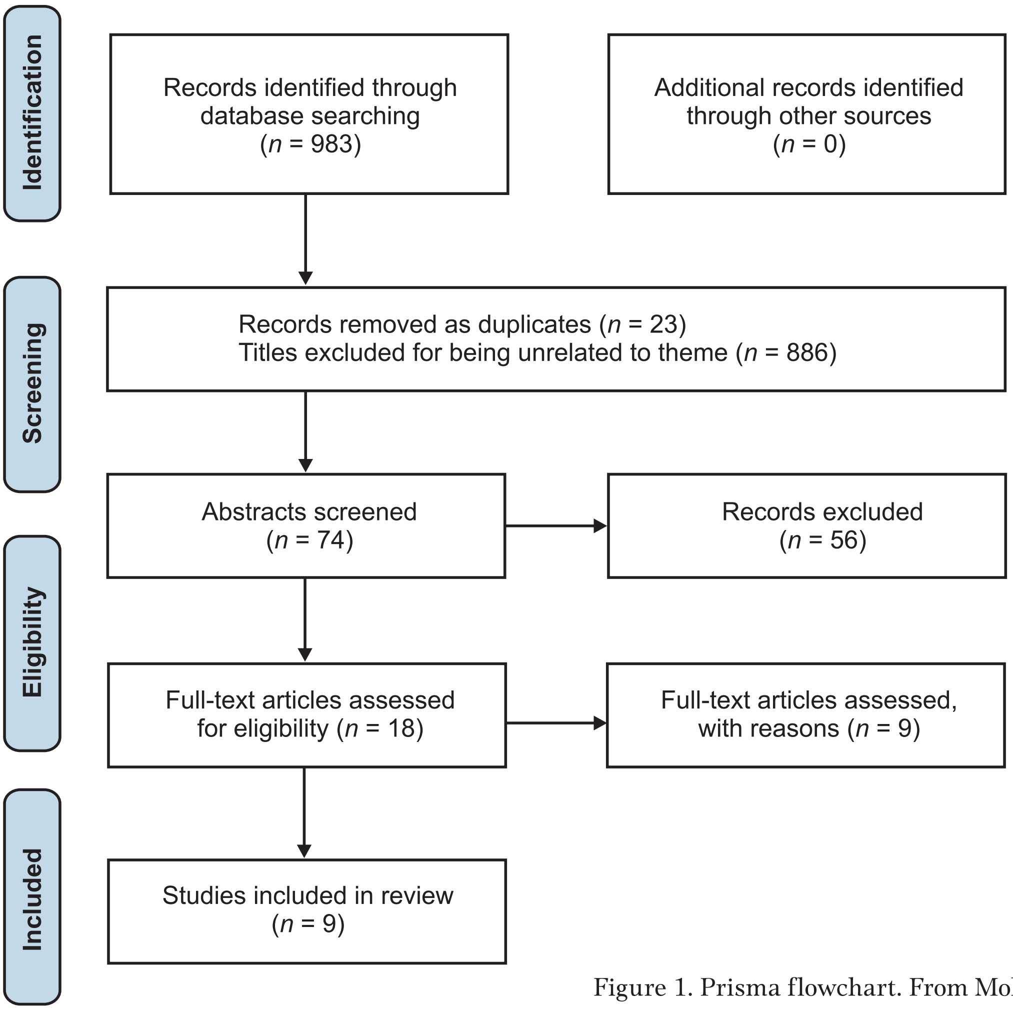

Figure 1. Prisma flowchart. From Moher et al. [9]

Eligibility criteria

The following inclusion criteria were applied: 1) randomised or nonrandomised clinical trials, 2) published in the last 10 years (considering the recommendations, discussions and limitations of the current literature), 3) in English or Portuguese (as the main language used in scientific studies and the language of the researchers' country of origin, respectively), 4) with participants diagnosed with idiopathic PD (in order to cover most of this population), 5) studies that included an instrument to measure pain, 6) studies with physiotherapeutic intervention.

Exclusion criteria were: (1) case or feasibility studies, (2) studies with non-physiotherapeutic treatments (for example, pharmacological, surgical treatments, etc.), (3) studies in languages other than English and Portuguese, (4) studies that did not assess pain with measurement instruments, (5) participants with secondary parkinsonism (for example, side effects of medication), and (6) studies that did not address PD and pain.

