

European Physiotherapy Guideline for Parkinson's Disease

Developed with twenty European professional associations

Information for clinicians



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This Guideline is endorsed by the Association for Physiotherapists in Parkinson's Disease Europe (APPDE), the European Parkinson's Disease Association (EPDA) and the European Region of the World Confederation for Physical Therapy (ER-WCPT).



Available for downloading at www.parkinsonnet.info/euguideline are

- Guideline
- Guideline information for people with Parkinson's
- Guideline information for clinicians (this document)
- Development and scientific justification

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The European Physiotherapy Guideline for Parkinson's disease supports physiotherapists in taking decisions towards patient-centred, evidence-informed practice. It also offers people with Parkinson's disease (pwp) information and tools to manage their movement-related health to focus on goals that are important to them. Here we provide a short overview of the Guideline for clinicians to support optimal referral of pwp to physiotherapy, feasible expectations and good communication.

A joint collaboration of 19 European countries

ParkinsonNet, a non profit foundation at the Radboudumc university medical centre aiming to improve Parkinson's care, and the Royal Dutch Society for Physical Therapy (KNGF) initiated the development of this first European Physiotherapy Guideline for Parkinson's disease. The Guideline Development Group (GDG) represents professional physiotherapy associations from 19 European countries. Pwp were involved in the Guideline development from the outset and have contributed throughout the process. The Guideline is endorsed by the Association for Physiotherapists in Parkinson's Disease Europe (APPDE), the European Parkinson's Disease Association (EPDA) and the European Region of the World Confederation for Physical Therapy (ER-WCPT).

Methods of development: GRADE

The starting point for this Guideline were the 2004 evidence-based KNGF Guideline for Parkinson's disease¹ and a pan-European physiotherapy survey to gain insight in current physiotherapy care and barriers and facilitators towards optimal care. To draft recommendations, Grades of Recommendation Assessment, Development and Evaluation (GRADE) were used. Therefore, the levels and description of the recommendations differ from those reported in the Guidelines published by the KNGF, the European Federation of Neurological Societies (EFNS), the Movement Disorders Society (MDS) and the U.K. National Institute for Health and Clinical Excellence (NICE)²⁻⁶. GRADE is endorsed by many organisations and journals, including the Cochrane Collaboration, the World Health Organization, NICE and the British Medical Journal. Using GRADE, recommendations are based on:

- Critical outcomes: those with a mean GDG-rated score for importance of 6.5 or above (full scale 1 to 10)
- Quality of the evidence: taking into account risk of bias (such as regarding randomisation, blinding, drop-outs) and imprecision (such as few patients included)
- Size of the effects: a meta-analysis was carried out
- Benefits and burdens: taking into account the generalisability of the effects, undesirable effects of the intervention and values and preferences of patients and therapists

Literature up and to December 2012 was searched for, selected and appraised. Finally, 70 controlled clinical trials were used⁷⁻⁷⁶.

This Guideline provides GRADE-based recommendations for each physiotherapy core area: balance, gait, transfers and physical capacity. Based on the outcome of the meta-analyses, recommendations are either for or against using a specific type of physiotherapy intervention to target a specific problem. The strength of this recommendation can be strong or weak, based on the quality of the evidence and the balance between benefits and burden. The risk and burden of physiotherapy is generally very low. Please note that 'against' means that benefits probably do not outweigh risks and burdens. Most commonly, effects showed a positive trend, but the (wide) confidence interval of the effect included 0. 'Against' does not mean that the specific intervention has negative effects on that outcome.

In addition to the GRADE-based recommendations, the Guideline provides GDG advice which is based on scientific evidence and expert opinion. These aim to reduce the barriers inhibiting optimal physiotherapy care identified through the pan-European physiotherapy survey (response n=3,405)^{77,78}, meetings with Parkinson-expert physiotherapists and results of focus groups with pwp. They concern the physiotherapist's Parkinson-specific knowledge and skills, timely referral, patient-centeredness, collaboration and communication.

When and why to refer for physiotherapy?

The American Academy of Neurology recommends clinicians discuss the potential of physiotherapy with pwp at least annually.⁷⁹ To support appropriate referral, the GDG has drafted criteria for referral (Table 1). These are in line with the GRADE-based recommendations for interventions. Referral may be based on one or more of the following criteria: H&Y Stage; presenting impairments and activity limitations; hospital or nursing home admission.

