

# European Physiotherapy Guideline for Parkinson's Disease

Developed with twenty European professional associations

Development and scientific justification



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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).



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Available for downloading at [www.parkinsonnet.info/euguideline](http://www.parkinsonnet.info/euguideline) are

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

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## European Physiotherapy Guideline for Parkinson's Disease

Parkinson's disease, or Parkinson's, is a complex disorder. It is characterised by a wide array of motor and non-motor problems for which medical intervention alone is insufficient. Many allied health professionals can be involved in the management of Parkinson's disease, of which physiotherapy is the most applied and supported by scientific evidence. In 2004, the Royal Dutch society for Physical Therapy (KNGF) published the first evidence-informed guideline with practice recommendations for physiotherapy in Parkinson's. An external audit in 2008 showed that this Guideline is one of the few Parkinson's disease guidelines that are of good quality. Following a request from the Association of Physiotherapists in Parkinson's disease Europe (APPDE), the KNGF agreed upon a proposal of ParkinsonNet to update and adapt the Guideline into a European guideline. The APPDE, the European Region of the World Confederation for Physical Therapy (ER-WCPT) and the European Parkinson's Disease Association (EPDA), an umbrella organisation representing 45 national member organisations ([www.epda.eu.com](http://www.epda.eu.com)) endorsed the development. Representatives of as many as 20 member organisations of the ER-WCPT, as well as representatives of Parkinson associations participated in the development process.

The GDG developed this Guideline according to international standards for guideline development, addressing all items of the Appraisal of Guidelines for Research and Evaluation Instrument (AGREE, [www.agreetrust.org](http://www.agreetrust.org)) and using 'Grading of Recommendations Assessment, Development and Evaluation' (GRADE) to develop the recommendations.

### 1.2 The Guideline Development Group

In 2011, all 20 physiotherapy participating associations nominated a representative for the Writing Group, the Reading Group or the Review Panel. Together these groups make up the Guideline Development Group (GDG). None of the GDG members had an intellectual conflict of interest. Selection criteria for Writing Group members were geographic dispersion throughout Europe and a good balance between clinical and research Parkinson-specific expertise. Through the EPDA and the Dutch Parkinson association, pwp fully participated in both the Writing and Reading Group.

An international Steering Group evaluated the development process. Members of this group had extended expertise in physiotherapy, neurology, Parkinson's disease, the pwp' perspective and guideline development in general.

### 1.3 Timeline

In 2011, after the initiation of the European survey, the 10 Writing Group members started their activities<sup>11</sup>. They prepared the first drafts of the key questions to be addressed, the overall contents of the Guideline, the literature review and the recommendations. For this, they met three times: June 2011, February and November 2012. Furthermore, the GDG communicated electronically. Members of the Reading Group provided feedback at eight points during the development process, between February 2012 and May 2014. Members of the Review Panel provided feedback on two penultimate versions: October 2013 and April 2014. These versions were also published online for public feedback. Finally, at the time of publication of this Guideline, Parkinson-expert neurologists, members of the European Section of the Parkinson and Movement Disorder Society are reviewing the referral criteria as described in the Section for clinicians. Their Viewpoint will be published in the MDS online journal Clinical Practice.

### 1.4 Identifying barriers in current care

The 2004 KNGF-Guideline Parkinson's disease, unique in its field, was the starting point for the development of this European Guideline<sup>12,13</sup>. In addition, the GDG used the 2010 Dutch Multidisciplinary Guideline for Parkinson's disease<sup>14</sup>. The Dutch Multidisciplinary Guideline is an update of the 2006 National Institute for Health and Clinical Excellence (NICE) Guideline published in the United Kingdom (UK)<sup>15</sup>, extended with recommendations for interdisciplinary collaboration and

care organisation. Aiming to provide recommendations to optimise care, as a first step, the GDG gained insight into barriers physiotherapists currently experience when wishing to provide intervention to pwp. These were identified by means of a web-based survey sent to 9,646 physiotherapists of 17 European countries<sup>11</sup>. Of the responding 3,405 physiotherapists, 84% had treated at least one pwp the past year, and identified many barriers to delivery of optimal care (Table 1.4a). Through focus groups with 50 expert users, and with Dutch ParkinsonNet physiotherapists, points for improvement of the 2004 KNGF Guideline were identified (Table 1.4b). In addition, barriers in current care reported by pwp and therapists were identified in the international literature using the search terms "Patient's perspective" OR "Patient Satisfaction"[Mesh] AND "Parkinson Disease"[Mesh]' (Table 1.4c)<sup>16-22</sup>. The GDG used these barriers and suggestions for improvement in the development of this Guideline by transforming them into key questions. For example, What are the consequences of cognitive impairments for physiotherapy treatment? and What treatment strategies improve the performance of walking?

**Table 1.4a Physiotherapist' perceived barriers in delivering optimal care to pwp**

<b>Low treatment volume</b>	The median annual treatment volume* reported was as low as 4, ranging from 2 to 5 in different countries. The reported optimum annual treatment volume to gain and maintain Parkinson expertise was 10
<b>Limited knowledge &amp; skills</b>	The majority reported limited Parkinson's specific knowledge and skills: only 16% reported (very) high self-perceived Parkinson-expertise, increasing to 26% in physiotherapists with a treatment volume $\geq 5$
<b>Referral at too late a stage</b>	To 33%, referral at too late a stage was a major barrier. Even though physiotherapy is important from disease onset, most of the pwp treated were in the complicated phase (HY 3 and 4)
<b>Time constraints</b>	One in three physiotherapists reported limited time with the pwp as a major barrier. Parkinson's disease is a complex condition involving slowness of movement, speech and thinking. As a result, physiotherapy assessment and treatment for pwp requires more time than other patient groups
<b>Collaboration</b>	25% would like more communication with their peers on pwp and related issues
<b>Measurement tools</b>	40% of experts did not use measurement tools. The main reasons were lack of time (32%), insufficient knowledge and skills (29%), difficulty interpreting results (25%) and unavailability of tools (23%). Also tools not recommended in the 2004 Guideline are used, such as Berg Balance and Tinetti Balance & Gait
<b>Intervention</b>	Less than 60% of therapists applied cognitive movement strategies and physical capacity training, recommended by the KNGF Guideline. For most interventions, only 50% of physiotherapists felt above average competence applying them.

