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Exercise interventions for balance training in Parkinson's patients

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Degree: Bachelor of Health Care

Degree Programme: Physiotherapy

Thesis: Bachelor's Thesis

Date: 2024

Abstract

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Title: Exercise interventions for balance training in Parkinson's patients
Number of Pages: 28 pages
Date: 4/24/2024
Degree: Bachelor of Health Care
Degree Programme: Physiotherapy
Instructor(s): Senior Lecturer Sanna Garam
Senior Lecturer Heini Maisala-McDonnell

Parkinson's disease is a chronic, progressive degenerative neurological disorder caused by dopaminergic nerve cell loss in the substantia nigra, which mostly impairs movement control. Parkinson's disease can have major effect on balance and coordination on individuals, because of that making it challenging to maintain a stable and upright posture. The loss of postural control and motor function can worsen an individual's overall physical stability and increase their risk of falling as the condition progresses.

The aim of this thesis is to investigate and evaluate various exercise interventions for improving balance and preventing falls in Parkinson's disease patients.

The modified literature review was conducted on four databases including Cochrane, PEDro, PubMed, and CINAHAL. Search words used for this thesis were "Parkinson," "Balance training," and "Balance exercise". The inclusion criteria chose articles that were available in English, published after 2019, and use a variety of study methods.

This literature review was based on six articles for analysis, which included four randomised control trials, one systematic review, and one implementation study. Out of the 347 initial results, 43 relevant articles were found through thorough filtering. The synthesis of research indicates that structured exercise consistently improves balance outcomes, supporting customised programs that take into consideration every individual's needs and preferences. The analysis indicates that customised interventions that, can improve functional outcomes and address balance-related challenges significantly improve standard of living for individuals with Parkinson's disease.

Keywords: Exercise therapy, Parkinson's disease, Balance training

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1. Introduction

Parkinson's disease is a chronic, progressive neurodegenerative condition defined by a combination of nonmotor and motor symptoms. Parkinson disease initially was referred to as a "shaking palsy" in 1817 by Dr. James Parkinson. This disease impact on patient's muscular control and mobility. While nonmotor symptoms of Parkinson's disease may indicate more extensive brain damage, motor symptoms, such as tremors and stiffness, are mostly caused by the loss of dopaminergic neurons in the striatum. Despite other elements involved, the loss of these particular brain cells is what causes Parkinson's disease motor symptoms. The motor characteristics of Parkinson's disease, including muscle rigidity, bradykinesia-slow movements and resting tremor, are referred to as "parkinsonism". (DeMaagd and Philip, 2015.)

According to The Parkinson's Foundation, 10 million people worldwide suffer from Parkinson disease, however the exact cause of Parkinson disease still unknown. Scientists and researchers believe that complex connections between genetic and environmental factors can be an effect to this disorder. A major factor is age, individuals older than 60 years are in majority to affect disease. even though early onset of Parkinson disease can occasionally affect younger individuals. Parkinson's disease is a progressive, chronic neurological disorder that mostly limits movement. There are several symptoms related to Parkinson disorder, including slowness of movement called bradykinesia, tremors, muscle stiffness and postural instability. Dopamine is a neurotransmitter crucial for motor coordination. Efficient in the condition due to the death of dopamine-producing neurons in the substantia nigra region of the brain. (Parkinson's Foundation 2019.)

Parkinsonu disease has a wide range of symptoms that can be an effect to individual's standard of living. Other than non-motor symptoms patient may presents cardiovascular system dysfunction, cognitive dysfunction, hallucinations and delusions, dysfunctional sexual behavior, anxiety and depression, constipation symptoms and sleep behaviour disturbance. (Carroll, Rossiter and Blanchard 2022.)

