Chronic Diseases Journal

DOI: 10.22122/cdj.v12i4.887 Published by Vesnu Publications

Non-pharmacological rehabilitation of Parkinson's disease through exercise therapy and music therapy: A narrative review

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Review Article

Abstract

BACKGROUND: Parkinson's disease (PD) is a prevalent neurodegenerative condition affecting motor and non-motor functions. This narrative review explores non-pharmacological interventions, focusing on exercise therapy and music therapy.

METHODS: For this research, a thorough exploration of databases, including PubMed and Google Scholar, was undertaken to collect pertinent articles from reputable journals. The focus was on non-pharmacological rehabilitation for PD, targeting studies from the past decade with additional references reviewed. Emphasis was on articles addressing music and physical therapy for PD, resulting in the evaluation of 45 articles. Content analysis was employed, allowing for a detailed examination and synthesis of information from the literature.

RESULTS: The findings underscore the efficacy of exercise therapy, encompassing aerobic, resistance, and balance training, in ameliorating motor symptoms. This includes notable reductions in bradykinesia, rigidity, and postural instability. The positive influences of exercise interventions extend beyond their motor benefits to impacts to cognitive function, mood disorders, and sleep disturbances, presenting a holistic approach to PD management. Music therapy emerges as a promising avenue, especially when integrated with physical activity. Rhythmic auditory stimulation and group singing within the context of music therapy showcase affirmative impacts on motor control, attention, and communication outcomes for individuals with PD.

CONCLUSION: In conclusion, this narrative review sheds light on the considerable potential of non-pharmacological interventions, namely exercise therapy and music therapy, for PD rehabilitation. These insights not only contribute to the existing body of knowledge, but also offer valuable guidance for future research directions and clinical applications in the management of PD.

KEYWORDS: Parkinson's Disease; Rehabilitation; Exercise-Therapy; Music-Therapy; Narrative Review; Non-Pharmacological Therapy

Date of submission: 18 Dec. 2023, ***Date of acceptance:*** 29 Mar. 2024

Citation: Nikouei M. **Non-pharmacological rehabilitation of Parkinson's disease through exercise therapy and music therapy: A narrative review.** Chron Dis J 2024; 12(4).

Introduction

Parkinson's disease (PD) ranks as the second most prevalent neurodegenerative condition, following Alzheimer's disease.[1] It mainly affects the motor aspect of the nervous system.[2] In developed nations, PD is believed to affect approximately 0.3% of the overall population, 1.0% of individuals over the age of 60, and 3.0% of those over the age of 80. The estimated incidence rates for PD range from 8 to 18 cases per 100000 person-years.[3] According to the latest studies, the prevalence of Parkinson's disease in the general population of Iran is reported to be 50.4