\*unique number of pwp assessed and, if indicated, treated annually

**Table 1.4b Parkinson expert physiotherapists information needs**

- How to recognise atypical parkinsonisms from Parkinson's disease?
- How do impairments in cognition and co-morbidities influence physiotherapy treatment?
- What are referral criteria for other health professionals?
- How to optimise communication with other health professionals, including referring physicians?
- How to use and interpreted measurement tools?
- Why are certain measurement tools not recommended?
- How to discuss expectations towards the intervention with the pwp?
- How to support self-management, especially after completion of a treatment period?
- What are the general contents of a group treatment protocol?

**Table 1.4c Pwp needs towards optimal care**

Contents of care	Organisation of care
<ul style="list-style-type: none"> <li>Information about the expected treatment effect</li> <li>Taking into account fluctuations in daily functioning</li> <li>Information on mobility and exercise</li> <li>Discussion of the role of the carer</li> <li>Self-management support</li> <li>Emotional support, such as interest, motivation, taken seriously</li> </ul>	<ul style="list-style-type: none"> <li>Care by specialised healthcare providers</li> <li>Active involvement in clinical decision making</li> <li>Possibility to choose own physiotherapist</li> <li>Treatment at home</li> <li>Parkinson's specific knowledge in home care professionals</li> <li>Multidisciplinary collaboration: avoid conflicting information and advise; information exchange</li> </ul>

### 1.5 Literature search

The GDG determined which of the key questions could feasibly be addressed by undertaking a systematic literature search. The aim was to identify all controlled clinical trials (CCTs) in the field: trials in which two groups of pwp participated, of which at least one received a physiotherapy intervention. The GDG used literature search filters of the Cochrane Collaboration<sup>23</sup>, with the exception that next to RCTs also not randomised controlled clinical trials were identified (Table 1.5b). In addition, the GDG searched PEDRO using the wildcards 'Parkinson' and 'Parkinson's', and Writing and Reading Group members contributed trials not yet identified. The GDG addressed all others questions by expert opinion and a non-systematic literature search in PubMed up and to December 2012.

Of the 122 CCTs identified, the GDG excluded 52 for various reasons (Appendix 15)<sup>24-75</sup>. The GDG categorised the 70 remaining CCTs according to the evaluated physiotherapy interventions (Table 1.5c)<sup>76-145</sup>.

**Table 1.5a Key questions for which a systematic literature was carried out**

Contents of care
<ul style="list-style-type: none"> <li>What treatment strategies improve performance of transfers?</li> <li>What treatment strategies improve performance of manual activities?</li> <li>What treatment strategies improve performance of balance?</li> <li>What treatment strategies improve performance of gait?</li> <li>What treatment strategies improve performance of physical capacity?</li> <li>What treatment strategies improve respiratory functions?</li> <li>What treatment strategies reduce pain?</li> </ul>

**Table 1.5b Strategy systematic literature search**

Step	Aim	Search	Hits
1	Parkinson's	"Parkinson Disease"[Mesh] AND "Parkinson Disease, Secondary"[Mesh] OR Parkinson OR "Parkinson's disease" OR parkinsonism	80,891
2	Physiotherapy	"Physical Therapy (Specialty) "[MESH] OR "Physical Therapy Modalities"[MESH] OR Rehabilitation [MESH] OR Exercise[MESH] OR "Exercise Therapy"[MESH] OR "Resistance Training"[MESH] OR "Muscle Stretching Exercises"[MESH] OR "Breathing Exercises"[MESH] OR Physiotherapy OR "physical therapy" OR exercise OR rehabilitation	631,534
3	Combine 1 & 2	#1 AND #2	4,683
4	RCTs/CCTs	(randomised controlled trial [pt] OR controlled clinical trial [pt] OR randomised [tiab] OR placebo [tiab] OR clinical trials as topic [mesh: noexp] OR randomly [tiab] OR trial [ti]) NOT (animals [mh] NOT humans [mh])	767,963
5	Systematic reviews	((("meta-analysis" [pt] OR "meta-anal*" [tw] OR "metaanal*" [tw] OR ("quantitativ* review*" [tw] OR "quantitative* overview*" [tw] ) OR ("systematic* review*" [tw] OR "systematic* overview*" [tw]) OR ("methodologic* review*" [tw] OR "methodologic* overview*" [tw]) OR ("review" [pt] AND "medline" [tw])) AND ("2008/01/01"[PDAT] : "2012/31/12"[PDAT]))	48,334
6	Guidelines	((("guideline" [pt] OR "practice guideline" [pt] OR "health planning guidelines" [mh] OR "consensus development conference" [pt] OR "consensus development conference, nih" [pt] OR "consensus development conferences" [mh] OR "consensus development conferences, nih" [mh] OR "guidelines" [mh] OR "practice guidelines" [mh] OR (consensus [ti] AND statement [ti]))) AND ("2003/01/01"[PDAT] : "2012/31/12"[PDAT]))	18,953
7	Combine 3 & 4	#3 AND #4	618
8	Combine 3 & 5	#3 AND #5	47
9	Combine 3 & 6	#3 AND #6	9
10		("Patient's perspective" OR "Patient Satisfaction"[Mesh]) AND #3	133

**Table 1.5c Categories of physiotherapy interventions for pwp**

- Conventional physiotherapy
- Treadmill training
- Cueing
- Strategies for complex motor sequences
- Massage
- Martial arts
- Dance

### 1.6 Using GRADE to develop recommendations

Most guideline panels have used letters and numbers to summarise their recommendations, but they have used them with little uniformity to establish a best method<sup>146</sup>. The GDG has appraised evidence using GRADE, Grading of Recommendations Assessment Development and Evaluation ([www.GRADEworkinggroup.org](http://www.GRADEworkinggroup.org)). GRADE is endorsed by many major organisations such as the Cochrane Collaboration, the World Health Organisation, the UK National Institute for Health and Clinical Excellence and the British Medical Journal. With GRADE, the GDG graded the 'body of evidence' for each key question, instead of for separate publications as was common in 2004 (Fig. 1.6).

Fig. 1.6 From key questions to recommendations



The GDG formulated key questions based on the barriers identified; classified the outcomes used in the identified CCTs into capacity or performance measures on the different International Classification of Functioning (ICF) domains and scored the importance of the classes of outcomes. Only outcomes with a mean score of 6.5 or above on a scale of one to 10, that is critical outcomes, were used for the evidence grading (Appendix 14). Next, the GDG extracted all trial details necessary for the grading process and graded the quality of the evidence for each question and outcome: high, moderate, low or very low. All CCTs started at the high level. Possible reasons for downgrading were risk of bias, inconsistency, indirectness or imprecision of the results and publication bias (Table 1.6a). For each reason the GDG lowered the quality level by one level in case of a serious limitations, or by two levels in case of a very serious limitation. Limitations not expected to influence the outcome did not result in downgrading.

