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Low-Impact Exercises for Improving Symptoms in Parkinson's Disease: A Literature Review

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Abstract

Objective: This study fills an important research gap by focusing on the effectiveness of low-impact exercise in Parkinson's disease (PD), taking into account the different challenges faced by people with varying degrees of disease severity.

Motivation: Unlike generic investigations into exercise and PD, our research prioritizes low-impact activities, considering safety concerns related to balance deficits and coordination challenges in the PD population. The study aligns with a patient-centred approach, aiming to provide a safer alternative to traditional exercise modalities.

Approach: Conducting a comprehensive literature review, we conducted an online literature search on various databases, specifically investigating about low-impact exercises on both motor and non motor symptoms in PD individuals. Review process involved capturing diverse intervention types, durations, frequencies, and intensities.

Findings: The amalgamation of diverse outcome measures, including UPDRS, Berg Balance Scale, TUG, 6MWT, and PDQ-39, showcased the multifaceted impact of low-impact exercises on both movement related and non-movement related symptoms. Notably, aerobic exercises being treadmill walking, cycling, and group sessions, emerged as pivotal interventions, demonstrating improvements in gait, balance, flexibility, and overall quality of life for PD individuals.

Conclusion: While acknowledging limitations, such as potential publication bias and a focus on aerobic exercises, this study provides meaningful decision making information for clinicians and researchers. Future research should diversify interventions and methodologies to enhance the evidence base and address nuanced aspects of low-impact exercises in PD management. The results of this review contribute to the existing body of knowledge regarding the nuanced benefits of personalized low-impact exercise for Parkinson's disease.

Keywords: Parkinson's Disease, Low impact exercises, Rehabilitation, Physiotherapy

Introduction

Globally, Parkinson's Disease (PD) holds the position of being the second most prevalent age related degenerative neurological health condition, ranking just below Alzheimer's disease in prevalence (1). Its association with aging and diverse risk factors, ranging from drug exposure and head trauma to specific pesticides and medicines, underscores the complexity of its etiology. Mutations in key genetic elements also have a significant impact in adding complexity to the multifaceted origins of PD (2).

The progression of PD leads to a marked deterioration in the capacity to engage in basic activities culminating in a reduction of autonomy and a significant decrease in overall quality of life (QoL) (3). PD not only impacts the individual but also gives rise to considerable occupational and socioeconomic concerns, thereby introducing layers of intricacy to its management. The global frequency rate of PD varies between five and nineteen cases per lakh inhabitants, affecting individuals across diverse genders and ethnicities. With the expected doubling of PD cases worldwide from six million in 2015 to thirteen million by 2040, the escalating prevalence of PD makes it an increasingly pressing issue (4).

While pharmacological interventions have been the common and primary choice in managing motor presentations in PD, their limitations are evident (5). These drugs primarily provide symptomatic relief without halting the inexorable progression of the disease. As such, the search for non-pharmacological treatments becomes imperative to offer more comprehensive and effective interventions for patients (6).

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In this landscape, exercise demonstrated as a promising way to improve symptoms of Parkinson's disease (7). A surge in research interest over the past decade has explored the potential of interventions without medicines or surgery, placing physiotherapy and various forms of physical exercise at the forefront. Notably, exercises tailored to PD treatment, including balance and gait training in virtual reality environments, locomotor training using a body weight support harness on a treadmill, gait training using robotic technologies, and attention-based balance and gait training, attracting increasing attention due to their ability to tailor treatment plans for better outcomes (8).

The contributions of exercise in PD extend beyond mere coping up with symptoms. Studies show that the generation and release of monoaminergic neurotransmitters stimulated by exercise have a pivotal role in impacting neuromotor and mood disorders associated with PD (9). Furthermore, the contribution of exercise to non-motor deficits, such as those related to behaviour, mood, and cognition, is increasingly recognized (10). The expression of neurotrophic substances has been reported as a factor, by which exercise exerts its positive effects, as these substances appears to be induced by physical exercise sessions (10).