Studies selected for the review

Two independent reviewers (LT and TH) read all the articles, and divergences between them on whether the studies furnished enough data to be included in the study were solved by consensus. When they did not reach a consensus, a third researcher (JS) was consulted. After the selection, a detailed chart of the eligible articles was created in Microsoft Excel (Table 1).

Measurement of results

The outcome of interest was the self-reported pain intensity, using instruments such as the visual analog scale (VAS) [10], numeric rating scale for pain (NRS) [11], Nottingham Health Profile (NHP) [12], and Pain-O-Meter [13].

The second outcome of interest was functional capacity, where the following instruments were used for measurement: BBS – Berg Balance Scale; UPDRS – Unified Parkinson's Disease Rating Scale; STHW – Gait analysis during single-task habitual walking; DTHW – dual-task habitual walking; STFW – single-task fast walking; DTFW – dual-task fast walking; Short FES-I – Short Falls Efficacy Scale-International; TUG – Timed Up and Go; PDQ-39 – The Parkinson's Disease Questionnaire; TC6 – Six-minute walking test; SF-12 – A Short Form Health Survey; SF-36 – A Short Form Health Survey; PDQ-08 – Parkinson's Disease Questionnaire; HRQoL – Health-Related Quality of Life; five-point sit and stand test, and unipodal support test.

In addition to these instruments, the selected studies also used tests related to sleep quality, fatigue, cognitive function, and depressive symptoms, which were outside the scope of this review.

Data extraction

Data were extracted and coded by two independent authors (LT and TH) and reviewed by a third (JS). The following data were extracted when available: study design, sample size, experimental group intervention, control group intervention, duration, age, sex, stage and duration of the disease, pain assessment, functional capacity assessment, pain results, functional capacity results, and Jadad and Physiotherapy Evidence Database (PEDro) scale scores.

Some studies also measured PD symptoms by assessing the health-related quality of life with instruments such as the Parkinson's Disease Questionnaire 39 (PDQ-39) [14] and Short Form-36 (SF-36) [15], as well as functional mobility, assessed with the Timed 'Up and Go' Test [16] and Unified Parkinson's Disease Rating Scale (UPDRS) [17]. When available, these data were also extracted and summarised in Table 1.

Study validity criteria

The quality of the studies was assessed with the Jadad and PEDro quality scales by two independent researchers (LT and TH) and reviewed by a third (JS) (Table 1). Any differences in scale scores were solved by consensus.

The Jadad scale indicates the quality of clinical trials by assessing five items, each of which can be answered with either yes or no [18]. Thus, the final score ranges from 0 to 5 – the higher the score, the greater the quality.

The PEDro scale assesses physical therapy clinical trials with 11 assessment items. Each item – except for item 1 – scores 1 point, totalling 10 points [19]. Studies scoring 0 to 3 on the PEDro scale are considered as having low methodological quality. Nonetheless, the scale scores were not used as exclusion criteria for the assessed articles, due to the limited number of studies included. These data are summarised in Table 2.

Table 1. Study design, groups, sample size, duration, measurements of pain and functional capacity, clinical features and main outcomes