Table 1.6a Possible reasons for downgrading of the quality of evidence

Reason	Example
Risk of bias*	Design limitations, such as no (report of) randomisation procedure*, blinding*, allocation concealment* or intention to treat analyses*, or high numbers of drop outs*
Inconsistency	Differences in direction and size of the effect
Indirectness	Differences in intervention, people (in our case pwp and therapists) or outcome measures between studies
Imprecision*	Wide confidence intervals or large p-value; ; few pwp included*,
Publication bias	Studies or outcomes with expected small or no results not published

\*most frequent reasons for downgrading

Table 1.6b Statistics and formulae used for individual studies<sup>147</sup>

Statistic	Formula
Pooled standard deviation across groups (sd)	$\sqrt{(n1-1)sd1^2+(n2-1)sd2^2/(N-2)}$ When the sd of the response was not provided, pre-measurement sd was used
Mean Difference (MD)	$m1 - m2$ (response experimental minus mean response control) With standard error (SE) = $\sqrt{((sd1^2/n1)+(sd2^2/n1))}$
Standardised MD (SMD)	$(m1 - m2)/s * (1-(3/(4N-9)))$ With SE = $\sqrt{((N/n1*n2)+(SMD^2/(2(N-3.94))))}$
Confidence interval	MD or SMD $\pm 1.96*SE$

For estimation of the intervention effect, the Mean Difference (MD) or Standardised Mean Difference (SMD) was used (Table 1.6b)<sup>23</sup>. The MD and its 95% confidence interval (CI) are used when studies use an identical outcome measurement. The MD expresses the size of the intervention effect on the scale used. The CI expresses the range within which we can be 95% certain that the true effect lies. The SMD and its CI are used when studies assess the same outcome, but measure it in a variety of ways. The SMD expresses the size of the intervention effect relative to the variability. The SMD is adjusted for sample size using Hedge's g effect size matrix.

Initially, aiming to keep the development time and thus costs of this Guideline reasonable, the GDG intended to use MD's and SMD's from published meta-analysis. Over the past years, several systematic reviews including meta-analyses reviewing the efficacy of physiotherapy for pwp have been published. However, it appeared that for one key question, different meta-analysis included different CCTs. Moreover, some CCTs selected by the GDG were not included the meta-analysis. Therefore, the GDG performed a meta-analysis, using RevMan software (Cochrane Collaboration; <http://tech.cochrane.org/Revman>) to calculate the MD or SMD.

Finally, the GDG graded the recommendations as 'strong' or 'weak'. This strength reflects the generalisability of the effects amongst all pwp; the extent to which the benefits of the intervention outweigh undesirable effects (such as falls, burden of treatment and costs); the availability; and the values and preferences of pwp and therapists, if known<sup>148</sup>.

### 1.7 Selecting physiotherapy measurement tools

Use of measurement tools supports structured, objective and transparent assessment, evaluation and communication. However, this only is the case when appropriate tools are selected and the results well interpreted. The GDG has selected outcome measures for use in routine practice in individual pwp.

To determine the final set of tools, first the GDG checked the overview of tools recommended in the current Guideline<sup>149</sup>, identified through the European survey<sup>11</sup> or focus groups with Parkinson expert physiotherapists for completeness. Of all 37 identified tools, the GDG gathered information regarding psychometric properties: validity, reliability, responsiveness and interpretability, as well as and feasibility to use (Table 1.7)<sup>150</sup>. Based on these properties, the GDG selected the final set of recommended tools.

Given the focus of physiotherapy treatment and communication, tools on the activities and participation component of the ICF are considered preferable. The majority of tools available were developed for the benefit of scientific research and are focused on use in groups of pwp. The value of these instruments for indication and evaluative purposes in individual pwp is still unclear and may lead to false security. As a rule of thumb, when used in single pwp, these tools are less responsive because the measurement error in a single person is larger than it is in groups. Consequently, a single pwp a change in activity limitations needs to be larger in order to be picked up by the than it needs to be in groups of pwp.

**Table 1.7 Selection criteria for measurement tools**

Criteria	Meaning
Validity	Does it measure what it is supposed to measure? Does it have the same meaning for pwp? Is it within the scope of physiotherapy for pwp? Is it linked to the level of limitations in activities domain of the ICF?
Reliability	Are results consistent when used in consistent conditions?
Responsiveness & interpretability	Can it detect change over time? Can we assign a qualitative meaning to the (change in) quantitative scores?
Feasibility	Do benefits outweigh the burden in terms of costs, time, space and effort? Is it currently used by (many) physiotherapists? Is it available in many languages?

**1.8 Update of this Guideline**

Planned at the latest by 2019. The copyright holder of this Guideline will decide whether the Guideline needs an update. This depends on the amount and strength of new scientific evidence, changes in barriers in current care or changes in the organisation of care. New evidence will be appraised conforming methods used for this Guideline by a writing group assigned by the copyright holders. All participating associations will be offered the possibility to participate in this process. At [www.parkinsonnet.info/euguideline](http://www.parkinsonnet.info/euguideline), the users of the Guideline will be invited to share their experience and knowledge.

# Appendix 14

## Graded classes of outcomes

All outcomes reported in the CCTs used for this Guideline are grouped on ICF code (Appendix 9) and graded by the GDG for their importance on a scale of 1 (not important at all) to 10 (most important)

