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Beyond conventional therapies: exploring the role of Pilates in neurological physical therapy – a review of the latest research

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Abstract

Pilates exercise method, characterized by its holistic approach, underscores core stability, strength, and flexibility, coupled with meticulous muscle control, optimal posture, and focused attention on breathing. Widely embraced in both general and clinical fitness realms, this study aims to evaluate the integration of Pilates into physical therapy practices for patients with neurological disorders.

Existing studies indicate the potential efficacy of Pilates in diverse rehabilitation contexts. However, neurological disorders, specifically multiple sclerosis (MS) and

Parkinson's disease (PD), have been the primary focus. While systematic reviews and meta-analyses suggest Pilates as a plausible option in physiotherapy for PD and MS patients, a paucity of research on this subject necessitates a comprehensive review of recent original studies.

Analysis of gathered data suggests that Pilates, when incorporated, may yield benefits for patients with various neurological disorders. Consideration of Pilates as a supplementary element to physical activity for those with PD and MS emerges as a reasonable proposition. The study also encourages contemplation of Pilates in rehabilitation research across a broader spectrum of neurological disorders. Subsequent investigations, incorporating relevant considerations, will contribute to a nuanced understanding of Pilates' potential benefits and its comparative advantages over traditional interventions for neurological disorders.

Keywords: Pilates; exercise; neurorehabilitation; physiotherapy; multiple sclerosis; Parkinson’s disease;

Introduction and purpose

Pilates is an exercise method pioneered by Joseph Pilates during the 1920s. Australian physiotherapists adapted his technique, naming it Clinical Pilates exercises and making it suitable for clinical use. Pilates’ exercise system blended the practical movement styles and concepts of gymnastics, martial arts, yoga and dance with philosophical ideas. It entails a holistic approach to exercise, emphasizing core stability, strength, and flexibility, while also accenting precise control of muscles, proper posture, and focused attention on breathing. The workouts can take place on the floor or involve use of specialized equipment. Emphasis is placed on precision of each movement rather than promoting thoughtless repetition [1, 2, 3]. Originally, Pilates gained significant acceptance among professional dancers. Nowadays, it is popular among the general population, as well as in clinical and fitness environments. This widespread adoption has prompted health and fitness professionals to scrutinize the scientific validity of the benefits advocated by Joseph Pilates himself [4].

The primary objective of this study is to critically examine and assess the viability of integrating the Pilates exercise method into physical therapy practices for patients with neurological disorders. By conducting a review of recent research, the study aims to evaluate the efficacy, safety, and potential therapeutic benefits of Pilates in addressing various aspects of neurological conditions. The overarching goal is to provide insights into whether Pilates

could be considered a valuable adjunct to conventional physical therapy interventions for individuals with neurological disorders, shedding light on its potential impact on factors such as balance, strength, quality of life, cognition, physical performance, walking, and posture parameters. Through this investigation, we seek to contribute to the evidence base for informed decision-making in the field of neurorehabilitation, ultimately guiding clinicians and practitioners in optimizing rehabilitation strategies for patients with neurological conditions.

Description of the state of knowledge

Studies suggest that Pilates can be an effective tool in rehabilitation, particularly in terms of reducing pain and disability, in conditions such as chronic low back or neck pain, ankylosing spondylitis, post-menopausal osteoporosis, knee osteoarthritis, non-structural scoliosis or hypertension [5, 6]. Moreover, the research indicates that it has a positive impact on the mental well-being of patients by reducing depressive and anxiety symptoms [7]. Pilates is also reported to improve sleep quality, as well as quality of life in sedentary population [8, 9].

When considering neurological disorders, the majority of research on the influence of Pilates has been dedicated to multiple sclerosis (MS) and Parkinson's disease (PD). Nevertheless, it is imperative to note that the existing body of research on this subject remains relatively limited.

Accumulated evidence suggests that Pilates can serve as a rehabilitative tool for individuals with MS. The majority of studies demonstrate favorable outcomes following Pilates training interventions, indicating its safety and effectiveness in addressing various aspects of dysfunction, including balance, strength, quality of life, cognition, physical performance, walking, and posture parameters in individuals with MS [10]. Reports indicate high adherence rates and minimal adverse effects associated with Pilates interventions [11]. Additionally, therapeutic exercise, encompassing Pilates, exhibits a positive impact on the depressive symptoms experienced by individuals with MS [12]. While Pilates appears to be a feasible therapy for individuals with MS, leading to improvements in physical function and potentially assisting in the reduction of self-perceived fatigue, it is important to note that the discernible benefits of Pilates do not significantly surpass those derived from the performance of other physical therapies [13].