Epidemiological studies not only support the role of moderate to vigorous intensity exercise in reducing the risk of PD but also underscore the broader benefits of exercises and environmental enrichment in both normal aging and PD (11). The safety profile of physical exercise in the context of PD is reassuring, with rare adverse events reported in most studies included in systematic reviews (12).

The increasing number of trials and studies assessing physical exercise in PD reflects the growing interest and recognition of the potential efficacy of non-pharmacological and non-surgical interventions (13). As the scientific community delves deeper into understanding the intricate connections between physical exercise and PD, the outlook for leveraging exercise as a therapeutic tool continues to broaden (14). It is within this evolving landscape that the potential of physical exercise to modify neurotrophic factors, exhibit broad plasticity and resilience functions, and contribute meaningfully to PD management becomes increasingly apparent (15). In conclusion, the exploration of physical exercise as a viable and safe intervention represents a significant stride towards addressing the multifaceted challenges posed by Parkinson's disease on a global scale. Unlike generic investigations into exercise and PD, our study uniquely focuses on low-impact activities, recognizing the diverse spectrum of disease severity and associated challenges faced by individuals with PD. The rationale stems from the acknowledgment that high-impact exercises may pose increased risks, given the prevalent issues of balance deficits, muscle stiffness, and coordination challenges in this population.

Emphasizing safety and risk mitigation, the study aligns with a patient-centered approach, aiming to provide a safer alternative to traditional exercise modalities. Beyond risk reduction, the research delves into the long-term sustainability of exercise regimens, exploring how low-impact exercises can enhance adherence and practicality for individuals at different stages of PD. Furthermore, the study adopts a holistic perspective by not only assessing motor benefits but also exploring potential impacts on non-motor symptoms, encompassing cognitive function and emotional well-being. By addressing this critical scientific gap, our study seeks to contribute to the existing evidence on the use of low-impact exercise in PD.

Methodology

This study adopts a comprehensive methodology to examine the effectiveness of low-impact exercises in ameliorating symptoms of PD. The approach adheres with the established standards for conducting rigorous and scholarly literature reviews.

The initial phase was a meticulous search of electronic databases, including PubMed, Scopus, and Web of Science. A strategic use of keywords such as "Parkinson's Disease," "low-impact exercise," and "physical activity" facilitated the identification of relevant studies. Boolean operators were employed to refine search queries, ensuring the inclusion of peer-reviewed articles published in English between 2010 and 2023.

The inclusion criteria focused on studies specifically investigating the impact of low-impact exercises on both motor and non-motor symptoms in individuals diagnosed with PD. Studies exclusively centered on high-impact exercises or lacking relevance to the subject matter were excluded.

The data extraction process included the retrieval of pertinent information specific to the studies, considering variations in exercise types, duration, frequency, and intensity.

A narrative synthesis was used to analyze and interpret the data from included studies, taking into account variations in study designs, participant characteristics, and outcome measures.

Results

Literature review encompasses seven studies. The summary of the included studies has been systematically organized and presented in Table 1.

Table 1: Summary of Reviewed Studies

Study	Sample Size	Age (years)	Timeframe for disease persistence (years)	Therapeutic approach	Key traits of management	Outcome Measures
Solla (2019) (16)	Treatment group: 10, Control group: 10	IG: 67.8 (5.9), CG: 67.1 (6.3)	5±2.9	Routine care versus dancing	Nintey minutes per session, conducted twice weekly over a twelve-week period	Unified Parkinson's Disease Rating Scale - Motor Section, Six-Minute Walk Test, Berg Balance Scale, Timed Up and Go Test and gait
Arfa-Fatollahkhani (2019) (17)	Treatment group: 11, Control group: 9	IG: 60.63 (9.36), CG: 61.55 (8.57)	8.9 ±5.4	Low impact walking on a treadmill versus routine care	Thirty minutes per session, targeting 60% of maximum heart rate (HRmax), with two sessions per week over a ten-week duration	TUG, 6MWT
van der Kolk (2019) (18)	Treatment group: 65, Control group: 11	IG: 59.3 (8.3), CG: 59.4 (8.3)	4.5 ±2.1	Low intensity aerobic exercise versus routine care	30–45 min/session, 50–80% HRmax, three sessions per week for 24 weeks	UPDRS-III, TUG, 6MWT, PDQ-39
Sacheli (2019) (19)	Treatment group: 20, Control group: 15	IG: 66.76 (5.98), CG: 67.85 (8.50)	21 ±10.42	Low intensity aerobic exercise versus routine care	Sessions lasting between 40 and 60 minutes, targeting a heart rate within the range of 60–80% of maximum oxygen consumption (VO2 max). Conducted three times weekly over a 12-week period	UPDRS-III, TUG
Li (2022) (20)	Treatment group: 20, Control group: 20	IG: 67.57 (3.95), CG: 70.0 (5.59)	25 ±17.45	Wuqinxi Qigong Exercise versus Active Control	Sessions lasting 90 minutes, targeting a heart rate within the range of 60–70% of maximum heart rate (HRmax) or a perceived exertion level of 6–12 on the Borg Scale. Conducted twice weekly over a 24-week duration.	UPDRS-III