**Table Appendix 14.1 'Critical outcomes', outcomes with an importance-score of 6.5 or above**

Grouped outcome	Core area	ICF code	Tools used in research	mean score
Capacity measure of functional mobility (that is changing body position and walking)	Gait Transfers Balance	d	Tinetti Gait Assessment Timed Get-up and Go Sit to stand time Timed U-turn Turning in place 360 Standing up & lying down Ascend and descend stairs Climbing up & down a flight of stairs 5-step test Supine to standing turning time (Modified) Parkinson Activity Scale Short Physical Performance Battery (SPPB)	8,8
Capacity measure of Walking -1	Gait	d	Walking speed (3 to 24-m walk test; Backward walking)	8,6
Performance measure of Walking (that is gait)	Gait	d	Freezing of Gait Questionnaire Freezing of gait diary	8,3
Capacity # # # measure of Changing and maintaining body position (that is balance): DYNAMIC	Balance	d	Dynamic Gait Index Timed (single or tandem) stance Functional Reach Maximum balance range Berg Balance Scale Tinetti Balance Assessment Number of falls	8,2
Movement functions: Gait pattern -1	Gait	b	Step or Stride length (10, 12 or 24-m walk test)	8,2
Capacity measure of Walking - 2	Gait	d	Walking distance (2- or 6-minute walk)	8,1
Patient-based treatment effect		p	Goal Attainment Scaling (GAS) Patients Specific Index PD VAS for improvement problem Patient reported Clinical Global Impression scale (CGI) of Change	8,1
Performance measure of Changing and maintaining body position (that is balance)	Balance	d	(Modified) Falls Efficacy Scale (FES) ABC Parkinson's Disease Falls Risk Score Latency to falls / near falls	7,9
Movement functions: Gait pattern - 3	Gait	b	Cadence Variation of stride length	7,7
Quality of life			Parkinson's Disease Questionnaire 39 (PDQ-39) Parkinson's Disease QOL Questionnaire (PDQLQ) EuroQOL-5D Sickness Impact Profile (SIP) Nottingham Health Profile (NHP)	7,4
Movement functions: Gait pattern - 2	Gait	b	Step width	7,2
Performance measure of looking after one's health	Physical capacity	d	Physical Activity Scale for the Elderly (PASE) Phone-FITT Habitual Physical Activity Questionnaire	6,9
Movement functions: functions of involuntary movement, voluntary movement control and muscle tone	Balance	b	Pull test UPDRS – motor UPDRS Posture & Gait score	6,8
Muscle functions	Physical capacity	b	Muscle strength or power	6,6
Performance measure of self care (that is basic ADL)	All	d	None reported	6,5

**Table Appendix 14.2 'Non-critical outcomes' - outcomes with an importance-score lower than 6.5**

Grouped outcome	Core area	ICF code	Tools used in research	mean score
Composite score for disease severity	All	h	Short Parkinson Evaluation Scale-SCOPA Webster Rating Scale Unified Parkinson's Disease Rating Scale (UPDRS) total score Brown's Disability Scale Self-Assessment PD Disability Scale (SPDDS)	5,7
Mobility of joint functions	Physical capacity	b	Functional axial rotation Range of motion Thoracic kyphosis	5,7
Capacity measure of Fine hand use and lifting and carrying objects (that is manual activity)	Dexterity	d	Fugl-Meyer assessment Action research arm test (ARAT) Box and block test Grooved Pegboard Purdue Pegboard test	5,5
Performance # # measure of mobility and domestic life (that is extended ADL)	All	d	Nottingham Extended ADL Index Schwab and England ADL UPDRS – ADL	5,3
Pain		b	Visual Analogue Scale	6,3
Acceptability and safety of		NA	incidence of adverse outcomes drop-outs during study number of falls	6,2
Exercise tolerance functions: fatigability	Physical capacity	b	Fatigue Severity Scale (FSS)	5,4
Exercise tolerance functions: aerobic capacity	Physical capacity	b	Endurance / aerobic capacity Max cardiopulmonary exercise test Metabolic equivalents (MET)	5,3
Global mental functions		b	Hamilton Depression Rating Scale Geriatric Depression Scale Epworth Sleepiness Scale Attitudes to Self Scale Beck Depression Inventory (BDI) Beck Anxiety Inventory (BAI) Zung Self-Rating Depression Scale (SDS) Global patient's mood status (PMS) State-Trait Anxiety Inventory Hospital Anxiety and Depression Scale Positive and Negative Affect	4,8
Capacity measure of looking after one's health		d	Ambulatory activity monitoring	4,7
Specific mental functions		b	SCOPA-cog ADAS-cog SWM: spatial working memory SRM: spatial recognition memory PRM: pattern recognition memory SOC: stockings of Cambridge FAS: verbal fluency for letters CFA: category fluency for Wisconsin Card Sorting Test (WCST; executive function) Wechsler Adult Intelligence Scale III = attention Stroop test Clock drawing	4,7
Capacity # # # measure of balance - STATIC	Balance		Posturography (sensory organization test, postural sway)	4,3
Functions of the respiratory system	Physical capacity	b	Inspiratory muscle strength Inspiratory muscle endurance VO2peak	4,0
Functions related to the digestive system: swallowing		b	Safety: Penetration–aspiration score Swallowing timing	2,8