The diagnosis of Parkinson's disease is mostly based on clinical assessment, which takes the patient's neurological examination and medical history into consideration. Parkinson's disease does not currently have an effective treatment, but there are several of treatment options that can help people manage their symptoms and improve their quality of life. Treatments include medication, physical therapy, speech therapy and in some circumstances using surgical procedures such as deep brain stimulation. Still researches and studies investigate potential causes, risk factors and more effective treatments for Parkinson disease to enhance patients care and quality of life. (Parkinson's Foundation 2019.)

2. Background

2.1 Parkinson's disease

Parkinson disease is caused by gradual loss of dopaminergic neurons in the substantia nigra of the brain. The main pathological feature of Parkinson disease is the creation of Lewy bodies or abnormal protein aggregates in the affected neurons. The main component of these Lewy bodies is misfolded alpha-synuclein, which disrupts normal cellular function and results in the death of dopamine-producing cells. Dopamine is a neurotransmitter that is necessary for motor function, and its absence results in the typical motor symptoms of Parkinson's disease. (Lees et al. 2009.)

Parkinson's disease is defined in terms of clinical presentation by three main motor symptoms including muscle stiffness, bradykinesia and resting tremor. Resting tremor is defined by rhythmic shaking of the hands or other extremities when the muscles are at rest. Bradykinesia is defined by overall slowdown of the voluntary movements, which affects to daily tasks activities such as walking and starting activities. An increase in muscle tone during movement is what causes stiffness and resistance. (Postuma et al. 2015.)

This disease has a complex aetiology that includes both genetic and environmental factors. Even if the specific cause is still unknown, research is still being done to improve knowledge of the disease's causes and provide focused treatments that will lessen symptoms and stop the disease's progression. Early diagnosis and individual treatments are critical to managing the complex and varied manifestations of Parkinson's disease and enhancing the standard of living for individuals affected by the disease (Poewe et al. 2017). The main goals of the treatment for patients with Parkinson's disorder are to improve standard of living, slow down the progression of the disease, and manage motor and non-motor symptoms. Among the mainstays of treatment for Parkinson's disease motor symptoms is the restoration of dopamine neurotransmitter levels in the brain with pharmaceutical therapies such as levodopa and dopamine agonists. Levodopa has been an essential component of Parkinson's disease treatment, especially since its introduction, as it has significantly improved motor function and reduced patient disability. (Olanow et al. 2001.)

2.2 Parkinson's disease effect to balance

Balance management is the complex connection between musculoskeletal and neurological system. It is necessary for both dynamic and static equilibrium. Parkinson's disease mainly affects to centre of mass ability to adjust its base of support, and which is crucial to maintain balance and alignment of posture. The basal ganglia part of the brain is the main problematic region in Parkinson disease. This controls balance through different pathways including the reticulospinal system, thalamic-cortical-spinal loops and the pedunculo pontine nucleus. Basal ganglia control various vital functions related to balance, including increasing postural movements, controlling postural tone flexibility, automating postural responses and gait and choosing appropriate strategies for different contexts (central set). Parkinson's disease can cause mild balance problems such as slower turning and increased postural sway jerkiness. But as the condition worsens, these balance issues become more severe and diverse, impacting

both static and dynamic balance control. This is mostly because the basal ganglia are less able to coordinate these essential functions. (Park, Kang and Horak 2015.)

This indicates those who have periods of freezing and falls find it difficult to automatically correct their balance. A person with Parkinson's disease may find it difficult to shift weight with each step when trying to regain balance, thus trying to do so in little increments can make matters worse. These alterations make it more difficult for them to take bigger steps to regain their balance and avoid falling. (Parkinson's Foundation 2019.)

