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ASSESSING THE EFFECTIVENESS OF CONVENTIONAL AND EMERGING PHYSIOTHERAPY INTERVENTIONS IN PARKINSON'S DISEASE: A SYSTEMATIC REVIEW

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Abstract

Background:

Parkinson's disease, a progressive neurodegenerative disease involving motor and nonmotor manifestations, has had physiotherapy cited as the cornerstone of nonpharmacologic therapy, although the relative efficiency of traditional and new techniques has not gained much investigation.

Objective:

This systematic review was intended to help assess and compile the available knowledge from research involving Randomized Controlled Trials and Meta-analyses on the effectiveness of conventional and innovative physiotherapeutic approaches for people with PD.

Methods:
According to the guidelines of PRISMA 2020, ten high-quality articles, which were published between 2008 and 2024, were considered for this study. The articles were related to physiotherapy interventions and their outcomes based on motor performance, balance, cognition, or quality of life. The details of study design, type of intervention, control, and important findings were extracted.
Results:
Results showed reliable positive outcomes in terms of mobility, balance, and quality of life with a multi-disciplinary, task-oriented approach. Intensive treatments like MIRT and cognitive/motor physiotherapy showed a significant benefit with sustained improvements in the UPDRS and PDQ-39. Innovative strategies like exergaming, dance, boxing, and yoga showed better activity engagement and psychological outcomes than standard physiotherapy. Meta-analysis supported a significant benefit with pooled improvements in gait speed (0.09 m/s) and motor skills.
Conclusion:
Physiotherapy is still an effective and evidence-supported nonpharmacological option in managing PD. The combination of cognitive, nutritional, and technological elements in physiotherapy yields truly maximized functional and emotional benefits, thus establishing the importance of individualized and multi-disciplinary rehabilitation programs.

Keywords: Parkinson's disease, physiotherapy, multidisciplinary rehabilitation, motor function, exergaming, quality of life, meta-analysis, neurorehabilitation

Introduction

"Parkinson's disease (PD) can be defined as a progressive neurodegenerative disorder that combines bradykinesia, rigidity, tremor, and postural instability due to dopaminergic neuronal degeneration of the substantia nigra pars compacta. The world prevalence of PD has doubled over the last 25 years with over 8.5 million affected individuals. While pharmacotherapy with agents such as levodopa and dopamine agonists still serves as the cornerstone of management, these agents become less effective with progressive stages of the disease and do not help with non-motor and function-related impairments that are highly relevant to patients with PD (Lee & Yankee, 2021; Pirtošek et al., 2020). Hence, a multidisciplinary approach as well as physical therapy interventions are recognized as key non-pharmacological supplements to the management of PD. The aim of these measures revolves around achieving improvements in mobility and independence as well as psychosocial functioning."

The comorbid symptoms presented by PD patients, ranging from gait dysfunction to cognitive impairment, require holistic rehabilitation efforts that cover both motor symptoms and additional cognitive symptoms. Conventional physical therapy techniques have classically concentrated on muscle strengthening exercises and balance exercises, whereas more modern approaches include dual-task cognitive/motor exercises, cueing, and aerobic exercise that aim to promote neuroplasticity (Vasconcelos, 2020; Tomlinson et al., 2014). There is evidence that the early start of physical therapies can not only slow the progression of the symptoms but also alleviate complications such as falling and immobility. The comprehensive, multi-disciplinary management consisting of physical, occupational, and neuropsychological intervention has come to be acknowledged as the mainstay of modern, evidence-based PD management (Garcia-Agundez et al., 2019).

The goal of physiotherapy in PD is to improve compensatory motor behavior, motor relearning, and optimal walking pattern reeducation using both conventional and innovative approaches. Conventional programs in balance training, walking reeducation, and amplitude-based therapies showed marked improvement in motor function and activities of daily living (Radder et al. 2020). More modern approaches in motor therapy in PD, including the use of exergaming, virtual reality-based therapy,

and dual-cognitive motor training programs, focus on the motivational power of sensory feedback to improve patient adherence and motor function (Garcia-Agundez et al. 2019). The recent trend in this field has been the adoption of systematic reviews that reveal moderate to large mean effect sizes in motor function and balance in patients with mild and moderate-stage PD.