# Appendix 15 Overview of excluded CCTs: reasons for exclusion

**Table Appendix 15 Overview of excluded CCTs: reasons for exclusion**

Reason for exclusion	1 <sup>st</sup> Author, year
No or insufficient data for 'critical outcomes'	Bergen 2002 <sup>1</sup> Blackington 2002 <sup>2</sup> Burini 2006 <sup>3</sup> Byl 2009 <sup>4</sup> Cerri 1994 <sup>5</sup> Cianci 2010 <sup>6</sup> Dam 1996 <sup>7</sup> Ganesan 2010 <sup>8</sup> Hass 2006 <sup>9</sup> Homann 1998 <sup>10</sup> Inzelberg 2005 <sup>11*</sup> Katsikitis 1996 <sup>12</sup> Lee 2011 <sup>13</sup> Lehman 2005 <sup>14</sup> Marjama-Lyons 2002 <sup>15</sup> Shiba 1999 <sup>16</sup> Stallibrass 2002 <sup>17</sup> Tamir 2007 <sup>18</sup> Tanaka 2009 <sup>19</sup> Purchas 2007 <sup>20</sup> Troche 2010 <sup>21*</sup> Van Gerpen 2010 <sup>22</sup> Yen 2011 <sup>23</sup>
Identical to another, included CCT	Bridgewater 1996 <sup>24</sup> (identical to Bridgewater 1997 <sup>25</sup> ) Earhart 2010 <sup>26</sup> (identical to Duncan** 2012 <sup>27</sup> ) Forkink 1996 <sup>28</sup> (identical to Toole 2000 <sup>29</sup> ) Goodwin 2009 <sup>30</sup> (abstract of Goodwin 2011 <sup>31</sup> ) Hackney 2009 <sup>32</sup> (identical to other Hackney 2009 <sup>33</sup> ) Lim 2010 <sup>34</sup> (identical to Nieuwboer 2007 <sup>35</sup> ) Müller 1997 <sup>36</sup> (identical to Mohr 1996 <sup>37</sup> ) Schilling 2008 <sup>38</sup> (identical to Schilling 2010 <sup>39</sup> )
Type of intervention	Chiviacoski 2012 <sup>40</sup> (self-control within treatment, pwp choices) Fiorani 1997 <sup>41</sup> (occupational therapy) Formisano 1992 <sup>42</sup> (multidisciplinary rehabilitation: OT, PT, SLT) Gauthier 1987 <sup>43</sup> (occupational therapy) Gibberd 1981 <sup>44</sup> (multidisciplinary rehabilitation: OT, PT) Gobbi 2009 <sup>45</sup> (comparison exercise protocols, different contents & frequency) Guo 2009 <sup>46</sup> (multidisciplinary rehabilitation) Hass 2007 <sup>47</sup> (additive effect of creatine to progressive resistance training) Hurwitz 1989 <sup>48</sup> (nurse-student supervised range of motion exercises) Modugno 2010 <sup>49</sup> (PT as control intervention: 3 years, 2/wk, 2-3 hrs; N=10) Pacchetti 2000 <sup>50</sup> (active music improvisation using instruments and voice) Palmer 1986 <sup>51</sup> (intervention: slow stretching versus karate) Patti 1996 <sup>52</sup> (multidisciplinary rehabilitation) Reuter 2011 <sup>53</sup> (multidisciplinary rehabilitation) Tickle-Degnen 2010 <sup>54</sup> (multidisciplinary rehabilitation) Wade 2003 <sup>55</sup> (multidisciplinary rehabilitation) Wells 1999 <sup>56</sup> (osteopathy) White 2009 <sup>57</sup> (multidisciplinary rehabilitation)
Single (day) treatment only	Chouza 2011 <sup>58</sup> Fok 2012 <sup>59</sup> Haas 2006 <sup>60</sup> King 2009 <sup>61</sup>

\*no outcomes for respiration were selected as 'critical'



# Appendix 16

## Measurement tools considered for recommendation

The following pages provide psychometric properties and feasibility for use in pwp of all measurement tools that the GDG considered for recommendation in this Guideline. In alphabetical order: first the included, then the excluded tools.

**Table Appendix 16 Measurement tools considered for recommendation**

### Included measurement tools\*

1. 10 Meter Walk (10MW)
2. Activities Balance Confidence (ABC) Scale
3. Berg Balance Scale (BBS)
4. Borg Scale 6-20
5. Dynamic Gait Index (DGI)
6. Falls Efficacy Scale International (FES-I)
7. Five Times Sit-to-Stand (FTSTS)
8. Functional Gait Assessment (FGA)
9. Goal Attainment Scaling (GAS) – goals evaluation form
10. History of falling
11. Mini Balance Evaluation Systems Test (Mini-BESTest)
12. Modified Parkinson Activity Scale (M-PAS)
13. New Freezing of Gait Questionnaire (NFOG-Q)
14. Patients Specific Index PD (PSI-PD)
15. Push and Release Test (P&R Test)
16. Rapid Turns test
17. Six Minute Walk Distance (6MWD)
18. Timed Get-up and Go (TUG)

\*Chapter 5 supports decision-taking towards careful selection of appropriate tools in each unique pwp.

Note: No single pwp requires the use of all 18 tools.

### Excluded measurement tools

- a. 2-Minute step test
- b. Balance Evaluation Systems Test (BESTest)
- c. Freezing of Gait Questionnaire (FOGQ)
- d. Functional Reach (FR)
- e. Global Perceived Effect (GPE)
- f. LASA Physical Activity Questionnaire (LAPAQ)
- g. Lindop Scale
- h. Movement Disorder Society's (MDS) revision of the UPDRS (MDS-UPDRS)
- i. Nine Hole Peg Test
- j. Parkinson Activity Scale (PAS)
- k. Parkinson's Disease Questionnaire (PDQ-39)
- l. PHONE FITT
- m. Physical Activity Scale for the Elderly (PASE)
- n. Pull Test
- o. Purdue Pegboard Test
- p. Survey of Activities and Fear of Falling in the Elderly (SAFFE)
- q. Tinetti Performance Oriented Mobility Assessment (POMA) , Gait (G) and Balance (B)
- r. Unified Parkinson's Disease Rating Scale (UPDRS)
- s. WALK-12 Questionnaire

**Appendix 16. Abbreviations and explanation of terminology**

AUC	Area Under the ROC Curve: accuracy to discriminate; 0 to 100, with cut-off scores >0.9, excellent; 0.70-0.90, adequate; <0.70, poor <sup>62</sup>
Capacity (ICF)	Executing tasks in a standard environment, indicating the highest probable level of functioning in a given domain at a given moment
Ceiling effect	The tool is not sensitive enough to assess good functioning people as many people score the highest score: the tool items may be too easy
Changing and maintaining body position	Balance
Concurrent validity	Measure for correlation of the tool to another (validated) tool, measured at (approximately) the same time, using Spearman's or Pearson's rho (r). A form of criterion validity (also predictive validity)
Convergent validity	Degree to which the scores of tools, which theoretically are the same, relate. A form of construct validity; see also discriminative validity
Cronbach's	Cronbach's alpha: coefficient of internal consistency of results across items within the test; cut-off scores: ≥ 0.9 excellent, ≥ 0.8 good, ≥0.7 acceptable, ≥0.6 questionable, ≥0.5 poor, and < 0.5 unacceptable.
Current use	Based on results of the European Guideline' survey: low=<10%; intermediate=<10-35%, high=>35%
Discriminative validity	Degrees to which scores of tools that theoretically are different can be discriminated. A form of construct validity; see also convergent validity
Floor effect	Tool not sensitive enough to assess badly functioning people as many people score the lowest score: the tool items may be too difficult
ICC	Intraclass correlation coefficient, measure for intra-rater (test-retest) and inter-rater reliability; cut-off scores: > 0.89, excellent; 0.80-0.89, good; 0.70-0.79 moderate; <0.69, poor
ICF	International Classification of Functioning, Disability and Health
k	Weighted Kappa: agreement beyond that what be expected by chance; cut-off scores: ≤ 0=no agreement; 0.01-0.20=slight; 0.21-0.40=fair; 0.41-0.60=moderate; 0.61-0.80=substantial; 0.81-1.0 almost perfect <sup>63</sup>
LOA	Limits of agreement: mean difference and 95% LOA between two measurements: 95% of differences between two measurements
MCIC / MCID	Minimal Clinical Important Change / Difference: that are meaningful to patients
MDC	Minimal Detectable Changes: smallest minimal change falling outside the measurement error
Performance (ICF)	Executing tasks in the current environment, describing what an individual does in his or her current environment
Predictive validity	The extent to which the tool predicts the future score on another (validated) tool. A form of criterion validity (also concurrent validity)
r	Correlation coefficient, with cut-off scores >0.6, excellent; 0.30-0.60, adequate; <0.30, poor; see concurrent and predictive validity
ROC	Receiver operating characteristic: a graph showing the sensitivity (y-axis) versus 1-specificity (x -axis) for all possible cut-off points
SDDdiff	Smallest detectable difference between two raters (1.96 x (√2 x error): when a patient is scored by two different raters, and the scores differ > SDD, the patient is likely to have improved/ deteriorated
SEM	Standard error of measurement: standard deviation of sampling distribution, precision estimate of distribution around the "real" score
Sensitivity	Proportion of patients with the problem (such as falls, balance problems) who test positive
Specificity	Proportion of patients without the problem who test negative