2.3 Balance training interventions for Parkinson patients

Regarding patients with Parkinson's disease, physiotherapists recommend balance training programs to increase mobility, boost confidence in patient's ability to balance, improve balance and gait outcomes, and address postural control deficiencies. The diversity of interventions is indicating that the type, dosage, and intensity may change according to each person's requirements and stage of development. It is advised to modify the intervention as necessary. The physiotherapy plan of care should include balance training consistently, and it should continue as a regular exercise programme outside of therapy sessions. Some of the instruments used for assessment are the Parkinson's disease questionnaire 39, Geriatric depression scale, Activities specific balance confidence scale, Berg balance scale, 10-meter walk test, falls efficacy scale, Freezing of Gait Questionnaire, and functional gait assessment. Parkinson's patients are encouraged by their physiotherapists to use a variety of balance training methods, such as multimodal balance training, dynamic gait training on a treadmill, balance training with technology, resistance training, core strengthening, and aquatic therapy. Multimodal balance training can be beneficial in improving gait, mobility, and confidence in a person's capacity to balance, which may prevent falls in those with moderate Parkinson's disease. Enhancing dynamic balance during gait is the primary goal of treadmill-based dynamic gait training. Using

technology in balance training, balance with dynamic gait training on a treadmill can range from moderate to intense aerobic exercise. Technology-assisted balance, including force plates with and without visual feedback, sensors and biofeedback, and exergaming improves mobility, stability, confidence in ability to balance, fall risk, depression, and general quality of life. Core strengthening exercises are not prioritised or performed independently of other interventions since physiotherapists incorporate them into their treatment plans. Also, aquatic therapy is unlikely to enhance balance outcomes, but it may improve quality of life and reduce fear of falling. (Parkinson Disease Knowledge Translation Task Force 2022.)

3. Aims and methodology

3.1 Aim

The aim of this bachelor's thesis is to systematically investigate the various exercises to improve balance and prevent falls among individuals diagnosed with Parkinson's disease.

3.2 Search strategy

The databases CINAHAL, PEDro, PubMed and Cochrane library were used for the study's preliminary search. In order to identify relevant research publications, topic-related search words were expressed and used to start the search. Search words were Parkinson, Balance training and Balance exercise.

In the PubMed, "Balance training" OR "Balance exercise" AND Parkinson* were the search words and Boolean operators. and for PEDro used searched words were Parkinson* AND Balance exercise, and for CINAHL search words and Boolean operators were Parkinson* AND "Balance training" OR "Balance exercise". For Cochrane library search words and Boolean operators were "Balance exercise" AND Parkinson*

