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Clinical Practice Guidelines

Physical Therapist Management of Parkinson Disease: A Clinical Practice Guideline From the American Physical Therapy Association

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Abstract

A clinical practice guideline on Parkinson disease was developed by an American Physical Therapy Association volunteer guideline development group that consisted of physical therapists and a neurologist. The guideline was based on systematic reviews of current scientific and clinical information and accepted approaches for management of Parkinson disease.
The Spanish version of this clinical practice guideline is available as a supplement (Suppl. Appendix 1).

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Introduction

Overview

This clinical practice guideline (CPG) is based on a systematic review of published studies involving the physical therapist management of individuals with Parkinson disease (PD). In addition to providing practice recommendations (see Tab. 1 for summary of recommendations), this guideline also highlights limitations in the literature, areas that require future research, intentional vagueness, and potential benefits, risks, harms, and costs to implementing each recommendation.

This CPG is intended to be used by all qualified and appropriately trained physical therapists and physical therapist assistants involved in the management of individuals with PD. It also is intended to be an information resource for decision-makers, health care providers, and consumers.

Goals and Rationale

The purpose of this CPG is to help improve the physical therapist management of individuals with PD based on the current best evidence. Current evidence-based practice standards demand that clinicians use the best available evidence in their clinical decision-making, incorporate clinical expertise, and consider the individual's wants and needs. To assist clinicians, this CPG contains a systematic review of the available literature regarding the management of individuals with PD. This review included randomized controlled trials published between January 1, 1994, and June 16, 2020, and identifies where there is strong evidence, where evidence is lacking, and topics that future research must target to improve the management of individuals with PD.

Neurological care is provided in diverse settings by many different providers. This CPG is an educational tool to guide qualified clinicians through a series of treatment decisions as effort to improve quality and efficiency and reduce unwarranted variation of care. Recommendations guide evidence-based practice while considering the individual's wants and needs in the clinical decision-making process. This CPG should not be construed as including all proper methods of care or excluding methods of care reasonably directed at obtaining the same results. The ultimate judgment regarding the application of any specific procedure or treatment must be made considering all circumstances presented by the individual, including safety, preferences, and disease stage, as well as the needs and resources particular to the locality or institution.

Intended Users

This CPG is intended to be used by physical therapists, and physical therapist assistants under the direction of physical therapists, for the management of individuals with PD. Physical therapists are health care professionals who help individuals maintain, restore, and improve movement, activity, and functioning to enable optimal performance and enhance health, well-being, and quality of life. Neurologists, adult primary care clinicians, geriatricians, rehabilitation medicine provider, nurse practitioners, physician assistants, occupational therapists, speech language pathologists, and other health care professionals who routinely see individuals with PD in various practice settings also may benefit from this guideline. This guideline is not intended for use as an insurance benefit determination document.

Care for individuals with PD is based on decisions made by them in consultation with their health care team, which may comprise movement disorder specialists, general neurologists, geriatricians, primary care physicians, nurses, physical therapists, occupational therapists, speech language pathologists, registered dieticians, social workers, and other professionals. Care includes medical and pharmacological management and consideration of quality indicator guidelines such as those from the American Academy of Neurology.[1]

Once the individual (or advocate) has been informed of the nature of the available therapies and their rationale, duration, benefits, risks, and costs and has discussed the options with their health care provider, an informed and shared decision can be made.

Patient Population

This CPG addresses the management of adult idiopathic, typical PD. It is not intended to address management of individuals with atypical Parkinsonism disorders or other neurodegenerative conditions. Most studies reviewed include individuals in the early to mid-stages of PD as measured by Hoehn & Yahr (H&Y) stages 1 to 3.[2] Recommendations may not generalize to those in the advanced H&Y stages 4 to 5[2] of the disease.

Burden of Disease

As of 2017, over 1 million (1.04) people in the United States have been diagnosed with PD, and that number is expected to increase to nearly 1.64 million in 20 years.[3] Ninety-one percent of these individuals were over the age of 65 and eligible for Medicare, and 54% were men.[3] Globally, PD is the fastest growing of all neurological disorders, with a prevalence of 6.1 million, which is projected to increase to over 12 million worldwide by 2050.[4] The total US economic burden of PD was estimated to be $51.9 billion in 2017, with $25.4 billion representing direct medical costs and $26.5 billion representing indirect and nonmedical costs, including premature death and lost employment of people with PD and their care partners.[3] In 20 years, the total US economic burden of the disease is estimated to be $79.1 billion.[3] The average direct medical cost in 2017 for a person with PD eligible for Medicare was nearly $25,000.[3] The average combined economic loss of a person with PD and their care partner was nearly $25,600 in 2017, for an aggregate total economic impact of over $50,000 per year.[3] In the United States, people with PD are hospitalized 1.44 times more than those without the disease and experience rehospitalization at a higher rate.[5] In addition, during hospitalization, people with PD experience worsening symptoms and a decline in functional status that is below their baseline ability.[5] A review of the literature indicates that there is a higher prevalence of PD among White and Hispanic populations globally than among those of African or Asian descent.[6] In the United States, the incidence of PD by race is difficult to isolate from disparities in health care utilization affecting the actual occurrence of PD among different ethnic groups.[7] Therefore, it is unclear if there is a biological basis that might explain the lower prevalence among those of African Americans or if this is due to disparities in health care utilization. Community-based studies that allow for a direct comparison of ethnic groups to determine disease prevalence and economic impact by race or ethnicity are currently not available. However, it has

Table 1. Summary of Recommendations[a]

Intervention	Quality of Evidence	Strength of Recommendation	Recommendation
Aerobic exercise	High	♦♦♦♦	Physical therapists should implement moderate- to high-intensity aerobic exercise to improve VO_2, reduce motor disease severity and improve functional outcomes in individuals with Parkinson disease
Resistance training	High	♦♦♦♦	Physical therapists should implement resistance training to reduce motor disease severity and improve strength, power, nonmotor symptoms, functional outcomes, and quality of life in individuals with Parkinson disease
Balance training	High	♦♦♦♦	Physical therapists should implement balance training intervention programs to reduce postural control impairments and improve balance and gait outcomes, mobility, balance confidence, and quality of life in individuals with Parkinson disease
Flexibility exercises	Low	♦♦◊◊	Physical therapists may implement flexibility exercises to improve ROM in individuals with Parkinson disease
External cueing	High	♦♦♦♦	Physical therapists should implement external cueing to reduce motor disease severity and freezing of gait and to improve gait outcomes in individuals with Parkinson disease
Community-based exercise	High	♦♦♦♦	Physical therapists should recommend community-based exercise to reduce motor disease severity and improve nonmotor symptoms, functional outcomes, and quality of life in individuals with Parkinson disease
Gait training	High	♦♦♦♦	Physical therapists should implement gait training to reduce motor disease severity and improve stride length, gait speed, mobility, and balance in individuals with Parkinson disease
Task-specific training	High	♦♦♦♦	Physical therapists should implement task-specific training to improve task-specific impairment levels and functional outcomes for individuals with Parkinson disease
Behavior-change approach	High	♦♦♦◊	Physical therapists should implement behavior-change approaches to improve physical activity and quality of life in individuals with Parkinson disease
Integrated care	High	♦♦♦♦	Physical therapist services should be delivered within an integrated care approach to reduce motor disease severity and improve quality of life in individuals with Parkinson disease
Telerehabilitation	Moderate	♦♦◊◊	Physical therapist services may be delivered via telerehabilitation to improve balance in individuals with Parkinson disease

[a]ROM = range of motion; VO_2 = oxygen consumption.

been found that allied health utilization is lower in African American and Hispanic individuals compared with Caucasian individuals with PD.[8] Therefore, understanding this impact is an important area for future research to provide insight into disparities that exist between groups in terms of access to health care-related resources.

Etiology

The etiology of PD is unknown.[9] The degree to which environmental hazards, genetic susceptibility, head injury, or sedentary lifestyle contribute to the development of PD is not well understood. This diversity in the potential cause or causes of this disease leads to extensive variation in motor and nonmotor symptoms that affects both the central nervous system and many peripheral tissues in the body.[9]

Risk Factors

Because the disease etiology is not well understood, relevant risk factors that influence the development of the disease are difficult to determine. Age is a known risk factor for disease development and peaks at around age 80.[9] Men and those of Hispanic origin develop the disease at higher rates than do women or those of other ethnicities.[9] Environmental risk factors such as pesticide or herbicide exposure, prior head injury, β-blocker use, rural living, agricultural occupation, and well-water drinking have been linked to the development of the disease, and other environmental risk factors such as tobacco, caffeine, physical activity, NSAIDs, calcium channel blockers, and alcohol have been associated with a reduced risk of developing the disease.[9,10] Additionally, at least 23 loci or genetic locations have been identified as causing symptoms related to PD.[11]

Potential Benefits, Risks, Harms, and Costs

The potential benefits, risks, harms, and costs are provided for each recommendation within this document.

Emotional and Physical Impact

Disease duration in those diagnosed with PD can span decades.[4] Due to the progressive nature of the disease, there is considerable emotional, social, and physical impact. These impacts include compromised functional status and quality of life, social isolation due to the presence and severity of motor and nonmotor symptoms, and increased burden on care partners.[12]

Future Research

Consideration for future research is provided for each recommendation within this document.

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Figure 1. Guideline Development Group roster.

Methods

The methods used to develop this CPG were employed to minimize bias and enhance transparency in the selection, appraisal, and analysis of the available evidence. These processes are vital to the development of reliable, transparent, and accurate clinical recommendations for physical therapist management of PD. Methods from the American Physical Therapy Association (APTA) *Clinical Practice Guideline Manual*[13] and the American Academy of Orthopaedic Surgeons (AAOS) *Clinical Practice Guideline Methodology*[14] were used in development of this CPG.

This CPG evaluates the effectiveness of approaches in the physical therapist management of PD. APTA sought out the expertise of the AAOS Evidence-Based Medicine Unit as paid consultants to assist in the methodology of this CPG. The guideline development group (GDG) consisted of physical therapist members from APTA and its representative sections and academies, AAOS, the American Parkinson's Disease Association, and a neurologist from the American Academy of Neurology (Fig. 1). All GDG members, APTA staff, and methodologists were free of potential conflicts of interest relevant to the topic under study, as recommended by the National

Academies of Sciences and Medicine's *Clinical Guidelines We Can Trust.*[15]

This CPG was prepared by the APTA Parkinson Disease Clinical Practice Guideline Development Group (clinical experts) with the assistance of the AAOS Clinical Quality and Value Department (methodologists). To develop this guideline, the GDG held an introductory meeting on April 4, 2019, to establish the scope of the CPG. The GDG defined the scope of the CPG by creating PICOT questions (eg, population, intervention, comparison, outcome, and time) that directed the literature search. The AAOS medical librarian created and executed the search. (See Suppl. Appendix 2, for the search strategy used). AAOS appraised the included randomized controlled trial studies and performed quality assessments based on the published guideline methodology. The GDG performed final reviews of the literature and created the recommendations, provided rationale in the context of physical therapist practice, and adjusted the strength of the recommendations depending on the magnitude of benefit, risk, harm, and cost.

Best Evidence Synthesis

This CPG includes only the best available evidence for any given outcome addressing a recommendation. Accordingly, the highest quality evidence for any given outcome is included first if it was available. In the absence of 2 or more occurrences of an outcome based on the highest-quality (Level I) evidence, outcomes based on the next level of quality were considered until at least 2 or more occurrences of an outcome had been acquired (Tab. 2). For example, if there were 2 "moderate" quality (Level II) occurrences of an outcome that addressed a recommendation, the recommendation does not include "low" quality (Level III) occurrences of evidence for this outcome. A summary of excluded articles can be viewed in (Supplementary Appendixes 3 and 4 for included articles). The quality assessments for each included article and the data findings for each recommendation can be viewed in Supplementary Appendixes 5 and 6, respectively.

Literature Searches

The medical librarian conducted a comprehensive search of PubMed, Embase, and the Cochrane Central Register of Controlled Trials based on key terms and concepts from the PICOT questions. Bibliographies of relevant systematic reviews were hand searched for additional references. All databases were last searched on June 16, 2020, with limits for publication dates from 1994 through 2020, English language, and only randomized controlled trials. The PICOT questions used to define the literature search and inclusion criteria, and the literature search strategy used to develop this CPG, can be found in Supplementary Appendix 2.

Defining the Strength of the Recommendations

Judging the quality of evidence is only a steppingstone toward arriving at the strength of a CPG recommendation. The operational definitions for the quality of evidence are listed in Table 2, and rating of magnitude of benefits versus risk, harms, and cost is provided in Table 3. The strength of recommendation (Tab. 4) also considers the quality, quantity, and trade-off between the benefits and harms of a treatment, the magnitude of a treatment's effect, and whether there are data on critical outcomes. Table 5 addresses how to link the assigned grade with the language of obligation of each recommendation.

Patient Involvement

An individual with PD participated in the development of this CPG through the peer-review process. The reviewer provided important feedback on the draft from the perspective of a physical therapy user and commented on the clarity and feasibility of implementing the recommendations. The GDG took the reviewer's feedback into consideration in making any necessary edits to the CPG.

Voting on the Recommendations

GDG members agreed on the strength of every recommendation. Recommendations were approved and adopted when a majority of 60% of the GDG voted to approve. All recommendations received 100% agreement among the quorum of the voting GDG. No disagreements were recorded during recommendation voting. When changes were made to the strength of a recommendation based on the magnitude of benefit or potential risk, harm, or cost, the GDG voted and provided an explanation in the rationale.

Structure of the Recommendations

The outcome categories included in each recommendation statement are organized according to the World Health Organization's International Classification of Functioning, Disability and Health Model domains in the following order: impairment level, activity level, and participation level. This order does not reflect prevalence or strength of findings.

Outcome Measures

The body of evidence for this CPG is comprised of 242 articles (Fig. 2). Although several studies examined the same intervention, the outcome measures used to assess the effectiveness of each intervention varied considerably, and hence there are many outcome measures referred to in the rationale section within each recommendation. The large number of outcome measures utilized could contribute to unwanted variation in practice and led to challenges when determining the effect size of a particular intervention. The Academy of Neurologic Physical Therapy developed outcome measures in the Parkinson Evidence Database to Guide Effectiveness (PDEDGE).[16] Throughout this CPG, the outcome measures recommended by PDEDGE are identified in bold, and citations to test summaries on apta.org and the Shirley Ryan Ability Lab Rehabilitation Measures Database are provided, when available. More recently, a CPG recommending a core set of outcome measures for adults with neurological conditions was published as an effort to streamline the assessments utilized across patients with neurological conditions.[17] These largely align with the recommendations of the PDEDGE task force, providing additional guidance in the choice of outcome measures implemented.