Tollár (2019) (21)	Treatment group: 25, Control group: 24	IG: 70.6 (4.10), CG: 67.5 (4.28)	7.5 ±2.16	Low impact cycling versus waiting list	Sessions lasting 60 minutes, targeting 80% of maximum heart rate (HRmax). Conducted five times weekly over a 5-week duration	-
Schenkman (2017) (22)	Treatment group 1: 39, Treatment group 2: 42, Control group: 38	IG-1: 64 (9), IG-2: 63 (10), CG: 64 (10)	6.21 ±3.2	Intervention Group 1 (IG-1): Treadmill Exercise Intervention Group 2 (IG-2): Treadmill Exercise Control Group (CG): Wait-list Control	Intervention Group 1 (IG-1): Sessions lasting between 40 and 50 minutes, targeting 80–85% of maximum heart rate (HRmax). Conducted four times weekly over a 24-week duration.	

In terms of interventions, aerobic exercise emerged as a prominent modality. Studies incorporated aerobic exercises such as treadmill walking, cycling, and aerobic group sessions tailored to the unique needs of individuals with PD. The implementation of specific exercises like Wuqinxi Qigong demonstrated the diversity of low-impact interventions explored in the literature.

Dance:

The analysis of UPDRS-III following a dance-based intervention showed a notable decrease in UPDRS-III values, highlighting its effectiveness in addressing motor symptoms. Additionally, improvements were observed in the distance traversed while performing 6MWT, static balance values obtained from BBS, and the completion time of the TUG, emphasizing the positive impact on mobility and balance. Furthermore, the dynamic strength scores for lower limbs, upper-body flexibility, and gait characteristics, including distance covered in a single gait cycle, the number of steps taken per minute, walking speed, and cadence, showed significant improvements in the dance-based group (16). Additionally, dance cohort exhibited enhancements in BDI-II scores, SAS scores, and MOCA scores.

Aerobic exercise:

Aerobic exercise was effective in slowing the progression of movement related symptoms in people with PD. In a research of 160 PD participants, those who are in an aerobic exercise group for 6 months showed a significantly smaller improvements in MDS-UPDRS motor score (18).

Aerobic exercise was also found to enhance fitness among individuals with PD. In the study, aerobic exercise demonstrated improvements in VO2max, a measure of aerobic fitness. This increase in VO2max was associated with a slowing of the progression of motor symptoms (18). Aerobic exercise was found to improve dopamine release in people with PD (19).

Treadmill :

Treadmill training (TT) shown to be a beneficial intervention for improving symptoms in PD (17). A study revealed that TT demonstrated greater efficacy compared to the standard of care in enhancing balance and functional capacity in individuals with mild Parkinson's disease. The study also, indicates that TT demonstrated effectiveness in enhancing the quality of life (QoL) in PD (17). TT has demonstrated long term benefits as the he study found that the benefits of TT were maintained for at least 4 months after the intervention ended (17).

Compared to participants receiving standard care, those engaged in TT demonstrated a significantly smaller increase in their UPDRS motor score, a key indicator of PD severity. Furthermore, the TT group experienced notable improvement in their MDS-UPDRS motor sub score , highlighting positive changes in specific motor functions (22).