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per 100000 individuals. Additionally, the estimated prevalence of this disease among the Iranian population over 50 years of age is 261.1 per 100000 individuals.[4] With the progressing aging of the global population, the prevalence of PD is anticipated to experience a significant surge, doubling within the upcoming two decades.[5] The underlying mechanisms of PD involve the progressive loss of dopaminergic neurons in a specific region of the midbrain called the substantia nigra pars compacta. This leads to dysfunction in the nigrostriatal pathway, which is responsible for the communication and regulation of other regions within the basal ganglia. This disruption in pathway function is believed to be the cause of the motor symptoms observed in PD.[6,7] A commonly used understanding of PD pathology can be summarized as the gradual development of unique accumulations of α-synuclein protein within neurons. These accumulations take the form of round Lewy bodies and thread-like Lewy neurites, and they primarily occur in vulnerable neurons. The progression of this pathology starts in the lower brainstem and gradually extends to the midbrain, eventually spreading further to affect the limbic and neocortical regions.[8,9] At the time of initial diagnosis, a significant number of dopaminergic neurons in the substantia nigra have already been depleted, and the process of neurodegeneration has extended to affect various other regions within the central nervous system.[10] The main clinical indication of PD is the presence of motor impairments, which encompass bradykinesia, resting tremor, rigidity, postural instability, and dystonia. Bradykinesia, being the most distinctive clinical feature of PD, typically manifests as a delay in initiating voluntary movements accompanied by decreased speed and range of repetitive actions. Motor symptoms typically initiate on one side of the body and gradually progress to affect the opposite side within a few years. In addition to the motor symptoms, non-motor symptoms have also been recognized as an essential component of PD. Compelling evidence indicates that these non-motor symptoms can manifest years before the onset of motor symptoms, potentially serving as early indicators of the disease. Non-motor symptoms commonly encompass cognitive impairment, hyposmia, constipation, rapid eye movement (REM) sleep behavior disorder (RBD), and depression.[11,12] The progressive nature of PD leads to a gradual accumulation of disabilities, which can significantly impact the ability to perform activities of daily living (ADLs). Thus, PD places a significant load on individuals, their families, and society.[7] For over 5 decades, pharmacological intervention, specifically the use of levodopa, has remained the primary treatment method for addressing motor symptoms in PD.[13] Despite its potential therapeutic benefits, long-term use of levodopa poses significant limitations, including the occurrence of dyskinesia and the wearing-off phenomenon.[14] In addition, there is a lack of satisfactory treatment options for non-motor symptoms, as the number of medications approved by the U.S. Food and Drug Administration (FDA) for addressing these issues is limited.[15] Another approach for treating PD is surgical intervention, which also carries its own specific risks.[2] Moreover, increasing evidence of early non-motor and motor impairments highlights the necessity for effective non-pharmacological interventions in the early stages of the disease. Furthermore, in recent years, findings have emerged regarding the impact of non-pharmacological approaches such as music therapy and exercise therapy on Parkinson's symptoms, although the available findings are limited.[16,17] For example, in the study conducted by Pacchetti et al. on 32 individuals with PD, it was observed that patients who underwent music therapy showed a significant improvement in motor symptoms and their daily activities.[18] In

addition, In a study conducted in 2017 on 21 individuals with Parkinson's disease, it was revealed that patients undergoing treatment with exercise movements showed greater improvement in motor symptoms and disease-related disabilities compared to the control group.[19] Taking into account the aforementioned factors and considering the difficulties and disabilities caused by PD, the present review study has been designed to examine the two existing non-pharmacological approaches (exercise therapy and music therapy) for rehabilitation in PD.

Methods

Database: For this study, a comprehensive search was conducted across research databases including PubMed, Google Scholar, and other pertinent websites to gather relevant articles from esteemed journals with high citation scores.

Selection: The emphasis was on the non-pharmacological rehabilitation of PD, particularly targeting studies published in the last decade, although a thorough review of all articles spanning from 1984 to 2023 was conducted. Additional sources were discovered by scrutinizing the references of the selected materials. Preference was given to articles specifically addressing music therapy and physical therapy for PD rehabilitation. Ultimately, 45 articles underwent evaluation.

Analysis: The study utilizes content analysis as its analytical approach, enabling readers to gain a comprehensive and nuanced understanding of music therapy and exercise therapy as non-pharmacological treatments of PD. This involves categorizing and synthesizing information extracted from the literature.