Role of the Funding Source

The American Physical Therapy Association, which funded the travel for 1 GDG meeting and for the AAOS services, provided coordination but played no other role in the design and conduct of this CPG or in the reporting of the recommendations.

Peer Review and Public Commentary

Following the formation of a final draft, the CPG draft was subjected to a 3-week peer review for additional input from

Table 2. Rating Quality of Evidence

Rating of Overall Quality of Evidence	Definition
High	Preponderance of Level I or II evidence with at least 1 Level I study. Indicates a high level of certainty that further research is not likely to change outcomes of the combined evidence.
Moderate	Preponderance of Level II evidence. Indicates a moderate level of certainty that further research is not likely to change the outcomes direction of the combined evidence; however, further evidence may impact the magnitude of the outcome.
Low	A moderate level of certainty of slight benefit, harm, or cost, or a low level of certainty for moderate-to-substantial benefit, harm, or cost. Based on Level II thru V evidence. Indicates that there is some, but not enough evidence to be confident of the true outcomes of the study and that future research may change the direction of the outcome and/or impact magnitude of the outcome.
Insufficient	Based on Level II thru V evidence. Indicates that there is minimal or conflicting evidence to support the true direction and/or magnitude of the outcome. Future research may inform the recommendation.

Table 3. Magnitude of Benefit, Risk, Harms, or Cost

Rating of Magnitude	Definition
Substantial	The balance of the benefits vs risk, harms, or cost overwhelmingly supports a specified direction.
Moderate	The balance of the benefits vs risk, harms, or cost supports a specified direction.
Slight	The balance of the benefits vs risk, harms, or cost demonstrates a small support in a specified direction.

Table 4. Strength of Recommendations

Strength	Strength Visual	Definition
Strong	♦♦♦♦	A high level of certainty of moderate-to-substantial benefit, harms, or cost, or a moderate level of certainty for substantial benefit, harms, or cost (based on a preponderance [2 or more] of Level I or II evidence with at least 1 Level I study).
Moderate	♦♦♦◊	A high level of certainty of slight-to-moderate benefit, harms, or cost, or a moderate level of certainty for a moderate level of benefit, harms, or cost (based on a preponderance of Level II evidence, or a single high-quality randomized controlled trial).
Weak	♦♦◊◊	A moderate level of certainty of slight benefit, harms, or cost, or a low level of certainty for moderate-to-substantial benefit, harms, or cost (based on Level II thru V evidence).
Theoretical/ foundational	♦◊◊◊	A preponderance of evidence from animal or cadaver studies, from conceptual/theoretical models/principles, or from basic science/bench research, or published expert opinion in peer-reviewed journals that supports the recommendation.
Best Practice	♦◊◊◊	Recommended practice based on current clinical practice norms; exceptional situations in which validating studies have not or cannot be performed yet there is a clear benefit, harm, or cost; or expert opinion.

Table 5. Linking the Strength of Recommendation, Quality of Evidence, Rating of Magnitude, and Preponderance of Risk Versus Harm to the Language of Obligation

Recommendation Strength	Quality of Evidence and Rating of Magnitude	Preponderance of Benefit or Risk, Harms, or Cost	Level of Obligation to Follow Recommendation
Strong	High quality and moderate-to-substantial magnitude	Benefit	Must or should
	or		
	Moderate quality and substantial magnitude	Risk, harms, or cost	Must not or should not
Moderate	High quality and slight-to-moderate magnitude	Benefit	Should
	or		
	Moderate quality and moderate magnitude	Risk, harms, or cost	Should not
Weak	Moderate quality and slight magnitude	Benefit	May
	or		
	Low quality and moderate-to-substantial magnitude	Risk, harms, or cost	May not
Theoretical/ foundational	N/A	Benefit	May
		Risk, harms, or cost	May not
Best practice	Insufficient quality and clear magnitude	Benefit	Should or may
		Risk, harms, or cost	Should not or may not

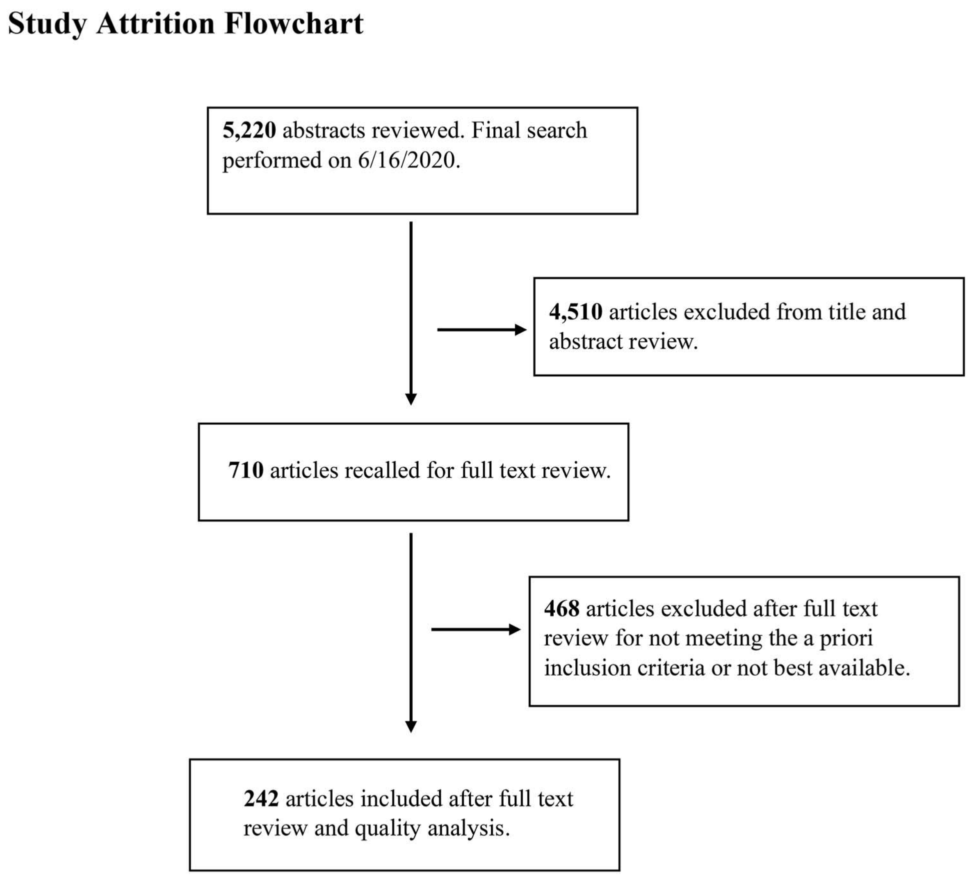

Figure 2. Study attrition flowchart.

external content experts and stakeholders. More than 250 comments from 12 societies were collected via an electronic structured review form. All peer reviewers were required to disclose any potential conflicts of interest, which were recorded and, as necessary, addressed.

After modifying the draft in response to peer review, the CPG was subjected to a 2-week public comment period. Commenters consisted of the APTA Board of Directors (Board), the APTA Scientific and Practice Affairs Committee, all relevant APTA sections and academies, stakeholder organizations, and the physical therapy community at large. More than 47 public comments were received. Revisions to the draft were made in response to relevant comments.

Recommendations

Aerobic Exercise ♦♦♦♦

Physical therapists should implement moderate- to high-intensity aerobic exercise to improve oxygen consumption (VO_2), reduce motor disease severity, and improve functional outcomes in individuals with PD. *Evidence quality: high; recommendation strength: strong.*

Action Statement Profile

Aggregate evidence quality: 9 high-quality studies[18–26] and 7 moderate-quality studies.[27–33]

Rationale

Nine high-quality and 7 moderate-quality studies examined the benefits of aerobic exercise in individuals with PD. Exercise studies encompassed in this section included an aerobic component, spanning moderate to high intensity. Across most studies, moderate-intensity exercise was defined as 60% to 75% of maximum heart rate (HR), whereas high-intensity exercise was defined as 75% to 85% of maximum HR.[21,23,24] However, there was variability in how moderate-exercise and high-intensity exercise were defined to determine target HR. Some studies used a percentage of HR reserve,[26,32] others used a percentage of HR maximum,[24] and others relied on a percentage of VO_2max.[18,30] Furthermore, some studies encompassed aerobic exercise that started at moderate intensity and gradually increased to high intensity,[26,31] whereas other studies defined target intensities that spanned the moderate to high ranges.[22] These studies also varied considerably in sample size, comparison group, outcomes measured, mode, and dose of aerobic exercise.

VO_2 and motor disease severity

Improvements at the impairment level have been demonstrated in many aerobic exercise trials in PD. High-[24,26] and moderate-quality[29,30,32] studies found that aerobic exercise compared with control (eg, usual care, stretching, strengthening) improved VO_2, suggesting a specificity of training effect. Though the effect of aerobic training on motor signs was mixed, 4 high-quality studies[22–24,26] revealed significantly reduced motor decline as measured by the **Movement Disorders Society Unified Parkinson Disease Rating Scale part III motor examination**.[34,35] Two of the high-quality aerobic exercise trials with the largest sample sizes[24,26] found less motor decline compared with a control condition (eg, usual care, stretching) in those with de novo PD or early PD (H&Y stages 1 to 2) tested in the "off" state. It has been suggested that dopaminergic replacement medications may mask the benefits of exercise, thus potentially accounting for lack of effects of aerobic exercise on motor symptoms when measured in the "on" state.[36] The variation in the timing of the assessment of motor signs may contribute to the mixed results across studies. Few studies have examined the effects of aerobic exercise on nonmotor signs; however, improvements in cognition,[33] sleep,[27] and depression[25] have been revealed compared with a usual care control condition.

Most aerobic exercise studies in individuals with PD consisted of walking on a treadmill or stationary cycling. Few studies have directly compared different modes of aerobic exercise, though no differences have been revealed when direct comparisons were made.[18] Results across studies using different modes of aerobic exercise were comparable,[24,26] suggesting no single form of aerobic exercise was superior to another. The intensity of aerobic exercise varied across studies. Improvements have been observed with both moderate- and high-intensity aerobic exercise across a variety of outcomes. Studies that have directly compared moderate- and high-intensity aerobic exercise[24,32] have found no differences between groups. However, in a 6-month phase II trial,[24] reduced motor decline was found in the high-intensity aerobic condition versus usual care control but not in the moderate-intensity aerobic condition versus usual care condition. This suggests a potential differential effect of high-intensity exercise on motor disease severity, though additional studies directly comparing moderate- and high-intensity aerobic exercise are needed to determine if there is a dose–response effect.

Functional outcomes and quality of life

Aerobic exercise has also been shown to improve various aspects of function and quality of life in individuals with PD. Two high-quality[19,25] and 2 moderate-quality studies[29,32] revealed improvements in gait-related outcomes, including the **6-Minute Walk Test (6MWT)**,[37,38] compared with usual care, strengthening, or low-intensity exercise. Other high-quality studies found improvements in balance and activities of daily living (ADLs)[22,25] compared with usual care or low-intensity exercise. Aerobic exercise has also been shown to improve global physical status or quality of life related to mobility[25,29] compared with a usual care control condition, though the evidence is limited to 1 high-quality and 1 moderate-quality study.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows:

- Improvements in VO_2
- Improvements in motor and nonmotor impairments
- Improvements in functional activities (eg, gait, balance, ADLs)
- Improvements in quality of life

Risk, harms, and/or cost are as follows:

- Aerobic exercise does not cause harm when therapists follow appropriate screening procedures to ensure there are no other medical conditions (eg, cardiac) that would preclude engagement in moderate- to high-intensity aerobic exercise.
- Some studies reveal that individuals with PD experienced minor musculoskeletal injuries with participation in aerobic exercise; however, most resolved without incident. Gradually progressing the duration and intensity of the aerobic exercise is recommended to reduce risk of injury.
- The mode of aerobic exercise should be chosen to ensure safe participation. For example, cycling rather than treadmill walking may be a safer aerobic exercise option in those who are at high risk of falling and/or with freezing of gait (FOG).

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Additional studies are necessary to determine the optimal intensity of aerobic exercise. Large, adequately powered studies directly comparing high- and moderate-intensity exercise are needed to determine if high-intensity aerobic exercise is superior to moderate-intensity exercise in reducing motor disease severity and in improving functional outcomes and quality of life. It is also important to determine if the benefits of aerobic exercise modify symptoms versus the disease progression in people with PD. More guidance on the optimal frequency and duration of aerobic exercise is also needed. In addition, more studies are warranted to determine the effects of aerobic exercise on nonmotor outcomes (eg, cognition, depression, sleep, anxiety). Furthermore, the adoption of a common set of outcome measures across aerobic exercise trials would facilitate the direct comparison of studies, thereby advancing the field forward more expeditiously.

Value Judgments

Given the potential benefits of moderate- to high-intensity aerobic exercise to reduce motor disease severity in PD, the GDG recommends that physical therapists prescribe aerobic exercise very early in the course of the disease. Though it is not clear whether the effects of aerobic exercise are disease modifying, the potential to reduce motor disease severity with aerobic exercise warrants early intervention.

Intentional Vagueness

Given the variability in the dosing of aerobic exercise across studies, the optimal dosing of aerobic exercise has not been determined. However, many studies reveal a benefit of aerobic exercise when implemented at least 3 days per week for 30 to 40 minutes each at moderate to high intensity. Due to autonomic dysfunction leading to a blunted HR response in some individuals with PD, rate of perceived exertion should also be considered as a means of monitoring exercise intensity.[39] Although the length of the trials and timing of follow-up assessments vary considerably among studies, it appears that gains dissipate if exercise is discontinued. This suggests that regular, long-term engagement in aerobic exercise is needed to sustain a benefit.

Exclusions

Most aerobic exercise studies include individuals with mild to moderate PD (H&Y stages 1–3). These recommendations may not apply to those with severe PD who do not have the capacity to engage in moderate- to high-intensity aerobic exercise.

Quality Improvement

Organizations may use documentation of moderate- to high-intensity aerobic exercise as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of moderate- to high-intensity aerobic exercise programs to improve VO_2 and functional outcomes and reduce motor disease severity.