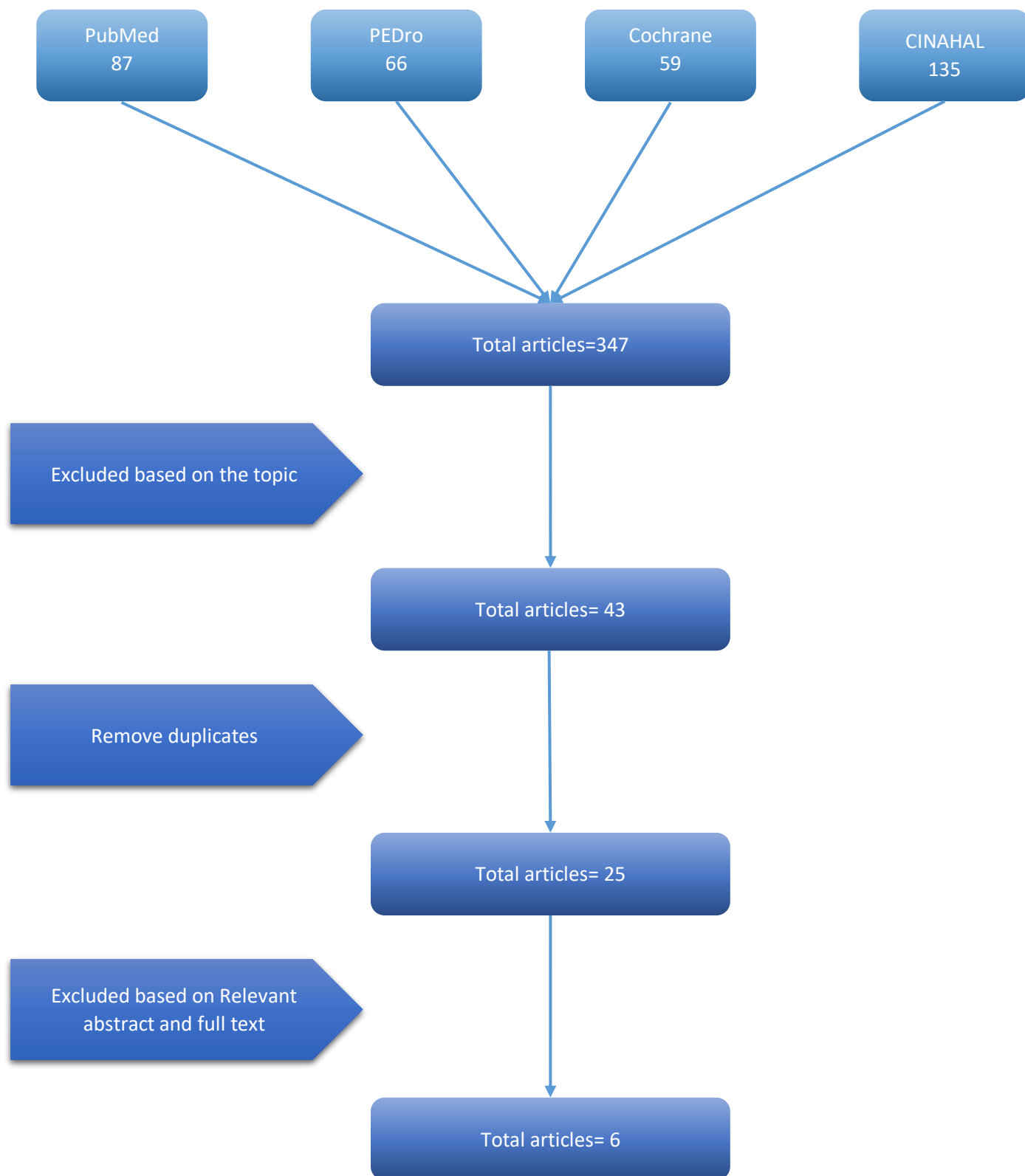
Only researches completed after 2019 were included in every database selected article. All the articles relevant to exercise intervention for Parkinson patients were included in the next step. Table 1 displays the inclusion and exclusion criteria.

Table 1 Inclusion criteria and exclusion criteria.

	Inclusion Criteria	Exclusion Criteria
Published year	After 2019	Before 2019
Published language	Studies that are available in English	Research and translations available in every other language
Method	All type of methods of study and articles	None
Contents	Contents exercise interventions for Parkinson's disease for balance training	Patients with a different neurological condition, investigating various therapeutic techniques

After the literature has been evaluated and complied with the inclusion criteria, a certain number of articles were finalised and used to gather data. The combined data will be investigated on various exercise interventions that Parkinson's patients can utilise to improve their balance.

Figure1 Flow chart for excluding data.



4. Results

This modified literature review was conducted by methodically compiling pertinent material from a variety of databases, such as PubMed, PEDro, CINAHL, and Cochrane. There were 347 results found in total from the first search. 43 articles were found to be relevant to the research topic after a screening process. A refined set of 25 articles was produced by carefully eliminating identical articles according to inclusion and exclusion criteria. Figure 1 above demonstrates the steps involved in data extraction.

Out of this approach, six articles were found to be particularly relevant. Table 2 displays summarization of the articles that fulfilled the criteria and were selected and finalised.

Table 2; Summarisation of the selected articles.

