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Moving Beyond Medication: Harnessing the Power of Physical Therapy and Dance Therapy in Parkinson's Disease Management

Ksawery Adamiec
Medical University of Silesia in Katowice, Poniatowskiego 15, 40-055 Katowice, Poland
rk200@o2.pl
https://orcid.org/0009-0006-0867-9291

Dominik Trojanowski
Medical University of Silesia in Katowice, Poniatowskiego 15, 40-055 Katowice, Poland
dttrojanowski@gmail.com
https://orcid.org/0009-0003-0758-9567

Małgorzata Rodak
Bonifraters Medical Center Ltd.
87 Ks. Leopolda Markiefki Street,
40-211 Katowice, Poland
malgorzatarodak12@gmail.com
https://orcid.org/0000-0002-5517-1558

Joanna Smorońska-Rypel
Bonifraters Medical Center Ltd.
87 Ks. Leopolda Markiefki Street,
40-211 Katowice, Poland
joanna.smoronska123@gmail.com
https://orcid.org/0009-0008-3364-209X

Błażej Szymczuk
Medical University of Silesia in Katowice, Poniatowskiego 15, 40-055 Katowice, Poland
blazej.szymczuk@gmail.com
https://orcid.org/0009-0000-0515-5413

Magdalena Kajzar
Bonifraters Medical Center Ltd.
87 Ks. Leopolda Markiefki Street,
40-211 Katowice, Poland
magdalena.kajzar12@gmail.com
https://orcid.org/0009-0005-4616-7636

Kamila Nitka
Medical Center in Łańcut Ltd.
5 Paderewski Street,
37-100 Łańcuta, Poland
kamila.nitka@gmail.com
https://orcid.org/0009-0007-3399-571X

Magdalena Iwan
Medical University of Silesia in Katowice, Poniatowskiego 15, 40-055 Katowice, Poland
iwanmagdalenawnmk@gmail.com
https://orcid.org/0009-0000-0385-0877

Natalia Piątkowska
Provincial Hospital in Poznań
7/19 Juraszów Street,
60-479 Poznań, Poland
nataliapiatkowska98@gmail.com
https://orcid.org/0009-0001-7508-6043

Jakub Milczarek
Medical University of Silesia in Katowice, Poniatowskiego 15, 40-055 Katowice, Poland
jakubmilczarek95@wp.pl
https://orcid.org/0000-0002-4099-0999

Corresponding author:
Ksawery Adamiec
Medical University of Silesia in Katowice, Poniatowskiego 15, 40-055 Katowice, Poland
rk200@o2.pl
https://orcid.org/0009-0006-0867-9291

ABSTRACT

Introduction

Parkinson's disease (PD) poses significant challenges due to its complex array of motor and non-motor symptoms, impacting patients' quality of life. While traditional pharmacological treatments focus on motor symptoms, non-pharmacological interventions, including physical and dance therapy, offer alternative approaches.

Aim of the Study

This study aims to evaluate the therapeutic potential of physical and dance therapy, including tango, in managing motor symptoms and improving overall well-being in individuals with PD. It seeks to compare these interventions with traditional treatments and explore their efficacy.

State of Knowledge

Parkinson's disease management involves a combination of pharmacological and non-pharmacological approaches. Traditional treatments target motor symptoms but have limitations. Non-pharmacological interventions, such as deep brain stimulation and physical

therapy, complement traditional treatments. Dance therapy, including tango, shows promise in improving motor function and quality of life.

Conclusions

Physical and dance therapy, including tango, offer promising avenues for managing motor symptoms and enhancing quality of life in PD patients. While traditional treatments remain essential, non-pharmacological interventions provide valuable alternatives. Further research is needed to refine intervention parameters and compare their effectiveness comprehensively. Overall, these therapies present holistic approaches to PD management, addressing both motor and non-motor symptoms for improved patient outcomes.