Resistance Training ♦♦♦♦

Physical therapists should implement resistance training to reduce motor disease severity and improve strength, power, nonmotor symptoms, functional outcomes, and quality of life in individuals with PD. *Evidence Quality: high; Recommendation Strength: strong.*

Action Statement Profile

Aggregate Evidence Quality: 19 high-quality studies[22,40–57] and 28 moderate-quality studies.[28,32,58–83]

Rationale

Strength and power

Physical therapists should implement resistance training programs that are progressive in nature. Benefits were observed whether resistance training was carried out alone or as part of a multimodal program to improve strength and power in individuals with PD. There were 3 high-quality[44,48,79] and 3 moderate-quality studies[73,81,82] that favor resistance training compared with control to improve strength and power. The control groups in these studies included pharmacologic treatment alone;[26,30] nonexercise, education-based interventions[61,63,64]; or a low-intensity home-based exercise intervention.[55] When comparing resistance training with other modes of exercise, there are 2 high-quality studies[43,49] and 1 moderate-quality study[66] that favor resistance training to improve strength and power. A progressive resistance training program was shown to be more effective than a nonprogressive exercise intervention (modified from the Fitness Counts Booklet, Parkinson's Foundation) for improving elbow flexion and extension torque[66] and elbow flexion torque.[43] A progressive resistance training protocol using a weighted vest and ankle weights (60-minute class, twice weekly for 24 weeks) was superior to either tai chi or a stretching program to improve knee flexion and knee extension peak torque value as measured with use of isokinetic dynamometer.[49]

There was 1 high-quality[79] and 2 moderate-quality studies[61,81] that compared resistance training with other forms of resistance training. Resistance training with instability (RTI) was favored compared with resistance training alone to improve strength/power of the plantar flexors and knee extensors as measured via surface electromyography signals identified during submaximal isometric contractions on an isokinetic dynamometry.[79,81] RTI is described as resistance training (leg press, latissimus dorsi pulldown, ankle plantar flexion, chest press, and half squat) with an added progressive and concomitant increase in resistance and instability applied via unstable devices (eg, balance pad, dyna discs, balance discs, BOSU, and Swiss ball).

In 1 moderate-quality study[61] strength training was favored compared with power training to improve strength/power as measured by the chest press normalized at 80% of 1-repetition maximum. In this same study, power training was favored over strength training to improve strength/power as measured by the leg press normalized at 40% of 1-repetition maximum.

One high-quality study[52] and 2 moderate-quality studies[71,72] favored multimodal interventions that included resistance training compared with nonexercise, education-based controls to improve strength and power in people with PD. However, 2 high-quality studies found no difference between multimodal interventions that included resistance training and usual care control groups to improve strength and power in people with PD.[40,41] Multimodal interventions that included resistance training were not superior to modes of intervention that did not include resistance training (low-intensity trunk exercise and turning training control[24] and nonexercise, education-based control[54]) to improve lower extremity strength and power in individuals with PD, as indicated by 2 high-quality studies.[42,72] However, 1 moderate-quality study[32] favored resistance training compared with high-intensity treadmill training to improve lower extremity strength via the leg press.

Nonmotor symptoms

Physical therapists should implement resistance training that follows guidelines from the American College of Sports Medicine (ACSM) for progression to reduce nonmotor symptoms in individuals with PD.[84] There were 3 high-quality studies that favored resistance training compared with control (not engaged in exercise) to improve nonmotor function.[44,46,79] There was 1 moderate-quality study[80] that favored resistance training compared with control. One high-quality study[44] favored progressive resistance training compared with a non-exercising control group (standard pharmacological treatment only) for depression (Hamilton Depression Rating Scale). Silva-Batista[79] favored progressive RTI for improvements in cognition (**Montreal Cognitive Assessment**).[85] Ferreira[46] favored resistance training over standard pharmacological treatment to improve anxiety (Beck Anxiety Inventory). All 3 of these studies followed ACSM guidelines on progression of resistance.

Three high-quality[22,51,52] and 3 moderate-quality studies[59,62,63] identified no difference between multimodal interventions that included resistance training and controls that received a low-intensity exercise intervention,[10] nonexercise, education-based interventions,[33,34,44] or a handwriting intervention[41,45] to improve nonmotor symptoms. This evidence suggests that 1 mode of resistance training intervention is not superior to another to improve nonmotor symptoms.

Motor disease severity

Physical therapists should implement resistance training to reduce motor disease severity and can include it as 1 component of a multimodal program. Two high-quality studies favored resistance training compared with a stretching, balance, and strengthening program[25] or a stretching intervention[31] to improve Unified Parkinson's Disease Rating Scale (UPDRS) motor scores. There were 2 high-quality studies[22,52] and 4 moderate-quality studies[62,69,70,72] that favored multimodal interventions that included resistance training compared with a low-intensity exercise intervention,[10] nonexercise, education-based interventions,[34,54] handwriting interventions,[44] a pharmacologic intervention,[52] or no treatment[51] to improve motor disease severity as measured by UPDRS motor scores. There were 5 high-quality[44,45,50,55,57] and 1 moderate-quality study[80] that found no differences in disease severity when comparing resistance training with a control group.

Functional outcomes

There were 5 high-quality studies that favored resistance training compared with controls to improve function.[44,48,50,55,79] Progressive resistance training was favored over a pharmacologic treatment to improve mobility (Timed "Up & Go" Test [TUG] and a 2-minute sit-to-stand),[26,30] gait speed,[26,30] flexibility,[26] and balance (Tinetti & Sit & Reach).[30] Resistance training was favored over usual physical activity to improve fast gait speed on the **10-Meter Walk Test (10MWT)**,[86,87] and progressive RTI was favored over a nonexercised, education-based intervention to improve balance (BESTest) and stability (Biodex Balance system).[61] Progressive resistance training plus movement strategy training and falls education was favored over a control group that engaged in guided education and discussion to improve fall rate over 12 months and activities of daily living (UPDRS activities of daily living score). All 5 of these high-quality studies followed a systematic progression of resistance, with 4 of them following recommendations from the ACSM on progression of resistance.[84]

One high-quality study[79] and 3 moderate-quality studies[61,80,81] addressed 3 different modes of resistance training to improve balance and stability in people with PD. RTI was favored over resistance training to improve balance on all domains of the BESTest except reactive postural responses and sensory orientation.[79] RTI was also favored over resistance training to improve stability as measured by an overall stability index on the Biodex Balance System.[78,79]

The effects of resistance training on gait velocity were mixed. One high-quality study[54] measured the effect of a 24-month progressive strengthening program of trunk and upper/lower extremity (PRET-PD) on gait velocity (m/s), stride length (m), cadence (steps/minute), and double support time (percentage of gait cycle). At 24 months, there were no significant differences between groups (PRET-PD vs modified Fitness Count) on gait measures. However, both groups increased fast gait velocity, comfortable cadence, and fast cadence while in an "off" medication state compared with baseline and increases in comfortable and fast cadence while in the "on" medication state. Another high-quality study[49] demonstrated improvements in stride length and walking velocity that were similar to a tai chi group.

Multimodal interventions

Physical therapists should implement resistance training, either alone or as a part of a multimodal intervention, to improve function. Three high-quality studies[22,47,72] favored multimodal interventions that included resistance training compared with control to improve balance as measured by the **Mini BESTest**,[88,89] the Functional Reach Test, and the Berg Balance Scale (BBS). One of these studies identified these improvements both in the "on" and "off" medication state for individuals with PD.[22]

Three high-quality studies[42,52,53] and 1 moderate-quality study[64] compared multimodal interventions that included a resistance training component to another active intervention (eg, power yoga, low-intensity exercise, turning-based training, conventional physical therapy). No clear pattern was observed to indicate superiority of multimodal interventions with a resistance training component versus other active interventions.

Quality of life

There are 2 high-quality studies[46,55] that endorse the use of resistance training to improve quality of life compared with pharmacologic treatment[28] or usual care.[37] One high-quality study[25] and 1 moderate-quality study[16] favored resistance training over a multimodal program (Modified Fitness Counts) and over aerobic training to improve quality of life. In contrast, there are 2 high-quality[44,50] and 3 moderate-quality studies[28,58,80] that found no difference in the effect of resistance training on quality of life compared with pharmacologic treatment,[44,58] a nonexercise education-based intervention,[50,80] or usual care.[28] Another high-quality study[40] endorsed resistance training as part of a multimodal intervention to improve quality of life. These findings suggest that implementing resistance training for individuals with PD can influence quality of life.

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows:

- Improvements in strength/power
- Improvements in nonmotor symptoms (anxiety, cognition, depression)
- Reductions in motor disease severity
- Improvements in activities (gait speed, balance, mobility, stability)
- Improvements in quality of life
- Reduction in fall rate

Risk, harms, and/or costs are as follows:

- There are 6 studies[22,28,43,51,54,90] that found no significant difference in adverse events with resistance training compared with control or another active condition. In these studies, adverse events included strains and sprains, delayed onset muscle soreness, fatigue, cardiovascular events, pain, and falls. In 2 studies, hospitalizations and deaths occurred that were deemed unrelated to participation in these studies.[35,76] In 1 study, injurious falls were reported; however, there were similar rates of injurious falls in the experimental group (progressive resistance strength training and movement strategy training) and the control group (education-based life skills training).[43]

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Studies are needed to determine the effects of resistance training on nonmotor outcomes (eg, cognition, depression, sleep, anxiety), functional outcomes (eg, gait, balance, falls), and quality of life. Of importance, a common set of outcome measures is needed across these trials to allow direct comparison of results. More research is also needed to determine the lasting effects and/or long-term benefits of resistance training in those with mild, moderate, and severe PD.

Value Judgments

Physical therapists should be aware that improvement in outcomes due to resistance training is likely dose specific (eg, greater improvement in outcomes with longer duration or higher intensity of resistance training.) Some outcomes that did not show change with resistance training may show change after implementation of a longer or more intense resistance training dose. Resistance exercise may yield different outcomes when assessments are performed during the "on" medication state versus the "off" medication state. Outcomes may vary for individuals at more advanced stages of the disease. The value of specific modes of resistance exercise (eg, free weights, weighted vests, weight machines, closed- vs open-chain activities, body weight resistance) has not been compared, and therefore 1 mode cannot be recommended over another.

Intentional Vagueness

Given the variability in the dosing of resistance exercise across studies, the optimal dosing of resistance training has not been determined. However, many studies reveal a benefit of resistance exercise when implemented 1 to 2 days per week for 30 to 60 minutes while applying 80% of the repetition maximum to achieve strength gains and 40% of the repetition maximum to improve power. Studies also support progressively increasing the load by 2% when 3 sets of 15 repetitions are achieved with good form. Although the length of the trials and timing of follow-up assessments varies considerably among studies, it appears that gains dissipate if exercise is discontinued. This suggests that regular, long-term engagement in resistance exercise is needed to sustain a benefit.

Exclusions

Studies included only individuals in the early to moderate stages of PD without cognitive impairment; therefore, these recommendations may not apply to individuals with advanced PD (H&Y stage 5) or significant cognitive impairment.

Quality Improvement

Organizations may use documentation of resistance training programs as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of progressive resistance training programs to reduce motor disease severity and improve strength, power, nonmotor symptoms, functional outcomes, and quality of life.

Balance Training ♦♦♦♦

Physical therapists should implement balance training intervention programs to reduce postural control impairments and improve balance and gait outcomes, mobility, balance confidence, and quality of life in individuals with PD. *Evidence quality: high; recommendation strength: strong.*

Action Statement Profile

Aggregate evidence quality: 32 high-quality studies[40–42,47,91–118] and 20 moderate-quality studies.[31,77,119–136]

Rationale

Of the 52 aggregated articles related to balance training, 12 high-quality studies[40,41,47,91,95,101,104,108,114–116,118] and 10 moderate-quality studies[31,119,121,126–128,131,132,136,137] examined the benefits of balance training in individuals with PD compared with usual medical care (eg, medications only), conventional physical therapy (eg, without balance protocol), or general exercise (eg, calisthenics, stretching). These 22 studies varied considerably with regard to sample size, comparison group, outcomes measured, and type and dose of balance intervention. The remaining 30 articles addressed aspects of balance training that are included in the detailed rationale when appropriate (eg, physical activity, technology, comparing different types of balance interventions).

Postural control impairments outcomes

Improvements in postural control were found in 3 high-quality studies[101,115,118] and 2 moderate-quality studies.[128,131] Postural control impairment measures included sway, the Sensory Organization Test, limits of stability measured with technology (Balance Master/SMART Balance System) and the Functional Reach Test, and subscales of the **Mini-BESTest**[88,89] (reactive postural control). Interventions that improved postural control tended to include aspects of task specificity such as weight shifting with and without technology[101,118,131] and perturbation training.[128] There were no significant changes in impairment measures in 3 high-quality studies of primarily home-based, minimally supervised interventions compared with control.[40,41,91]

Balance outcomes

Balance outcomes improved in studies comparing a balance intervention group with a control group (usual care, gentle exercise, no intervention) in 6 high-quality studies[47,95,104,114–116] and 5 moderate-quality studies.[119,121,128,136,137] There was variation in the intervention approaches used to target balance, but most studies included multimodal balance training that incorporated elements of strengthening, sensory integration, anticipatory postural adjustments, compensatory postural adjustments, gait, and functional task training. The **Mini-BESTest**[88,89] was the most frequently used primary outcome measure (4 out of 7 high-quality studies). Additional balance measures reported in the high-quality articles included BBS and single-leg stance. High-quality studies that demonstrated favorable outcomes ranged in frequency (2–3 times per week) and duration (10–30 total hours: 5–12 weeks).

Mobility outcomes

Improvements in mobility outcome measures were identified in 3 high-quality studies[95,115,116] and 2 moderate-quality studies.[119,121] Mobility improved in individuals with PD when a supervised multimodal balance program was implemented 2 to 3 times per week, 16 to 30 total hours, for at least 5 and up to 10 weeks. Due to variability in settings, frequency, and delivery patterns, session durations ranged from 30 to 120 minutes. Common among these intervention programs was an emphasis on multidirectional stepping, motor agility, anticipatory postural control, and reactive balance. However, balance training that was a primarily home-based, minimally supervised intervention did not show significant improvements in mobility.[40,41,47,108]

Gait Outcomes

Improvements in gait outcomes, including gait velocity, **Functional Gait Assessment**,[138,139] **Freezing of Gait (FOG-Q)**,[140] and spatiotemporal measures (step length and stride) were found in 4 high-quality studies[40,95,101,114] and 1 moderate-quality study.[131] Each study that noted improvement in gait outcomes included an aspect of gait training in the intervention in addition to balance training; therefore, it is not possible to isolate the effects of balance training alone on gait outcomes.