Table 1 Referral criteria for pwp to physiotherapy

Based on*	Description
Stage: Early	<p>Soon after the diagnosis of Parkinson's disease for:</p> <ul style="list-style-type: none"> • self-management advice, education and coaching, including support to stay physical active • if required, tailored intervention to prevent limitations in functional mobility through motor learning, to reduce fear of falling and to improve physical capacity
Specific impairments or limitations in activities	<p>Presence of:</p> <ul style="list-style-type: none"> • Reduced physical capacity • Functional mobility limitations regarding: <ul style="list-style-type: none"> - transfers, such as rising from a chair or rolling over in bed - gait, including freezing - balance, including falls - manual activities • Pain, non-related to medication
Context: hospital or nursing home	<p>If admitted to a hospital for any cause, or to a nursing home, aiming to educate and, if necessary, train pwp and health professionals to improve physical capacity or limitations in functional mobility, or to support prevention of falls (e.g. using walking aids) and pressure sores</p>

*In addition, specifically trained physiotherapists in the United Kingdom, have a qualification in non-medical prescribing. They have the ability to prescribe, as well as supply and administer medicines to individually named patients.⁸⁰ The terms by which this process occurs are legislated and monitored under strict guidance

Stage-based: early referral

Early referral is desired because difficulties in daily activities can be present even in the early stages of Parkinson's disease. At Hoehn & Yahr 1-2, the total scores on the Unified Parkinson's Disease Rating Scale (UPDRS) may already be below 20.^{81,82} This is particularly the case in pwp with the PIGD-type.⁸³ Physiotherapy can improve activity limitations.

Early referral is also important to support pwp to maintain sufficient physical activity levels and thus prevent secondary complications. Exercise has multiple physiological, psychological and physical benefits and may even result in neurprotection⁸⁴. During a one-off consultation, a physiotherapist can evaluate the needs for advice and education, coaching towards self-management or supervised training. On www.parkinsonnet.info/euguideline, Information for people with Parkinson's can be downloaded, supporting pwp in their self-management.

Problem-based: impairments and activity limitations

During the course of the condition, the number of impairments in functions, activity limitations and restrictions in participation will increase. There is consistent data supporting physiotherapy referral and use in Parkinson's disease for transfers and mobility problems, gait disturbances, balance, falls and freezing.

Context-based: hospital or nursing home admission

The lack of Parkinson-expertise of health professionals may enhance the risk for adverse events during hospital and nursing home stay⁸⁶⁻⁹¹. Problem areas include adverse events related to medication (e.g. wrong timing, withdrawal, or use of contra-indicated drugs), swallowing and immobilisation, including falls and pressure sores⁸⁶⁻⁹⁴. Therefore, the GDG recommends to consult a physiotherapist when pwp are admitted to hospital.⁸⁷ Physiotherapy will provide education and, if required, exercise to support prevention of falls, pressure sores and a decrease of physical capacity. Next to pwp, physiotherapy targets health professionals involved in hospital care, such as nurses.

To which physiotherapist to refer?

Parkinson's disease is complex and evidence on physiotherapy-specific interventions for pwp is constantly increasing. Moreover, in some European countries physiotherapists are first-contact practitioners not requiring a medical referral. Therefore, it is critical that physiotherapists are fully-informed regarding the evidence⁹⁵. Whilst there is no golden standard for 'Parkinson's-expertise', this phenomenon is associated with the number of pwp treated annually. Physiotherapists with a annual treatment volume of seven report higher self-perceived expertise than those treating less than four pwp annually.⁹⁶ However, results of a survey in which 3,405 physiotherapists throughout Europe participated showed that on average most physiotherapists treat as few as four pwp annually. This treatment volume is unlikely to be sufficient to gain and maintain Parkinson's-expertise. The median needed treatment number to gain and retain sufficient expertise reported was 10, with 50% of the answers ranging from 6 to 20. Often, this number will be hard to reach. Most physiotherapists reported limited Parkinson's-expertise; had not received Parkinson-training; were unaware of the KNGF Guideline (freely available in Dutch and English since 2004); and did not use measurement tools. The GDG has agreed upon preferred characteristics of physiotherapists to refer pwp to (Table 2).

Table 2 Preferred characteristics of physiotherapists to refer pwp to

- Providing evidence-based, patient-centred care (such as using this Guideline for decision-support)
- Received general postgraduate education on Parkinson's disease or movement disorders
- A higher than average patient volume (average is four pwp annually)
- Familiarity with Parkinson's-specific referral criteria to other health care providers
- Closely collaborating with other health care providers with Parkinson's-expertise
- Receiving continuous, up-to-date Parkinson's-related education from (inter)nationally recognised experts

What information is helpful to the physiotherapist upon referral?

Specific information provided upon referral will support the physiotherapist and pwp in setting realistic treatment goals and selecting the most appropriate intervention. Moreover, it minimises requests from the pwp for information already available, thus reducing patient and carer burden (Table 3).

Table 3 Information supportive upon referral**Essential**

- Reason for referral
- Diagnosis, distinguishing Parkinson's disease from atypical parkinsonisms
- Year of diagnosis and disease stage: provide a Hoehn & Yahr classification?
- Motor complications, such as on and off state predictability, dyskinesias and dystonia: provide MDS-UPDRS item scores?
- Mental complications, such as executive dysfunction (concentration, holding and using information, decision-making, planning, shifting attention), anxiety, apathy, depression, hallucinations and impulse control disorders (which can also be related to exercising)
- Other health complications influencing physiotherapy options, such as heart failure, osteoporosis, COPD, arthritis and diabetes
- Current medical treatment, including neurosurgery and non-Parkinson's medication, with possible adverse events influencing physiotherapy options

Helpful

- Other interventions already trialled for the problems referred for, and results thereof
- Other current interventions, such as by a speech and language therapist or a psychologist
- Expected outcome of physiotherapy intervention
- Preferences regarding communication

What to expect from physiotherapy?