Results

Exercise and physical therapy

Exercise and motor symptoms: In this section, we aim to review articles related to rehabilitation in PD through exercise training. A randomized controlled trial (RCT), titled Park-in-Shape, was conducted on 130 participants to evaluate the effects of a home-based and remotely supervised moderate to high intensity aerobic cycling program on individuals with PD. The program involved cycling sessions of 30-45 minutes, 3 times per week. The trial compared this intervention with an active control condition over a period of 6 months. The results revealed a significant and clinically meaningful reduction in off-state motor symptoms in the aerobic training group when compared to the control group at the end of 6 month.[20] The findings of Schenkman et al. are in line with these findings. In a RCT (referred to as the SPARX trial) involving 128 individuals newly diagnosed with PD, high-intensity aerobic treadmill training 4 days a week, targeting 80-85% of maximum heart rate, resulted in a significant reduction in motor symptoms and improvement in cardiorespiratory fitness (indicated by increased VO2 max, reflecting maximum oxygen consumption) after 6 months compared to a control group.[21] In a RCT conducted by Marusiak et al., the impact of aerobic interval training (AIT) on bimanual motor control and the signs and symptoms of PD was investigated.[22] The researchers assigned 20 participants with mild to moderate PD to either a treatment group or a control group. In the treatment group, consisting of 10 patients, routine care was provided along with an 8-week AIT program of moderate intensity. The control group, also consisting of 10 patients, received routine care and underwent an 8-week program of standard physical therapy. Finally, the group that received AIT demonstrated significant improvements across various domains compared to the control group. These improvements included enhanced bimanual motor control and executive function, as well as a reduction in neurological Parkinsonian signs, specifically a decrease in the severity of

upper-extremity bradykinesia.[22] In a clinical study published in 2019, researchers aimed to evaluate the impact of high cadence cycling on bradykinesia, rigidity, and mobility in individuals with mild to moderate idiopathic PD.[23] The 16 subjects were randomly assigned to either a treatment group or a control group. The treatment group, consisting of 8 individuals, underwent 6 sessions of 40 minutes of high-cadence cycling, with a day of rest between each session. The control group, also consisting of 8 individuals, performed a stretching routine for 6 sessions, with a day of rest between each session. Motor function and mobility were assessed after each session using the Unified Parkinson's Disease Rating Scale (UPDRS) Motor III scale, Kinesia ONE, and Timed up and Go Test. Following the 6 sessions, the cycling group demonstrated significant improvements in all measured areas. There were improvements in UPDRS scores (a 2.5-point improvement; P = 0.002), hand movement amplitude (P = 0.013), rapid alternating hand movement speed (P = 0.003), and gait (P = 0.012). In contrast, the control group that underwent stretching exercises did not demonstrate any improvement in the measured outcomes.[23] Another study involving individuals with PD and moderate motor symptoms, discovered that engaging in walking and Nordic walking training can result in positive changes, including improvements in stride length, gait variability, maximum walking speed, and motor scores as assessed by the UPDRS.[24] In another study, researchers examined the effects of curved-walking training (CWT) versus general exercise training on the walking ability of PD patients. The CWT group received 12 sessions of CWT using a turning-based treadmill, while the other group underwent general exercise training. The results showed that the CWT group experienced greater improvements in straight-walking speed, cadence, and step length compared to the general exercise group. Additionally, CWT had positive effects on freezing of gait (FOG) for at least 1 month, suggesting that task-specific training is more effective than traditional general exercise for PD patients.[25] An important point to note in most of the mentioned studies is the mention of the high intensity and aerobic nature of the exercise utilized in the intervention groups. However, this does not mean that other forms of exercise have no impact on improving the motor symptoms of PD. In a study published in 2020, researchers investigated the effects of resistance training on bradykinesia and motor symptoms in patients with PD. A total of 40 participants were assigned to either a treatment group, where they underwent a resistance training program twice a week for 9 weeks, or a control group that attended lectures about PD. The researchers assessed various measures, including the Bradykinesia UPDRS subscale, knee extensor strength, Ten Meter Walk Test (TMW), Timed Up and Go Test (TUG), and 30-second Chair Stand (T30), before and after the intervention period. After 9 weeks of intervention, the treatment group showed significant improvements in all aspects compared to the control group.[26] Moreover, the progressive resistance exercise training (PRET)-PD study, one of the largest trials on resistance training, followed an acute training period with ongoing guidance and support for 2 years.[27] Participants in the experimental group demonstrated improvements in strength, mobility, disease severity (UPDRS), and cognition over the course of the study.[27] PD can affect axial muscles, including the muscles involved in respiration and coughing, leading to difficulties in these processes. Several studies have shown that resistance exercises in individuals with PD can strengthen respiratory muscles and subsequently, increase cough force and improve swallowing function.[28] Additionally, studies have been conducted on the impact of balance exercises on individuals