Balance confidence outcomes

Outcomes related to balance confidence including the Falls Efficacy Scale-International and Activities Specific Balance Confidence Scale improved in 2 high-quality studies[41,47] and 3 moderate-quality studies[119,121,137] compared with control. Changes in balance confidence were not significant in 3 high-quality studies[40,95,108] and 1 moderate-quality study.[131]

Quality of life outcomes

Of the 12 high-quality studies considered for this recommendation statement, only 5 included measures of quality of life, including **Parkinson's Disease Quesionnaire-39 (PDQ-39)**[40,41,104,141,142] Euro-QoL-5 Dimension (EQ-5D),[47,91] Short-form Health Survey – 6 Dimension ,[41] 12-item Short Form Health Survey,[41] and Positive Affect Scale.[41] Of these, balance intervention was favored over control in **PDQ-39**[40,141,142] and EQ-5D.[91] This finding should be interpreted cautiously, because the other studies that measured quality of life either favored control[104] or showed no significant difference between balance intervention and control.[41,47]

Fall outcomes

The effect of balance training on falls outcomes is mixed. Several studies have examined the effect of balance training on fall rate and found no significant effect.[41,47,91,115,116,119] Interestingly, 1 high-quality study using a 6-month duration, primarily home-based, minimally supervised exercise program targeting fall risk factors found that falls were reduced in individuals with mild PD, but not in people with more severe PD.[41] Similarly, another moderate-quality study found in a secondary analysis that individuals with more moderate disease but not severe disease had decreased fall rates in the experimental group.[121] This would suggest that physical therapists may consider intervening earlier in the disease process with balance interventions intended to reduce fall rates.

Nonmotor symptom outcomes

Moderate-strength evidence suggests that balance training could be used to improve nonmotor symptoms compared with usual medical care or control interventions. Two moderate-quality studies supported improvements in depression as measured by the Geriatric Depression Scale.[119,121] One moderate-quality study supported improvements in cognition as measured by the Wechsler Memory Scale difficult III subscore when balance interventions were performed for at least 4 months.

Physical activity outcomes

Limited evidence supports the effect of balance training on physical activity. One high-quality study[47] demonstrated that recreational physical activity increased following balance training. Two high-quality[95,114] and 2 moderate-quality studies[119,121] demonstrated no difference in physical activity as measured by daily steps or the Physical Activity Scale for the Elderly between a balance training intervention and usual care.

Intervention comparisons

Technology

Balance interventions using technology were compared with traditional balance interventions without technology in 11 high-quality[42,94,98,101–103,107,111,112,117,118] and 5 moderate-quality studies.[122–124,130,131] Strong evidence supports the use of technology to reduce motor disease severity[94,111] and improve balance outcomes[94,112] and postural control impairment measures of stability (sway and the Sensory Organization Test).[42,94,107] There was moderate-strength evidence based on 1 high-quality study supporting the use of technology over traditional balance interventions for mobility outcomes,[94] balance confidence,[112] falls,[112] depression,[111] and quality of life.[112] However, heterogenous outcome measures and frequent equivocal results make it challenging to formulate a definitive recommendation. Many of the studies that demonstrated benefits of using technology required equipment that is not yet commercially available, such as wearable sensors,[94,112] research-grade force plates,[111] rotational treadmills,[42] or exergaming systems that are discontinued.[107]

Supervision

One high-quality study[99] and 1 moderate-quality study[120] compared more supervised with less supervised balance interventions. There was moderate-quality evidence that suggested physical therapists should use greater levels of supervision to have greater gains in self-efficacy,[99] motivation, and step length.[120]

Balance training compared with dynamic gait training

Five high-quality studies[96,100,102,109,110] and 2 moderate-quality studies[31,125] examined dynamic gait training interventions (low, moderate, and vigorous aerobic intensities) compared with balance training. Although results were mixed, moderate-to-vigorous aerobic training conducted on a treadmill may be superior to balance training to improve balance outcomes based on 1 high-quality[109] and 1 moderate-quality study.[31] Additionally, aerobic exercise conducted on a treadmill may improve gait outcomes to a greater extent than balance training based on 2 high-quality studies.[100,110] Because aerobic treadmill training can also challenge gait and balance, it is challenging to determine which aspect of the intervention accounts for the improvements observed.

Balance training compared with resistance training

Physical therapists should use balance training over resistance training to improve postural control, balance outcomes, and spatiotemporal gait impairments. This statement is supported by 1 high-quality study[105] and 3 moderate-quality studies.[77,133,134] The high-quality study suggested that the outcomes of balance and amount of sway were significantly improved with balance training compared with resistance training.[105] Two moderate-quality studies suggested that gait related measures may be improved with balance training over resistance training.[77,134]

Core strengthening for balance compared with conventional physical therapy

Two high-quality studies[92,97] compared core strengthening with conventional physical therapy, with conflicting findings related to balance. Therefore, no definitive statement can be made. One high-quality study suggested that core strengthening may improve balance [anticipatory, reactive postural control, and dynamic gait items of the **Mini BESTest**,[88,89] **Activities-specific Balance Confidence Scale** (ABC)[143]] and stability (forward and left directions on the Limits of Stability Test).[78] Another high-quality study suggested that improvements in sway (electronic platform)[83] resulted from core strengthening. The GDG concluded that physical therapists could recommend core strengthening as a part of balance training interventions if the goal was to improve balance, stability, and sway as measured above. Conventional physical therapy may be more effective than core strengthening to improve range of motion (ROM) or quality of life.[97]

Aquatic balance training compared with land-based balance training

Physical therapists may consider aquatic therapy over land-based therapy to improve fear of falling and quality of life. One high-quality study favored aquatic-based balance exercise over land-based exercise for improving postural sway and quality of life in individuals with PD.[106] Another high-quality study favored aquatic-based balance exercise over land-based balance exercise to improve fear of falling as measured by the Falls Efficacy Scale but showed no difference in postural sway.[113]

Potential Benefits, Risks, Harms, and Costs of Implementing This Recommendation

Benefits are as follows:

- Improvements in postural control impairments
- Improvements in balance outcomes
- Improvements in mobility outcomes
- Improvements in gait outcomes
- Improvements in outcomes related to balance confidence
- Improvements in quality of life
- Improvements in nonmotor symptoms

Risk, harms, and/or cost are as follows:

- Falls are a potential risk when individuals with PD are implementing balance exercises. However, few studies reported adverse events, but those that did reported a small number of adverse events that were minor in nature and found no difference in number of adverse events between intervention groups and control.[119,121]
- One study published cost-effectiveness data,[127] noting that balance intervention provided in a group setting was more costly than the usual care control group but yielded greater gains in balance, gait, and quality-adjusted life years for individuals with PD.
- Many high- and moderate-quality studies[42,94,98,103,107,111,112,117,118,122–124,130,131] used technology to deliver balance interventions. The cost of using many of these technologies may be prohibitive to clinical facilities and therefore less accessible to some individuals with PD.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Additional high-quality research is needed in several areas. More research is needed to determine the benefits of balance training in reducing fall rates. Given mixed results, the essential ingredients of balance training necessary to reduce fall rate remain unclear and need to be determined to better inform practice. More research is also needed to determine which patients with PD benefit most from balance training when the goal is to reduce fall risk and rate. It is important to determine the cost-effectiveness of balance training relative to the cost of adverse events, including injurious falls, hospitalizations, and transition to supported living environments. Research is also needed to compare different types of balance interventions (eg, dynamic gait training compared with traditional balance training), various doses of balance interventions, and methods of delivery (individual, group, home) to better inform care delivery patterns. Research is also needed to determine which gait outcomes benefit from balance interventions when these interventions are delivered separately from gait interventions. Future research should also focus on standardizing outcomes across studies and incorporating evidence-based balance and functional outcomes that are responsive to change. Due to mixed evidence or a paucity of evidence, more research is needed to assess the benefits of balance training on nonmotor signs, physical activity levels, and quality of life.

Value Judgments

Physical therapists should include balance training interventions as part of a comprehensive exercise program to improve postural control, balance, and functional mobility. Given the high prevalence of falls in PD and evidence from 2 studies[41,121] revealing reduced fall rates in those with lower disease severity, physical therapists should consider initiating balance training early in the course of the disease.

Intentional Vagueness

The dosing of balance interventions varies across studies. However, many studies reveal a benefit of balance training when implemented 2 to 3 times per week for 16 to 30 total hours over 5 to 10 weeks. Given that falls are multifactorial in PD, balance training may need to be combined with other interventions to reduce fall rate, particularly those with greater disease severity.

Exclusions

The included studies only included individuals with disease severity classified as H&Y stages 1 to 4; therefore, these recommendations may not apply to individuals with advanced PD (H&Y stage 5).

Quality Improvement

Organizations may use documentation of balance training as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of balance training to reduce postural control impairments and improve balance and gait outcomes, mobility, balance confidence, and quality of life.

Flexibility Exercises ♦♦◊◊

Physical therapists may implement flexibility exercises to improve ROM in individuals with PD. *Evidence quality: low; recommendation strength: weak.*

Action Statement Profile

Aggregate evidence quality: 1 moderate-quality study.[144]

Rationale

One moderate-quality study[144] found that exercise specifically designed to improve spinal flexibility improved axial rotation, whereas other measures (functional reach and timed supine to and from standing) were unchanged compared with a waitlist control condition. This study did not examine flexibility of the extremities. The evidence quality was rated low because there was only 1 study of moderate quality that met the inclusion criteria.

Potential Benefits, Risks, Harms, and Cost of Implementing This Recommendation

Benefits are as follows:

- Improvements in axial ROM

Risk, harms, and/or cost are as follows:

- No adverse events were noted.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost demonstrates a small support for this recommendation.

Future Research

Additional high-quality studies to examine the effects of stretching and flexibility (axial and appendicular) on ROM and function are necessary. Studies are warranted to determine which modes of exercise or combinations of ROM exercises (axial mobility, general flexibility) are most effective in preserving or restoring ROM and function in individuals with PD. Continued comparative studies are also needed to determine if supervised or unsupervised programs are superior for improving flexibility. Last, studies are needed to determine optimal outcome measures for determining improvement in flexibility and effect on motor symptoms, function, and quality of life in individuals with PD.

Value Judgments

Given that rigidity is a prominent symptom of PD that can lead to ROM restrictions, physical therapists may include general stretching and flexibility for individuals with PD at all stages of the disease.

Intentional Vagueness

Given the limited research available, recommendations regarding target muscle groups, dosing parameters, mode of flexibility exercise, and supervised versus unsupervised exercise cannot be made.

Exclusions

None were identified.

Quality Improvement

Organizations may use documentation of flexibility exercises as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of flexibility exercises to improve ROM.

External Cueing ♦♦♦♦

Physical therapists should implement external cueing to reduce motor disease severity and FOG and to improve gait outcomes in individuals with PD. *Evidence quality: high; recommendation strength: strong.*

Action Statement Profile

Aggregate evidence quality: 13 high-quality studies[93,111,145–155] and 16 moderate-quality studies.[69,137,156–169]

Rationale

Thirteen high-quality and 16 moderate-quality studies examined the benefits of external cueing in individuals with PD. External cueing was defined for the purposes of this CPG as an external temporal or spatial stimuli,[151] including rhythmic auditory cueing,[93,146,152,154] visual cues,[111,148,150,155] verbal cues, or attentional cues.[170,171] These studies varied considerably regarding sample size, comparison group, outcomes measured, mode, frequency, duration, and type of external cueing.

Motor disease severity

Four high-quality studies[93,111,148,154] and 1 moderate-quality study[159] identified that external cueing was superior to other modes of intervention or no cueing training at all for reducing motor disease severity as measured by the UPDRS III. Gait training with visual cues was superior to overground training without cues,[148] and visual feedback during balance training was superior to conventional balance training without visual feedback.[111] Rhythmic auditory stimuli (RAS) provided during balance training was superior to a general educational program,[93] RAS during treadmill training was superior to treadmill training without RAS,[159] and cueing training that included visual, auditory, or somatosensory cues during standing balance and gait tasks[154] was superior to no cueing training. Cueing in all these studies was delivered between 20 minutes to 1 hour, 2 to 5 times per week for 3 to 8 weeks.

Three high-quality studies[145,150,152] and 1 moderate-quality study[157] identified reductions in motor disease severity when different modes of external cueing were compared, indicating that no one mode of external cueing is superior to another. An additional high-quality study[155] and a moderate-quality study[167] also identified no difference in motor disease severity when external cueing was compared with conventional physical therapy. External cueing in these studies included visual and auditory cues delivered during gait training on a treadmill instrumented with a visual display,[150] visual and auditory cues provided during overground gait training,[150,152,155] cues with an internal focus of attention,[145,157] visual cues placed on the limbs with emphasis on an external focus during limb movements,[145,157] and active music therapy.[167]

One moderate-quality study identified that music delivered continuously during overground walking was superior to music that played only if the participant achieved a predetermined stride length via a preprogrammed wearable sensor.[158] Two moderate-quality studies favored an attentional strategy using cues to produce large amplitude whole body movements Lee Silverman Voice Treatment physical or occupational therapy improves mobility and movement used in everyday function (LSVT BIG) delivered for 1 hour, 4 times per week for 8 weeks compared with 1 hour of Nordic walking 2 times per week for 8 weeks.[163] LSVT BIG was also favored over a shortened amplitude-oriented training delivered 5 times per week for 2 weeks.[165]

Gait outcomes

Spatiotemporal parameters of gait

Four high-quality studies[149,153–155] and 2 moderate-quality studies[159,168] identified that external cueing was superior to usual physical therapy care,[149,155] overground gait training without cues,[153] treadmill gait training without cues,[159] and no treatment[154,168] to improve gait speed as measured by an instrumented treadmill[149,155] during a 20-m walk[153] and during the **10MWT**.[86,87,154,159,168] External cueing in these studies included augmented proprioceptive stimuli applied to the feet through shoe sensors during treadmill training[149] and overground gait training using visual cues[153]; a multimodal exercise program that included overground gait training with visual cues[155]; cueing training that included visual, auditory, or somatosensory cues during standing balance and gait tasks[154,168]; and treadmill training using RAS.[159] Cueing interventions in all of these studies was delivered 2 to 5 times per week for 3 to 8 weeks.