Author and year/ study design	Sample size and groups	Duration	Age (years) / sex	Disease stage (Hoehn-Yahr)/ duration in years	Pain assessment/ functional capacity assessment	Pain results	Functional capacity results
Pérez de la Cruz 2017 [20] Single-blind randomised clinical trial	n = 30 Experimental: Ai Chi (n = 15) Control: land exercises (n = 15)	10 weeks, twice a week, 45 min 20 sessions 1-month follow-up	EG: 67.53**/ 6 males and 9 females CG: 66.80**/ 7 males and 8 females	EG: 2–3***/ 2–11*** CG: 2–3***/ 2–13***	VAS/UPDRS, TUG, TINETTI, BBS, FTSTS	EG: pain intensity reduced, which was maintained in the follow-up* CG: less significant reduction in pain intensity than in the experimental group (p = 0.006).	EG: improved gait, balance, activities of daily living, and motor examination CG: no other significant results
Pérez-de la Cruz 2018 [21] Randomised clinical trial	n = 29 Experimental: Ai Chi + aquatic exercises (n = 14) Control: land exercises (n = 15)	11 weeks, twice a week, 45 min 22 sessions 1-month follow-up	EG: 65.87**/ 5 males and 9 females CG: 66.44**/ 7 males and 8 females	EG: 2–3***/ > 2 years CG: 2–3***/ > 2 years	VAS/TUG, FTSTS, unipodal support test, Yesavage Geriatric Depression Scale, PDQ-39	EG: pain intensity reduced, which was maintained in the follow-up* CG: pain intensity reduced	EG: improved functional mobility and muscle power CG: less significant improvement in functional mobility and muscle power than the experimental group at post-intervention and follow-up
Pérez-de la Cruz 2019 [22] Randomised clinical trial	n = 30 Experimental: Ai Chi (n = 15) Control: land exercises (n = 15)	10 weeks, twice a week, 45 min 20 sessions 1-month follow-up	EG: 67.53**/ 7 males and 8 females CG: 66.80**/ 8 males and 7 females	EG: 2–3***/ 3–11*** CG: 2–3***/ 3–13***	VAS / SF-36, Geriatric Depression Scale	EG: pain intensity reduced, which was maintained in the follow-up* CG: less significant reduction in pain intensity than in the experimental group (p = 0.006).	EG: improved depression and quality of life CG: no other significant results
Atan et al. 2019 [23] Double-blind randomised controlled study	n = 35 10% BWSTT: amplitude of movement, stretching, strengthening, and balance exercises; BWSTT with 10% (n = 10) 20% BWSTT: amplitude of movement, stretching, strengthening, and balance exercises; BWSTT with 20% (n = 10) 0% BWSTT: amplitude of movement, stretching, strengthening, and balance exercises; conventional treadmill training (n = 10)	6 weeks, 5 times a week, 30 min 30 sessions	Groups of BWSTT with 0% support: 69.7**/7 females and 3 males Groups of BWSTT with 10% support: 72.2**/6 females and 4 males Groups of BWSTT with the 20% support: 68.6**/ 6 females and 4 males	0% support: 2–4***/5.6** 10% support: 2–4***/9.8** 20% support: 2–4***/7.6**	NHP/TC6, UPDRS, BBS, Fatigue Impact Scale, Fatigue Severity Scale scores	EG: pain intensity educed in the 10% and 20% BWSTT groups*	0%-support BWSTT group: improved balance and emotional subscores 10%- and 20%-support BWSTT group: improved 6-minute Walk Test, motor examination, and NHP emotional and pain subscores

Lena et al. 2017 [24] Non-randomised clinical trial pilot study	n = 6 Experimental: group A/ hyperactivity of thoracic/lumbar paravertebral muscles ipsilateral to the inclined side of the trunk: stretching and resistance exercises, gait training, balance training, mobility exercises, and breathing (n = 3) Group B/ hyperactivity of the thoracic/lumbar paravertebral muscles contralateral to the inclined side of the trunk: same exercise program (n = 3)	10 consecutive sessions, 90 min	60.2 ± 4**/ 2 males and 4 females	2–3***/6–12***	VAS / UPDRS, degree of lateral trunk flexion, EMG	Group A: pain intensity reduced* Group B: no significant results	Group A: improved motor examination, activities of daily living, and degree of trunk flexion Group B: no other significant results
Toosizadeh et al. 2015 [25] Randomised clinical trial pilot study	n = 15 Experimental: electroacupuncture (n = 10) Control: simulated treatment (placebo) (n = 5)	3 weeks, once a week, 3 min 3 sessions	EG: 71.1**/ 6 males and 4 females CG: 71.4**/ 2 males and 3 females	EG: 3.0**/ unquoted data CG: 2.9**/ unquoted data	VAS / SF-12, Short FES-I, UPDRS, MMSE	EG: pain intensity reduced CG: no significant results	EG: improved balance, activities of daily living, and motor examination; reduced fall condition and stiffness; decreased concern with falls CG: no other significant results
Lei et al. 2016 [26] Randomised clinical trial pilot study	n = 15 Experimental: electroacupuncture (standard acupuncture points) (n = 10) Control: electroacupuncture treatment at placebo points (n = 5)	3 weeks, once a week, 30 min 3 sessions	EG: 69.8**/ 6 males and 4 females CG: 71.0**/ 2 males and 3 females	EG: 3.0**/6.2** CG: 2.9**/5.2**	VAS / STHW, DTHW, STFW, DTFW, UPDRS, SF-12, FES-I	EG: pain intensity reduced CG: no significant results	EG: improved gait, step length, and gait speed; improved activities of daily living and motor examination CG: no other significant results
Gandolfi et al. 2019 [27] Single-blind randomised controlled study	n = 37 Experimental: active self-correction exercises with visual and proprioceptive feedback, passive and active trunk stabilisation exercises and functional tasks (n = 19) Control: joint mobility, muscle strengthening and stretching, gait and balance exercises (n = 18)	4 weeks, 5 times a week, 60 min 20 sessions 1-month follow-up	EG: 72.42**/ 9 males and 10 females CG: 70.72**/ 15 males, 3 females	EG: 3**/8.01** CG: 2**/6.57**	NRS/ UPDRS, PDQ-08, Mini BESTest	EG: pain intensity reduced* CG: pain intensity reduced*	EG: improved dynamic and static balance > CG CG: non-significant improvements in dynamic and static balance and reduction of anterior trunk flexion compared to the experimental group
Skogar et al. 2013 [28] Randomised prospective controlled study	n = 45 Experimental: full-body tactile stimulation + room immersed in scent of lavender + specific stress-oriented music (n = 29) Active control: only resting with music, without any tactile stimulation (n = 16)	8 weeks, twice a week in the first 3 weeks; then 1 intervention per week 10 sessions follow-up in the 11th, 14th, 21st, and 34th weeks	EG: 50–79***/ 10 males and 19 females CG: 50–74***/ 6 males, 9 females	EG: males 1.5**/ > 2 years females 2.5**/ > 2 years CG: males 3.0**/ > 2 years females: 2.0**/ > 2 years	VAS, POM/ HRQoL, UPDRS, PDSS, SF-36	EG: pain intensity reduced* CG: no significant results	EG: improved sleep and quality of life CG: less significant improvement in quality of life than the experimental group