Prescribing Pilates for individuals with mild-to-moderate PD also appears to be a safe intervention. Preliminary evidence suggests that engaging in Pilates may yield positive

outcomes in terms of fitness, balance, and physical function in patients suffering from PD. Notably, Pilates demonstrates superior effects on their lower-body function compared to other conventional exercises [14]. It stands out for its exceptional impact on proactive balance [15]. Among mind-body exercises, next to yoga, Tai-Chi, Qigong, and dance, Pilates emerges as the most effective in enhancing functional mobility and balance performance [16]. Additionally, it has been identified as one of the most preferable exercise modes for improving gait performance in patients with PD [17].

To summarize, available systematic reviews and meta-analyses suggest that Pilates may represent a viable option in physiotherapy for patients with PD and MS. Unfortunately, there is a scarcity of research on this subject, and the evidence is of low quality. Additionally, there is a deficiency of comparative studies between Pilates and other forms of exercise. In this study, we will conduct a review of the latest original research, examining what has been recently established and whether Pilates has been investigated in patients with other neurological disorders.

Materials and methods

A search was conducted on the PubMed database for literature published between June 2018 and June 2023. Using the keyword "Pilates," 464 articles were initially identified. Ultimately, 16 original papers relevant to the study's topic were included in the review. These comprised five studies on Parkinson's disease, eight on multiple sclerosis, one on lumbar disc herniation, one on tension-type headache and one on stiff person syndrome. Each paragraph comprises a brief introductory overview of the respective disease, followed by a concise description of the findings derived from the conducted research.

Results

Parkinson’s disease

After Alzheimer's disease, Parkinson's disease (PD) stands as the second most prevalent neurodegenerative disorder of the central nervous system. The incidence is slightly higher in men than in women. Typically, the disease manifests around the age of 65 to 70 years. PD represents the primary cause of parkinsonism, a clinical syndrome that encompasses features such as bradykinesia, cogwheel rigidity, resting tremor, a stooped

shuffling gait and imbalance. Furthermore, cognitive symptoms associated with the disease were observed. Neuropathologically, PD is defined by the existence of Lewy bodies containing alpha-synuclein in the substantia nigra of the brain. The depletion of dopaminergic neurons in the pars compacta of the substantia nigra results in a diminished facilitation of voluntary movements. Treatment options cover pharmacotherapy as well as nonpharmacological alternatives, including exercise, education, support groups, speech therapy, and nutrition. Consistent exercise and physical therapy can significantly help alleviate certain physical manifestations of PD, such as joint rigidity and flexed posture. Prioritizing exercises that enhance flexibility, strength, and balance is crucial. Engaging in such activities may empower patients by fostering a sense of control over certain aspects of the disease [18, 19, 20]. Futhermore, while there are no medications proven to decelerate the progression of PD, various scientific investigations suggest that continuous aerobic exercise may serve as a method to impede the advancement of PD. This recommendation for regular aerobic exercise should be considered as routine advice for individuals diagnosed with PD [21].

The randomized controlled trial (RCT) conducted by Fahriye Çoban et al. aimed to assess the impact of Clinical Pilates and traditional physiotherapy exercises on balance and postural control of individuals with PD. For a duration of 8 weeks, 40 patients engaged in exercises twice a week, with each session lasting 45 minutes, and assessments of balance, lower-extremity strength, fall risk, and functional mobility were conducted at both the beginning and the end of this period. It was demonstrated that clinical Pilates was equally effective as conventional physiotherapy, yielding superior results in dynamic balance [22].

In another study, a single-blinded RCT, Júlia de Faria et al. investigated the impact of Mat Pilates Training (MPT) and Multicomponent Training (MCT) on the spatiotemporal variables of gait during daily dual-task performance in individuals with idiopathic PD. Gait analysis during walking on a platform holding two bags provided a simulation of real-life scenarios, where individuals face an increased risk of falling compared to single-task walking. 34 participants were randomly assigned to one of two interventions: MPT or MCT. For 20 weeks they were engaged in the training for 60 minutes, three times per week. Both groups experienced positive effects on gait speed during load transport as a result of the two interventions proposed, but the MPT group exhibited a spatiotemporal adjustment of speed and cadence that could enhance gait stability, a characteristic not observed in the MCT group [23].