Key words

parkinson's disease; physical therapy; dance therapy; non-pharmacological interventions

Introduction:

Parkinson's disease (PD) is a progressive, idiopathic neurodegenerative disorder characterized primarily by motor symptoms such as bradykinesia (slowness of movement), resting tremor, rigidity, and postural instability. These symptoms result from the loss of dopamine-producing neurons in the substantia nigra pars compacta, a region of the brain that plays a critical role in movement control. Non-motor symptoms (NMS) are also a significant aspect of the disease, affecting patients' quality of life and overall well-being. They can precede the onset of motor symptoms by several years. [1,2,3]

Epidemiology

Parkinson's disease (PD) is one of the most common neurodegenerative disorders, second only to Alzheimer's disease. Analyses from the Global Burden of Disease, Injuries, and Risk Factors Study (GBD) indicate that Parkinson's disease is the fastest-growing neurological disorder in terms of prevalence, disability, and mortality rates. In 1990, the global prevalence of PD was estimated to be 2.5 million cases. By 2016, this number had increased to 6.1 million [4]. In a recent update based on GBD data, Ou et al. estimated that the global number of PD patients reached 8.4 million in 2019 [5].

Pathophysiology

The pathophysiology of Parkinson's disease (PD) involves the progressive loss or degeneration of dopaminergic neurons in the substantia nigra, accompanied by the formation of Lewy Bodies, which are abnormal aggregates containing proteins like alpha-synuclein and ubiquitin. This neuronal loss leads to significant impairment in motor control. Environmental stressors, aging, and genetic mutations contribute to neuropathological changes, including chronic inflammation in the brain and cellular senescence. Mitochondrial dysfunction, oxidative stress, and impaired protein degradation systems also play roles in PD progression. The "dual-hit" hypothesis proposes that a pathogen enters the brain via the olfactory route or through the gut, leading to the formation of Lewy Bodies in various structures, including the intestines, vagus nerve, and brain [2].

Symptoms

Motor symptoms

Parkinson's disease is characterized by a range of motor symptoms, including a resting tremor that typically starts on one side of the body, slowed movements (bradykinesia), muscle stiffness (rigidity), a shuffling gait, and difficulty maintaining balance (postural instability). These symptoms often develop gradually, and individuals may initially attribute them to normal aging. The progression of motor symptoms varies widely among patients. Some may experience dominant features such as tremor, rigidity, or postural instability.

Beyond the classic motor symptoms, Parkinson's disease can also manifest in other ways. These include a reduced ability to show facial expressions (hypomimia), decreased blinking, blurred vision, difficulty looking upward, muscle cramps (dystonia), a stooped posture, challenges with turning in bed, spinal deformities like kyphosis or scoliosis, a distinct shuffling walk, episodes of "freezing" where movement becomes momentarily impossible, and speech difficulties like softening of the voice (hypophonia) or repetitive speech patterns (palilalia). [2,6,7]

Non-motor symptoms

Non-motor symptoms in Parkinson's disease encompass various cognitive, behavioral, and autonomic changes, as well as sensory and sleep disturbances. These symptoms pose significant challenges to quality of life and management since they often do not respond well to standard dopamine therapy. They can precede motor symptoms by years, affecting nearly 90% of

individuals with Parkinson's disease. These symptoms may worsen due to disease progression or medication side effects. They include cognitive impairment, dementia, psychosis, mood disorders, sleep disturbances, autonomic dysfunction, and sensory issues like pain and olfactory dysfunction. Management involves a comprehensive approach tailored to each individual's specific needs, including education, lifestyle modifications, medication adjustments, and supportive therapies to address these diverse symptoms and improve overall quality of life. [2,6,7]

Treatment

Parkinson's disease management typically involves a combination of pharmacological and non-pharmacological approaches to address both motor and non-motor symptoms.

Pharmacological treatment

Parkinson's disease (PD) is currently managed with treatments aimed at alleviating motor symptoms, as there are no disease-modifying drugs available. The primary treatment approach involves levodopa-based preparations, which replenish dopamine levels in the depleted striatum. However, levodopa can lead to significant side effects and motor complications over time, such as dyskinesias and on-off motor fluctuations. To mitigate these effects, it is often combined with peripheral inhibitors of DOPA decarboxylase, such as carbidopa or benserazide. Dopamine agonists are another class of drugs used to treat PD, which stimulate dopamine receptors and are often prescribed as initial therapy, especially in younger patients. They can delay the need for levodopa therapy but may cause side effects such as nausea, hallucinations, and impulse control disorders.