EG – experimental group, CG – control group, BWSTT – Body-Weight Supported, VAS – visual analogue scale, BBS – Berg Balance Scale, UPDRS – Unified Parkinson's Disease Rating Scale, STHW – gait analysis during single-task habitual walking, DTHW – dual-task habitual walking, STFW – single-task fast walking, DTFW – dual-task fast walking, Short FES-I – Short Falls Efficacy Scale-International, EMG – electromyography, TUG – Timed Up and Go, PDQ-39 – Parkinson's Disease Questionnaire, NHP – Nottingham Health Profile, TC6 – Six-minute walking test, SF-12 – Short Form Health Survey, SF-36 – 36-Item Short Form Health Survey, NRS – Numeric Rating Scale for pain, POM – Pain-O-Meter, PDQ-08 – Parkinson's Disease Questionnaire, HRQoL – Health-Related Quality of Life, PDSS – Parkinson's Disease Sleep Scale, MMSE – Mini- Mental State Examination
* significant changes (p < 0.05), ** average, *** minimum and maximum

Table 2. Methodological quality and quality of studies

Author and year	Jadad score	Pedro score
Pérez-de la Cruz 2017 [20]	3/5	8/11
Pérez-de la Cruz 2018 [21]	3/5	6/11
Pérez-de la Cruz 2019 [22]	3/5	7/11
Atan et al. 2019 [23]	4/5	7/11
Lena et al. 2017 [24]	1/5	5/11
Toosizadeh et al. 2015 [25]	3/5	8/11
Lei et al. 2016 [26]	3/5	9/11
Gandolfi et al. 2019 [27]	3/5	7/11
Skogar et al. 2013 [28]	3/5	3/11

Ethical approval

The conducted research is not related to either human or animal use.

Results

Study selection

The search in the databases identified 983 studies. After the initial screening, 74 studies had their abstracts read – of which, 18 were read in full text. Nine articles were excluded for not meeting the inclusion criteria; hence, nine studies were selected for the analysis (Figure 1).

Participants' characteristics

Altogether, 242 participants in the articles furnished data for this review. All studies had male and female participants, and their mean age was 50 to 81 years. All of them had idiopathic PD, with mild-to-moderate symptoms of the disease (stages 1 to 4 on the Hoehn & Yahr scale), as presented in Table 1.

Study characteristics

All nine studies reported the type of physical therapy intervention they used and the outcomes they analysed. Three of them [20, 21, 22] were conducted in water (aquatic physical therapy), while six [23–28] were performed on land. The aquatic modalities involved Ai Chi (*n* = 3), while the land interventions included physical therapy exercises (n = 2), gait training with body weight support (*n* = 1), electroacupuncture (*n* = 2), and massage therapy (*n* = 1).