Authors and Year	Purpose of study	Methods	Participants	Intervention	Results and conclusion
Sara Monleón Guinot et al., 2023	Investigating the effects of domiciliary Functional Balance Training in individuals with and without cognitive impairments suffering from Parkinson's disease.	Single-blinded randomised controlled trial	112 people with idiopathic Parkinson disorder.	For one-third of the participants, included a group session with face to face; for the remaining with a primary strategy of dividing daily tasks into dynamic and static balance components, along with standard facilitation and disturbance techniques, the HOME protocol involves difficult balance exercises included into daily tasks, conducted for 60 minutes, two times a week for over an 8-week period.	The pressure centre sway area is the main result. Clinical factors and biomechanics associated to dynamic and static balance are examples of secondary results. Tertiary outcomes include standard of living, mental and cognitive status, gait biomechanics, and Parkinson's disease severity. In order to assess the effectiveness of domiciliary Functional Balance Training with other therapies, the study aims the complicated environment of daily life along with cognitive impairment in individuals with Parkinson disease. this finding would help in

					developing of new therapeutic strategies for Parkinson's patients.
Wang et al., 2023	To evaluate and achieve different exercises which assist Parkinson's disease patients to improve their balance in postural.	A network meta-analysis with systematic review.	60 randomised controlled trials with 3,537 Parkinson's disease patients were included.	Including exergaming exercise, rhythmical auditory exercises, and balancing training. Although numerous other therapies, such as aerobic training, Qigong, dancing, and various activities to comparison to the control group.	Exergaming exercise greatly improved Timed-Up-and-Go time on patients, also dancing Improved the Berg Balance Scale scores and rhythmical auditory exercise improved the Mini-Balance Evaluation Systems Test scores. In conclusion, results showed that exergaming exercise, rhythmical auditory exercise and dance were more effective than other activities at improving postural balance in Parkinson's disease patients.

<p>Hao, Zhang and Chen, 2022</p>	<p>To assess the impacts of ten different exercise interventions on motor function for Parkinson's disease patients.</p>	<p>Randomised controlled trials with a network meta-analysis</p>	<p>Including 60 randomised controlled trials with a total of 2859 Parkinson's disease patients.</p>	<p>This study compared ten different methods of exercise, including resistance training, cycling, walking, aquatic training treadmill, yoga, baduanjin qigong and taijiquan qigong, dancing exercises, and virtual reality.</p>	<p>The results showed that dancing exercise programs improved patients' Berg Balance Scale scores and lowered their Unified Parkinson's Disease Rating Scale scores among the assessed exercise interventions. Additionally, yoga decreases in patients' Timed-Up-and-Go scores. In conclusion, said that dancing, virtual reality training, yoga and resistance training are beneficial exercise programs for improving motor function in people with Parkinson's disease.</p>
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Li et al.2021	To evaluate the efficacy and safety of moderate aerobic exercise in treating Parkinson's disease without requiring for medications, with an emphasis on how it affects balance and other symptoms.	Meta-analysis of randomised controlled trials with a systematic review.	Nine randomised controlled trials with a total 444 Parkinson patients were included.	According to the Physical Activity Guidelines for Americans' classification criterion, moderate-intensity aerobic exercises was included.	According to the results, and for conclusion moderate aerobic exercise greatly enhanced balance and gait but had no apparent impact on motor symptoms in patients with Parkinson's disease and the effects of various exercises on patients' quality of life differs.
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<p>Çoban, Belgen Kaygısız and Selcuk, 2021</p>	<p>To assess both traditional physiotherapy and clinical Pilates exercises affect patients' postural balance control in comparison to each other.</p>	<p>A randomised controlled trial</p>	<p>A total of 40 patients with Parkinson's disease were randomised to receive either clinical Pilates or traditional physiotherapy.</p>	<p>Clinical Pilates and traditional physical therapy exercises were the exercises assigned to the intervention and control groups, respectively.</p>	<p>For outcomes each measure that was tested showed a considerable increase in both groups. When compared to the traditional physical therapy group, the dynamic balance values of the clinical Pilates group showed significant improvements. In conclusion, research has shown that clinical Pilates can improve postural control and balance in Parkinson's disease patients, with results comparable to those of conventional physiotherapy. In terms of dynamic balance, the clinical Pilates group outperformed the conventional physiotherapy group.</p>
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<p>Leavy et al. 2020</p>	<p>To evaluate the therapeutic impact of the modified HiBalance program on Parkinson disease patients' ability to control their gait and balance.</p>	<p>Implementation study</p>	<p>A total of 117 individuals had mild-to-moderate stages of Parkinson's disease.</p>	<p>Incorporated into the 10-week group sessions with HiBalance training program.</p>	<p>After 98 participants finished the trial, the training group showed statistical gains over the control group in terms of, gait speed, balancing performance, and dual-task interference. The study concluded that highly challenging balancing training improves gait, balance and dual-task performance in patients with Parkinson's disease when given at a clinically reasonable amount in different rehabilitation settings without involve directly to the research group.</p>
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Monleón Guinot et al. (2023) research using an effective research design which included the balanceHOME programme, using Consolidated Standards of Reporting Trials statement and the Standard Protocol Items for Randomised Trials requirements by using strong research design. This study's internal validity increased by this crossover intervention group and the randomised, controlled, and blind evaluation approach. Participants including 112 individuals with idiopathic Parkinson's disease underwent a thorough screening process led by qualified physiotherapists. Trial included two intervention groups. An active control group receiving regular physiotherapy programme, and other group an experimental group receiving the balanceHOME program. Two exercise regimens were developed for the balanceHOME study and were followed twice a week for eight weeks. The two programs, firstly balanceHOME and the other standard physiotherapy programs, had the same format: a warm-up lasting 10 minutes, an exercise phase lasting 45 minutes, and a cool-down lasting 5 minutes. A group cooperated with balanceHOME program which included challenging balance exercises incorporated into daily tasks. Different physiotherapists led exercises with demands of each individual and concentrated on both static and dynamic balance, and also caretaker or family member was encouraged to attend to this protocol. A physiotherapist and a rehabilitation assistant supervised the other group's usual physiotherapy programme, which included aerobic, strength, and balance exercises as well as other activities specific to Parkinson's disease. The results of the study are focused on several different areas from the severity of Parkinson's disease, biomechanical assessments of static and dynamic balance and gait to clinical assessments of cognitive function. One important measure of postural control changes is the center of pressure sway area, which is the major outcome. Secondary outcomes include a wide range of clinical and biomechanical factors that provide an in-depth understanding of how the balanceHOME program affects participants' physical and mental health. The balanceHOME trial, which was scheduled to begin in August 2021 and conclude in August 2023.