**1. 10 Meter Walk (10MW)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Walking	Seconds required to walk 10 meter: comfortable and fast walking speed (m/s); assistive devices can be used;valid as 6MWD at home	Concurrent validity UPDRS ADL, r=0.41 <sup>64</sup> ; comfortable speed accounted for 23% variance UPDRS motor & total scores <sup>64</sup> ; Good convergent validity→ comfortable speed with Posturo-Locomotor-Manual Test scores (r=0.76) <sup>65</sup>	Excellent test-retest reliability: comfortable speed, ICC0.97 <sup>66</sup> ; Good test-retest reliability comfortable speed: ICC0.87 <sup>67</sup> ; walking speed, ICC0.8, and step frequency ICC 0.80 <sup>68</sup>	H&Y1-4: MDC95 for comfortable speed 0.18 m/s (mean baseline 1.16 m/s); MDC95 for fast speed 0.25 m/s (mean baseline 1.47 m/s) <sup>66</sup> ; H&Y 1-3: MDC95 0.19m/s <sup>68</sup>	Assessment time 5 min; Required materials: stopwatch, marked 12m pathway (10m plus 2m at end for deceleration); Current use >35% Benefits: assesses velocity, step and stride length: useful for cueing. Drawbacks: large space required; different methods of conducting the 10MW are described

**2. Activities Balance Confidence (ABC) Scale**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of Changing & maintaining body position	Interview or self-report questionnaire, level of self-confidence: 16 ambulation activities, 11-point ordinal scale: 0% to 100% (complete confidence). Total score: mean <sup>69</sup>	Good convergent validity: TUG r=-0.44; walking sub-scale of NUDS r=-0.48, p= 0.02); item 1 (mobility) of the PD Quest-Short Form r=0.51 <sup>70</sup> Concurrent validity: BESTest: r=0.636 <sup>71</sup> ; BBS r=0.64; BESTest r=0.79; HY r=0.59; UPDRS motor r=0.52; UPDRS Total r=0.73 <sup>72</sup> ; 6MWD R2=17.1% <sup>73</sup> Adequate discriminative validity: 1) fallers vs non-fallers: mean HY3, ABC < 76% (AUC 0.76, sens 0.84, spec 0.62) <sup>74</sup> ; mean HY 2.8, ABC ≤80% (OR 0.06) <sup>73</sup> ; ABC <69% (AUC 0.82, sens 0.93, spec 0.67) <sup>75</sup> ; 2) pwp (HY 1-3) vs controls: sens 0.86, spec 0.52 <sup>76</sup> ; 3) between HY stages: HY1 (baseline 94.9 %) vs HY3 (baseline 81.0 %) <sup>70</sup> ; HY1.8 vs HY3.5 <sup>77</sup>	Moderate to excellent test-retest reliability: ICC=0.94; H&Y 1-4 <sup>66</sup> ; ICC=0.79; H&Y 1-3 <sup>70</sup> SEM= 4.01 <sup>70</sup>	H&Y 1-4, mean baseline 70%: MDC95 13% <sup>66</sup> H&Y 1-3, mean baseline 91%: MDC <sub>95</sub> 11.12 % <sup>70</sup>	Assessment time 15 min; No materials or costs materials; Current use 10-35%

**3. Berg Balance Scale (BBS)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Changing & maintaining body position	Observation balance performance 14 items involving sitting, standing and changes in position ordinal: 0 (worst) to 4, max 56	Moderate to good concurrent validity: BESTest r=0.87, UPDRS ADL r=-0.81; FGA r=0.78;; TUG r=0.78; Self-selected walking speed r= 0.73; FOF r=0.69; ABC r=0.64; Fast walking speed r=0.64; UPDRS motor r=0.51, 0.58 and 0.71; UPDRS ADL r=-0.64; H&Y r=0.45, r=0.61 and 0.63; Modified Schwab & England (ADL) r=0.55 and 0.71; PDQ-39 r=0.61; Functional Reach r=0.50 <sup>64;66;72;78-81</sup> Adequate discrimination fallers vs non-fallers: HY2-3, BBS ≤ 54 points (sens 0.79, spec 0.74) <sup>82</sup> ; HY mean 2.3 BBS≤51 sens 0.74 spec 0.77 <sup>83</sup> ; HY3, BBS<44 (AUC 0.85, sens 0.68, spec 0.96) <sup>74</sup> ; HY1-4, BBS≤47 (AUC 0.79, sens 0.72, spec 0.75) <sup>72</sup> ; HY1-4, BBS≤45 (sens 0.64, spec 0.83) <sup>84</sup> ; mean HY2.4, BBS≤47 6 mnths AUC 0.87 (sens 0.79, spec 0.86); 12 mnths AUC 0.68 (sens 0.46, spec 0.81) <sup>85</sup> ; HY1-2 AUC 0.61 (sens .65, spec .51) <sup>86</sup> ; HY1-2 vs HY3-4 AUC 0.84, cut-off ≥52 (sens .77, spec .74) <sup>83</sup> ; Increases with disease progression <sup>77</sup> ; HY1-2 vs 3-4: BBS<52 AUC 0.84 (sens 0.77, spec 0.74) <sup>83</sup>	Test-retest good to excellent: ICC=0.94 <sup>86</sup> ; 0.80 <sup>72</sup> ; 0.87 <sup>88</sup> Inter-rater adequate to excellent: ICC=0.95 <sup>72</sup> ; 0.74 <sup>86</sup> ; 0.8487 Intra/inter-rater excellent: ICC= 0.99 <sup>88</sup> Adequate internal consistency: α=0.86 <sup>66</sup> to 0.92 <sup>87</sup>	H&Y 1-3, baseline 53.77/56: SDD 2.84 points (5%) <sup>68</sup> H&Y 1-4, mean baseline 50/56: MDC95 5 points <sup>66</sup>	Assessment time 20 min; Required materials: ruler, two chairs with(out) arms, stopwatch; item to pick up; step or footstool; Current use >35% Benefits: widely used Drawbacks: mainly static balance; ceiling effect (absence pwp specific impairments: freezing, multi tasking); identifies fallers less accurate than than (Mini-)BEST <sup>72;85</sup>