An additional high-quality study[150] identified that visual and auditory cues delivered during gait training on a treadmill instrumented with a visual display were superior to visual and auditory cues provided during overground gait training to improve gait speed, measured using an instrumented treadmill, and delivered 7 times per week for 4 weeks.

In addition to gait speed, other spatiotemporal parameters of gait positively influenced by external cueing includes stride length in 2 high-quality studies[149,150] and cadence in 2 high-quality stidies.[149,155]

Overall, external cueing provided during overground or treadmill training or during standing balance training that includes visual, auditory, and/or proprioceptive cues has immediate and positive impact on spatiotemporal parameters of gait including gait speed, stride length, and cadence in individuals with PD.

Functional gait outcomes

One high-quality study[93] and 3 moderate-quality studies[160,161,163] identified that external cueing was superior to general education,[93] traditional overground gait training,[161] home-based nonsupervised exercise,[163] and home-based walking without cues[160] to improve mobility as measured by the TUG[93,160,161,163] and the **Dual Task TUG**[172] (item 14 of the **Mini BESTest**).[88,89,93] External cueing in these studies included RAS-supported multimodal balance training performed 2 times per week for 5 weeks,[93] treadmill training that integrated RAS with auditory cues provided by music performed 3 times per week for 8 weeks,[161] LSVT BIG performed 4 times per week for 4 weeks,[163] and treadmill training using music cues combined with home walking without cues performed 6 times per week for 8 weeks.[160]

Capato et al[93] also identified improvements in turning with RAS-supported balance training. An additional moderate-quality study[169] identified improvements in single- and dual-task foot clearance during 5 practice trials of a clock-turn intervention.

Three high-quality studies[150,151,153] and 2 moderate-quality studies[160,163] identified that external cueing was also beneficial for improving longer distance walking as measured by the **6MWT**[37,38,150] and the number of steps taken over a 20-m walkway.[153]

Overall, external cueing provided during overground or treadmill training or during standing balance training that includes visual and/or auditory cues has immediate and positive impact on mobility, turning, and distance walked in individuals with PD.

Freezing of gait

FOG was shown to improve with cueing compared with a no-cueing condition in 1 high-quality study.[93] In this study, balance training plus RAS was superior to an educational control in improving FOG.[93] In a high-quality, randomized cross-over trial, FOG was not significantly affected by the cueing intervention.[154] However, when a subgroup of freezers was analyzed, there was a significant reduction in freezing severity (**FOG-Q**[140] scores) with cueing compared with a no-cueing condition.[154] Greater improvement in FOG was shown with treadmill training plus visual and auditory cues compared with overground gait training with visual and auditory cues.[150] It is plausible that the treadmill itself may provide an additional form of cueing. One high-quality study[152] revealed that no one form of auditory cueing [ecological stimuli = footstep recordings vs artificial (metronome)] was superior to another in reducing FOG.

Potential Benefits, Risks, Harms, and Cost of Implementing This Recommendation

Benefits are as follows:

- Improvements in motor disease severity
- Improvements in spatiotemporal parameters of gait
- Improvements in functional gait outcomes
- Improvements in FOG

Risk, harms, and/or cost are as follows:

- Gait training with external cues should not cause harm if routine safety procedures are followed.
- The cost of utilizing technology for the external cueing source should be considered.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Additional high-quality studies are needed to determine the most effective timing, intensity, and mode of external cueing depending on the outcome of interest and disease severity.

More studies are also needed to determine the optimal type, timing, and dosing of cueing to reduce FOG. No studies were identified that investigated the effects of external cueing on fall rate or number of falls, indicating an important area for further research. Optimal modes of delivery leveraging advances in technology should also be examined. The lasting effects of cueing are unclear, because benefits appear to dissipate over time. More studies are needed to determine optimal dosing to sustain benefits over time (eg, ongoing use vs booster sessions).

Value Judgments

Given the early changes observed in spatiotemporal parameters of gait, the predominance of walking limitation in individuals with PD, and the lack of robust benefits from pharmacological interventions, the GDG recommends initiating gait training with external cues early in the course of the disease.

Intentional Vagueness

Given the variability in the dosing of external cueing, optimal dosing recommendations cannot be provided. Given that effects appear to dissipate when the cues are removed, ongoing gait and standing balance training with cueing may be necessary.

Exclusions

None.

Quality Improvement

Organizations may use documentation of external cueing as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of external cueing to reduce motor disease severity and FOG and to improve gait outcomes.

Community-Based Exercise ♦♦♦♦

Physical therapists should recommend community-based exercise to reduce motor disease severity and improve nonmotor symptoms, functional outcomes, and quality of life in individuals with PD. *Evidence strength: high; recommendation strength: strong.*

Action Statement Profile

Aggregate evidence quality: 27 high-quality studies,[40,41,47,49,52,53,99,129,173–191] 29 moderate-quality studies,[62,63,68,69,83,126,192–214] and 1 low-quality study.[215]

Rationale

Fifty-seven total studies examined the effects of community-based exercise in individuals with PD. These studies varied considerably in sample size, comparison group, outcomes measured, mode, and dose of exercise.

Community-based exercise is defined in this CPG as follows: (1) programs in which groups of individuals exercise together; or (2) programs in which individuals follow a predetermined exercise program in a community setting either at home or in a community facility. These programs often include a home exercise component. It is not necessary for community exercise programs to be led by a physical therapist, nor are they associated with periodic assessments of individualized physical therapy programs.

Motor disease severity

Four high-quality studies[52,173,176,180] and 6 moderate-quality studies[62,195,200,203,210,215] indicated that community-based exercise programs reduced motor disease severity as measured by the **Movement Disorders Society Unified Parkinson Disease Rating Scale part III motor examination.**[34,35] All of the high-quality studies consisted of varied interventions (yoga, dance, Pilates, power training); however, the doses were consistent (1-hour sessions 2 times per week for 12–13 weeks). There was greater variability in dosing in the moderate-quality studies with a minimum of 16 sessions and a maximum of 96 sessions, ranging from 1 time per week for 16 weeks to 2 times per week for 12 months. The intervention types were also varied and included aerobic and anerobic exercise via a booklet, tango dance, tai chi, power training, Dance for PD, and qigong.

Nonmotor symptoms

Two high-quality studies[179,185] and 1 moderate-quality study[214] found that community-based exercise improved depression as measured by the Hospital Anxiety and Depression Scale, Beck Depression Inventory, and the Geriatric Depression Scale, and improved cognition as measured by **Montreal Cognitive Assessment,**[85] Mini-Mental State Examination, and Wechsler Memory. One high-quality[179] and 1 moderate-quality study[214] revealed improvements in anxiety as measured by the Hospital Anxiety and Depression Scale and State–Trait Anxiety Inventory. One high-quality study found improvements in sleep as measured by the Parkinson Disease Sleep Scale.[173] The studies that improved nonmotor symptoms all included interventions for breathing and relaxation, with frequency and duration ranging from 1 to 2 hours per week for 8 to 25 weeks.

Functional outcomes

Ten high-quality studies[40,41,47,52,53,175–177,181,184] and 8 moderate-quality studies[83,192–195,201,212,214] were in favor of community-based exercise for improving function (walk tests, balance, mobility, falls, fall fear/risk, and ADLs). These community-based exercise programs included tai chi,[175] resistance training,[53] action observation training,[181] dance,[177,184,195] balance exercise and lower extremity strengthening,[40,41,47,83] Pilates,[192,194] Nordic walk,[193] qigong,[201] mindful meditation,[214] Feldenkrais,[212] and power yoga.[203] High-speed yoga[52] and action observation training[181] led to improvements in gait speed, and tai chi and dance led to improvements in functional mobility as measured by the TUG test and improvements in turning as measured by the 360-degree Turn Test and 3-dimensional motion analysis.[175–177,184,212]

The effect of community-based exercise on balance is not clear, because there were 8 high-quality studies[40,129,175,178,181,186,191,199] that demonstrated no significant improvements in balance and 5 high-quality studies[47,52,53,176,184] favored community-based exercise to improve balance. There is no clear explanation for these conflicting results, because the aforementioned studies examined community-based exercise programs with similar outcome measures and nonactive control comparisons. The studies that did not demonstrate significant improvements included strength and balance training, tai chi, ai chi, dance, qi dance, yoga, and action observation training. The studies that did demonstrate significant improvements in balance included strength and balance training, resistance training, tai chi, power yoga, and tango. There was no consistent difference in dose or mode of exercise that might explain this discrepancy.

Three high-quality studies[52,99,187] and 1 moderate-quality study[206] demonstrated improvements in gait-related outcomes, including sway, stride, FOG, and balance as measured by the BBS compared with power training, individual training, routine physical therapy, and home exercise program.

Quality of life

Five high-quality studies[40,129,179,185,188] and 2 moderate-quality studies[83,214] supported the use of community-based exercise to improve quality of life in individuals with PD. These studies measured quality of life using a variety of measurements, including the **PDQ-39** and **-8**,[141,142] Holistic Well-Being Scale, and Parkinson's Disease Quality of Life Questionnaire. Most studies that demonstrated improvements in quality of life included some aspect of mindful movement or awareness of movement.[129,179,185,188,214]

Intervention comparisons

Community-based exercise studies in PD consisted of a variety of exercise modes such as tai chi, ai chi, power yoga, hatha yoga, Pilates, group multimodal training, dance, noncontact boxing, Nordic walking, qigong, action observation training, mindful meditation, and the Feldenkrais method. Several studies have made direct comparisons between community-based exercise programs. Results across several high-quality studies using different modes of exercise in community-based programs appear comparable for impairment and participation-based measures,[174,183,207] suggesting no 1 mode of exercise in a community exercise program is superior to another. However, other comparisons suggest that 1 intervention is favored over another. Several studies examined the effect of community-based exercise on balance outcomes. Three high-quality studies[49,174,182] and 1 moderate-quality study[204] indicated superior balance outcomes when comparing boxing over traditional multi-modal exercise,[174] tai chi over stretching exercise,[49] ai chi exercise over dry land exercise,[182] and Pilates over conventional physical therapy.[204] Similarly, studies of tai chi,[49] ai chi,[182] and Pilates[204] found superior mobility outcomes as measured by the TUG. The essential components that distinguish more effective from less effective community-based exercise programs are not clear.

Two high-quality studies[99,190] and 1 moderate-quality study[206] examined an intervention delivered in a community-based group exercise program versus an individual-based program. One of those high-quality studies showed improved adherence to the community-based exercise program compared with an individual-based program.[190] Another high-quality study showed improved quality of life as measured by the **PDQ-39**.[99,141,142] This suggests there may be some benefit to a community-based group exercise over individual exercise programs.

Potential Benefits, Risks, Harms, and Cost of Implementing This Recommendation

Benefits are as follows:

- Improvements in motor (strength/power, posture, hand-upper extremity dexterity, hand-eye coordination) and nonmotor symptoms (anxiety, depression, cognition, and sleep)
- Improvements in functional outcomes (eg, gait, balance, mobility, ADLs, walking capacity and velocity, walking measures, turning) and falls/fear of falling
- Improvements in quality of life

Risk, harms, and/or cost are as follows:

- Three high-quality studies[179,184,187] and 2 moderate-quality studies[62,210] found no significant differences in adverse events between community-based exercise and the comparison groups.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Given the benefits associated with participation in community-based exercise programs for individuals with PD, more information about adherence rates and long-term outcomes compared with individual home exercise programs would help to inform exercise recommendations provided by physical therapists. Additionally, a meta-analysis of the effect of community-based exercise on balance is warranted given the conflicting evidence in several high-quality studies. Finally, future research should stratify analyses by disease severity, subtype of PD, or functional ability, or focus on intervention studies that are targeted to subgroups of individuals with PD.

Value Judgments

Given the potential benefits of community-based exercise programs to improve motor and nonmotor symptoms, the work group recommends that physical therapists encourage individuals with PD to participate in community-based exercise programs. Though it is not clear what mode of exercise yields the most optimal results, one that targets the most relevant areas of concern (eg, balance, aerobic conditioning, strength, flexibility) for a given individual may be most beneficial. Considering that PD is a progressive disease, regular access to and participation in community-based exercise is recommended.

Intentional Vagueness

Given the variability in the study interventions, with no clear mode of exercise shown to be superior, the work group cannot recommend 1 community-based exercise program over another.

Exclusions

Most studies include individuals with mild to moderate PD (H&Y stages 1–3). These recommendations may not apply to individuals with severe PD, who may not have the capacity to engage in community-based exercise programs. Most studies limited participation to those who did not have cognitive impairments. These recommendations may not apply to individuals with cognitive impairments.

Quality Improvement

Organizations may use documentation of community-based exercise programs as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of community-based exercise programs to reduce motor disease severity and improve nonmotor symptoms, functional outcomes, and quality of life.

Gait Training ♦♦♦♦

Physical therapists should implement gait training to reduce motor disease severity and improve stride length, gait speed, mobility, and balance in individuals with PD. *Evidence quality: high; recommendation strength: strong.*

Action Statement Profile

Aggregate evidence quality: 20 high-quality studies[100,102,109,110,216–231] and 13 moderate-quality studies.[125,232–243]

Rationale

Most studies examining the benefits of gait training in individuals with PD compare 1 form of gait training with another. Fewer studies compare gait training with a usual care control intervention or with other types of interventions. The approaches to gait training and the outcomes assessed vary widely across studies.

Motor disease severity

Gait training has been shown to reduce motor disease severity (**UPDRS III**)[34,35] in individuals with PD. When comparing different types of gait training within a study, 4 high-quality studies[102,216,217,230] and 3 moderate-quality studies[125,232,237] found that motor disease severity was reduced with the gait training interventions, although 2 high-quality studies[218,223] and 1 moderate-quality study[233] indicated no reduction in motor disease severity with any of the gait training interventions. In 1 moderate-quality study,[239] a decrease in motor disease severity was found with partial weight-supported treadmill training compared with usual care. When comparing gait training with other treatments, a reduction in motor disease severity was found for gait training (curved walking rotating treadmill) compared with general exercise.[219] Both robotic-assisted gait training (RAGT) and balance training reduced motor disease severity compared with general exercise.[226]

Step length and cadence

Three high-quality studies[219,226,227] and 1 moderate-quality study[243] compared gait training with other treatment approaches, revealing improvements in step length. One high-quality study found that step length improved for 2 types of gait training interventions (treadmill and RGAT), whereas proprioceptive neuromuscular facilitation (PNF)-based (nonambulatory) gait training (rhythmic initiation, slow reversal, and agonistic reversal exercises applied to the pelvic region) did not improve step length.[226] One high-quality study[227] and 1 moderate-quality study[243] compared gait training interventions with conventional multimodal therapies (RAGT and downhill treadmill training), finding the gait interventions had greater step length improvements. Curved walking training improved step length and cadence in both straight path and curved path walking compared with the control exercise program.[219]

There were mixed results when comparing step length outcomes with different types of gait training. Two high-quality studies[222,226] and 1 moderate-quality study[241] found that gait training improved stride length in individuals with PD regardless of which gait training interventions were provided (treadmill with and without virtual reality [VR], treadmill training, RGAT). Three high-quality studies[222,224,229] and 1 moderate-quality study[233] found that 1 gait training technique had greater improvements in step length than another technique, but there was no consistent difference between these studies regarding which technique was best (RGAT vs treadmill; backward vs forward walking; treadmill vs overground).