Evrim Göz et al. carried out an RCT in order to explore the impact of Pilates training and elastic taping on the balance and postural control of individuals in the early stages of PD. 20 patients were randomly assigned to one of three groups: Pilates (PG), elastic taping (ET), and control (wait list). The Pilates group underwent training sessions, each lasting 60 minutes, twice a week for 6 weeks. In the elastic taping group, participants received elastic taping applied to the upper back twice a week in addition to Pilates training, with a focus on postural correction over the same 6-week period. After 6 weeks, The Trunk Impairment Scale scores, the Berg Balance Scale scores, step length values and body sway performance did not exhibit significant changes in any of the three treatment groups. The reaction time parameter of the Limits of Stability test significantly decreased in both the PG and the ET group. The end-sway parameter of the tandem walk test also saw a significant decrease in the ET group, with no significant changes in the PG and the control group. Walking speed values in the walk across test showed a significant increase in both the PG and ET groups. The rising index of the sit-to-stand test significantly improved in the ET group. In conclusion, the patients experienced positive effects on dynamic balance parameters through the application of both Pilates and elastic taping methods. No significant disparity in treatment effectiveness was observed between the PG and ET groups [24].

David Pereira Maciel et al. conducted a prospective open-label non-randomized controlled clinical trial involving eventually a total of 40 patients with PD. These participants were divided into two groups: the intervention group (IG) and the control group (CG). Patients in the IG group underwent twelve 1-hour Pilates sessions, with a frequency of 2 times per week, spanning a total of 6 weeks. Participants in the control group (CG) were advised to engage in regular exercise throughout the specified period, incorporating walking and stretching activities at least twice a week. The study revealed a significant improvement in PD patients when comparing pre- and post-intervention assessments. Furthermore, when compared to the CG group, the intervention group demonstrated notable enhancements in endpoints such as Performance-Oriented Mobility (POMA) Scale, Timed Up and Go (TUG), Functional Reach Test (FRT) and Parkinson's Activity Scale (PAS) [25].

A pilot study performed by Jose Maria Cancela et al. targeted to evaluate the feasibility and effectiveness of a Mat Pilates program in individuals experiencing mild to moderate PD. The exercises were performed by 16 patients twice a week for 12 weeks. The feasibility of the Mat Pilates program was demonstrated, with excellent adherence and no observed adverse effects (except for one participant who encountered mild dizziness during the second session but successfully completed it). Positive impacts on participants' fitness

levels were noted, with the exception of shoulder range of motion and dynamic balance. Additionally, the program positively influenced the participants' quality of life [26].

Multiple sclerosis

With a global impact on over 2 million individuals, multiple sclerosis (MS) stands as the foremost chronic inflammatory disease of the central nervous system. The distinctive pathological hallmark of MS is the presence of perivenular inflammatory lesions, ultimately resulting in the formation of demyelinating plaques. Symptoms typically manifest between the ages of 20 to 30 years, with women being nearly three times more prone to developing MS compared to men. Characterized by fully or partially reversible episodes of neurologic disability lasting days or weeks, MS often presents with various syndromes. When it comes to the most common movement disorders observed in MS, these include restless legs syndrome, tremor, ataxia, parkinsonism, paroxysmal dyskinesias, dystonia, chorea and ballism, facial myokymia, tics, and tourettism. Following an average span of 10 to 20 years, a progressive clinical course emerges in a significant number of individuals, ultimately resulting in compromised mobility and cognition. The management of MS encompasses two main categories: disease-modifying pharmacological therapies, which are typically specific to MS and aim to modify the course of the disease, and symptomatic therapies, which are frequently used across various medical conditions to alleviate symptoms arising from neurological dysfunction. The latter frequently involves a multidisciplinary approach, including pharmacological, surgical, and physical therapies [27, 28, 29, 30].

Zuhal Abassyanık et al. conducted an RCT, where 33 patients with MS were divided into two groups. The Pilates exercises group underwent weekly therapy for 8 weeks, accompanied by a home exercise program. The home exercise group followed standardized exercises reflecting routine clinical practice. The authors assessed differences in influence of these two interventions on various abilities. The outcomes revealed no significant differences in walking speed, perceived walking ability, and fear of falling between the Pilates and home exercise groups. However, Clinical Pilates training demonstrated superiority over the home exercise program in terms of walking endurance, postural stability, core stability, respiratory function and cognitive functions [31]. Authors of this study also performed another one, in which they compared impact of clinical Pilates training and yoga training in total of 28 people with MS. This quasi-experimental study demonstrated positive effects on walking and respiratory aspects in individuals with MS who underwent yoga and clinical Pilates training.