Monoamine oxidase B (MAO-B) inhibitors and catechol-O-methyl transferase (COMT) inhibitors work by inhibiting enzymes involved in dopamine metabolism, thereby preserving endogenous dopamine levels. They can be used alone or in combination with levodopa-based treatments.

Other treatments for PD include anticholinergics, which reduce the activity of acetylcholine and may improve rigidity and tremors, and amantadine, which can alleviate motor symptoms and limit levodopa-induced dyskinesias.

Emerging treatments for PD are focused on targeting the underlying pathology of the disease, particularly the aggregation of alpha-synuclein. Immunotherapies, gene therapies, and drugs that reduce alpha-synuclein production or enhance its clearance are currently under

investigation in clinical trials. Additionally, repurposed drugs like nilotinib and exenatide show promise in providing neuroprotection and symptom relief. [2, 10]

Non-pharmacological treatment

Deep Brain Stimulation (DBS)

Deep Brain Stimulation (DBS) is a surgical procedure used in the treatment of Parkinson's disease (PD) that involves the implantation of electrodes into specific areas of the brain, such as the subthalamic nuclei (STN) or globus pallidus pars interna (GPi). These electrodes deliver electrical impulses to modulate abnormal brain activity associated with PD symptoms. DBS has largely replaced traditional ablative procedures due to its reversibility and adjustable nature. Patient selection is crucial, typically focusing on those with advanced PD, significant medication-related motor fluctuations, and medically intractable tremors, while excluding those with significant cognitive or psychiatric impairments. Despite its widespread use, several aspects of DBS therapy, including patient selection criteria, surgical techniques, and long-term outcomes, remain areas of ongoing research and debate. [2, 7, 11]

Physical Therapy

Physical therapy interventions for Parkinson's disease (PD) encompass a diverse array of approaches aimed at addressing the multifaceted motor and non-motor symptoms associated with the condition. One of the foundational interventions identified across several studies is aerobic exercise. The outcomes outcomes revealed several significant findings: community-based exercise demonstrated enhancements in motor symptoms among participants; typical exercise parameters included sessions lasting 60 minutes, occurring twice weekly, with tango and tai chi emerging as the prevailing movement modalities; the frequency of weekly exercise, along with participant age and treatment duration, emerged as influential factors shaping the observed results [12]. The studies emphasize the crucial role of physical activity in managing PD symptoms.[12,13,14] The authors discuss the efficacy of aerobic exercise in improving mobility, lower limb muscle strength, and gait function in PD patients. Such exercises not only promote physical well-being but also contribute to overall quality of life. [14, 15]

Community-based exercise programs have also garnered attention for their potential to alleviate motor symptoms in PD. In a few meta-analyses, it was demonstrated that physical exercise interventions contribute to improvements in balance, postural stability, and general mobility among individuals with PD [14, 16, 17]. These findings underscore the importance of structured exercise programs in mitigating motor impairments associated with PD and highlight the

potential benefits of community-based interventions in promoting long-term adherence to exercise regimens.

Innovative interventions such as non-invasive brain stimulation techniques have also been explored in PD rehabilitation. Yoon (2021) discusses the potential of repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) in modulating neural activity and improving motor function. While the evidence regarding their effectiveness remains mixed, certain protocols targeting specific brain regions have shown promise in ameliorating motor symptoms and gait performance. Moreover, within the realm of physiotherapy, there exists a diverse array of interventions and approaches. It is crucial to emphasize the importance of individualized treatment plans tailored to the specific needs of each patient [17].