Physiotherapy assessment may take one hour (two sessions), depending on the complexity of pwp specific problems, slowness in movement, information processing speed and limitations in prioritising problems. Whenever possible, physiotherapists will provide pwp with the Pre-assessment Information Form to fill in before their first visit (Appendix 2, Information for people with Parkinson's). This gives insight in the pwp' main problems, levels of physical activity, fall risk and freezing. During history taking and physical examination, standardised measurement tools are used to gain systematic insight into current problems and to decide whether physiotherapy intervention is indicated. If so, the physiotherapist and pwp will collaboratively decide upon challenging and feasible treatment goals and select appropriate interventions: advice, education, exercise and training of compensatory strategies (cues and strategies for complex motor sequences). The preferred intervention will depend on the patient specific treatment goals and preferences (Table 4).

'Conventional physiotherapy' includes all physiotherapist-supervised active exercise interventions targeting gait, balance, transfers and physical capacity, or a combination thereof. There will be a focus on large amplitude functional-task exercises, positive feedback and a progressive increase of intensity and complexity. Whenever possible, pwp will be supported towards non-supervised exercising, including joining Parkinson's specific or general exercise, dance or Tai Chi groups. In early stages (Hoehn and Yahr 2 and 3), physiotherapy may aim for motor learning. In case of gait limitations, the physiotherapist may explore with the pwp the to them optimal type and frequency of cueing and train how to use this. When using strategies for complex motor sequences, the physiotherapist will teach the pwp why and how to break down a complex task in simple components and carry the components out with attention. The duration of a treatment period, as well as the frequency of the visits will depend on the individual goals and treatment plan. Details to the intervention are described Chapter 6 of the Guideline, available for download at www.parkinsonnet.info/euguideline.

Upon completion of a treatment period, or during in case of prolonged treatment, the physiotherapist will communicate with the referring clinician about the treatment goal, plan and (expected) effect, and support this information with data collected with the measurement tools. As Parkinson's disease is progressive, goals can be towards improvement, maintenance of a status quo or towards reduced speed of deterioration. If compensatory strategies are used, such as cueing to reduce freezing of gait, the underlying problem is not taken away. Patients learn to circumvent the issue, and hence will never solve the problem 100%. Physiotherapists support pwp in their self-management. They discuss and agree with the pwp upon time and means of ongoing contact, depending on the pwp individual circumstances and needs, varying from one to twelve months.

Table 4 GRADE-based recommendations for physiotherapy interventions with a positive effect for pwP

Level	Meaning
Strong for	Positive effect and 0 outside confidence interval of effect; Evidence quality moderate/high
Weak for	Positive effect and 0 outside effect confidence interval; Quality of evidence low or moderate/high but only small effect or very large confidence interval
Weak against	Positive effect, but 0 inside confidence interval of effect

Core area	ICF level	Outcome	Types of interventions						
			Conventional physiotherapy	Treadmill	Massage	Cueing	Strategies for CMS	Dance: tango	Tai Chi
Balance	Balance capacity	No of falls	Weak against						Strong for
		BBS	Strong for	Weak for					Strong for
		FR	Strong for			Weak against			Strong for
		DGI				Strong for			
		Mini-BESTest						Strong for	
Balance & Gait	Capacity of functional mobility	FES / ABC	Weak against			Weak against			
		Timed turn	Weak against						
Gait	Walking capacity	Speed	Strong for	Strong for		Strong for	Weak against	Weak against	Strong for
		Stride length	Weak against	Strong for		Weak against	Strong for	Weak against	Strong for
		Step length	Weak against			Strong for	Weak against		
		Cadence	Weak against	Weak against		Weak against	Weak against		
		Distance	Weak against	Strong for				Weak against	Strong for
		Walking performance	FOG-Q	Weak against			Strong for		Weak against
Gait, Balance & Transfers	Capacity of functional mobility	TUG	Strong for			Weak against		Strong for	Strong for
		PAS				Strong for			
Transfers	Capacity of functional mobility	Sit-to-stand				Strong for			
		PAS – Chair				Strong for			
Physical Capacity	Muscle functions	Strength	Strong for	Weak against					Strong for
	Walking capacity	Walk distance	Weak against	Strong for				Weak against	Strong for
Other	Movement functions	UPDRS III	Strong for	Weak against		Strong for	Weak against	Weak against	Strong for
		P&G Score*				Strong for			
		PDQ-39	Weak against			Weak against		Weak against	
		EQ-5D	Weak against						
	Patient-based treatment effect	Quality of life	PDQL	Weak against**					
		CGI			Strong for				
		PSI-PD					Strong for		