Beyond motor symptoms, TT's benefits extend to improved balance, enhanced functional capacity, and higher quality of life (QoL) for PD patients. This evidence positions TT as a promising intervention for those seeking to actively manage their PD and elevate their overall well-being (22).

Cycling :

Cycling emerges as an effective intervention to manage symptoms of PD. One study compared effects of cycling and general exercise, revealing comparable improvements in various outcome measures (21). Notably, both cycling and exercise groups demonstrated significant enhancements in UPDRS-II, surpassing the improvements observed in the control group (21). PDQ mobility subscores exhibited similar improvements in both the cycling and exercise groups, surpassing the control group. Additionally, depression scores improved comparably in both interventions (21). Notably, the exercise group showed a 13% improvement in SE-ADL (Self-Efficacy for Daily Living), highlighting the broader impact of cycling on aspects beyond motor symptoms. Both EuroQol measures (EQ5D-VAS and EQ5D sum) demonstrated similar improvements in cycling and exercise groups (21). Cycling exhibited notable benefits in specific measures, such as the 6MWT (6-Minute Walk Test), where both cycling and exercise groups showed increased distance. Furthermore, improvements in Berg Balance Scale (BBS) scores were more pronounced in the exercise group than in cycling, emphasizing the positive impact of cycling on balance (21). The study also indicated favorable compliance and safety profiles for cycling, with a 100% compliance rate and no reported adverse events or dropouts (21).

Wuqinxi qigong exercise:

One study showed that WQ was more beneficial than stretching in improving speed of walking, distance covered in one gait cycle, and double support percentage (20). In addition, WQ was also found to be effective in improving motor symptoms, as estimated by the MDS-UPDRS, and quality of life, as measured by the PDQ-39 (20). These findings suggest that WQ may be an evidence based intervention for ienhancing the symptoms of PD (20).

Discussion

The synthesis of findings from various low-impact exercises, including dance, aerobic exercise, treadmill training, cycling, and Wuqinxi qigong exercise, provides valuable insights into their effectiveness in PD. The evidence suggests that these exercises yield positive outcomes in PD, emphasizing their potential as integral components of a comprehensive PD management approach.

Dance

Dance proved effective as an intervention to enhance both motor and nonmotor symptoms in individuals with Parkinson's disease. A comparative study undertaken to assess the impact of dance in comparison to a control group showed significant improvements in UPDRS-III scores, 6MWT distance, BBS scores, TUG time, FTSST time, BST, stride length, walking speed, walking cadence, number of straight walks, and GFI. The dance group also showed improvements in BDI-II scores, SAS scores, and MOCA scores. The findings suggest that dance-based interventions, particularly in the form of group sessions, offer multifaceted benefits in PD (16). Significant positive outcomes in motor symptoms, balance, and gait parameters underscore the potential of dance as a therapeutic approach in the management of PD (16). Notably, the dance group exhibited positive effects on non movement related aspects, including depressive symptoms, apathy, and cognitive impairments. These comprehensive enhancements advocate for the holistic benefits of dance-based interventions, making them a promising and versatile component in PD treatment. Further research as well as larger-scale studies can provide additional insights into the long lasting effects and sustainability of dance interventions for individuals with PD (16). These findings suggest that dance can be considered as an effective intervention in PD patients.

Treadmill :

In the long term, the benefits of TT persisted and extended beyond the initial intervention period (17). Two months after the baseline evaluation, the timed up and go test and six minute walk outcomes were better in TT group compared to the controls (17). Furthermore, the analysis of QoL using the SF-8 health survey indicated enduring positive effects of TT on both the mental and physical components of QoL. The statistically significant higher scores in both the Physical Component Summary (PCS) and Mental Component Summary (MCS) components four months after baseline analysis highlight the enduring impact of treadmill training on overall QoL (17). These findings suggest that treadmill training not only provides immediate benefits to mobility and functional capacity but also contributes to sustained improvements in the quality of life for individuals managing PD (17).