#### 4. Borg Scale 6-20

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Body functions:</i> Exercise tolerance functions	Self-report score for perceived exertion (physical activity intensity level): 6 (no exertion at all) to 20 (maximal exertion). <sup>89</sup> Can be used during 6MWD and (other) exercises	Unknown in pwp	Unknown in pwp	Note: Not applicable: Borg Scale 6-20 is used to prescribe and monitor exercise intensity, not for evaluative purposes	Assessment time 5 min; No materials or costs; Current use 10-35% Benefits: widely used in pwp to support exercising at the desired intensity Drawbacks: no psychometric data available for pwp

NOTE: In healthy adults, the BORG Scale 6-20 correlates moderate to good with physiological measures: heart rate ( $r = 0.62$ ), blood lactate ( $r = 0.57$ ),  $Vo_{2max}$  ( $r = 0.64$ ), ventilation ( $r = 0.61$ ) and respiration ( $r = 0.72$ )<sup>90</sup>; In healthy adults, Borg scores multiplied by 10 indicate heart rate

#### 5. Dynamic Gait Index (DGI)

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Changing & maintaining body position	Observation balance when performing gait related activities 8 items, 4-point ordinal scale: 0 (lowest level functioning) to 3. Total score max 24	Adequate discriminative validity fallers vs non-fallers: HY 2-3, $DGI \leq 22 =$ at risk (sens 0.89, spec 0.48) <sup>92</sup> ; HY3, $DGI < 19 =$ at risk (AUC 0.76, sens 0.68, spec 0.71) <sup>74</sup> ; HY1-4, $DGI \leq 19$ (sens 0.64, spec 0.85) <sup>94</sup>	Good test-retest reliability: $ICC=0.84$ <sup>91</sup> No systematic bias: LOA 2.9 to -3.0 points <sup>91</sup>	H&Y 1-3, mean baseline 21.6: MCD 2.9 points, (13.3% change) <sup>91</sup>	Assessment time 10 min; Required materials: shoe box, 2 cones, stairs, 6m walkway, 0.5 m wide; Current use 10-35% Benefits: better discriminative validity for fallers vs non-fallers than TUG and BBS <sup>74,84,92</sup> ; can be combined with Functional Gait Assessment (FGA); Drawback: does not include backward walk (as FGA does); need for specific material

#### 6. Falls Efficacy Scale International (FES-I)

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of Changing & maintaining body position	FES-I: 16-item questionnaire on self-confidence (efficacy) to avoid falling administered. Interview or self-report. 4-point ordinal scale: 1 to 4 (highest fear to fall). Total score range 16 to 64.	Unknown in pwp	Unknown in pwp	Unknown in pwp	Assessment time 10 min; No materials or costs; Current use 10-35% Benefits: available in many, validated languages at <a href="http://www.profane.eu.org">www.profane.eu.org</a> ; preferred in current scientific studies evaluating physiotherapy for pwp; provides better insight (more activities) than Short FES-I

NOTE: of the original FES, no psychometric properties in pwp are available; a Swedish version (FES(S)) differs in number of items and scoring options, suitable for the Swedish population; FES(S): Correlations with SAFFE  $r=-0.74$ ; physical functioning (SF-36)  $r=0.66$ ; fast gait speed,  $r=0.63$ ; TUG  $r=0.61$ ; UPDRS Parts II  $r=-0.58$  and III  $r=-0.46$ ; comfortable gait speed,  $r=0.30$ ; disease duration,  $r=-0.28$ ; and age  $r=-0.07$ .<sup>93</sup>; Good test-retest reliability,  $ICC=0.87$ ;  $SEM=12.3$  points; Discriminative validity: lower scores females vs men and for pwp reporting previous falls, FOF or unsteadiness versus those not who do not<sup>93</sup>

#### 7. Five Times Sit-to-Stand (FTSTS)

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Changing & maintaining body position	Balance measure: time needed for 5 times sit to stand	Discriminative validity fallers vs non-fallers, H&Y 1-4, $>16s$ (AUC 0.77, sens 0.75, spec 0.68) <sup>94</sup> Moderate to good concurrent validity: BBS $r=0.71$ , 6MWD $r=-0.60$ , ABC $r=0.54$ <sup>94</sup>	Excellent Inter-rater reliability: $ICC=0.99$ Moderate test-retest reliability $ICC=0.76$ <sup>94</sup>	Unknown in pwp	Assessment time 2 min; Required materials : stop-watch, 43cm chair; Current use unknown  Benefits: Quick measure for balance & leg strength; Drawbacks: not widely used yet; not for evaluation; Drawbacks: floor effect, pwp may be unable to perform without using the upper extremities <sup>94</sup>

#### 8. Functional Gait Assessment (FGA)

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Changing & maintaining body position	Observation of balance when performing gait related activities: 10 items, 4-point ordinal scale: 0 (lowest level functioning) to 3	Good concurrent validity with BBS ( $r=0.78$ ) <sup>72</sup> Discriminative validity fallers vs non-fallers: H&Y mean 2.5 FGA $\leq 15/30$ (AUC 0.80, sens 0.72) <sup>72</sup> ; H&Y 1.5-4, AUC 0.81 (ON) to 0.89 (OFF) <sup>95</sup> ; HY mean 2.4: 6 mnths AUC 0.80 (sens 0.64 spec 0.81) & 12 mnths AUC 0.70 (sens 0.46, spec 0.81) <sup>65</sup>	Excellent test-retest reliability: $ICC=0.91$ <sup>72</sup> Excellent inter-rater reliability: $ICC=0.93$ <sup>72</sup>	Unknown in pwp	Assessment time 10 min; Required materials: shoe box, 2 cones, stairs, 6m walkway, 0.5 m wide; Current use: unknown  Benefits: in older people, higher discriminative validity for fallers, as well as more reliable than BBS <sup>72</sup> ; can be combined with DGI; includes backward walking. Drawbacks: not widely used yet; identifies fallers less accurate than (Mini-)BESTest <sup>85</sup>