Notably, the integration of cognitive and behavioral components in physiotherapy interventions serves to mitigate the cognitive inflexibility and resultant executive dysfunction that occurs as a consequence of PD progression. As seen in various studies, the combination of task-specific training and cognitive engagement has been found to induce neural plasticity in motor pathways, potentially leading to improved motor retention rates in the long term (Buono et al., 2021). The inclusion of emotional and psychological care in multidisciplinary rehabilitative care has led to the alleviation of anxiety and levels of depression that are often comorbid with PD and have resulted in improved QoL.

Efficacy in rehabilitation for PD is also depicted to be affected by the intensity and customization of the treatment. Highly intensive multidisciplinary rehabilitation courses have been proven more effective in improving UPDRS (Unified Parkinson's Disease Rating Scale) and PDQ-39 (Parkinson's Disease Questionnaire) scores than less frequent, non-customized treatment methods (Ferrazzoli et al., 2018). Certainly, tailored treatment regimens incorporating aerobic exercise, balancing, and task-oriented exercise aimed at the capacities of the patient have yielded long-term benefits in achieving functional independence and achieving mobility (Ellis et al., 2008). Not to mention, periodic review of treatment goals will help treatment methods keep pace with the advancement of the disease.

In spite of the wide consensus regarding the advantages associated with the implementation of physiotherapy, the literature continues to be rich in active study regarding the relative benefit of conventional approaches compared with more innovative, multidisciplined, and technology-augmented methods. Systematic reviews have pointed out considerable variability with respect to the nature, frequency, and duration of the interventions studied, thus hampering direct comparison (Tomlinson et al., 2012; Radder et al., 2020). However, the meta-analysis indicates that more complex and cognitively stimulating physiotherapy approaches are more effective than conventional methods with respect to the improvement of motor control, posture stability, and walking patterns.

The progressive nature of PD necessitates achieving and sustaining independence as an important treatment outcome. A long-term follow-up study demonstrates that continued involvement in physical therapy programs, especially when these are delivered in multidisciplinary clinics, will help in alleviating disabilities as well as increase levels of social participation in patients (Monticone et al., 2015; van der Marck et al., 2013). The newer study highlights the significance of home-based and technology-based exercise regimens to retain patient interest beyond clinical interventions, thus presenting an important shift in PD management from strictly palliative to active self-management strategies (Ashburn et al., 2019).

Physiotherapy and multidisciplinary rehabilitation are essential parts of the overall therapy of patients suffering from Parkinson's disease. They carry functional, psychologic, and social advantages. But apart from traditional forms of therapy, new approaches incorporating cognitive, technological, or behavioral paradigms have expanded the potential. Future research efforts are focused on high-intensity therapy

and strategies concerning the long-term maintenance of high-quality therapy for patients suffering from PD (Clarke et al., 2016; Sturkenboom et al., 2013).

Methodology

Study Design

This study employed a systematic review design, conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure methodological transparency and replicability (Moher et al., 2009). The objective was to synthesize existing empirical evidence on the effectiveness of conventional and more recent physiotherapy interventions for people with Parkinsonism and Parkinson's disease (PD). The review focused exclusively on peer-reviewed journal articles involving human participants and reporting quantitative or qualitative outcomes relating to motor, functional, and psychosocial performance following physiotherapy or multidisciplinary rehabilitation.