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One of the included studies within the comprehensive review identified a significant positive impact of aerobic exercise on dopamine release in the caudate and heightened activation of the ventral striatum during reward anticipation among individuals in PD. The use of neuroimaging techniques, including fMRI measures, adds a layer of precision and credibility to these findings, affirming the robustness of the observed neurobiological effects. This study's insights go beyond addressing motor symptoms, suggesting that aerobic exercise may effectively address nonmotor symptoms in PD, making it a promising and holistic intervention for individuals navigating the complexities of this neurodegenerative condition.

Furthermore, the study highlights potential mechanisms through which aerobic exercise influences dopamine function in PD. Although the exact pathways are not fully elucidated, the modulation of neuroinflammation, the upregulation of glial and brain-derived trophic factors, and improvements in cerebral blood flow are proposed contributors. These multifaceted mechanisms signify a comprehensive approach to PD management, positioning aerobic exercise not only as a source of immediate symptomatic relief but also as a catalyst for sustained effects through enhanced corticostriatal plasticity. The high accuracy of these findings, derived from advanced neuroimaging techniques, underscores the scientific rigor of the study, reinforcing the proposition that aerobic exercise holds considerable promise as a nuanced and neurobiologically grounded intervention for individuals grappling with the challenges of PD.

Wuqinxi Qigong (WQ) is an ancient Chinese exercise effective in improving gait, balance, and quality of life in PD. WQ is a mind-body exercise that involves gentle movements that are coordinated with breathing. The movements are designed to mimic the movements of five animals: the tiger, deer, bear, monkey, and crane. WQ has been shown to have a number of beneficial effects for people with PD, including improved flexibility, strength, balance, and coordination. In addition, WQ has also been shown to reduce stress, anxiety, and depression (20). WQ is a safe and effective exercise for people of all ages and fitness levels. It can be done at home or in a group setting. WQ is a low-impact exercise, so it is gentle on the joints. It is also a flexible exercise, so it can be modified to meet the individual needs of each person.

In this literature review, a notable strength lies in the incorporation of a diverse set of outcome measures, contributing to a comprehensive evaluation of low-impact exercises for individuals with Parkinson's Disease (PD). By utilizing tools such as the Unified Parkinson's Disease Rating Scale (UPDRS), Berg Balance Scale, Timed Up and Go test, and the 6-Minute Walk Test (6MWT), the review captures a broad spectrum of motor and non-motor symptoms. The inclusion of the Parkinson's Disease Questionnaire-39 (PDQ-39) further enhances the disease-specific assessment, providing a holistic perspective on health-related quality of life.

Methodological rigor is evident throughout the review process, reinforcing the reliability of the synthesized information. The comprehensive search strategy applied to electronic databases such as PubMed, Scopus, and Web of Science ensures the inclusivity of relevant studies. The use of well-defined keywords, Boolean operators, and rigorous inclusion criteria, including the temporal and linguistic parameters, enhances the precision and relevance of the identified literature.

However, certain limitations warrant consideration in interpreting the findings of this literature review. This includes the heterogeneity observed in study designs across the included literature introduces complexities in synthesizing the results. Variations in intervention types, duration, frequency, and intensity may contribute to challenges in establishing a unified framework for assessing the impact of low-impact exercises on PD symptoms. The diverse methodologies employed in the selected studies necessitate cautious interpretation and consideration of the potential impact on the overall coherence of the findings.

Conclusion

This literature review systematically examined the efficacy of low-impact exercises in Parkinson's Disease (PD) management. The amalgamation of diverse outcome measures, including the Unified Parkinson's Disease Rating Scale, Berg Balance Scale, Timed Up and Go test, 6-Minute Walk Test, and PDQ-39, provided a comprehensive overview of the impact on both motor and non-motor symptoms. Notably, aerobic exercises, encompassing treadmill walking, cycling, and group sessions, emerged as pivotal interventions, showcasing improvements in gait, balance, flexibility, and overall quality of life for PD individuals. However, the review acknowledges limitations such as a potential publication bias and the predominant focus on aerobic exercises. Future research should diversify interventions and methodologies to enhance the evidence base. Despite limitations, this review offers valuable insights for clinicians and researchers, emphasizing the multifaceted benefits of low-impact exercises in PD management.

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Conflicts of interest

"The authors declare no conflict of interest."

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