with PD. Canning et al. conducted a study comparing balance training with control groups that did not receive balance training.[29] The balance training program included exercise interventions, including components of strength training. The results showed a decrease in fall rates in the balance training group. However, interestingly, there was no overall reduction in fall rates in the experimental group. Subgroup analysis of participants with lower disease severity revealed significant reductions in fall rates. Specifically, individuals with PD and low motor severity in the experimental group experienced a 69% decrease in falls, while those with high disease severity demonstrated a 61% increase in falls.[29] The results of a meta-analysis review indicate that engaging in highly demanding balance training, which involves shifting the body's center of mass and reducing the base of support (BOS) and reliance on upper limb support, may yield favorable outcomes in terms of postural stability.[30] Another meta-analysis revealed that exercise training led to a reduction in fall rates not only immediately after the training, but also during follow-up periods. Moreover, it was found that facility-based training showed greater effectiveness in enhancing long-term balance performance.[31]

Exercise and non-motor symptoms

Cognitive disorders: Another area of investigation has been the impact of different types of exercise on non-motor symptoms of PD, although it has received less attention compared to motor symptoms. A study demonstrated that engaging in 72 one-hour sessions of treadmill training over a period of 24 weeks in individuals with PD and mild motor dysfunction resulted in notable improvements in global cognition and quality of life (QOL).[24] In a systematic review conducted in 2018 within the same domain, it was determined that most exercise interventions showed varying degrees of improvement in cognitive function, with one particularly successful program utilizing tango dance to enhance both motor and cognitive function in individuals with PD. Participants who participated in the 24-week tango class exhibited significant enhancements in global cognitive function, as assessed by their MoCA scores.[32] Furthermore, aerobic exercise has been shown to positively affect brain regions such as the superior temporal and parietal prefrontal cortex, as well as the transverse tracts connecting the frontal and parietal lobes. This can enhance executive function in PD, which encompasses skills like judgment, planning, abstraction, problem-solving, sequencing, and mental flexibility.[14]

Mood disorders: Regarding mood disorders in PD, in an 8-week RCT involving 138 participants, mindfulness yoga training demonstrated superior improvement in depression and anxiety symptoms compared to the control group.[33] In a 2018 study conducted by Son and Choi, the impact of a Mindfulness Meditation-Based Complex Exercise Program (MMBCE) on non-motor symptoms of PD was investigated.[34] The study involved 63 PD patients who were randomly assigned to either an experimental or control group. The experimental group underwent 6 sessions of MMBCE over an 8-week period, while the control group received routine outpatient physical therapies. The MMBCE program integrated Mindfulness-Based Stress Reduction techniques with physical exercises specifically designed for older adults. Results showed noteworthy reductions in depression and anxiety among the patients in the experimental group.[34] In line with these findings, numerous studies support the positive impact of regular moderate aerobic activity (20-45 minutes, multiple times per week) on reducing depression symptoms compared to a sedentary lifestyle.[35]

Sleep disorders: In addition to the mentioned aspects, studies have also been conducted on

the impact of exercise on sleep disturbances in patients with PD. The study conducted by Amara and Memon revealed that participants who engaged in a multimodal exercise program comprising aerobic, resistance, and balance training for a period of 6 months experienced notable enhancements in sleep quality when compared to a control group.[36] In another study comparing 2 groups, namely an exercise group consisting of 23 participants and a non-exercise control group of 19, researchers measured the improvement in sleep quality among PD patients.[37] The exercise group followed a moderate-intensity aerobic exercise regimen, for a duration of 6 months. Significant improvements in sleep quality were observed in the exercise group based on the Brazilian Mini-Sleep Questionnaire, while no changes were noted in the control group.[37] Furthermore, similar findings have been obtained in a considerable number of other studies, which is in line with the mentioned research.[38,39]