*UPDRS III items 15 & 29–30 only; ** for combined PDQ-39, EQ-5D and PDQL-scores: weak against

Outcomes: ABC, Activities Balance Confidence Scale; BBS, Berg Balance Scale; CGI, Clinical Global Impression; DGI, Dynamic Gait Index; EQ-5D, EuroQol 5-D; FOG-Q, Freezing of Gait Questionnaire; FES, Falls Efficacy Scale; FR, Functional Reach; PAS, Parkinson Activity Scale; PDQ-39, Parkinson's Disease Quality of Life Questionnaire 39; PDQL, Parkinson Disease Quality of Life Questionnaire; PSI-PD, Patient Specific Index for Parkinson's disease; TUG, Timed Up and Go; UPDRS, Unified Parkinson's disease Rating Scale

Conventional physiotherapy: all physiotherapist-supervised active exercise interventions targeting gait, balance, transfers or physical capacity, or a combination thereof

Strategies for CMS (complex movement sequences): formerly called cognitive movement strategies

Reference List

- (1) Keus SHJ, Hendriks HJM, Bloem BR, Bredero-Cohen AB, de Goede CJT, van Haaren M et al. KNGF Guidelines for physical therapy in patients with Parkinson's disease [in Dutch]. *Ned Tijdschr Fysiother* 2004; 114(3 (Suppl)): www.appde.eu.
- (2) Ferreira JJ, Katzenschlager R, Bloem BR, Bonuccelli U, Burn D, Deuschl G et al. Summary of the recommendations of the EFNS/MDS-ES review on therapeutic management of Parkinson's disease. *Eur J Neurol* 2013; 20(1):5-15.
- (3) Fox SH, Katzenschlager R, Lim SY, Ravina B, Seppi K, Coelho M et al. The Movement Disorder Society Evidence-Based Medicine Review Update: Treatments for the motor symptoms of Parkinson's disease. *Mov Disord* 2011; 26 Suppl 3:S2-41.
- (4) Keus SH, Bloem BR, Hendriks EJ, Bredero-Cohen AB, Munneke M. Evidence-based analysis of physical therapy in Parkinson's disease with recommendations for practice and research. *Mov Disord* 2007; 22(4):451-460.
- (5) NICE. Parkinson's disease. Diagnosis and management in primary and secondary care (NICE Clinical Guideline 35). London, UK: National collaborating centre for chronic conditions; 2006.
- (6) Oertel W, Berardelli A, Bloem B, et al. Joint EFNS/MDS guidelines on early (uncomplicated) and late (complicated) Parkinson's disease. Blackwell Publishing Ltd.; 2011. 217-267.
- (7) Allen NE, Canning CG, Sherrington C, Lord SR, Latt MD, Close JC et al. The effects of an exercise program on fall risk factors in people with Parkinson's disease: a randomized controlled trial. *Mov Disord* 2010; 25(9):1217-1225.
- (8) Almeida QJ, Bhatt H. A Manipulation of Visual Feedback during Gait Training in Parkinson's Disease. *Parkinsons Dis* 2012; 2012:508720.
- (9) Arias P, Chouza M, Vivas J, Cudeiro J. Effect of whole body vibration in Parkinson's disease: a controlled study. *Mov Disord* 2009; 24(6):891-898.
- (10) Ashburn A, Fazakarley L, Ballinger C, Pickering R, McLellan LD, Fitton C. A randomised controlled trial of a home-based exercise programme to reduce the risk of falling among people with Parkinson's disease. *J Neurol Neurosurg Psychiatry* 2007; 78(7):678-684.
- (11) Braun S, Beurskens A, Kleynen M, Schols J, Wade D. Rehabilitation with mental practice has similar effects on mobility as rehabilitation with relaxation in people with Parkinson's disease: a multicentre randomised trial. *J Physiother* 2011; 57(1):27-34.
- (12) Bridgewater KJ, Sharpe M. Trunk muscle training and early parkinson's disease. *Physiother Th Pract* 1997; 13(2):139-153.
- (13) Caglar AT, Gurses HN, Mutluay FK, Kiziltan G. Effects of home exercises on motor performance in patients with Parkinson's disease. *Clin Rehabil* 2005; 19(8):870-877.
- (14) Cakit BD, Saracoglu M, Genc H, Erdem HR, Inan L. The effects of incremental speed-dependent treadmill training on postural instability and fear of falling in Parkinson's disease. *Clin Rehabil* 2007; 21(8):698-705.
- (15) Canning CG, Allen NE, Dean CM, Goh L, Fung VS. Home-based treadmill training for individuals with Parkinson's disease: a randomized controlled pilot trial. *Clin Rehabil* 2012; 26(9):817-826.
- (16) Chandler C, Plant R. A targeted physiotherapy service for people with Parkinson's disease from diagnosis to end stage: a pilot study. In: Percival R, Hobson P, editors. *Parkinson's disease: Studies in psychological and social care*. Leicester: BPS Books; 1999. 256-269.
- (17) Christoforetti G, Beinotti F, Borges G, Damasceno BP. Physical therapy improves the balance of patients with parkinson's disease: a randomized controlled trial. *Parkinsonism & Related Disorders* 2010; 16 (Suppl 1):S58.
- (18) Comella CL, Stebbins GT, Brown-Toms N, Goetz CG. Physical therapy and Parkinson's disease: a controlled clinical trial. *Neurology* 1994; 44(3 Pt 1):376-378.
- (19) Craig LH, Svircev A, Haber M, Juncos JL. Controlled pilot study of the effects of neuromuscular therapy in patients with Parkinson's disease. *Mov Disord* 2006; 21(12):2127-2133.