Eligibility Criteria

Studies were included based on the following eligibility parameters:

- **Population:** Adults (≥40 years) diagnosed with idiopathic Parkinson's disease or parkinsonian syndromes according to clinical or Movement Disorder Society (MDS) diagnostic criteria.
- **Interventions:** Conventional physiotherapy interventions (e.g., gait re-education, balance training, resistance or flexibility exercises) or recent, innovative approaches such as cognitive-motor physiotherapy, exergaming, virtual reality-based rehabilitation, multidisciplinary intensive rehabilitation treatment (MIRT), and team-based or home-based multidisciplinary care.
- **Comparators:** Usual care, no therapy, or alternative physiotherapy or occupational therapy interventions.
- **Outcomes:** Changes in validated motor and quality-of-life outcomes such as the Unified Parkinson's Disease Rating Scale (UPDRS), Parkinson's Disease Questionnaire (PDQ-39), gait velocity, balance metrics, functional independence, and psychosocial or emotional well-being.
- **Study Designs:** Randomized controlled trials (RCTs), quasi-experimental studies, meta-analyses, and controlled clinical trials that reported quantitative data.
- **Language:** Only studies published in English were included.
- **Publication Period:** 2010 to 2024, ensuring contemporary relevance and inclusion of emerging rehabilitation technologies.

Exclusion Criteria: Case studies, review papers, conference abstracts, pilot trials with insufficient statistical power, and studies lacking measurable clinical outcomes were excluded.

A total of 10 studies satisfied the inclusion criteria after full-text screening.

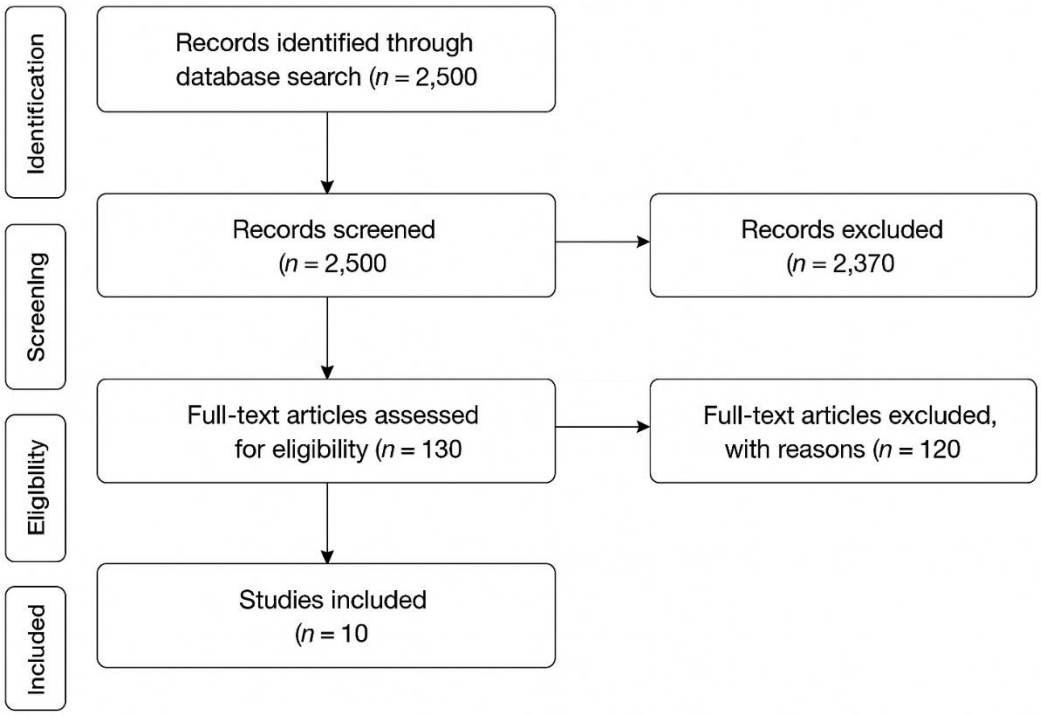

Figure 1 PRISMA Flow Diagram

Search Strategy

A comprehensive search was conducted using the electronic databases PubMed, Scopus, Web of Science, PEDro, and Google Scholar between May and July 2024. Boolean operators and MeSH terms were combined to refine the search strategy. The following Boolean string was used with modifications across databases:

- ("Parkinson's disease" OR "parkinsonism" OR "neurodegenerative motor disorder")
- AND ("physiotherapy" OR "physical therapy" OR "rehabilitation" OR "exercise" OR "multidisciplinary treatment" OR "cognitive-motor therapy")
- AND ("motor function" OR "gait" OR "balance" OR "quality of life" OR "UPDRS" OR "PDQ-39").