There were mixed results related to the effects of gait training on cadence. Two high-quality studies showed no improvement in cadence with gait training.[224,226] However, 1 high-quality study[227] revealed that cadence improved with RAGT compared with conventional therapy, and another high-quality study[222] found that cadence improved with RAGT but not with intensive treadmill training. One moderate study showed improvement in cadence with both treadmill and overground training.[233]

Gait speed

Three high-quality studies found that the gait training interventions (circular treadmill, RAGT, forward treadmill walking) yielded improvements in gait speed, whereas other interventions (general exercise, conventional therapy, PNF) did not.[219,226,227] Two moderate-quality studies revealed greater improvements in gait speed with downhill treadmill training compared with multimodal conventional therapy and with aerobic treadmill training plus conventional therapy compared with conventional therapy alone.[240,243]

Seven high-quality[109,217,218,223,225,226,231] and 3 moderate-quality[232,233,241] studies identified that gait speed improved regardless of the mode of gait training applied. Overground and treadmill training,[233] treadmill training forward and backward,[224] treadmill training both with and without repetitive transcranial magnetic stimulation,[231] treadmill training with and without perturbations,[109] and a smartphone application that offered positive and corrective feedback on gait and gait training with personalized gait advice[223] yielded similar favorable results within each study. One moderate-quality study measured gait speed while negotiating obstacles, with greater improvement with treadmill training with VR than treadmill training alone[242]; however, another study found that both single- and dual-task gait speed improved similarly in both treadmill and treadmill with VR training, making the impact of adding VR unclear.[241] One moderate-quality study incorporated the upper extremity during gait training, finding that although both groups improved, Nordic walking on the treadmill had greater improvements than treadmill training alone.[232] Variable gait speed outcomes were found in 4 high-quality studies[217,218,222,229] comparing RAGT with treadmill training. One study found greater gait speed improvements with treadmill training than with RAGT,[218] 2 studies showed RAGT improving greater than treadmill training,[222,229] and 1 study found similar improvements between treadmill and RAGT.[217]

Only 1 high-quality study found that an alternative treatment to gait training had a greater improvement in gait speed. When comparing VR (in-place walking), conventional overground gait training, and treadmill training, the VR group demonstrated greater improvements in gait speed than the overground training group, but at a similar level to the treadmill training group.[221]

Mobility

Gait training has been shown to improve walking outcomes (**6MWT**,[37,38] 2MWT test, TUG) in individuals with PD. Two high-quality studies compared gait training interventions with conventional therapy (primarily PNF-based nonambulatory gait training) and found greater improvements in the **6MWT**[37,38] with RAGT and treadmill training.[226,227] Two high-quality studies found greater improvements on the TUG with RAGT than with other physical therapist interventions not aimed at improving balance[228] or physical therapist interventions that included balance and postural reaction training.[102] Additionally, curved gait training on a treadmill resulted in improved mobility as measured by the TUG, compared with control exercise intervention.[219] One moderate-quality study found similar functional mobility improvements between the gait intervention group (conventional therapy plus moderate aerobic training) and conventional therapy.[240] One high-quality study found VR with walking in place improved **6MWT**[37,38] greater than conventional overground gait training, although treadmill-based gait training and the VR group demonstrated similar improvements.[221] Cakit et al[235] found that incremental speed-dependent treadmill training had greater improvement on walking distance than an inactive control group.

Seven high-quality studies[216–218,223,225,226,231] and 1 moderate-quality study[232] compared different gait training interventions and identified that walking outcomes improved regardless of the mode of gait training applied. In 3 high-quality studies, both conventional treadmill training and RAGT indicated similar improvements in the distance covered during the **6MWT**[37,38] and mobility as measured by the TUG.[217,218,226] One high-quality study[231] identified improvement in mobility (TUG) after treadmill training both with and without repetitive transcranial magnetic stimulation. Another high-quality study[223] compared a smartphone application that offered positive and corrective feedback during gait with gait training with personalized gait advice, finding similar improvements in the 2MWT for both groups. One moderate-quality study favored Nordic walking on the treadmill compared with treadmill training alone to improve mobility.[232]

In all of the studies assessing the impact of gait training on mobility, only 1 high-quality study[109] and 1 moderate-quality study[233] did not find all gait training interventions to improve all functional mobility outcomes, although some improvements in each study were noted.

Balance

Gait training has been shown to improve balance in individuals with PD, although there are some mixed results. One high-quality study[102] identified improvements in balance and balance confidence as measured by the BBS and the **ABC**[143] in the group that participated in RAGT as well as in the group that participated in physical therapist intervention with an emphasis on balance and postural reactions. Alternatively, RAGT resulted in improvements in balance as measured by the BBS compared with physical therapist intervention that did not focus on improvements in postural stability.[228] Another high-quality study found that gait training with RAGT demonstrated greater improvement in balance as measured by the BBS compared with treadmill training alone or PNF-based (nonambulatory) physical therapist interventions.[226] Similarly, a high-quality study identified improvements in balance as measured by the **Functional Gait Assessment**[138,139] using curved gait training on a treadmill compared with the control exercise group.[219]

One moderate-quality study identified that incremental speed-dependent treadmill training had greater improvement than an inactive control group on balance as measured by the BBS and the Dynamic Gait index and fear of falling measured by the Falls Efficacy Scale.[235] Another moderate-quality study identified improvements in balance as measured by the BBS in a group that participated in conventional gait training and a group that utilized body weight–supported treadmill training compared with an inactive control group.[239]

Three high-quality[216,225,230] and 2 moderate-quality[232,237] studies compared different gait training interventions and found, regardless of the gait training method used, performing gait training improved balance outcomes, whereas 3 high-quality studies[100,109,223] found gait training interventions did not improve balance. Furnari et al[237] compared RAGT plus a conventional exercise program with conventional gait training plus conventional exercise program, with both groups having similar significant improvements in balance (Tinetti balance scale). Although both groups improved, Bang et al[232] found that Nordic walking on the treadmill had greater balance improvements than treadmill training alone (BBS). One high-quality study found that treadmill training with 0%, 5%, and 10% additional load applied using a weight belt during treadmill training had similar improvements in balance on the Pull Test.[230] In 2 high-quality studies, gait training on the treadmill or on the treadmill with perturbations did not improve balance (**Mini-BESTest**[88,89], COP [center of pressure] sway, and **ABC**)[100,109,143] Another high-quality study found no improvement in balance (**Mini-BESTest**)[88,89] with either a smartphone application that offered feedback on gait or gait training with personalized gait advice.[223]

Freezing of gait

Four high-quality studies monitored FOG with gait training with mixed results.[217,219,223,225] Two high-quality studies found improvement with gait training including RGAT, treadmill training, and circular treadmill training.[217,219] Two high-quality studies found that gait training did not improve FOG with gait training, including treadmill training, a FOG phone app that included biofeedback with gait training, and gait training with FOG-specific advice.[223,225]

Falls

Only 1 high-quality study[225] and 2 moderate-quality[241,242] studies monitored falls after gait training. The high-quality study found that treadmill training decreased falls and fear of falling.[225] One moderate-quality study found falls decreased during the 6 months post treadmill training with and without VR,[241] but a similar study found only a trend toward decreasing falls.[242]

Fatigue

Two high-quality studies indicated that fatigue improved with treadmill training and RAGT but no improvement in control groups.[226,227]

Potential Benefits, Risks, Harms, and Cost of Implementing This Recommendation

Benefits are as follows:

- Reduced motor disease severity
- Improved step length
- Improved walking speed
- Improved walking capacity
- Improved functional mobility
- Improved balance

Risk, harms, and/or cost are as follows:

- Gait training should not cause harm if routine safety procedures are followed.
- When utilizing treadmill and harness, discomfort from the harness may occur.
- Fatigue can be a side effect of gait training.
- There is a risk of musculoskeletal discomfort with gait training (eg, lower extremity or back pain), which was occasionally reported. In most cases, modification of activity allowed continuation with treatment.
- The cost of gait training to physical therapy clinics can vary depending what equipment is utilized. The cost of robotic-assisted gait training devices and specialized treadmills for perturbations or circular walking can be expensive, so not all clinics will be able to provide these intervention strategies. Additionally, individuals with PD who may benefit from or seek these approaches may be referred to other sites and, depending on distance, this may add to the patients' costs in travel and time.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Further research is needed to determine the optimal dosing of gait training. In addition, the critical elements of gait training that optimize outcomes in PD need to be identified. Identifying those components of gait training that are most beneficial for various gait profiles (eg, FOG) or stages of PD is needed. Most gait training studies focus on impairment and activity-based outcomes, whereas it would be beneficial to have a better understanding of the impact of gait training on participation level outcomes. Last, a standard set of outcomes should be used across studies to facilitate direct comparisons between studies.

Value Judgments

Given that a decline in walking ability occurs over the disease continuum in PD and that gait training improves walking and other functional outcomes, the GDG recommends initiating gait training early after diagnosis to optimize walking-related outcomes.

Intentional Vagueness

Given the variability in the dosing of gait training across studies, the optimal dosing has not been determined. However, many studies reveal a benefit of gait training when implemented 20 to 60 minutes, 3 to 5 days per week, for 4 to 12 weeks. It is important to note that most studies that included a long-term follow-up (3–6 months posttraining) had a variable decline in outcomes with time. Gait training may need to be a continued activity to decrease the decline in functional outcomes.

Gait training was administered on the treadmill with and without robotic assist, with varying amounts of cardiovascular intensities and body weight support. Select parameters may be important for different individuals at various stages, but that specificity is not yet clear.

There was no single gait training intervention that demonstrated greater improvement than other types of gait training (eg, overground vs treadmill vs robotic assisted).

Exclusions

Individuals who are at H&Y stages 4 to 5 of PD were not included in many of the studies, and this information may not be generalizable to those populations. Individuals who are at high risk for falls may require a harness or safety device to optimize safety. Screening for the presence of comorbidities that may interfere with participation in gait training should be implemented.

Quality Improvement

Organizations may use documentation of gait training as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of gait training to reduce motor disease severity and improve stride length, gait speed, mobility, and balance.

Task-Specific Training ♦♦♦♦

Physical therapists should implement task-specific training to improve task-specific impairment level and functional outcomes for individuals with PD. *Evidence quality: high; recommendation strength: strong*.

Action Statement Profile

Aggregate evidence quality: 15 high-quality studies[42,50,244–256] and 7 moderate-quality studies.[121,169,257–261]

Rationale

In the 15 high-quality studies and 7 moderate-quality studies, there were a variety of tasks trained and therefore outcomes assessed. Overall, studies suggest that task-specific training improves the outcome targeted using a variety of approaches. The articles assessed were subgrouped based on the task trained including mental imagery, upper extremity training, turning training, fall prevention training, dual-task training, bladder training, and multimodal training.

Mental imagery

Task-specific mental imagery (with sufficient repetitions) paired with actively performing the task resulted in improvements in the target outcome. In 4 high-quality studies[244,245,247,250] and 1 moderate-quality study,[257] individuals were specifically trained with various mental imagery or gait observation techniques, yielding mixed results. Mental imagery training using dynamic neurocognitive imagery, with the goal of developing an individual's imagery skills, kinesthetic and proprioceptive sense, and motor self-awareness, improved mental imagery ability (Movement Imagery Questionnaire-Revised 2nd Edition and Kinesthetic and Visual Imagery Questionnaire, and Vividness of Movement Imagery Questionnaire-Revised Version) and pelvic schema (measured by the ability to draw a pelvis) compared with a group that read health and wellness literature and performed video-based gross and fine motor exercises.[244,245] When functional outcomes were assessed following dynamic neurocognitive imagery mental imagery, there was an improvement in **6MWT**[37,38] and TUG but not pain, UPDRS, **ABC**,[143] 30-second chair stand test, **Mini-BESTest**,[88,89] **TUG dual task**,[172] or 360 degree turn.[244] Watching videos of individuals with and without PD walk and being trained to discriminate between them (8 days of training) did not demonstrate any spatiotemporal gait improvements either at home or in a laboratory environment.[250] Locomotor imagery including 10 minutes of watching their own gait and that of an adult male without PD from various views in addition to physical therapist interventions, however, improved lower extremity joint kinematics and functional gait (**Functional Gait Assessment**)[138,139] compared with physical therapist services alone.[247] One moderate-quality study found no significant improvement in functional gait outcomes (**10MWT**[86,87] or TUG) when utilizing mental imagery embedded in the therapy session.[257] However, the task-specific mental imagery may not have been as effective due to the limited repetitions of imagery in this study.

Upper extremity

Task-specific training that is focused on the upper extremities should improve strength and manual dexterity and may improve sensation and goal attainment. Three high-quality studies[246,252,255] focused on upper extremity impairments (weakness, poor manual dexterity, and decreased sensation), and 1 moderate-quality study[261] focused on upper extremity function (goal attainment).

Task-specific training of the upper extremity (based on patient-specified goals, dexterity training, and specific finger strengthening with therapy putty) compared with a more general upper extremity exercise program (generalized ROM, grasp, and manipulation; general resistance band exercises, and general exercises) in 3 high-quality studies found greater improvement in pinch and grip strength, dexterity (**9-hole-peg test**, Dexterity Questionnaire 24, Purdue Pegboard Test, and Chessington Occupational Therapy Neurologic Assessment Battery dexterity task), and patient-specified goal attainment.[246,252,255]

One moderate-quality study compared sensorimotor-specific training versus current rehabilitation in the upper extremity, finding improved wrist proprioception, touch threshold (Weinstein enhanced sensory test), the ability to sense weight and texture of objects (hand active sensation test), and hand dexterity (in dominant hand only, Purdue pegboard test) with the sensorimotor-specific training.[261] This study did not find an improvement in haptic object test recognition or functional use as assessed with the box and box test.