In the realm of Parkinson's disease (PD) rehabilitation, virtual reality (VR) stands out as a groundbreaking tool, offering immersive environments conducive to balance training and activities of daily living (ADL). One of the studies highlights the potential of VR-based interventions, providing a safe and captivating avenue for therapy. These interventions not only cater to in-person sessions but also pave the way for remote delivery of rehabilitation services via telehealth platforms. Through the integration of VR technology, telerehabilitation emerges as a promising avenue for administering home-based exercise programs, ultimately increasing accessibility and promoting greater adherence to therapy regimens. [14]

For non-motor symptoms, dance and yoga were particularly effective in reducing depression and anxiety. Resistance training (RT) was unique in its ability to enhance cognitive function and improve sleep quality in PD patients. Additionally, various exercises significantly diminished the fear of falling among those with Parkinson's disease. [18]

Dance therapy

Dance therapy has emerged as a promising intervention for individuals with Parkinson's disease (PD), offering a multifaceted approach to addressing motor impairments, functional limitations, and quality of life. Through the examination of several research articles, we can glean insights into the effectiveness, health benefits, and potential mechanisms underlying dance therapy in patients with PD.

Firstly, the choice of dance styles investigated in PD research varies, with tango being a predominant focus due to its ability to target PD-specific impairments such as backward walking, turning, varied speeds, and frequent starting and stopping movements [19]. Other

styles, including ballroom, Irish Set dancing and video game-based dance have also shown promise in improving motor function and balance in PD [19, 20, 21]. This diversity suggests that a range of dance forms may offer therapeutic benefits for individuals with PD.

In terms of participant characteristics, studies indicate that dance therapy interventions often include both male and female participants, although the proportion of female participants tends to be higher in studies involving older adults compared to those focusing on PD [19]. Despite this difference, both populations demonstrate improvements in motor function following dance therapy interventions, highlighting the potential efficacy of this approach across diverse demographic groups.

Duration and intensity of dance therapy sessions vary across studies, with interventions typically lasting 10-13 weeks and involving sessions ranging from once to twice per week for 60-90 minutes [19]. While longer-term interventions have been explored in PD, the majority of studies focus on shorter-term programs. Importantly, adherence to recommended exercise guidelines, such as those outlined by the CDC, is often lacking in both PD and older adult populations undergoing dance therapy [19]. This suggests the need for further investigation into optimal training schedules and intensity levels to maximize therapeutic benefits.

The health benefits of dance therapy in PD are manifold, encompassing improvements in motor function, balance, functional mobility, gait, flexibility, proprioception, tactile performance, and upper extremity motor control. Studies consistently report enhancements in balance and gait parameters following dance therapy interventions, with particular improvements observed in static balance, dynamic postural control, and gait speed [19, 20, 21]. Furthermore, dance therapy has been shown to improve functional strength, endurance, cardiovascular health, and muscle power in both PD and older adult populations [19].

Beyond motor symptoms, dance has demonstrated significant effects on non-motor symptoms in PD. These include improvements in mood, cognition, participation in activities of daily living (ADLs), and overall QoL. Mood disturbances and depression, common non-motor symptoms in PD, have shown improvement with dance interventions. Studies have reported reductions in depressive symptoms and apathy following dance interventions. Furthermore, cognitive function, particularly aspects such as executive function, visuospatial memory, and task switching, have shown improvement with dance interventions, albeit with varying degrees of effectiveness. [22, 23]

Dance interventions have also positively impacted participation in ADLs and QoL in PD patients. Participants in dance programs have reported increased participation in instrumental, leisure, and social activities, indicating a broader impact beyond motor improvements. While

studies have reported mixed findings regarding changes in QoL as measured by the Parkinson's Disease Questionnaire-39 (PDQ-39), improvements in overall QoL have been consistently observed in healthy older adults participating in dance interventions. [22, 23]

Safety concerns regarding dance interventions have been minimal, with few adverse events reported across studies. Falls, a significant risk in PD patients, have been effectively managed in dance interventions. Moreover, follow-up assessments have shown sustained benefits in motor function, spatial working memory, and balance even after cessation of dance programs [22, 23]

Possible mechanisms underlying the therapeutic effects of dance therapy in PD include the engagement of sensorimotor circuits, rhythmic auditory stimulation, social interaction, cognitive engagement, and emotional expression. Dance involves coordinated movement to music, which may facilitate motor learning and neural plasticity through auditory-motor synchronization and rhythmical cueing [22]. Moreover, the social and emotional aspects of dance therapy can enhance motivation, reduce stress, and improve overall well-being, thereby contributing to its therapeutic efficacy [21].