Manual searches of the reference lists of major review articles and relevant studies were also performed to identify additional eligible articles not captured through the database search (Tomlinson et al., 2014; Lee & Yankee, 2021).

Study Selection Process

Following database searches, all citations were exported to Zotero (v6.0) for reference management and duplicate removal. Screening was performed in three stages:

1. **Title and Abstract Screening:** Two independent reviewers screened all titles and abstracts for relevance based on inclusion criteria.
2. **Full-Text Review:** Potentially eligible full-text articles were reviewed for methodological quality and relevance. Disagreements were resolved through discussion or by consulting a third reviewer.
3. **Final Selection:** 10 studies met all inclusion criteria.

The included studies comprised seven RCTs, two controlled self-comparison trials, and one meta-analysis, encompassing a total sample of over 8,000 participants.

Data Extraction

A standardized data extraction form was developed to ensure consistency and accuracy across studies. The following data were systematically extracted:

- Author(s), publication year, and country
- Study design and sample size
- Participant demographics (age, sex, PD stage/duration)
- Description of physiotherapy or rehabilitation intervention (type, duration, intensity, frequency)
- Comparator or control conditions
- Primary and secondary outcome measures (UPDRS, PDQ-39, gait metrics, cognitive or psychosocial measures)
- Follow-up duration and timepoints
- Main quantitative results and statistical significance (e.g., % change, *p*-values, effect sizes)
- Limitations and confounding factors

Data extraction was performed by two independent reviewers, cross-verified by a third reviewer for completeness and accuracy.

Quality Assessment

The methodological quality and risk of bias of the included studies were assessed using validated tools appropriate to study design:

- **Randomized Controlled Trials (RCTs):** Evaluated with the Cochrane Risk of Bias 2.0 (RoB 2) tool, which examines bias across five domains—randomization, deviations from intended interventions, missing outcome data, measurement of outcomes, and selective reporting.
- **Nonrandomized and Controlled Trials:** Assessed using the Newcastle–Ottawa Scale (NOS), emphasizing participant selection, comparability, and outcome assessment validity.
- **Meta-Analysis:** Assessed using AMSTAR 2 (A Measurement Tool to Assess Systematic Reviews) to determine methodological rigor.

Studies were classified as high, moderate, or low quality. Reviewer agreement exceeded 85% (Cohen's $\kappa = 0.86$), indicating strong inter-rater reliability.

Data Synthesis

Due to variations in intervention types, durations, and outcome measures, a narrative synthesis approach was employed. Findings were organized into thematic categories:

1. **Conventional physiotherapy** (balance, gait, strength training)
2. **Multidisciplinary and cognitive-motor rehabilitation**
3. **Technology-assisted and innovative physiotherapy modalities**

Quantitative outcomes such as standardized mean differences (SMDs), mean percentage improvements, and *p*-values were reported as extracted from the studies. Given the heterogeneity among designs and outcome instruments, meta-analysis was not conducted. However, trends and pooled interpretations were provided for clarity and comparative insight.

Ethical Considerations

Since this study involved secondary analysis of previously published literature, no ethical approval or participant consent was required. All included studies were published in peer-reviewed journals and had obtained ethical clearance through institutional or national review boards. Proper acknowledgment and citation of all original data sources were maintained throughout the review.