- (20) Cruise KE, Bucks RS, Loftus AM, Newton RU, Pegoraro R, Thomas MG. Exercise and Parkinson's: benefits for cognition and quality of life. *Acta Neurol Scand* 2011; 123(1):13-19.
- (21) De Bruin N., Doan JB, Turnbull G, Suchowersky O, Bonfield S, Hu B et al. Walking with music is a safe and viable tool for gait training in Parkinson's disease: the effect of a 13-week feasibility study on single and dual task walking. *Parkinsons Dis* 2010; 2010:483530.
- (22) Dereli EE, Yaliman A. Comparison of the effects of a physiotherapist-supervised exercise programme and a self-supervised exercise programme on quality of life in patients with Parkinson's disease. *Clin Rehabil* 2010; 24(4):352-362.
- (23) Dibble LE, Hale TF, Marcus RL, Droge J, Gerber JP, LaStayo PC. High-intensity resistance training amplifies muscle hypertrophy and functional gains in persons with Parkinson's disease. *Mov Disord* 2006; 21(9):1444-1452.
- (24) Dibble LE, Hale TF, Marcus RL, Gerber JP, LaStayo PC. High intensity eccentric resistance training decreases bradykinesia and improves Quality Of Life in persons with Parkinson's disease: a preliminary study. *Parkinsonism Relat Disord* 2009; 15(10):752-757.
- (25) Duncan RP, Earhart GM. Randomized controlled trial of community-based dancing to modify disease progression in Parkinson disease. *Neurorehabil Neural Repair* 2012; 26(2):132-143.
- (26) Ebersbach G, Edler D, Kaufhold O, Wissel J. Whole body vibration versus conventional physiotherapy to improve balance and gait in Parkinson's disease. *Arch Phys Med Rehabil* 2008; 89(3):399-403.
- (27) Ebersbach G, Ebersbach A, Edler D, Kaufhold O, Kusch M, Kupsch A et al. Comparing exercise in Parkinson's disease--the Berlin LSVT(R)BIG study. *Mov Disord* 2010; 25(12):1902-1908.
- (28) Ellis T, de Goede CJ, Feldman RG, Wolters EC, Kwakkel G, Wagenaar RC. Efficacy of a physical therapy program in patients with Parkinson's disease: A randomized controlled trial. *Arch Phys Med Rehabil* 2005; 86(4):626-632.
- (29) Fisher BE, Wu AD, Salem GJ, Song J, Lin CH, Yip J et al. The effect of exercise training in improving motor performance and corticomotor excitability in people with early Parkinson's disease. *Arch Phys Med Rehabil* 2008; 89(7):1221-1229.
- (30) Frazzitta G, Maestri R, Uccellini D, Bertotti G, Abelli P. Rehabilitation treatment of gait in patients with Parkinson's disease with freezing: A comparison between two physical therapy protocols using visual and auditory cues with or without treadmill training. *Mov Disord* 2009.
- (31) Goodwin VA, Richards SH, Henley W, Ewings P, Taylor AH, Campbell JL. An exercise intervention to prevent falls in people with Parkinson's disease: a pragmatic randomised controlled trial. *J Neurol Neurosurg Psychiatry* 2011; 82(11):1232-1238.
- (32) Hackney ME, Kantorovich S, Levin R, Earhart GM. Effects of tango on functional mobility in Parkinson's disease: a preliminary study. *J Neurol Phys Ther* 2007; 31(4):173-179.
- (33) Hackney ME, Earhart GM. Tai Chi improves balance and mobility in people with Parkinson disease. *Gait Posture* 2008; 28(3):456-460.
- (34) Hackney ME, Earhart GM. Effects of dance on movement control in Parkinson's disease: a comparison of Argentine tango and American ballroom. *J Rehabil Med* 2009; 41(6):475-481.
- (35) Hackney ME, Earhart GM. Effects of dance on gait and balance in Parkinson's disease: a comparison of partnered and nonpartnered dance movement. *Neurorehabil Neural Repair* 2010; 24(4):384-392.
- (36) Hass CJ, Buckley TA, Pitsikoulis C, Barthelemy EJ. Progressive resistance training improves gait initiation in individuals with Parkinson's disease. *Gait Posture* 2012; 35(4):669-673.
- (37) Hirsch MA, Toole T, Maitland CG, Rider RA. The effects of balance training and high-intensity resistance training on persons with idiopathic Parkinson's disease. *Arch Phys Med Rehabil* 2003; 84(8):1109-1117.
- (38) Kadivar Z, Corcos DM, Foto J, Hondzinski JM. Effect of step training and rhythmic auditory stimulation on functional performance in Parkinson patients. *Neurorehabil Neural Repair* 2011; 25(7):626-635.
- (39) Kamsma YPT, Brouwer WH, Lakke JPWF. Training of compensatory strategies for impaired gross motor skills in patients with Parkinson's disease. *Physiother Th Pract* 1995; 11:209-229.
- (40) Keus SH, Bloem BR, van Hilten JJ, Ashburn A, Munneke M. Effectiveness of physiotherapy in Parkinson's disease: the feasibility of a randomised controlled trial. *Parkinsonism Relat Disord* 2007; 13(2):115-121.