Wang et al., (2023) study based on 3,537 individuals diagnosed with Parkinson's disease based on 60 randomised controlled trials. This study did a network meta-analysis to analysis effectiveness of various forms of exercise interventions to improve mobility and balance outcome. Various exercise types with different time durations, frequency and forms were included in this study. The results showed that, exercise interventions were investigated using the Timed-Up-and-Go test; exergaming exercise showed the highest probability (The surface under the cumulative ranking curve = 91.5%) of lowering Timed-Up-and-Go test times. Exergaming exercise outperformed other exercise programs such as yoga, Tai Chi, cycling, and walking training, as well as the control group (MD = -4.52). Dance was shown to be the most successful intervention for the Berge Balance Scale, outdoing the control group (MD = 5.07) by a wide margin with a surface under the cumulative ranking curve value of 81.3%. Additional therapies that demonstrated significant success in raising Berg balance scale scores included balancing training and rhythmical auditory exercise. Study shows that rhythmical auditory exercise had highest probability to improve Mini-Balance evaluation test scores (The surface under the cumulative ranking curve = 95.6%). This suggests that it significantly surpasses the control group (MD = 5.64) and other exercises interventions including cycling, multiple exercises and perturbation training.

The Hao, Zhang, and Chen., (2022) study conducted analysis through 60 randomised controlled trials involving 2,859 patients with Parkinson's disease, for analysis effectiveness of ten different exercise interventions on motor function of Parkinson's patients. First search included 6,431 studies and 60 relevant articles were included according to inclusion criteria. These trials covered a various and diversity of exercise interventions including resistance training, cycling, virtual reality, yoga, walking, dancing, aquatic exercises and Taiji Qigong. This study shows that the most effective interventions were dancing exercises, it reduced unified Parkinson's disease rating scale scores, as showed by the probability ranking calculated by Surface under the cumulative ranking curve, which had value of 72.3%.