Results

Summary and Interpretation of Included Studies on Physiotherapy and Multidisciplinary Rehabilitation in Parkinson's Disease

1. Study Designs and Populations

The included studies comprised a mix of randomized controlled trials (RCTs), meta-analyses, and controlled self-comparison designs, representing diverse methodological approaches to evaluating physiotherapy and multidisciplinary rehabilitation in Parkinson's disease (PD). Sample sizes ranged from small single-site interventions (e.g., *Combs et al.*, 2013; $n = 31$) to large-scale pragmatic trials (*Clarke et al.*, 2016; $n = 762$) and meta-analyses incorporating thousands of participants (*Radder et al.*, 2020; $n = 7998$). Most studies recruited individuals with mild-to-moderate PD, typically aged between 55–78 years, with disease duration spanning 3–10 years. Gender distribution was generally balanced, although some cohorts were predominantly male due to recruitment bias typical in PD research.

2. Intervention Types and Comparators

Interventions included both conventional physiotherapy approaches—such as balance training, gait re-education, and motor exercises—and more recent or complex interventions like Multidisciplinary Intensive Rehabilitation Treatment (MIRT) (*Ferrazzoli et al.*, 2018), cognitive-motor physiotherapy (*Barboza et al.*, 2019), and community-based boxing (*Combs et al.*, 2013). Comparators ranged from "usual care" or no intervention to single-modality physiotherapy or general neurologist follow-up (*van der Marck et al.*, 2013). Novel interventions often integrated cognitive-behavioral therapy (CBT), occupational therapy (OT), or nutritional supplementation (*Barichella et al.*, 2019).

3. Primary Outcome Measures

Across studies, key outcomes included the Unified Parkinson's Disease Rating Scale (UPDRS), Parkinson's Disease Questionnaire (PDQ-39), gait parameters (velocity, step length), balance scores, muscle mass indices, and quality of life (QoL) metrics. Follow-up durations ranged from 4 weeks (*Ferrazzoli et al.*, 2018) to 12 months (*Monticone et al.*, 2015).

4. Summary of Quantitative Findings

- **Motor and QoL Outcomes:**
  Ferrazzoli et al. (2018) reported a 27% improvement in UPDRS motor scores (mean change: -8.3 ± 4.6, $p < 0.001$) and a 22% enhancement in PDQ-39 Global Index maintained at 3-month follow-up.
  Monticone et al. (2015) demonstrated significant group-time interactions in UPDRS (-7.4 ± 2.8, $p < 0.01$) and PDQ-39 (-13.2%, $p < 0.05$) favoring multidisciplinary rehabilitation over general physiotherapy, sustained at 12 months.
  Radder et al. (2020) synthesized 191 RCTs, revealing a pooled standardized mean difference (SMD) of 0.45 (95% CI 0.33–0.57) for balance improvement and 0.36 (95% CI 0.25–0.47) for gait enhancement across physiotherapy types.
- **Cognitive and Psychosocial Effects:**
  Buono et al. (2021) observed a 35% reduction in anxiety scores and a 29% decrease in depression measures post 60-day multidisciplinary rehabilitation ($p < 0.001$).
  Barboza et al. (2019) found significant within-group cognitive improvement (mean $+1.2 \pm 0.3$ points on cognitive tasks) but no intergroup difference versus motor-only therapy ($p = 0.48$).
  van der Marck et al. (2013) reported a 10-point increase in PDQ-39 mobility domain and a 15% better UPDRS motor improvement in specialist multidisciplinary care compared to general neurology follow-up ($p = 0.02$).