Music therapy

In recent years, studies have been conducted on the effects of music therapy on PD. Pohl et al. investigated the effects of a group-based music intervention on individuals diagnosed with PD.[40] The participants were randomly assigned to either the intervention group or the control group. The intervention included performing physical exercises while listening to soft classical music, conducted twice a week for a period of 12 weeks. The primary focus was on evaluating dual-task ability, while secondary outcomes included cognition, balance, concerns about falling, freezing of gait, and QOL. The findings indicated no significant disparities in dual-task ability between the 2 groups. However, the intervention group reported immediate enhancements in falls efficacy and QOL following the intervention, which were not sustained at the 3-month follow-up.[40] Another clinical study conducted in 2020 examined the effects of combining music listening with physical activity on individuals with PD; 13 non-randomized patients were assessed over 3 time periods: 1- baseline, 2- treatment, and 3- no treatment and follow-up. The intervention involved performing physical exercises while listening to music through headphones for 8 weeks. Various variables were analyzed, including disability, cognitive function, muscle strength, balance, and functional mobility. The results revealed significant improvements in cognitive function and muscle strength during the treatment period compared to the no treatment period. Additionally, balance initially improved, but declined in the no-treatment period. Overall, the study suggests that music therapy combined with physical activity has positive effects on alleviating PD symptoms.[41] One of the interesting studies in this field is the research conducted by Park and Kim in 2021; The aim of this study was to assess the impact of a drum-playing intervention with rhythmic cueing on upper extremity motor control and attention control in individuals with PD.[42] A total of 12 participants were randomly assigned to either the drum-playing intervention with rhythmic cueing group or the control group. The findings revealed significant enhancements in the drum playing with rhythmic cueing (DPRC) group, including increased sustained time of entrainment (at 45 beats per minute) and reduced latency time until entrainment from pretest to posttest. Specifically, the DPRC group demonstrated significant improvements in latency time until entrainment and cognitive measures. These results indicate the considerable potential of DPRC in enhancing upper extremity motor control and attention control, supporting the advancement of novel interventions incorporating this technique for PD rehabilitation.[42] Thaut et al. conducted another study to investigate the effects of rhythmic auditory stimulation (RAS) training

on reducing falls in PD patients with a history of recurrent falls.[43] They randomly allocated 60 PD patients into intervention and control group. Participants in both groups engaged in 30 minutes of home-based gait training with music (RAS training) daily. However, there was a difference in the duration of this intervention. The intervention group received RAS training for 24 weeks, while in the control group, the RAS training was discontinued after 8 weeks. By week 8, both groups showed significant improvement. However, in week 16, after the control group had discontinued training, significant differences emerged. The control group had an increase in the fall index (M = 10, SD = 6). Resuming training led to a reduction in falls, and by week 24, the group differences were no longer significant (M experimental = 3, SD = 2.6; M control = 5, SD = 4.4; P > 0.05). Therefore, RAS training effectively reduced falls in PD patients and improved key gait parameters such as velocity and stride length.[43] Another study aimed to assess the feasibility of music-contingent gait training and its impact on neuropsychological test performance and mood in individuals with PD.[44] A total of 30 participants with mild to moderate PD were semi-randomly assigned to either an experimental training group or a control music group. The training group underwent 12 weeks of music-contingent training, where the music was played based on achieving a specific stride length adjusted according to individual performance. The control group received hybrid training, starting with 6 weeks of noncontingent music walking, followed by 6 weeks of music-contingent training. Blinded assessors conducted assessments of global cognition, memory, executive function, attention, working memory at baseline, 6 weeks, and 12 weeks. Motor function, mood, and anxiety were also evaluated. While improvements in cognitive measures were not clinically significant, both groups experienced significant reductions in depression and anxiety over time. It indicates the beneficial effects of music-contingent gait training for individuals with PD.[44] In 2023, an interesting methodological study was conducted by Karpodini et al.[45] The objective of this study was to investigate the immediate effects of a musickinetic (MSK) program specifically designed for individuals with PD on anxiety levels, selected kinematic and kinetic parameters, and frontal cortex hemodynamic responses during gait initiation and steady-state walking. This research followed a blind cross-over RCT format, involving 13 PD volunteers who participated in a 45-minute MSK program under 2 conditions: synchronous learning format and asynchronous remote video-based format. The program included various sections such as warm-up exercises, movement combinations, and a dance sequence, accompanied by music with a clear and predictable rhythm. Gait biomechanics and frontal cortex hemodynamic responses were analyzed using 10-camera 3D motion analysis and functional near-infrared spectroscopy (f-NIRS) systems, respectively. Anxiety levels were assessed using the Hamilton Anxiety Rating Scale. The study expected that music-guided physical movements will improve motor impairments in PD, and subsequently, alleviate anxiety and distress in affected individuals.[45] In a study titled "Parkinsong", Tamplin et al. investigated the effects of group singing sessions on voice, speech, and cognitive communication outcomes in individuals with PD.[46] The intervention involved participation in weekly and monthly group singing sessions, which included activities such as vocal warm-ups, strengthening respiratory power, and high-intensity vocal exercises. Separate control groups were also included for both the weekly and monthly interventions. At the end of this study, significant improvements were observed in vocal loudness, speech,