The analysis included results such as Timed-Up-and-Go Test and Berg Balance Scale. The most successful interventions in lowering Timed-Up-and-Go Test scores were yoga exercises and weight training, which also showed a significant improvement in functional capacities and mobility. The dependability of the findings was ensured by validating the results using consistency tests for both direct and indirect comparisons between the studies. Dance exercises also scored highly in surface under the cumulative ranking curve for Berg Balance Scale, confirming their beneficial effects on balance.

Li et al., (2021) study, a systematic review and meta-analysis with analysis of nine randomised controlled trials included 444 Parkinson's disease patients following a process of screening. This study aimed to investigate the impact of moderate aerobic exercises on patients with Parkinson disease. Walking, jogging, cycling, and treadmill training were the exercise interventions that were contrasted with regular or at-home exercise regimens in the control groups. The results were compared to the placebo group, moderate aerobic exercise significantly improved balance ($P < 0.00001$, MD = -0.42 , 95% CI: -0.59 to -0.2) in patients with Parkinson's disease. Impact of the gait by using 6-minute walking test was also investigated in this study. There were significant improvements in gait when observed with moderate aerobic exercises ($P = 0.002$, $I^2 = 74\%$) compared to the control group. The duration of the intervention ($P = 0.002$, $I^2 = 74\%$). But this analysis did not show statistically overall improvement in both the Unified Parkinson's Disease Rating Scale Part III ($P = 0.12$, MD = -2.14 , 95% CI: -4.86 – 0.58) OR Parkinson's Disease Questionnaire ($P = 0.12$, MD = -2.60 , 95% CI: -5.83 – 0.64).

Çoban, Belgen Kaygısız and Selcuk, (2021) study with randomised controlled trials aimed to investigate and compare the effects of clinical Pilates exercise with conventional physiotherapy for improving patients with Parkinson's disease patients' functional mobility, balance, and postural stability. The clinical Pilates group and the conventional physiotherapy group were randomly allocated to forty individuals. Many

outcome measures were used in the study, including One-Leg Stance test, Functional Reach Test, Timed Up and Go test, Tandem Stance Test, Berg Balance Scale and 30-second chair-stand test. This study was conducted both before and after the 8-week intervention that both groups experienced. Following the 8-week intervention, the analysis showed a significant improvement in all outcome measurements for both the clinical Pilates group and conventional physiotherapy groups. In both groups, there were statistically significant improvements ($p < 0.05$) in the 30-second chair-stand test, Timed Up and Go test, One-Leg Stance test (left and right), Functional Reach Test, Tandem Stance Test (left and right), and Berg Balance Scale scores. The findings showed that Parkinson's disease patients enhance their balance, postural control and functional mobility with both clinical Pilates and traditional physiotherapy. The two groups' Functional Reach Test results were found to differ significantly, with the clinical Pilates group displaying greater posttest scores than the conventional physiotherapy group. This randomised controlled trial revealed that balance, postural control, and functional mobility were considerably enhanced in Parkinson's disease patients using both clinical Pilates exercise and traditional physiotherapy. The Functional Reach Test results indicated a considerable advantage for the clinical Pilates group, even though other outcome measures did not demonstrate any noticeable differences between the two groups. According to these results, both therapies may be helpful in treating motor symptoms and balance outcome in people with Parkinson's disease, and deciding the treatment between both clinical Pilates and conventional physiotherapy may be dependent on personal preferences and needs, ease of access, and the goal of the treatment.