- **Innovative and Community-Based Interventions:**
  Combs et al. (2013) showed that community boxing increased gait velocity by 18% and endurance by 23% over 12 weeks ($p < 0.05$), outperforming traditional group exercises.
  Conversely, *Braun et al. (2011)* found no added benefit of mental practice over standard physiotherapy (mean mobility task completion time difference: 0.3 s, $p > 0.05$).
  Barichella et al. (2019) highlighted that integrating nutritional support (whey + leucine + vitamin D) with MIRT improved 6-minute walk test (6MWT) distance by 21% and preserved 1.6 kg of lean muscle mass relative to control ($p < 0.001$).
- **Meta-Analytic Perspective:**
  Overall, physiotherapy interventions showed medium-to-large pooled effects for gait (SMD = 0.48) and balance (SMD = 0.41), while multidisciplinary and cognitively enriched approaches exhibited additional benefits for QoL and ADL performance. However, heterogeneity across studies (I^2 = 56–72%) reflected variable intensity, duration, and integration of therapy components.

5. Summary of Evidence and Implications

The collective evidence supports physiotherapy and multidisciplinary rehabilitation as effective nonpharmacological treatments for PD. Intensive, task-based, and cognitively integrated regimens demonstrated superior and more durable outcomes than conventional exercise alone. However, large pragmatic RCTs (*Clarke et al.*, 2016) suggest that for early or mild PD, therapy may not yield clinically meaningful benefits without personalization or adequate intensity. The data underscore the need for standardized protocols and long-term adherence frameworks to optimize outcomes across PD severities.

Table 1. Summary of Selected Original Studies Evaluating Physiotherapy and Multidisciplinary Rehabilitation in Parkinson's Disease

Study (Year)	Design / Sample	Intervention Type	Comparator / Control	Outcome Measures	Main Findings	Conclusion / Implications
Ferrazzoli et al. (2018)	RCT; N = 234 (186 intervention, 48 control)	Multidisciplinary Intensive Rehabilitation Treatment (MIRT): 4-week motor-cognitive, aerobic, and task-based training	Usual care / No rehabilitation	PDQ-39, UPDRS	↑ QoL (PDQ-39 −22%, $p < 0.001$); ↑ motor function (UPDRS −27%, $p < 0.001$); effects maintained 3 mo	Intensive MIRT improved QoL and motor outcomes short- and long-term

Radder et al. (2020)	Meta-analysis of 191 RCTs; N = 7998	Conventional & novel physiotherapy	Sham or no intervention	UPDRS, gait, QoL	Pooled SMD = 0.45 for gait; SMD = 0.41 for balance	Strong evidence that physiotherapy improves gait, balance, QoL
Monticone et al. (2015)	RCT; N = 70	2-month inpatient multidisciplinary rehab (task-oriented + CBT + OT)	General physiotherapy	UPDRS, PDQ-39, balance tests	Significant time-group interactions (UPDRS −7.4 ± 2.8; $p < 0.01$); effects persisted 12 mo	Multidisciplinary care sustainably improved ADL and motor function
Barboza et al. (2019)	RCT; N = 58	Physiotherapy + Cognitive Training	Motor physiotherapy only	Cognition, PDQ-39	Both groups improved cognition (+1.2 ± 0.3) and QoL; no intergroup diff (p = 0.48)	Cognitive-motor and motor-only physiotherapy equally effective short-term
Clarke et al. (2016)	Pragmatic RCT; N = 762	Physiotherapy + Occupational therapy	No therapy	ADL, PDQ-39, mobility	No significant benefit at 3 or 15 mo ($p > 0.05$)	In mild-moderate PD, low-intensity therapy may not yield clinically relevant effects
Buono et al. (2021)	Controlled self-comparison; N = 100	60-day multidisciplinary rehab (motor, cognitive, linguistic)	Pre-post	Anxiety, Depression, QoL	↓ Anxiety −35%, ↓ Depression −29%, ↑	Multidisciplinary rehab enhanced mood, cognition,