Notably, Pilates training showed superiority in enhancing walking speed, quality of life, and balance confidence compared to yoga training [32].

An 8-week RCT including total of 80 participants, executed by Karl M. Fleming et al., targeted to quantify the effects of home-based Pilates on symptoms of anxiety, depression and fatigue among patients suffering from MS, with a wait-list as a control group. A significant improvement in these areas was observed in the intervention group, including moderate-to-large, clinically meaningful improvements in depressive and fatigue symptoms, particularly among female individuals with MS [33]. The same authors published a qualitative analysis, where 10 women with MS, who engaged in either an eight-week supervised Pilates program (n=4) or a home-based Pilates program (n=6), were invited and willingly agreed to participate in interviews. Key findings suggest that Pilates is a secure, well-received, and appropriately intense exercise method, promoting enhanced mental health among individuals with MS. Specifically, home-based Pilates effectively tackled barriers related to exercise participation and accessibility within this community [34].

An RCT carried out by Mehdi Gheitasi et al. analyzed outcomes in 30 men with MS divided into two groups: a Pilates training group and a control group, which was not included in any Pilates training and only received usual medical care. According to the results, there was a significant increase in functional balance indices within the Pilates training group compared to the control group following a 12-week training period [35].

Parisa Najafi et al. in their RCT revealed several positive outcomes during the investigation following 8 weeks of tele-Pilates and tele-yoga, compared to a control group, which did not implement an intervention, in 45 females with MS. These results included a prolactin serum levels increase, which may contribute to repairment of the myelin; a cortisol decrease, possibly indicative of the adjustment of HPA dysregulation; improvements in depression, possibly associated with the cortisol serum levels reductions, or vice versa; and enhancements in physical activity levels, walking speed, and quality of life [36].

Lumbar disc herniation

A lumbar disc herniation (LDH) is defined as a displacement of disc material (nucleus pulposus or annulus fibrosis) beyond the typical boundaries of the intervertebral disc space. This phenomenon leads to sensations of pain, weakness, or numbness in a myotomal or dermatomal distribution [37]. The peak prevalence is observed in individuals aged 30–50 years. Men are affected twice as often as women [38]. The initial approach for the majority of

patients with LDH involves non-surgical treatments. The primary goal is to alleviate pain through various therapies, including medication, physical exercises, spinal manipulation, traction (manual or mechanical), epidural steroid injections, and other less commonly used modalities. Surgical treatment (discectomy) is recommended only for certain patients. Indications for surgery include the severity of pain and/or disability, insufficient response to conservative treatment, presence of typical radiculopathy with neurological deficits, and the duration of complaints [39].

In a study led by Gülşan Taşpınar et al., 54 patients diagnosed with LDH were randomized into two groups. One group engaged in clinical Pilates exercises (CPE), while the other served as the control group, refraining from any form of exercise. The study group participants underwent exercises three times a week for a duration of 6 weeks. At the study's conclusion, the CPE group exhibited significantly greater reductions in pain levels and Oswestry disability index, along with notable increases in the sit-reach test and hand-finger-to-floor distance. Additionally, the CPE group demonstrated a longer duration in the lateral bridge and sits-ups test, and most of the Short Form-36 sub-parameters, all of which were statistically significant. These findings indicate that CPE emerged as an effective and secure approach for individuals experiencing symptomatic LDH. The use of CPE resulted in a noteworthy reduction in pain levels and functional disability, accompanied by improvements in flexibility, static and dynamic endurance, and, to some extent, in their quality of life [40].

Tension-type headache

Tension-type headache (TTH) is characterized by recurrent oppressive headaches of mild to moderate intensity, bilateral location, and no aggravation by routine physical activity. It holds the distinction of being the most prevalent primary headache and the most widespread neurological disorder globally. The progression from episodic to chronic TTH can result from central sensitization induced by prolonged nociceptive stimulation in myofascial tissues. The primary approach to clinical management involves pharmacological therapy, which is categorized into acute and preventive treatments. Furthermore, non-pharmacological therapies with strong evidence and safety for TTH management encompass physical and occupational therapies, behavioral therapies, complementary and integrative medicine, as well as lifestyle enhancements. These therapies can be utilized alone or in combination with pharmacotherapy, and multiple non-pharmacological interventions can be employed concurrently or sequentially [41, 42, 43].