As for pain classification, two studies [24, 27] addressed musculoskeletal pain (such as back pain and pain caused by Pisa syndrome) and six articles treated participants who reported diffuse pain.

Concerning pain assessment instruments, most studies (*n* = 7) [20–22, 24–26, 28] used VAS, NRS, and NHP. The pain was the main outcome in only three studies [20, 22, 28], while in the other six [21, 23–27], it was a secondary outcome. The treatments lasted from three to 30 sessions, and five studies [20–22, 27, 28] conducted a follow-up, lasting from three to 34 weeks.

Methodological quality

The article quality assessment results with the Jadad scale ranged from 1 to 4 points. Eight articles [20–23, 25–28] were classified as high quality (scoring ≥ 3) and one [24] as low quality (scoring 2).

The PEDro scale was also used to guide and assess the quality of the articles, which scored from 3 to 9 points – one study [28] had the lowest and one [26] had the highest of these scores.

Discussion

Clinical variables and relationship with pain

Regarding the duration of the disease, eight articles [20–24, 26–28] provided this data, which ranged from two to thirteen years. Regardless of disease duration and severity, patients achieved positive results in pain management, which corroborates a systematic review with meta-analysis, indicating that pain sensitivity did not increase with disease duration and severity [29]. However, there are studies that show that the frequency and intensity of pain are greater in more advanced stages of PD, and its management may be more difficult [30]. Both sexes benefited from decreased pain in the interventions analysed, although a cross-sectional study indicated that female PD patients experienced pain sensations more intensely than male PD patients [30]. Thus, pain control in females may be more complex.

Coriolano et al. [31], in their observational study, observed no correlation with the mean age of the study population (64.3 years) and the presence of pain, similar to the study of Fil et al. [32], who conducted a literature review evaluating possible mechanisms, classifications, assessment, and potential risk factors for pain in PD and found that age was not considered in all studies and the correlation between different types of pain with age was not investigated in some studies.

According to the European Guideline of Physiotherapy for Parkinson's disease [33], in a physiotherapy session, the active exercises must be supervised by the physiotherapist and they recommend training for at least eight weeks, three times a week for 45 minutes, always with a directed and functional objective. In view of this, all the articles selected that involved active therapies [20, 21, 22–24, 27] met these standards and despite the different distributions of sessions, obtained positive results in pain management in their interventions.

This study investigated the literature to verify and analyse physical therapy treatments to manage pain in individuals with PD, which is one of the most disabling symptoms of this neurodegenerative disease and can affect the quality of life of PD patients [7].

The studies included in this review approached various types of physical therapy interventions for people with PD. However, most of them (n = 6) [21, 23–27] considered pain a secondary outcome, as they had another main objective in controlling motor or non-motor PD symptoms. Moreover, they did not indicate whether the participants took analgesics chronically. The pain was significantly decreased in approximately 80% of the studies. Hence, the review demonstrated that physical therapy had positive results in managing pain in PD patients in stages 1 to 4 on the Hoehn & Yahr scale. The studies are listed below, according to the type of intervention and pain assessment instrument they used.

Types of intervention

Aquatic physical therapy

Three studies [20, 21, 22] analysed the effectiveness of hydrotherapy to treat pain in individuals with PD. Perez de La Cruz, in 2017, 2018, and 2019, conducted Ai Chi interventions in PD participants. The results indicate that the Ai Chi program is a treatment option to ease pain in people with mild-to-moderate PD. Moreover, its effects remained one month after the treatment. A study by Silva et al. [34] demonstrated that hot water diminishes the sensitivity of free nerve endings (and therefore pain perception), eases muscle tension, and improves/maintains the amplitude of movement. Also, sensory stimuli compete with painful stimuli during immersion, breaking the cycle of pain [35]. However, there is a scarcity of studies approaching other aquatic physical therapy methods to ease the pain in PD patients, such as Watsu, a pain-relieving relaxation method based on passive and rhythmic movements induced by the flow of water [24, 36] This method is well-described in the literature regarding different health conditions, such as the study by Antunes et al. [37], in which the pain was relieved in individuals with fibromyalgia submitted to Watsu. Thus, further studies should address other hydrotherapy methods or physical therapy exercises in hot water to verify their analgesic effects.