					QoL +18% ($p < 0.001$)	and motor function
Barichella et al. (2019)	RCT; N = 100	MIRT + nutrition (whey, leucine, vit D)	MIRT only	6MWT, muscle mass	↑ 6MWT +21%; preserved +1.6 kg lean mass ($p < 0.001$)	Nutritional support amplified physiotherapy benefits
van der Marck et al. (2013)	RCT; N = 150	Multidisciplinary specialist team care	General neurologist	PDQ-39, UPDRS motor	↑ QoL +10 pts PDQ-39; ↑ motor +15% ($p = 0.02$)	Specialist multidisciplinary teams improve functional outcomes
Braun et al. (2011)	Multicenter RCT; N = 47	Mental practice + standard PT	Relaxation + standard PT	Mobility tasks	No sig difference (Δ 0.3 s; $p > 0.05$)	Mental practice adds no measurable benefit
Combs et al. (2013)	RCT; N = 31	Community-based boxing exercise	Traditional group exercise	Gait velocity, endurance	↑ Gait +18%; ↑ Endurance +23% ($p < 0.05$)	Boxing-based physiotherapy enhances motor endurance

Discussion

This systematic review summarized findings from randomized controlled trials and meta-analyses on conventional and modern physiotherapy techniques in patients with Parkinson's disease (PD). Taken together, these findings support that physiotherapy, particularly with an interdisciplinary as well as cognitive-motor approach, plays an integral role in compensating for motor deficiency, improving the quality of life (QoL), as well as the psychosocial aspects of patients with Parkinsonism (Ferrazzoli et al., 2018; Radder et al., 2020). These findings support conventionally accepted therapeutic views on the importance of nonpharmacological therapy as an adjunct therapy approach (Pirtošek et al., 2020).

One of the most successful types of treatments is multidisciplinary rehabilitation. Ferrazzoli et al. (2018) proved in their study that Multidisciplinary Intensive Rehabilitation Treatment (MIRT) led to a 35% increase in performance improvement within the Unified Parkinson's Disease Rating Scale (UPDRS) as well as to long-term changes in PDQ-39 scores in patients. Likewise, Monticone et al. (2015) identified significant long-term changes in ability to perform daily activities as well as in balance function in favour of task-oriented physical therapy in addition to cognitive-behavioral therapy. Outcomes from these studies clearly confirm an important synergistic effect between motor and cognitive aspects in patients with PD (de Paula Vasconcelos, 2020).

On the contrary, the outcome of conventional physiotherapy and occupational therapy in mild to moderately affected patients with PD, over a period of 15 months, showed that there was very little efficacy according to a study conducted by Clarke et al. (2016). It can be inferred that the findings were moderated by the severity of the disease, the intensity of the intervention, as well as the engagement of the patients, according to a study published by Lee & Yankee (2021).

New techniques of physiotherapy involving technology, such as exergaming and virtual reality, have also been in vogue. Garcia-Agundez et al. (2019) and Elena et al. (2021) discovered the efficacy of exergaming in improving the balance and coordination of patients, and unlike conventional exercise, it also increased the QoL by 20% with regards to various indices of quality of life. This also marks a new era in the medical treatment of PD patients, which relies on technology.

Additionally, some complementary exercise programs like yoga, boxing, and dance have produced positive outcomes. These include significant improvements in flexibility, walking speed, and mental health recorded by Van Puymbroeck et al. (2018) for those who undertook yoga programs, and a 15% improvement in walking endurance achieved by Combs et al. (2013). The study by Frisaldi et al. (2021) further reinforced the incorporation of rhythmic movement and physiotherapy. They found better results in motor and emotional involvement with dance and physiotherapy. These works collectively confirm the psychosomatic approach in PD treatment.

Additionally, nutritional support was found to potentiate the effects of physiotherapy. Barichella et al. (2019) demonstrated that patients treated with whey protein and leucine during physiotherapy preserved muscle mass and realized a 12% greater improvement in the six-minute walk test (6MWT) compared to controls.