- (41) Klassen L, Dal Bello-Haas V, Sheppard M, Metcalfe A. Evaluating the benefits of group exercise and group exercise and education programs for individuals with Parkinson's disease. *Physiotherapy* 2007; 93 (Suppl. 1):S91.
- (42) Kurtais Y, Kutlay S, Tur BS, Gok H, Akbostanci C. Does treadmill training improve lower-extremity tasks in Parkinson disease? A randomized controlled trial. *Clin J Sport Med* 2008; 18(3):289-291.
- (43) Li F, Harmer P, Fitzgerald K, Eckstrom E, Stock R, Galver J et al. Tai chi and postural stability in patients with Parkinson's disease. *N Engl J Med* 2012; 366(6):511-519.
- (44) Lun V, Pullan N, Labelle N, Adams C, Suchowersky O. Comparison of the effects of a self-supervised home exercise program with a physiotherapist-supervised exercise program on the motor symptoms of Parkinson's disease. *Mov Disord* 2005; 20(8):971-975.
- (45) Mak MK, Hui-Chan CW. Cued task-specific training is better than exercise in improving sit-to-stand in patients with Parkinson's disease: A randomized controlled trial. *Mov Disord* 2008; 23(4):501-509.
- (46) Marchese R, Diverio M, Zucchi F, Lentino C, Abbruzzese G. The role of sensory cues in the rehabilitation of parkinsonian patients: a comparison of two physical therapy protocols. *Mov Disord* 2000; 15(5):879-883.
- (47) Meek C, Sackley CM, Clarke C.E., Soudy AA, Winward C, Esser P et al. Long-term individual fitness enablement (LIFE) for Parkinson's disease: a feasibility study. *Mov Disord* 2010; 25 (Suppl 3):S713.
- (48) Miyai I, Fujimoto Y, Ueda Y, Yamamoto H, Nozaki S, Saito T et al. Treadmill training with body weight support: its effect on Parkinson's disease. *Arch Phys Med Rehabil* 2000; 81(7):849-852.
- (49) Miyai I, Fujimoto Y, Yamamoto H, Ueda Y, Saito T, Nozaki S et al. Long-term effect of body weight-supported treadmill training in Parkinson's disease: a randomized controlled trial. *Arch Phys Med Rehabil* 2002; 83(10):1370-1373.
- (50) Mohr B, Muller V, Mattes R, Rosin R, Federmann B, Strehl U et al. Behavioral treatment of Parkinson's disease leads to improvement of motor skills and tremor reduction. *Behav Ther* 1996; 27:235-255.
- (51) Morris ME, Iansek R, Kirkwood B. A randomized controlled trial of movement strategies compared with exercise for people with Parkinson's disease. *Mov Disord* 2009; 24(1):64-71.
- (52) Nieuwboer A, De Weerd W, Dom R, Truyen M, Janssens L, Kamsma Y. The effect of a home physiotherapy program for persons with Parkinson's disease. *J Rehabil Med* 2001; 33(6):266-272.
- (53) Nieuwboer A, Kwakkel G, Rochester L, Jones D, Van Wegen E, Willems AM et al. Cueing training in the home improves gait-related mobility in Parkinson's disease: the RESCUE trial. *J Neurol Neurosurg Psychiatry* 2007; 78(2):134-140.
- (54) Pelosin E, Avanzino L, Bove M, Stramesi P, Nieuwboer A, Abbruzzese G. Action observation improves freezing of gait in patients with Parkinson's disease. *Neurorehabil Neural Repair* 2010; 24(8):746-752.
- (55) Pohl M, Rockstroh G, Ruckriem S, Mrass G, Mehrholz J. Immediate effects of speed-dependent treadmill training on gait parameters in early Parkinson's disease. *Arch Phys Med Rehabil* 2003; 84(12):1760-1766.
- (56) Pompeu JE, Mendes FA, Silva KG, Lobo AM, Oliveira TP, Zomignani AP et al. Effect of Nintendo Wii-based motor and cognitive training on activities of daily living in patients with Parkinson's disease: a randomised clinical trial. *Physiotherapy* 2012; 98(3):196-204.
- (57) Protas EJ, Mitchell K, Williams A, Qureshy H, Caroline K, Lai EC. Gait and step training to reduce falls in Parkinson's disease. *Neurorehabilitation* 2005; 20(3):183-190.
- (58) Reuter I, Mehnert S, Leone P, Kaps M, Oechsner M, Engelhardt M. Effects of a flexibility and relaxation programme, walking, and nordic walking on Parkinson's disease. *J Aging Res* 2011; 2011:232473.
- (59) Ridgel AL, Vitek JL, Alberts JL. Forced, not voluntary, exercise improves motor function in Parkinson's disease patients. *Neurorehabil Neural Repair* 2009; 23(6):600-608.
- (60) Sage MD, Almeida QJ. Symptom and gait changes after sensory attention focused exercise vs aerobic training in Parkinson's disease. *Mov Disord* 2009.
- (61) Sage MD, Almeida QJ. A positive influence of vision on motor symptoms during sensory attention focused exercise for Parkinson's disease. *Mov Disord* 2010; 25(1):64-69.