Turning

Task-specific turning practice should be utilized for individuals with PD. Two high-quality studies[42,256] and 1 moderate-quality study[169] focused on turning training using different modalities. One high-quality study compared a turning-based training program performed on a rotational treadmill, an exercise group focused on balance and strengthening exercises to target turning, and a general exercise group, with all groups including turning training on level surfaces each session.[42] The study found that both the turning-based rotational treadmill program and turning-specific exercise group had greater turning improvement than the general exercise group, indicating the benefit of task-specific training.[42] Furthermore, this study found that the impairments that improved were different based on the specific training received, although the overall improvement in turning was similar.[42] Another high-quality study looked at training functional turning in an aquatic setting[256] and found that focusing on obstacles (slalom walking, obstacle circling, crossing over a step, and walking back and forth in a narrow passage) had significantly greater improvement in TUG and FOG than general aquatic therapy. Non–task-specific measures of balance (BBS and functional reach test), however, improved in both groups similarly.[256] A moderate-quality study observed ability to learn the clock-turning strategy and performance of turns within only 1 session.[169] The single session may not have been enough time to learn the new strategy, because it did not improve TUG time or decrease the number of steps for turning, but it did improve foot clearance, decreased step variability, and improved step symmetry.[169]

Dual task

Physical therapists may consider using dual-task training to improve functional dual-task walking, because there were mixed results in the 3 high-quality studies focused on specifically training dual tasks in individuals with PD.[249,251,254] One high-quality study found decreased dual-task cost on gait speed, improved balance (**Mini-BESTest**),[88,89] and improved perception of **FOG** (**FOG-Q**)[140] when comparing agility boot camp utilizing cognitive challenges during tasks compared with education as the control (80 minutes, 3 times a week for 6 weeks).[251] Two high-quality studies[249,254] (same data set) found that specifically training cognition and gait together during the session (dual task training) did not lead to better dual task outcomes than cognition and gait trained separately within the same session. Both dual- and single-task training (70 minutes, 2 times a week for 6 weeks) demonstrated similar improvements as measured by dual-task gait speed and spatiotemporal gait parameters during dual-task walking under 3 different dual-task conditions (with auditory stroop, backward digit span, and using a mobile phone).[249,254]

Falls

Interventions focused on task-specific training to decrease falls have mixed results, with 1 high-quality study[50] demonstrating decreased falls and 1 moderate-quality study[121] demonstrating no difference in falls. The high-quality study had 3 groups, including fall prevention education with movement strategy training (strategies to prevent falls and improve mobility and balance during functional tasks using attention; mental rehearsal and visualization of the movement; verbal, rhythmical, and visual cues; training of caregiver in the home environment), fall prevention education paired with progressive resistance strength training, and life skills information (not fall or mobility related).[50] This study found that movement strategy training or progressive resistance strength training paired with falls prevention education prevented falls prospectively for 12 months better than the control group, with the resistance training program being more effective at preventing falls than the movement strategy training. The moderate-quality study showed task-specific training for fall prevention that included a home assessment of fall risk factors, strengthening and balance training, and functional practice of turning and complex environments improved balance, fear of falling, and ability to get out of a chair, but it did not decrease falls compared with an inactive control group.[121] This study also found that task-specific training for fall prevention may increase fall risk in individuals at the H&Y stage 4 and have better improvement in moderate disease severity.

Bladder training

One moderate study looked at lower urinary tract symptoms in individuals with PD and found that task-specific training for bladder management versus conservative advice improved number of voids per day and amount voided with each micturition and decreased incontinence and bladder interference with daily life, but it did not improve overall quality of life or urgency.[259]

Multimodal intervention

Physical therapy is usually delivered in a multimodal manner, not targeting only 1 specific outcome but rather designed to improve multiple deficits of an individual with PD. It may be beneficial to include task-specific training within a multimodal treatment plan based on 3 high-quality studies,[248,253,260] although it is important to note that, due to the multimodal nature of the studies, the improvement in the task-specific outcomes cannot be considered causal, because the outcomes could be from any of the treatments, or the combination provided within each study. One high-quality study[253] in an inpatient setting compared movement strategy training (cognitive-focused planning for movements, mental rehearsal, avoiding dual task, and cuing) with musculoskeletal exercise (focused on strengthening, ROM/flexibility, and postural alignment) and identified greater improvements in balance for the movement strategy training as measured by the Pull Test. It is important to note that participants received usual inpatient care, and the extent that these interventions contributed to the results was not measured. Another high-quality study[248] included functional training, functional strengthening, gait training overground and on treadmill, balance training, and recreational games compared with a medication-only control group. They identified improvements in the targeted activities of daily living (ADLs-**UPDRS II**),[34,35] motor disease severity (**UPDRS III**),[34,35] gait speed, and quality of life (SIP-68-Sickness impact profile) in the functional training group. A moderate-quality study[260] compared aerobic training plus task-oriented circuit training with 11 different stations focused on balance, walking, and reaching to aerobic training alone. This study looked at many outcomes, but the outcomes that directly related to the specific tasks trained included TUG, BBS, limits of stability, postural stability test, Pull Test, and **6MWT**.[37,38] All the outcomes improved in both groups, with only the limits of stability, Pull Test, and postural stability demonstrating greater improvement in the task-oriented circuit training group.

Potential Benefits, Risks, Harms, and Cost of Implementing This Recommendation

Benefits as follows:

- Improvement in the task that was specifically trained
- Improvement in upper extremity strength, dexterity, sensation, and goal attainment
- Improvement in mental imagery
- Improvement in turning and functional mobility
- Improvement in bladder function

Risk, harms, and cost are as follows:

- No increased risk was noted.
- Dropouts across studies were primarily related to lack of enjoyment with engaging in a particular activity, suggesting that patient preferences should be considered.
- There is typically no increased cost to utilizing task-specific training.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

Additional studies are needed to determine the benefit of task-specific training for varying levels of cognition. Additionally, studies are needed to determine the optimal dosage of task-specific training needed to optimize outcomes as well as to determine lasting effects of task-specific training to inform duration of training needed. It may be important to determine which impairments and functional tasks require task-specific training and which may improve by more general training to allow for greatest utilization of time.

Value Judgments

Based on this evidence, task-specific training is important for individuals with PD. Patient preference should be strongly considered when choosing targeted outcomes for task-specific training.

Intentional Vagueness

Given the variability in the dosing of task-specific training across studies, the optimal dosing has not been determined for any specific task. However, the studies with single-day training frequencies had less robust improvement than other studies with longer training durations. Most studies looking at task-specific training utilized 30 to 90 minute sessions, 2 to 5 times a week, for 2 to 12 weeks.

Exclusions

Individuals who are H&Y stages 4 to 5 and have impaired cognition were not included in many of the studies, and this information may not be generalizable to those populations.

Screening is required for the presence of comorbidities that may interfere with participation in task-specific training.

Quality Improvement

Organizations may use documentation of task-specific training as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of task specific training to improve task-specific impairment level and functional outcomes.

Behavior-Change Approach ♦♦♦◊

Physical therapists should implement behavior-change approaches to improve physical activity and quality of life in individuals with PD. *Evidence quality: strong; recommendation strength: moderate – downgraded*.

Action Statement Profile

Aggregate evidence quality: 4 high-quality studies[262–265] and 5 moderate-quality studies.[62,63,266–268]

Rationale

Four high-quality and 5 moderate-quality studies examined the benefits of physical therapy and/or exercise interventions combined with behavior-change approaches in individuals with PD. Behavior-change approaches generally include strategies applying health behavior change theories (eg, self-determination theory, social cognitive theory, transtheoretical model) and behavioral-change strategies such as goal setting, action planning, coaching, provision of feedback, and/or problem solving. These studies varied considerably with regard to the types of behavior change approach used, outcomes measured, and comparison groups (usual medical care, self-guided exercise, and general physical therapy), which contributed to the GDG's decision to downgrade the recommendation strength to moderate.

Motor disease severity

One moderate-quality study[62] found that exercise combined with behavior-change approaches improved motor disease severity (**UPDRS-III**) compared with usual care.

Bladder control

One high-quality study[265] found that bladder retraining combined with behavior-change approaches improved bladder control-related outcomes compared with bladder diary alone.

Physical activity

One high-quality study[263] of exercise combined with behavior-change approaches and 1 moderate-quality[267] study of physical therapist interventions using behavior-change approaches found physical activity improved in individuals with PD compared with self-guided exercise or physical therapy only. In another high-quality study,[262] physical activity did not improve significantly following physical therapy with behavior-change approaches delivered using a mobile health application compared with physical therapy with a less intense behavior-change approach.[262]

Walking capacity

One moderate-quality study[267] of physical therapy using behavior-change approaches found improved walking capacity (**6MWT**)[37,38] compared with physical therapy alone, whereas 1 high-quality study[262] found no significant difference between physical therapy with behavior-change approaches using mobile health technology compared with a less intense behavior-change intervention.

Quality of life

One high-quality study[264] supported the use of physical therapy with behavior-change approaches to improve PD-related quality of life (**PDQ-39**)[141,142] compared with general physical therapy and usual care control groups. However, a moderate-quality study[62] revealed no improvement in quality of life compared with usual care using non–disease-specific quality-of-life measures (EQ-5D and SF-36).

Potential Benefits, Risks, Harms, and Cost of Implementing This Recommendation

Benefits are as follows:

- Improved participation: disease-related quality of life and physical activity
- Improved activities: walking capacity
- Improved body structure and function: motor disease severity, bladder function

Risk, harm, and/or cost:

- There are no significant risks or harms associated with the use of behavior change approaches with physical therapy compared with physical therapy alone.
- Additional training of physical therapists may be necessary to optimize delivery of behavior change approaches within physical therapist practice.
- Enhancing behavior change approaches with psychoeducation[263] and mobile health technology[262] may increase the costs for the health care team and/or for the patient but may also mitigate costs for patients and care partners related to reduced travel to the health care facility.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost supports this recommendation.

Future Research

Additional research is needed to determine the benefits of behavior change approaches combined with physical therapy compared with physical therapy alone to improve engagement in exercise and/or increase physical activity in persons with PD. The components of behavior change approaches should be clearly described. Additional research is needed to identify the critical elements of behavior change approaches (eg, goal setting, action planning, feedback) that are most likely to result in optimal engagement in the desired behavior (eg, exercise, physical activity). Outcomes should include feasibility, adherence, and cost as well as disease severity, physical function, quality of life, and physical activity.

Value Judgments

Given the importance of increasing self-efficacy and long-term engagement in exercise to optimize health in people with

PD, the GDG recommends that physical therapists include behavior change approaches as part of their intervention.

Intentional Vagueness

The types of behavioral change approaches described in the studies reviewed varied considerably; thus, the GDG did not make a recommendation related to implementing a particular type of behavior change approach.

Exclusions

The studies reviewed included people with mild to moderate PD (H&Y stages 1–3). The benefits of behavior change approaches are not known among people with greater disease severity or cognitive impairments.

Quality Improvement

Organizations may use documentation of behavior-change approaches as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of documentation of behavior-change approaches to improve physical activity and quality of life.

Integrated Care ♦♦♦♦

Physical therapist services should be delivered within an integrated care approach to reduce motor disease severity and improve quality of life in individuals with PD. *Evidence quality: strong; recommendation strength: strong.*

Action Statement Profile

Aggregate evidence quality: 8 high-quality studies[264,269–275] and 8 moderate-quality studies.[268,276–282]

Rationale

There were 8 high-quality studies[264,269–275] and 8 moderate-quality studies[268,276–282] providing strong evidence comparing an integrated care approach to control. Integrated care approaches include multidisciplinary, interdisciplinary, and interprofessional health care teams working to improve quality and safety of services provided to people with medically complex needs.[283] Integrated care approaches for individuals with PD involve a variety of professionals, which may include but are not limited to physical therapists or movement disorder specialists, neurologists, rehabilitation medicine providers, nurses, social workers, speech therapists, occupational therapists, and others. In most studies, integrated care was compared with medical management by a neurologist only, except for Monticone,[273] which used a comparison with an exercise-only control group.

Motor disease severity

Three high-quality studies revealed reductions in motor disease severity (**UPDRS-III**)[34,35] with integrated care compared with control.[271–273] Participants in 2 studies completed a 4-week intensive inpatient rehabilitation programs with 2 hours of physical therapy and 1 hour of occupational therapy per day, 5 times per week compared with a control group that received medical management alone.[271,272] The third study compared 8 weeks of inpatient rehabilitation with a multidisciplinary approach including physical therapy, occupational therapy, and cognitive training provided by psychologists with inpatient physical therapy alone for 8 weeks, finding improved **UPDRS-III**[34,35] scores in the group receiving multidisciplinary care.[273] Three additional moderate-quality studies supported that **UPDRS-III**[34,35] scores were improved compared with medical management alone using varied integrated care approaches, including: intensive inpatient rehabilitation,[278] outpatient care with movement disorders specialists, nurses, and social workers,[281] and outpatient care with movement disorders specialists, nurses, physical therapists, occupational therapists, and speech-language pathologists.[277] The addition of aquatic therapy to the integrated care team in an intensive inpatient rehabilitation environment was not associated with any significant benefits in **UPDRS-III**.[34,35,269]

Nonmotor symptoms

Three moderate-quality studies reported improved nonmotor symptoms (anxiety, depression, and psychosocial consequences) following various integrated care approaches compared with usual medical care control groups.[277,279,281] These integrated care approaches included outpatient care with movement disorders specialists, nurses, and social workers (no rehabilitation therapies specified),[281] outpatient care with movement disorders specialists, nurses, physical therapists, occupational therapists, and speech-language pathologists (individually tailored therapies with no set dose),[277] and home health care with a nurse, physical therapist, occupational therapist, and speech-language pathologist (approximately 9 hours of therapy over 6 weeks).[279] Gage et al[279] found less anxiety with home-based multidisciplinary care compared with a usual care control after 6 weeks.[279]

Functional outcomes (gait, mobility, balance, and activities of daily living)

Three high-quality studies[271,273,275] and 2 moderate-quality studies[278,282] favored integrated care versus control for functional activities, but there was high variability in the functional measures used across studies. One high-quality study found improvements in walking activities including gait speed and spatiotemporal gait parameters, physical performance, and stability (tandem stance and Pastor test).[275] Another high-quality study revealed improvements in balance as measured by the BBS.[273] Two high-quality studies supported improvements in activities of daily living compared with control[271,273]; however, 1 moderate-quality study indicated no difference in activities of daily living between a group receiving physical therapist services and occupational therapist services compared with a group that received no therapy.[276]

Quality-of-life outcomes

Three high-quality studies supported improvements in health-related quality of life (**PDQ-39**)[141,142] with integrated care compared with usual medical care control.[264,270,273] These programs compared usual medical management without rehabilitation with a 4-week inpatient intensive rehabilitation with physical, occupational, and speech therapy (60 hours of therapy)[270] or a 6-week outpatient rehabilitation program with physical therapist, occupational therapist, and speech therapist services (18–27 hours of therapy).[264] A third study compared 8 weeks of inpatient multidisciplinary rehabilitation with physical therapy, occupational therapy, and cognitive training provided by psychologists with inpatient physical therapy alone.[273] Two additional moderate-quality studies supported the finding that integrated care was associated with better quality-of-life outcomes compared with medical management alone.[276,281]

Levodopa equivalent daily dose

One high-quality study[271] and 3 moderate-quality studies[277,278,281] compared the effect of an integrated care model with usual medical care on levodopa equivalent daily dose (LEDD). The integrated care model that included neurologists, physiatrists, psychologists, nurses, physical therapists, and occupational therapists resulted in no significant increase in LEDD[278] compared with the usual care group where a significant increase in the LEDD was observed, suggesting worsening disease severity. However, other models with physical therapist and occupational therapist services,[271] individualized treatment plan, home visits by a PD nurse and access to a hotline,[277] or care from a movement disorders specialist, nurse, and social worker[281] did not result in a significant difference in LEDD compared with control conditions.