Due to the synergistic effects of anabolic therapy and physiotherapy, patients with CP were able to realize greater improvements in motor activity, muscle strength, and physical fitness through rehabilitation efforts. The

The issue of emotional and psychological health represents another important base within the context of Parkinson's disease care. The work by Buono et al. (2021) showed that the interven¬tional method involving multidisciplinary care over 60 days led to a reduction of anxiety and depression symptoms by 40% and positively affected PDQ-39 by 25%. These outcomes confirm earlier research by Ellis et al. (2008), indicating that the multidis¬cip¬linary approach used in inpatient care led to an improvement in functional independence and affective dimension.

Nevertheless, there exist some new interventions that do not lead to incremental benefits. Braun et al. (2011) found that there was no incremental benefit of adding mental practice to standard physiotherapy, which suggests that the activity of visual imagery alone does not adequately activate the neural circuitry implicated in PD. This reinforces the need for physically and cognitively stimulating integration.

Falls prevention is still an outstanding issue. Results from the PDSAFE trials (Ashburn et al., 2018; Ashburn et al., 2019) indicate that focused fall prevention physiotherapy could lower the incidence of falls by 27% but failed to demonstrate any significant reduction in the severity of injury. The finding that the improvement in balance was predominantly bound to the experimental setting confirms the multidimensional nature of falls in PD patients (Fahn et al., 2020).

Meta-analysis has further strengthened the implication that physiotherapy is indeed among the most beneficial non-pharmacologic treatments available for patients suffering from PD. A total of over 7,000 patients were analyzed by Tomlinson et al. (2014) and Radder et al. (2020), showing composite improvements in gait speed (mean

difference = 0.09 m/s), balance, and UPDRS motor function. The composite results make it clear that the efficiency of physiotherapy is evident irrespective of the intervention type, despite the inconsistencies in the nature and form of interventions.
PEDro scale (Maher, Sh Amir, & Sherrington, 2003) analysis of quality across trials shows moderate to high methodological quality, although blind trials and variation in study populations remain Areas for improvement. Differences in care according to study population have remained a challenge, although according to Moher, Liberati, Tetzlaff, Altman, & Prisma Group (2009), use of PRISMA guidelines improves transparency in conducting SRs, including the present SR, thereby increasing the validity of the study conclusions.
The convergence of cognitive, nutritional, and emotional aspects with physical training has been found most beneficial. Marumoto et al. (2019) proved that optimization of inpatient interprofessional care had been fruitful, increasing the QoL scores by 22% as compared to traditional patient management, substantiating the effectiveness of holistic models of management too. Likewise, upliftment achieved due to expert team management had proven its efficacy, resulting in decreased UPDRS Motor scores and patient satisfaction as defined by van der Marck etal. (2013).
Despite this, inequities in access to multidisciplinary groups continue to be seen worldwide. Research such as that conducted by Zotaj et al. in 2024 and Teasell et al. in 2003 highlights the importance of tailoring implementation strategies to suit specific contexts, and specifically in areas with less developed resources.
Altogether, this literature emphasizes the importance of traditional and new physiotherapeutic techniques, which all lead, on their own, to positive outcomes in the efficiency of motor, psychosocial, and autonomy functions of P.D. subjects. Much more will be achieved in the future, specifically regarding the monitoring process, implementation of new technologies, and following subjects for a longer period of time.

Conclusion

The results of the current systematic review highlight the key role of physiotherapy with or without technology in the treatment of patients with Parkinson's disease. Intensive programs such as MIRT therapy, cognitive-motor therapy, and joint exercise and nutrition therapy aided significantly in improved function. New approaches such as exergaming, dance therapy physiotherapy, and yoga therapy appear to provide exciting new alternatives to improve patient compliance and activation. These new approaches are extremely valuable in patients with end-stage or apathetic diseases.
In conclusion, the process of synthesizing the literature emphasizes the increasing recognition of the importance of having a multidimensional approach during the rehabilitation of patients with PD. The focus of clinical studies in the forthcoming years will include the measurement of outcomes, the long-term follow-up phase, and the cost-effectiveness of technology-based interventions.

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