Pain intensity in PD and disability scores are associated with advanced disease stages and higher motor scores, as assessed with the Unified Parkinson's Disease Rating Scale [2]. Perez de La Cruz [20], in 2017, with his Ai chi Aquatic program, obtained improvements in motor examination, as assessed by the UPDRS. Thus, it is inferred that with less motor impairment, there may be less pain.

In a study by Perez-de la Cruz [21], in 2018, the Aquatic Physical Therapy program with the Ai Chi method showed improvements in functional mobility, and muscle strength and power, as assessed by TUG and TSL5, respectively. In the literature, there are studies of the relationship of functional mobility with pain, such as the cross-sectional study by Silva [38], in which the authors found a negative and significant association of functional mobility with disability, reinforcing the association of low back pain with decreased functional mobility in the elderly [39]. Corroborating these findings, the study by Garza-Villarreal et al. [40], consisting of a sample with fibromyalgia who received music therapy, associated pain reduction with improved functional mobility. In the aquatic environment, the resistance properties of water, such as viscosity and turbulence, can provide functional mobility gains [41]. In addition, taking advantage of the therapeutic properties of water can assist in prescribing motor skill training in PD [41].

Another study by Pérez-de la Cruz [22], in 2019, used aquatic Ai Chi sessions, achieving gains such as improved depression and quality of life, and reduced pain. Factors such as muscle weakness and stiffness, psychological and sleep changes, and pain can influence quality of life in individuals with PD [41]. The pain, along with the decrease in the individual's physical capacity, may be associated with depressive symptoms that eventually cause a decline in the activities of daily living, which directly affects the individual's emotional state, influencing their quality of life [42]. Also, people with PD and pain tend to have more severe depression, and there is a strong correlation between pain and depression, since a deficiency of norepinephrine, dopamine, and other substances in the body can lead to depression [43]. Therefore, it is realised that indirectly, pain control can alleviate depression in people with PD [42].

Therapeutic physical exercises

Gandolfi et al. [27] presented positive results in diminishing the pain of PD patients in a rehabilitation program specifically focusing on the trunk. The intervention group did active correction exercises with visual and proprioceptive techniques, feedback to improve neuromotor trunk control, and dual-task exercises. Meanwhile, the control group worked on joint mobility, muscle strengthening and stretching, gait exercises, and balance. The individuals in both groups had pathological trunk flexion, whose consequences include pain. The results indicated that pain decreased in both groups. Such improvement may be grounded in evidence that physical activity can diminish pain intensity [44]. This corroborates the findings by Castro et al. [45], who argue that exercise programs are effective in avoiding pain increase and even minimising it, motivating adherence to the program. Physical exercises release analgesic substances and promote functional autonomy, encouraging functionally-limited individuals to change abnormal pain-related behaviours, and increasing their self-effectiveness, motivation, wellbeing, and satisfaction [46]. Furthermore, the positive training effects of Gandolfi et al.'s study were associated with improvements in dynamic and central balance and integration of sensory input processes, which may correlate with pain reduction.

Skeletal abnormalities – such as anterior trunk flexion and exaggerated lateral trunk flexion, named Pisa syndrome – appear as PD progresses, and both can increase the risk of backache. Hence, there is a close relationship between chronic backache and flexion posture [47]. This corroborates the study by Lena et al. [24], whose sample of PD patients had Pisa syndrome and backache and through a brief postural exercise program, had their backache relieved. Even though the results were favourable, the sample was small (n = 6) and the Jadad scale score was low (1 point), indicating a high risk of bias. The case study by Rosarion [48] found favourable backache relief results in a male with PD; the protocol also involved kinesiotherapy, with functional and aerobic exercises. A study by Feital et al. [49] obtained positive backache improvement results in PD patients; however, they did so with Pilates. The study focused on nonspecific chronic backache, addressed in 24 one-hour sessions for 12 weeks. Although the pain was relieved, this feasibility study did not have a control group or blinded examiners. These findings corroborate the studies by Notarnicola et al. [50] and Natour et al. [51], who argue that Pilates significantly improves the desensitisation to pain, relieves the painful condition, and diminishes the use of medication. According to Oliveira et al. [52], Pilates possibly has analgesic effects because backache is associated with muscle tension caused by poor posture. The method eases the intervertebral tension that may cause pain, improving the flexibility and strengthening the abdomen. It is worth mentioning that flexibility and muscle strength are components of functional capacity (FC), which is essential for the maintenance of basic body functions, and conservation of sufficient levels of these capacities improves the FC of the individual in addition to reducing the risk of suffering injuries [53]. Thus, with the improvement of components of the functional capacity, there may be a relief of pain.