voice-related QOL measures, and anxiety in intervention group compared to the control group.[46] Furthermore, in line with the mentioned studies, a RCT conducted in 2019 revealed that the combination of treadmill training and music listening can have significant effects on improving motor symptoms in individuals with PD.[47]

Discussion

The aim of this narrative review study was to examine the validity of non-pharmacological methods for improving the symptoms and signs of individuals with PD. The 2 non-pharmacological methods investigated in this study were exercise therapy and music therapy. As mentioned in most reviewed studies, different types of exercise (aerobic, resistance, and balance) can lead to improvements in PD symptoms, although the extent of their effects varies. Most articles focused on examining the impact of aerobic exercise on PD. Additionally, in the majority of studies, the focus was on the effects of exercise movements on motor symptoms of PD. However, significant studies have also been conducted in this area on non-motor symptoms of PD. Furthermore, our study findings were consistent with the findings of previous studies in this field.[48,49] Multiple mechanisms have been proposed to justify the positive effects of various types of exercise on Parkinson's disease symptoms. Previous studies have shown that in individuals with Parkinson's, the levels of neurotrophic factors such as brain-derived neurotrophic factor (BDNF) and Glial cell line-derived neurotrophic factor (GDNF), which are essential for neuronal survival, brain plasticity, and consequently, better brain function, are reduced. However, animal studies have indicated that long-term exercise can increase the levels of these neurotrophic factors, and consequently, protect neurons against damage.[50,51] In addition to these, evidence suggests that exercise can reduce mitochondrial dysfunction in neuronal cells through the inhibition of cytochrome c release, subsequently, leading to a decrease in neurodegeneration in PD.[52,53] Recent studies have also shown that exercise can increase the activity of antioxidant factors and repair enzymes, such as Superoxide dismutase (SOD), thus protecting neurons against oxidative stress in PD.[52,54] Furthermore, the inhibition of inflammatory factors like TNF-alpha and IL-6 through exercise can effectively decrease neuroinflammation, which is a crucial mechanism involved in Parkinson's disease.[52,55] Exercise has been shown in recent studies to promote the clearance of alpha-synuclein aggregates, the accumulation of which is a major contributor to the motor symptoms in PD. This is achieved through the activation of autophagy-enhancing genes, resulting in the improvement of the disease.[56] Moreover, exercise, especially when performed for an extended duration, can prevent muscle atrophy by regulating the metabolism of muscle cells. This can have a significant impact on improving the motor symptoms in Parkinson's patients.[57] Another notable mechanism in this context is angiogenesis. It has been observed in PD animal models that long-term exercise leads to increased development of blood vessels in various brain regions such as the hippocampus and striatum. As a result, brain metabolism is enhanced, ultimately leading to a reduction in neuronal cell death.[58] Moreover, aerobic exercise has been demonstrated to have positive effects on specific brain regions such as the superior temporal and parietal prefrontal cortex, as well as the transverse tracts connecting the frontal and parietal lobes. These effects can lead to improvements in executive function among individuals with PD. Executive function encompasses cognitive processes such as judgment, planning, problem-solving, sequencing, and mental flexibility.[14] Functional