Overall, dance emerges as a valuable complementary therapy for individuals with PD, offering not only improvements in motor symptoms but also addressing non-motor symptoms, participation, and QoL. However, more research is needed to determine optimal intervention parameters, including dance style, frequency, duration, and intensity. Direct comparisons between different forms of dance are necessary to elucidate the differential effects and inform recommendations for tailored interventions. Additionally, further investigation into the long-term effects of dance on motor and non-motor symptoms, as well as its impact on specific subsets of PD patients, is warranted to maximize its therapeutic potential.

Tango

Tango dancing has emerged as a promising intervention for individuals with Parkinson's disease, offering various benefits and effects on motor symptoms, cognitive function, and overall well-being. Research suggests that short-duration, intensive tango dancing programs can lead to improvements in motor function and mobility among individuals with PD [24]. Furthermore, community-based Argentine tango dance programs have been associated with increased activity participation and social engagement, contributing to enhanced quality of life for individuals with PD [25].

A systematic review and meta-analysis of studies examining tango in PD indicates significant improvements in motor severity and balance among participants, highlighting the therapeutic

potential of tango for managing PD symptoms [26]. Additionally, adapted tango interventions have shown positive effects on spatial cognition and disease severity in individuals with PD, suggesting that tango may enhance cognitive function alongside addressing motor symptoms [27].

Comparative studies have explored the effectiveness of tango compared to other forms of physical therapy for PD management. While tango may not show significant improvements in certain gait-related outcomes compared to treadmill exercise or stretching interventions, it offers unique benefits such as social interaction, group learning, and structured motor training, which may contribute to its overall effectiveness in PD management [28].

Conclusions

In conclusion, Parkinson's disease (PD) presents a multifaceted challenge, impacting both motor and non-motor functions and significantly affecting patients' quality of life. While traditional pharmacological treatments target motor symptoms, they often come with limitations and may not address the full spectrum of PD manifestations.

Non-pharmacological approaches, such as deep brain stimulation (DBS) and physical therapy, offer additional avenues for symptom management and improving overall well-being in PD patients. Physical therapy, including dance therapy, has shown promise in improving motor function, balance, and quality of life.

Research suggests that dance therapy, including tango, holds potential for managing PD symptoms. Tango interventions have demonstrated improvements in motor severity, balance, and cognitive function, highlighting their therapeutic benefits. While tango may not show superiority in certain outcomes compared to other physical therapy modalities, its unique combination of structured motor training, social interaction, and cognitive engagement sets it apart as a valuable intervention for PD management.

Further research is needed to optimize the parameters of dance therapy interventions and compare their effectiveness with other forms of physical therapy. Direct comparisons between different dance styles and tailored interventions for specific subsets of PD patients are warranted. Overall, dance therapy, including tango, offers a promising approach to symptom management and improving quality of life for individuals with PD.

Author's contribution

Conceptualization: Ksawery Adamiec, Dominik Trojanowski, Małgorzata Rodak

Methodology: Magdalena Kajzar, Magdalena Iwan

Software: Kamila Nitka, Ksawery Adamiec

Check: Magdalena Iwan, Błażej Szymczuk, Magdalena Kajzar

Formal analysis: Joanna Smorońska-Rypel, Natalia Piątkowska, Dominik Trojanowski

Investigation, Kamila Nitka, Błażej Szymczuk, Jakub Milczarek

Resources: Ksawery Adamiec, Jakub Milczarek,,

Data curation: Joanna Smorońska-Rypel, Małgorzata Rodak

Writing - rough preparation: Ksawery Adamiec, Dominik Trojanowski

Writing - review and editing: Małgorzata Rodak, Magdalena Kajzar, Błażej Szymczuk

Visualization: Ksawery Adamiec, Dominik Trojanowski

Supervision: Magdalena Iwan, Kamila Nitka

Project administration: Ksawery Adamiec, Dominik Trojanowski, Małgorzata Rodak

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