Electroacupuncture

Electroacupuncture is a pain-management method that stimulates ergoreceptors and activates Aδ and C fibres [54]. The hyperstimulation of myelinated Aδ fibre nerve endings generates competition for stimuli, as these fibres are closely related to the transmission of nociceptive pain stimuli [55].

The articles by Lei et al. [26] and Toosizadeh et al. [25] analysed the effectiveness of electroacupuncture in 20 selected points for gait disorder in PD patients, assessing pain with VAS as a secondary outcome. Their results demonstrate improved balance and (consequently) gait; also, though not statistically significantly, pain decreased by 44% in comparison with the initial assessment. However, the study lasted only three weeks, with one session a week, which may not have been enough to significantly ease the pain. The studies used a frequency of 4 or 100 Hz for 30 minutes in the experimental group. Pain relief is seemingly associated with the fact that high-frequency stimulation (100 Hz) helps release neuropeptides into the central nervous system by releasing dynorphin A, serotonin, noradrenaline, and glutamate, which are involved in nociceptive processing. On the other hand, this frequency has noncumulative effects, which may explain the temporary analgesia. Contrarily, the 4 Hz frequency has cumulative effects, inducing the central release of endorphins and encephalins – i.e., the alternated and sequential combination of the 100 Hz and 4 Hz frequencies may explain the improved pain response [56, 55].

Furthermore, in the study by Lei et al. [26], there was an improvement in gait, stride length, and gait speed. In PD, there is a relevant alteration in gait, due to muscle stiffness and changes in muscle synergism, including muscle relaxation, often resulting in muscle pain and changes in posture [57]. Thus, it appears that with improved gait, secondary positive effects on pain occurred. However, pain reduction was obtained in a study using acupuncture in elderly people with chronic pain, which favoured the gait kinematic parameters, because with the reduction of pain, there is a reduction of energy expenditure during the gait cycle, increasing the gait speed and stride [58]. Thus, it seems that pain relief can improve gait and vice versa. In addition to pain reduction, the study by Toosizadeh et al. [25] achieved an improvement in the activity of daily living and motor examination; as well as improved balance, and reduced falls and stiffness. We can relate that the muscle stiffness observed in PD can predispose to an increase in the number of falls and level of pain, in addition to compromising balance and agility when walking [59].

Massage therapy

Skogar et al. [28] observed a decrease in pain duration in people with PD and chronic pain by using tactile stimulation. The authors found that the pain was relieved in both the intervention group and control group (which was only exposed to relaxing music, with no massage), but sleep was only improved in the intervention group. Touching the skin can be a powerful pain modulator, and the proprioceptive stimulus rate can help inhibit painful stimuli in the central nervous system. Touching the body of people in pain can help them experience pleasant sensations, such as relaxation, well-being, and relief [46]. The benefits of massage in relieving pain were likewise observed in other clinical conditions, such as fibromyalgia in the study by Nadal-Nicolás et al. [60]. This research achieved a similar result by using manual therapy with rhythmic pressure to ease the pain, with benefits that include decreased immediate and later perception of pain. The group that was submitted to relaxing music had their pain relieved, which was an expected result because music therapy helps ease the pain [61]. However, little is known about the effects of music as a pain treatment therapy, as there is little high-level scientific evidence of it. Clinical practice guidelines recommend music therapy to treat the pain (level of evidence C), which can be complementary in the assistance to PD patients [61]. Thus, the pain in the intervention group was seemingly reduced by the combination of massage and music therapy.