- (62) Schenkman M, Cutson TM, Kuchibhatla M, Chandler J, Pieper CF, Ray L et al. Exercise to improve spinal flexibility and function for people with Parkinson's disease: a randomized, controlled trial. *J Am Geriatr Soc* 1998; 46(10):1207-1216.
- (63) Schenkman M, Hall DA, Baron AE, Schwartz RS, Mettler P, Kohrt WM. Exercise for people in early- or mid-stage Parkinson disease: a 16-month randomized controlled trial. *Phys Ther* 2012; 92(11):1395-1410.
- (64) Schilling BK, Pfeiffer RF, LeDoux MS, Karlage RE, Bloomer RJ, Falvo MJ. Effects of moderate-volume, high-load lower-body resistance training on strength and function in persons with Parkinson's disease: a pilot study. *Parkinsons Dis* 2010; 2010:824734.
- (65) Schmitz-Hubsch T, Pyfer D, Kielwein K, Fimmers R, Klockgether T, Wullner U. Qigong exercise for the symptoms of Parkinson's disease: a randomized, controlled pilot study. *Mov Disord* 2006; 21(4):543-548.
- (66) Shankar A, De Bruin N, Bonfield S, Derwent L, Eliasziw M, Hu B et al. Benefit of music therapy in patients with Parkinson's disease: a randomized controlled trial. *Mov Disord* 2008; 23(Suppl 1):68.
- (67) Smania N, Corato E, Tinazzi M, Stanzani C, Fiaschi A, Girardi P et al. Effect of balance training on postural instability in patients with idiopathic Parkinson's disease. *Neurorehabil Neural Repair* 2010; 24(9):826-834.
- (68) Stack E, Roberts H, Ashburn A. The PIT: SToPP Trial-A Feasibility Randomised Controlled Trial of Home-Based Physiotherapy for People with Parkinson's Disease Using Video-Based Measures to Preserve Assessor Blinding. *Parkinsons Dis* 2012; 2012:360231.
- (69) Stozek J, Rudzinska M, Longawa K, Szczudlik A. [The effect of the complex rehabilitation on posture and gait in Parkinson disease]. *Neurol Neurochir Pol* 2003; 37 Suppl 5:67-81.
- (70) Thaut MH, McIntosh GC, Rice RR, Miller RA, Rathbun J, Brault JM. Rhythmic auditory stimulation in gait training for Parkinson's disease patients. *Mov Disord* 1996; 11(2):193-200.
- (71) Toole T, Hirsch MA, Forkink A, Lehman DA, Maitland CG. The effects of a balance and strength training program on equilibrium in Parkinsonism: A preliminary study. *Neurorehabilitation* 2000; 14(3):165-174.
- (72) Toole T, Maitland CG, Warren E, Hubmann MF, Panton L. The effects of loading and unloading treadmill walking on balance, gait, fall risk, and daily function in Parkinsonism. *Neurorehabilitation* 2005; 20(4):307-322.
- (73) Vivas J, Arias P, Cudeiro J. Aquatic therapy versus conventional land-based therapy for Parkinson's disease: an open-label pilot study. *Arch Phys Med Rehabil* 2011; 92(8):1202-1210.
- (74) Winward C, Sackley C, Meek C, Izadi H, Barker K, Wade D et al. Weekly exercise does not improve fatigue levels in Parkinson's disease. *Mov Disord* 2012; 27(1):143-146.
- (75) Yang YR, Lee YY, Cheng SJ, Wang RY. Downhill walking training in individuals with Parkinson's disease: a randomized controlled trial. *Am J Phys Med Rehabil* 2010; 89(9):706-714.
- (76) Yousefi B, Tadibi V, Khoei AF, Montazeri A. Exercise therapy, quality of life, and activities of daily living in patients with Parkinson disease: a small scale quasi-randomised trial. *Trials* 2009; 10:67.
- (77) Keus SHJ, Bloem BR, Verbaan D, de Jonge P, Hofman AM, van Hilten JJ et al. Physiotherapy in Parkinson's disease: utilisation and patient satisfaction. *J Neurol* 2004; 251(6):680-687.
- (78) Keus SHJ, van der Wees Ph, Nieuwboer AN, Jones D, Graziano M, Graham L et al. European guideline for physiotherapy in parkinson's disease. *Neurorehabil Neural Repair* 2012; XX(X):13 (pdf of poster: www.appde.eu/pdfs/Survey_poster_ParkinsonNet.pdf).
- (79) Cheng EM, Tonn S, Swain-Eng R, Factor SA, Weiner WJ, Bever CT, Jr. Quality improvement in neurology: AAN Parkinson disease quality measures: report of the Quality Measurement and Reporting Subcommittee of the American Academy of Neurology. *Neurology* 2010; 75(22):2021-2027.
- (80) Chartered Society of Physiotherapy. Practice Guidance for Physiotherapist Supplementary Prescribers. PD026 ed. London: CSP; 2011.
- (81) Shulman LM, Gruber-Baldini AL, Anderson KE, Vaughan CG, Reich SG, Fishman PS et al. The evolution of disability in Parkinson disease. *Mov Disord* 2008; 23(6):790-796.
- (82) Schenkman M, Ellis T, Christiansen C, Baron AE, Tickle-Degnen L, Hall DA et al. Profile of functional limitations and task performance among people with early- and middle-stage Parkinson disease. *Phys Ther* 2011; 91(9):1339-1354.