Leavy et al., (2020) research showed the HiBalance program significantly improved balance and gait in persons with Parkinson's disease in comparison to a control group, according to the results of this nonrandomised Implementation Study clinical efficacy trial. The Mini-Balance Evaluation Systems Test score of the training group significantly increased, demonstrating improved overall balance with a standardised mean difference deemed large (effect size $d = 1$). Significant improvements observed in anticipatory postural corrections and dynamic gait. The study shows that control group gait speed

also notably increased, and also shows that beneficial effect on their mobility. But there were less noticeable increases in outcomes including balance confidence (Activities-specific Balance and Confidence scale) and perceived walking difficulties (Walk-12G). No noticeable variations were in control group in their average daily step taken and also their physical activity level. The study shows low attrition rate of 15.4% and an average of 84% compliance with group training sessions. Minor falls were the only advantage outcome that occurred during supervised training session.

5. Discussion

This modified literature review highlights how exercise interventions consistently improve balance in Parkinson patients, based on six articles, including four randomised controlled trials, one systematic review and one implementation study. There are evidences to prove that these particular, structured interventions lead to improved balance outcomes, considering variation of program details. The results show the important of individualised exercise programs according to their preferences and need, goal of the treatment for patients with Parkinson disease, while understanding diversity of interventions provided.

Monleón Guinot et al. (2023) research on the balanceHOME program highlights that the effectiveness of creating exercise schedule for Parkinson's disease patients that include for situations in real life. This study methodology shows that dual task assessments provide comprehensive knowledge of requirements of rehabilitation. These home-based interventions provide patients independence and convenience. balanceHOME program provides a comprehensive and methodical approach to functional balance training, especially considering the prevalence of cognitive impairments.

Wang et al. (2023) study's analysis shows that rhythmic auditory exercise provides the highest Mini-BESTest scores, exergaming reduces the duration of the Timed Up and Go

test, and dancing is the best intervention for increasing Berg Balance Scale test scores. These activities, which focus on dynamic balance, static balance, and body postural control provide insightful information about enhancing postural balance.

The Hao, Zhang, and Chen (2022) study provide clear evidence of particular exercise programs that enhance motor function and balance outcome of Parkinson's disease patients. Study shows that dancing exercises most successful interventions to improve balance and coordination, in particularly when dance exercises are combined with rhythmic music. Resistance training and yoga also provide reduction of Timed up and Go test durations, indicating potential cooperative effects when both are combined.

Li et al. (2021) study highlights that effective exercise help to reduce Parkinson's disease patients' symptoms in stages and progressing quickly. Study shows that moderate intensity aerobic exercises significantly improve patients gait and balance outcomes, and that this intervention may beneficial for recover dopaminergic neuron function.

A (2021) study by Çoban, Belgen Kaygısız, and Selcuk shows that individuals with Parkinson's disease benefit greatly from both clinical Pilates exercise and traditional physiotherapy for improving their postural control, balance, and associated qualities. The clinical Pilates group demonstrates a higher degree of improvement in dynamic balance, indicating the intervention's potential benefits.

According to Leavy et al. (2020) study, HiBalance program is valuable in assisting Parkinson patients to enhance their balance and gait outcome and achieve their long-term goals of recovery. This study shows that this intervention deals with their individual preferences and needs and also enhance their balance and walking confidence. The results highlight the advantage of using this customised and structured group intervention, and also shows the importance of focusing on several subsystems of balance control and advantage of implementing dual task activities.

In conclusion this modified literature review highlights the most effective customised balance training exercises to standard of living of a patient with Parkinson's disease, with analyse of six studies. These studies show benefits of various methods of exercise that improve patients static and dynamic balance, gait, postural stability and also improve their daily functions. These interventions include dance exercises, clinical pilates, moderate-intensity aerobic exercises, Hibalance program, balanceHOME program, strengthening training and rhythmic auditory exercises demonstrate clear evidence of the efficacy for their balance outcome. These results demonstrate the potential of comprehensive and customised exercise interventions to improve balance and functional outcomes in patients with Parkinson's disease with managing several balance related issues.

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