Gait training with body weight support

The study by Atan et al. [23] used body-weight-supported treadmill training (BWSTT) in individuals with moderate-to-advanced PD, aiming to compare it with conventional treadmill training (TT) and different weight supports. After 6 weeks, the 20% BWSTT group had their pain decreased, whereas the control group (TT) did not significantly improve. Hence, the study demonstrates that BWSTT can protect joints by decreasing their load, ensuring less painful movements, enabling a safe gait, and stimulating activity-dependent neural plasticity. Regarding the other results, the study also obtained positive gains in gait, balance, fatigue, quality of life, and pain in patients with moderate to advanced PD. According to Broetz [62], joint pain comes from stiffness, postural and mechanical alterations, inadequate gait and lack of mobility, aspects that are present in PD, thus, by improving these factors, pain tends to improve. In addition, according to Ford [63], the treatment of pain, combined with physical exercise programs and physical therapy, is indicated, aiming to restore mainly the functional mobility and other factors. However, the study did not have a long-term follow-up of the 20% BWSTT group results – which would be important because the gait in activities of daily living is the same for both the TT and BWSTT groups. Moreover, BWSTT is preferred by people with advanced PD because they have more severe symptoms, which hinder TT. Advanced PD may be related to osteoarthritis and the level of pain – these findings corroborate the study by Watanabe and Someya [64], in which the level of pain significantly improved in people with knee osteoarthritis after three weeks of BWSTT. Thus, the study by Atan and collaborators [23] raises doubts about whether the recruited individuals with advanced PD had osteoarthritis.

Active and passive therapies

Both therapies, active [20–24, 27] and passive [25, 26, 28], have been shown to reduce pain in people with Parkinson's disease. However, in a study with an exercise program for individuals with low back pain, this therapy showed significant pain reduction and posture improvement compared to passive therapies such as massage or physical resources such as ultrasound [65]. Passive techniques such as electroacupuncture can be associated with active techniques, since a systematic review with meta-analysis recommends associating acupuncture with exercises, as it seems to be effective in improving the intensity of chronic musculoskeletal pain in the lumbar region [66]. Passive therapies are usually discouraged as a primary focus, as they place the responsibility for pain management on the therapist, arousing a sense of dependence in the patient. Treatment in a passive manner can assist in pain reduction, however, active treatment keeps the patient functional in the long term [67]. Even though passive treatments can be effective, it is critical to encourage the patient to adhere to an active treatment model, as active care can promote structural and functional changes in the nervous system and optimise persistent and constant pain signalling for comfort and pleasure [67]. Passive treatments can be transitional, for example, a physical therapist can transition from using myofascial release to teaching the patient home exercises to increase their range of motion by offering spinal manipulation [67].

Assessment instruments

Most of the studies (*n* = 7) [20–22, 24–26, 28] used VAS to assess pain, in which the person in pain represents its intensity by checking a point between the opposite ends ('no pain' and 'the worst imaginable pain') on a horizontal 10-cm line [68]. The study by Gandolfi et al. [27] used the NRS [11], a 10-point scale that measures pain intensity, which is widely used in clinical settings for being easy to apply and score. Many studies in the literature have shown high correlations between the VAS and NRS, although the NRS has greater adherence and ease of use than VAS [69, 70]. However, these instruments only quantify pain intensity; they do not assess the type, duration, or frequency of pain, or its interference with other aspects, such as the quality of life.

The Turkish version of the NHP, used only in the study by Atan et al. [23], has 38 items in the pain, physical mobility, emotional reactions, energy, social isolation, and sleep dimensions [12]. Unlike the NRS and VAS, this scale does not quantify pain intensity; it only scores 1 when pain is present or 0 when it is absent. This can mask pain intensity before and after the intervention program.

Only the study by Skogar et al. [28] used the Pain-O-Meter scale, which has two pain assessment methods: the VAS, with a movable marker that individuals use to classify their pain; and a list with 15 sensory and 11 affective word descriptors, each of them ascribed an intensity score from 1 (low) to 5 (high) [13].

As a limitation, the studies included in this review did not have meta-analyses and used only pain intensity assessments, instead of validated scales/instruments for PD patients. King's Parkinson's Disease Pain Scale (KPPS) is currently the only specific one to identify and grade PD pain. It has seven pain dimensions, and its total score indicates the impact of the pain on the person's life [71]. Also, the studies did not use multidimensional scales – such as the McGill questionnaire, which assesses the pain's frequency, intensity, duration, character, severity, location, and temporal qualities [72]. Hence, future studies should apply multidimensional instruments, providing a broader perspective of the dimensions of pain.

Conclusions

In conclusion, land and aquatic physical therapy methods improved the levels of pain in people with PD. However, the literature lacks studies on the topic, which warrants further research. Future studies should recruit larger samples, include more comprehensive pain assessment instruments, and conduct follow-ups to verify the duration of the effects.

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Conflict of interest

The authors state no conflict of interest.

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