Agathe Leite et al. conducted a case series with 9 undergraduate students suffering from TTH. During this observational study, the participants attended Clinical Pilates sessions, which were structured into four 30-minute classes with a 2 to 4-day interval between each session. Following the intervention, it was observed that pain intensity decreased in only two participants. However, all participants demonstrated improvement in the impact of TTH on normal daily life and functional ability. Only one participant did not show improvement in functional disability attributed to pain in the cervical region. Regarding negative emotional states, six individuals reported improvements, while one individual noted a decline in sleep quality following the program [44].

Stiff person syndrome

Stiff person syndrome (SPS) is a rare disorder distinguished by fluctuating rigidity and stiffness affecting the axial and proximal lower limb muscles. It is characterized by the presence of painful spasms and continuous motor unit activity observed on electromyography. As the disease progresses, activities of daily living become significantly impaired, and patients often report challenges in tasks such as dressing, walking, and bending forward. SPS is estimated to have a prevalence of 1–2 cases per million. Most individuals affected by SPS typically present between the ages of 20 and 50. Classical SPS predominantly affects women, occurring two to three times more frequently than in men. Nearly all cases of SPS have an autoimmune origin, with the majority showing the presence of the glutamic acid decarboxylase (GAD) autoantibody. However, there are also paraneoplastic variations. The focus of therapy is on providing symptomatic relief and modulating the autoimmune process. Primary treatment approaches involve the use of γ-aminobutyric acid (GABA)-ergic and other antispasmodic agents to alleviate symptoms. Additionally, immunomodulatory agents can be employed to mitigate the abnormal immune processes [45, 46]. While not universally necessary, preferred, or tolerated, selective physiotherapy approaches, such as aqua therapy, deep tissue massage, heat, or ultrasound therapy, may provide benefits to certain patients at different stages of the disease [47].

Beliz Belgen Kaygisiz et al. published a case report of a woman suffering from SPS, who underwent 8-week Clinical Pilates training program. The patient exercised twice a week with a certified physiotherapist and on the remaining days, she followed instructions for home workouts. When she enrolled in the training, her main complaints were increased low back pain, balance issues throughout the day, and frequent spasms towards the end of the day. The

physiotherapy program resulted in enhancements in range of motion, flexibility, strength, functional mobility, and balance measurements, along with a reduction in the patient's pain level. These results suggest that Clinical Pilates may provide an effective and safe intervention method for patients with SPS. While the results are promising, it's important to note that they cannot be generalized to the entire population with the disease [48].

Conclusions

The data gathered in this review suggest that Pilates is a form of exercise that, when engaged in, may bring benefits to patients with various neurological disorders. The majority of studies in this direction focus on multiple sclerosis and Parkinson's disease. They indicate that Pilates improves the motor functions of these patients, is well-tolerated, and can positively impact their mental state and quality of life. It seems reasonable to contemplate Pilates as a supplementary component to physical activity for these patients.

Some individual studies suggest the potential applicability of Pilates in patients with other conditions such as lumbar disc herniation, tension-type headaches, and stiff person syndrome. In these cases, data are very limited; nevertheless, the research outcomes encourage considering Pilates in the rehabilitation studies of patients with a broader spectrum of neurological disorders.

Considering implications for future research, imperative measures include an increased number of randomized clinical trials with enhanced methodological rigor, more precise intervention descriptions, and standardization of the methodologies employed for evaluating specific variables, facilitating meta-analyses and thereby elevating the levels of evidence. Additionally, there is a necessity to explore potential long-term effects of the intervention, necessitating larger patient samples and conducting comparative analyses between Pilates intervention and other relevant interventions. Researchers should also work on establishing precise guidelines for movement patterns that can be adapted to accommodate varying degrees of motor impairment. Further investigations, taking these considerations into account, will contribute to a better understanding of the extent to which Pilates may be beneficial and recommended for patients with neurological disorders and whether it holds an advantage over other traditional interventions.

Disclosures

Author's contribution

Conceptualization: Monika Maleszewska, Aleksandra Żmijewska; Methodology: Marcin Kapica, Mikołaj Wojtas; Formal analysis: Julia Piątkiewicz, Karol Momot; Investigation: Karen Głogowska, Mateusz Sztybór; Writing - rough preparation: Gabriela Nowak, Maria Krzyżanowska; Writing - review and editing: Monika Maleszewska, Aleksandra Żmijewska; Supervision: Monika Maleszewska, Aleksandra Żmijewska.

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