MRI studies utilizing reward tasks have demonstrated that regular aerobic exercise can increase activity in the ventral striatum of individuals with PD. This suggests that exercise may engage the mesolimbic pathway, leading to an enhanced ability to anticipate rewards and potentially contributing to improvements in mood disorders.[59] These two elements provide compelling reasons to support the positive effects of exercise on alleviating non-motor symptoms in individuals with PD.

Another topic investigated in this study was the impact of music therapy on the rehabilitation of PD. Similar to exercise, most examined articles in this field also emphasized that music has positive effects on Parkinson's symptoms. A notable and significant commonality in most of these studies was the concurrent use of music alongside physical movements. A similar study conducted by Giraldez et al.[60] in 2021 also supports our research findings. Recent researches has revealed that the dopaminergic system is associated with the pleasure experienced while listening to music. Moreover, studies indicate that dopamine release is higher when listening to familiar music, which can be beneficial in PD.[61,62] The efficacy of integrating music with physical exercise in individuals with PD can be attributed to the rhythmic cues generated by music's unique structure, which promote accurate coordination of movements during physical activity.[63] Furthermore, research has shown that auditory stimuli can strengthen the remaining activities of the basal ganglia-thalamo-cortical motor circuit and the cerebello-thalamo-cortical network, resulting in improved motor deficits. This is why providing auditory cueing to individuals with PD can enhance their movement abilities and facilitate a certain level of rehabilitation by music.[64]

Limitations: Initially, our goal was to conduct a comprehensive review of all available non-pharmacological approaches for rehabilitation in PD. However, considering the extensive and vast volume of literature in this field, we focused our investigation on 2 non-pharmacological approaches. Given the high significance of Parkinson's disease and the diverse range of non-pharmacological treatments available, it is recommended that future studies concentrate on this subject matter.

Conclusion

In conclusion, this narrative review underscores the significant potential of non-pharmacological interventions, specifically exercise therapy and music therapy, in the comprehensive rehabilitation of individuals with Parkinson's disease (PD). The multifaceted benefits of exercise, including aerobic, resistance, and balance training, are consistently demonstrated in improving both motor and non-motor symptoms. Notably, high-intensity aerobic exercises exhibit a remarkable reduction in bradykinesia, rigidity, and postural instability, while resistance training and balance exercises contribute to enhanced motor function and a reduction in falls.

Moreover, the positive effects of exercise interventions extend beyond motor symptoms, encompassing improvements in cognitive function, mood disorders, and sleep disturbances. The integration of music therapy, particularly when combined with physical activity, emerges as a promising avenue for addressing various PD symptoms. Rhythmic auditory stimulation and group singing, as components of music therapy, positively impact motor control, attention, and communication outcomes in individuals with PD.

These collective findings advocate for the holistic approach of non-pharmacological interventions in PD rehabilitation. By addressing a spectrum of symptoms and functional domains, these interventions offer a more comprehensive and nuanced strategy for enhancing the overall well-being and QOL for

individuals living with Parkinson's disease. The potential synergies between exercise and music therapy underscore the importance of a multidisciplinary approach, opening avenues for further research and the development of tailored rehabilitation programs for individuals with PD.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

None.

Financials support and sponsorship

No financial support was provided for this study.

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