Comparisons of types of integrated care models

One high-quality[269] and 2 moderate-quality studies[279,280] compared integrated care models with different numbers of providers. In 1 study, the group with more team members (12 team members vs 6), had a greater improvement in quality of life (**PDQ-39**).[141,142,280] In another study, a 6-week home-based multidisciplinary team (MDT) approach alone was compared with the MDT followed by 4 months of Parkinson-trained caregiver assist (PCA).[279] MDT followed by PCA had better quality of life outcomes (less long-term decline in mental component of SF36; EQ5D slightly improved).[279]

One high-quality study[264] and 1 moderate-quality study[268] from the same trial compared an integrated self-management approach with usual care. Participants were randomly assigned to 1 of 3 conditions for 6 weeks of intervention: 0 hours of rehabilitation; 18 hours of clinic group rehabilitation plus 9 hours of attention-control social sessions; or 27 hours of rehabilitation, with 18 hours in clinic group rehabilitation and 9 hours of rehabilitation designed to transfer clinic training into home and community routines. At 6 weeks, there was a beneficial effect of increased rehabilitation hours on quality of life (**PDQ-39**),[141,142] and effects persisted at 6 months. The difference between 18 and 27 hours was not significant.[264] There were no significant differences in walking function between groups.[264,268]

Potential Benefits, Risks, Harms, and Cost of Implementing This Recommendation

Benefits are as follows:

- Reductions in motor disease severity
- Improvements in nonmotor symptoms (anxiety, depression, and psychosocial consequences)
- Improvements in functional outcomes (walking activities including gait speed and spatiotemporal gait parameters, activities of daily living, physical performance, balance, and stability)
- Improvements in quality of life
- Improvements in health care utilization (LEDD)

Risks, harms, and/or cost are as follows:

- One high-quality study[273] and 1 moderate-quality study[276] found that there were no significant differences in adverse events in those who participated in integrated care versus a control condition.
- One moderate-quality study[279] suggested that compared with usual medical management care, the integrated care model was associated with improved pain management (Pain Visual Analog Scale on medication) but also with more accident and emergency adverse events. Discussion of this finding suggested that this might be explained by many adverse events coming to the attention of the multidisciplinary team or personal care assistant during their visits, whereas this attention did not occur in the control condition.
- Increasing the size of the team and the duration of care each week may require changes to the current health care system, increasing costs and negatively affecting feasibility and acceptability. One moderate-quality study[279] directly measured costs and found no significant differences in the overall health care costs between 2 integrated care approaches (multidisciplinary care and multidisciplinary care combined with extra caregiver support).
- Use of integrated care approaches varies widely across health care organizations. True interdisciplinary integrated care approaches, which would require team meetings and increased lines of communication between physicians and physical therapists, may present a greater challenge in some organizations. The presence of physical therapists with expertise in PD may not be feasible in all neurology clinics due to organizational and health system structures. This could require significant changes in processes, staffing, and organization.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost overwhelmingly supports this recommendation.

Future Research

The research supporting integrated care approaches over usual care or neurologist care alone is promising. However, additional high-quality research is needed regarding the optimal time to initiate integrated care and the composition of the team. In addition, more research is needed on the long-term benefits and costs related to health care utilization, hospitalizations, falls, and institutionalization related to maintaining integrated care approaches from diagnosis to advanced PD care.

Value Judgment

Due to the complex nature of signs and symptoms associated with PD, the GDG suggests adopting an integrated care approach for management of PD over the course of the disease. True integration of care, communication, and coordination between team members should be addressed to prevent overburdening the individual with PD and their care partners with multiple team members' input.[284]

Intentional Vagueness

Our description of integrated care approaches is intentionally vague due to the heterogeneity of intervention types and timing.

Exclusions

Most studies included individuals with mild to moderate PD (H&Y stages 1–3). These recommendations may not apply to those with severe PD. Most studies limited participation to those who did not have cognitive impairments. These recommendations may not apply to those with cognitive impairments (Mini-Mental State Exam <24).

Quality Improvement

Organizations may use documentation of interprofessional, multi-disciplinary, or interdisciplinary health care teams as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of interprofessional, multi-disciplinary, or interdisciplinary health care teams to improve quality and safety of services provided to people with medically complex needs.

Telerehabilitation ♦♦◊◊

Physical therapist services may be delivered via telerehabilitation to improve balance in individuals with PD. *Evidence quality: moderate; recommendation strength: weak – downgraded.*

Action Statement Profile

Aggregate evidence quality: 1 high-quality study[262] and 1 moderate-quality study.[124]

Rationale

The Centers for Medicare and Medicaid Services definition of telemedicine was used, which is "the exchange of information via telecommunication systems between the provider and the patient to improve a patient's health."[285] There is limited evidence available based on 1 moderate-quality study[124] to support the use of telehealth (specifically, remotely supervised Wii-based balance training) for improvements in balance based on the BBS compared with in-person sensory integration balance training for individuals with PD. One high-quality study[262] showed that quality of life, walking capacity (**6MWT**),[37,38] and physical activity did not improve significantly with a mobile health-mediated behavior change approach compared with a less-intense intervention using activity diaries. However, the intervention using a mobile health application appeared to differentially benefit the less active subgroup for improvement in health-related quality-of-life mobility subscore (**PDQ-39** mobility score).[141,142,262] Variability in the outcome measures and the specifics of the interventions used between the 2 included studies contributed to the GDG's decision to downgrade the recommendation strength to weak.

Potential Benefits, Risks, Harms, and Cost of Implementing This Recommendation

Benefits are as follows:

- Improved activities: balance
- Improved participation

Risk, harms, and/or cost are as follows:

- The studies included reported no significant differences in adverse events between the telerehabilitation/mobile health and control groups.
- No falls were reported. Gandolfi et al[124] had a caregiver always present to monitor the patients (H&Y stages 2.5–3.0) for safety. Independent participation by patients in such a program without caregiver monitoring remains to be determined.
- The use of telerehabilitation and mobile technologies may be better suited for individuals with no cognitive impairment and low fall risk.
- Cost analyses of the telerehabilitation intervention compared with the control intervention showed that the total cost for rehabilitation per individual was 36% lower in the telerehabilitation group versus the in-person rehabilitation group.[124] Equipment costs were 94% greater in the telerehabilitation group, but these were surpassed by in-person treatment costs, which were 50% greater for the in-person rehabilitation group.
- The use of mobile health technology may increase the costs for the health care team or for the patient but may also decrease costs related to travel and access to care for patients and care partners.

Benefit-harm assessment: The balance of the benefits versus risk, harms, or cost demonstrates a small support for this recommendation.

Future Research

Further research is needed with robust study designs to examine the benefits of telerehabilitation and mobile health technology for safety, feasibility (and usability for patients and providers), efficacy for disease severity, physical function, quality of life, physical activity, and cost and resource utilization.

Value Judgments

Besides the reduced burden of travel, access, inclement weather, and other barriers to long-term engagement in in-person programs, the utilization of telerehabilitation is especially important in light of low referral rates (14.2%) to rehabilitation and inequitable care with referral rates even lower in African American patients (7.6%).[8] Song et al[286] reported that during the COVID-19 pandemic, the amount, duration, and frequency of exercise were reduced in individuals with PD, associated with a worsening of motor and nonmotor symptoms. Telerehabilitation and the use of mobile technology may be a viable option for intervention considering this and similar situations limiting in-person access to rehabilitation, especially since individuals with PD are predominantly older adults with other preexisting health conditions, who often rely on transportation support to get to in-person health care appointments.

Intentional Vagueness

Due to the limited evidence available, we do not make specific recommendations about the type of technology to be used or dosage of interventions.

Exclusions

The articles included people with mild to moderate PD (H&Y stages 1–3) without cognitive impairments. The use of telerehabilitation or mobile technology may be less effective or unsuitable for people with advanced PD or cognitive impairments.

Quality Improvement

Organizations may use documentation of physical therapist services delivered via telerehabilitation as a performance indicator.

Implementation and Audit

Organizations may audit occurrence of physical therapist services delivered via telerehabilitation to improve balance.

Best-Practice Statements

Deep Brain Stimulation

In the absence of reliable evidence, the opinion of the GDG is that more research is needed on the effects of physical therapist interventions in individuals undergoing deep brain stimulation. *Strength of recommendation: best practice*.

Rationale

There are no studies that meet inclusion criteria and answer the question of interest regarding deep brain stimulation (DBS) surgery and physical therapist interventions.

Future Research

Future research should examine the effects of physical therapist interventions when included as part of management either pre- or post-DBS surgery. Duncan et al[287] published a protocol paper for a pilot randomized controlled trial investigating gait and balance interventions following subthalamic nucleus-DBS versus usual care following subthalamic nucleus-DBS. At the time of this CPG publication, this trial is in progress and may contribute, along with other studies, to the body of evidence.

Expert Care

In the absence of reliable evidence, the opinion of the GDG is that physical therapist services delivered by physical therapists with expertise in PD may result in improved outcomes compared with those without expertise. Strength of recommendation: best practice.

Rationale

In an observational study,[288] health insurance claims were analyzed from a database that included a population of patients with PD in the Netherlands over a 3-year period. Health care use and outcomes were compared between patients who received physical therapy by a specialized physical therapist (N = 2129) and those who received usual care (N = 2252). A specialized physical therapist was defined in this study as someone who received advanced targeted training in PD as part of the ParkinsonNet approach. The primary outcome measure was the percentage of patients who experienced a PD-related complication, which consisted of a visit or admission to a hospital because of fracture, other orthopedic condition, or pneumonia. There was reduced probability of experiencing a PD-related complication in patients who received specialized physical therapy (17%) compared with the usual care group (21%).

The European Physiotherapy Guidelines for Parkinson's Disease[289] recommends that health professionals who treat these individuals have PD expertise. Both the National Institute for Health and Care Excellence Guidelines[290] and the Canadian Guideline for Parkinson Disease[291] support the delivery of physical therapist services by clinicians with experience in PD. Specifically, the Canadian Guideline for Parkinson Disease states that "consideration should be given to referring people who are in the early stages of PD to a physiotherapist with experience of the disease for assessment, education and advice, including information about physical activity."[291]

Future Research

Further research is needed comparing rehabilitation outcomes in patients receiving physical therapy by clinicians trained in PD-specific management with outcomes in patients treated by untrained clinicians. In addition, what constitutes expertise in physical therapist practice related to PD needs to be further defined.

Nonrecommendations

Due to the unavailability of randomized controlled trial evidence as dictated by the literature search criteria, the GDG refrained from creating recommendations on the following topics:

- Risk factors
- Motor learning

Revision Plans

This CPG represents a cross-sectional view of current management strategies and may become outdated as new evidence becomes available. In 5 years, this CPG will either: (1) revised by APTA in accordance with new evidence, changing practice, rapidly emerging treatment options, and new technology; (2) reaffirmed; or (3) withdrawn.

Dissemination Plans

The primary purpose of this CPG is to provide interested readers with full documentation of the best available evidence for various intervention strategies associated with the physical therapist management of PD. Publication of this CPG will be in *PTJ: Physical Therapy and Rehabilitation Journal*, the journal of the American Physical Therapy Association. This CPG is available in Spanish; see Supplementary Appendix 1.

Education and awareness about this CPG will be disseminated via online resources, such as webinars, podcasts, pocket guides https://www.guidelinecentral.com/aptamembers/, and continuing education courses; at professional annual meetings; and via social media. A CPG+, which includes an appraisal rating using the AGREE II tool, highlights, a check-your-practice section, and review comments, is available on APTA's website (https://www.apta.org/patient-care/evidence-based-practice-resources/cpgs/parkinson-disease) for this CPG. A knowledge translation task force led by the APTA Academy of Neurologic Physical Therapy has been formed and will create additional implementation tools during the

3 years following the publication of this CPG. Please visit the CPG+ webpage or www.neuropt.org for details.

Podcast Interview

A podcast interview with the authors is available at https://www.apta.org/apta-and-you/news-publications/podcasts/2022/ptj-parkinson-cpg.

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Disclaimer

This CPG was developed by an American Physical Therapy (APTA) volunteer GDG consisting of physical therapists and a neurologist. It was based on systematic reviews of current scientific literature, clinical information, and accepted approaches to the physical therapist management of PD. This CPG is not intended to be a fixed protocol, as some patients may require more or less treatment. Clinical patients may not necessarily be the same as participants in a clinical trial. Patient care and treatment should always be based on a clinician's independent medical judgment, given the individual patient's clinical circumstances.

Disclosures

In accordance with APTA policy, all individuals whose names appear as authors or contributors to this CPG filed a disclosure statement as part of the submission process. All panel members provided full disclosure of potential conflicts of interest prior to voting on the recommendations contained within this CPG.

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