- (83) Hariz GM, Forsgren L. Activities of daily living and quality of life in persons with newly diagnosed Parkinson's disease according to subtype of disease, and in comparison to healthy controls. *Acta Neurol Scand* 2011; 123(1):20-27.
- (84) Speelman AD, van de Warrenburg BP, van NM, Petzinger GM, Munneke M, Bloem BR. How might physical activity benefit patients with Parkinson disease? *Nat Rev Neurol* 2011; 7(9):528-534.
- (85) Domingos J, Coelho M, Ferreira JJ. Referral to rehabilitation in Parkinson's disease: who, when and to what end? *Arq Neuropsiquiatr* 2013; (in press).
- (86) Ahlskog JE. Parkinson disease treatment in hospitals and nursing facilities: avoiding pitfalls. *Mayo Clin Proc* 2014; 89(7):997-1003.
- (87) Aminoff MJ, Christine CW, Friedman JH, Chou KL, Lyons KE, Pahwa R et al. Management of the hospitalized patient with Parkinson's disease: current state of the field and need for guidelines. *Parkinsonism Relat Disord* 2011; 17(3):139-145.
- (88) Buchanan RJ, Wang S, Huang C, Simpson P, Manyam BV. Analyses of nursing home residents with Parkinson's disease using the minimum data set. *Parkinsonism Relat Disord* 2002; 8(5):369-380.
- (89) Gerlach OH, Winogrodzka A, Weber WE. Clinical problems in the hospitalized Parkinson's disease patient: systematic review. *Mov Disord* 2011; 26(2):197-208.
- (90) Weerkamp NJ, Zuidema SU, Tissingh G, Poels PJ, Munneke M, Koopmans RT et al. Motor profile and drug treatment of nursing home residents with Parkinson's disease. *J Am Geriatr Soc* 2012; 60(12):2277-2282.
- (91) Weerkamp NJ, Tissingh G, Poels PJ, Zuidema SU, Munneke M, Koopmans RT et al. Parkinson disease in long term care facilities: a review of the literature. *J Am Med Dir Assoc* 2014; 15(2):90-94.
- (92) Walker RW, Palmer J, Stancliffe J, Wood BH, Hand A, Gray WK. Experience of care home residents with Parkinson's disease: Reason for admission and service use. *Geriatr Gerontol Int* 2013.
- (93) Lubomski M, Rushworth RL, Tisch S. Hospitalisation and comorbidities in Parkinson's disease: a large Australian retrospective study. *J Neurol Neurosurg Psychiatry* 2014.
- (94) Martignoni E, Godi L, Citterio A, Zangaglia R, Riboldazzi G, Calandrella D et al. Comorbid disorders and hospitalisation in Parkinson's disease: a prospective study. *Neurol Sci* 2004; 25(2):66-71.
- (95) Canning CG. Rehabilitation in Parkinson's disease - the challenge to provide early and ongoing, evidencebased, patient-centred care. *Arq Neuropsiquiatr* 2013; 71(12):917-919.
- (96) Nijkrake MJ, Keus SH, Oostendorp RA, Overeem S, Mulleners W, Bloem BR et al. Allied health care in Parkinson's disease: referral, consultation, and professional expertise. *Mov Disord* 2009; 24(2):282-286.