NOTE: Equates to the DGI: exclusion of walking around obstacles; addition of 3 sensory integration tasks: gait with narrow base of support, ambulating backwards, gait with eyes closed

#### 9. Goal Attainment Scaling (GAS) – goals evaluation form

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
Patient-centred goals and treatment effects in all ICF components	Setting SMART goals with pwp (and carer); each goal 5 levels of outcome: optimum, 2 above, 2 below. Sum score, independent of number of goals, max 50 (all goals met)	Face validity: patient decides upon goals, what to evaluate Furthermore, unknown in pwp	Unknown in pwp	Unknown in pwp	Assessment time describing SMART goals 10 min; scoring level reached (evaluation) 1 min; No materials or costs; Current use $<10\%$  Benefits: supports setting SMART goals  Drawbacks: may be time-consuming to describe a goal on 5 levels; especially when $>1$ goal is chosen

NOTE: There is strong evidence for the reliability, validity and sensitivity of the GAS in physical and neurological rehabilitation in general<sup>96</sup>; In (frail) elderly, the GAS has adequate concurrent validity with ADL measures ( $r = 0.45$  to  $0.59$ )<sup>96-98</sup> Cognitive impairments may reduce its feasibility, validity, reliability and responsiveness<sup>99</sup>; GAS can detect clinically relevant change in geriatric day hospital care<sup>100</sup> and is more sensitive than standardised ADL measures<sup>97</sup>

**10. History of falling**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of Changing & maintaining body position	Questionnaire: interview or self-report, retrospective number of (near) falls, circumstances & causes; 2 to 13 questions	Face validity: based on optimal time span for recall (in elderly) <sup>101</sup> ; specific vocabulary to optimise recall of falls in pwp <sup>102</sup> Retrospective falls report good discriminative validity to identify pwp at fall risk: ≥1 fall in previous year (sens 77%, spec 60%), ≥2 falls in previous year (sens 68%, spec 81%) <sup>103</sup> ; a fall in the previous year OR 4.0 <sup>104</sup> to OR 5.0 <sup>105</sup>	Unknown in pwp	Unknown in pwp	Assessment time 5-15 min; No materials or costs; Current use 10-35%  Benefits: past falls best predictor of future falls, designed for pwp  Drawbacks: retrospective, thus under reporting

**11. Mini Balance Evaluation Systems Test (Mini-BESTest)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Changing & maintaining body position AND Body functions: Involuntary movement reaction functions	Observation balance in 14 activities; 3 point ordinal scale: 0 (severe) to 2 (normal), max score 28	Good concurrent validity with BESTest r=0.96 <sup>106</sup> ; BBS, r=0.79, and UPDRS, r= -0.51 <sup>83</sup> Good discriminative validity fallers vs non fallers: AUC 0.84 <sup>106</sup> ; average score 27% difference; cut-off scores: 20/32 (63%) (sens 0.88, spec 0.78), 23/32 (72%) (sens 0.96, spec 0.47) <sup>106</sup> ; 19/30 (sens 0.79, spec 0.67 AUC 0.75) <sup>107</sup> ; HY1-2 vs HY3-4 AUC=0.91; ≤20 HY mean 2.3 (sens .89; spec .81) <sup>83</sup> ; H≤20 HY mean 2.4: 6 mnths AUC 0.87 (sens 0.86 spec 0.78) & 12 mnths AUC 0.77 (sens 0.62, spec 0.74) <sup>85</sup>	Mostly HY2-3: good test-retest reliability, ICC=0.92 <sup>106</sup> Excellent inter-rater reliability, ICC=0.91 <sup>106</sup>	Unknown in pwp	Assessment time 15 min; Required materials: shoe box, 2 cones, stairs, stopwatch, 0.5m wide walkway; Current use unknown Benefits: no ceiling effect (as with the BBS); discriminates fallers vs non fallers better than FGA and BBS <sup>85</sup> ; also available in Portuguese (Brazil), Greek and Japanese: www.bestest.us. Drawback: does not include backward walk (as FGA does); identifies fallers more accurate than BBS and FGA <sup>85</sup>

Note: Swedish translated version Correlations with BBS r=0.94, TUG r=-0.81 and FES(S) r=0.26<sup>108</sup>

**12. Modified Parkinson Activity Scale (M-PAS)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of functional mobility (that is changing body position and walking)	14-item observation performance functional activities: chair transfer (2 items); gait akinesia (6 items); bed mobility (6 items). <sup>109</sup> Quantitative and qualitative scoring on an ordinal scale from 4 (best) to 0 (impossible or dependent on help)	Face validity: based on core areas and limitations in activities described in evidence-based physiotherapy guidelines for pwp <sup>109;110</sup>	Excellent test-retest reliability Total score: ICC=0.93 in OFF, ICC=0.81 in ON; poor to excellent test-retest reliability sub scores in ON and OFF, range ICC=0.41-0.91 <sup>109</sup> Good to excellent inter-rater reliability (Kappa 0.86 to 0.98) <sup>109</sup> Adequate internal consistency (PAS total score Cronbach's 0.85; chair transfer 0.76; gait akinesia 0.75; bed mobility with/without covers 0.79/0.89) <sup>109</sup>	Unknown	Assessment time 30 min; Required materials: chair, cup, water, bed, bed cover; Current use 10-35%  Benefits: supportive for gaining insight into quality of movement specific for physiotherapy in pwp; Drawbacks: cannot be used for evaluation

**13. New Freezing of Gait Questionnaire (NFOG-Q)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of Walking	Clinician-administered tool assessing clinical aspects of freezing of gait (FOG) and influence on QOL: three parts (9 items, total score range 0-28): Part I, dichotomous, to exclude patients without FOG; Part II (items 2-6, score range 0-19): FOG duration & frequency; Part III: impact of FOQ on daily life (items 7-9; score range 0-9) <sup>111</sup>	Poor concurrent validity with time spent frozen during TUG tasks (r=0.35) or number of FOG events (r=0.30). <sup>112</sup> ; for freezers only with H&Y (r=0.30) and falling (r=0.35 <sup>113</sup> )	Good reliability between pwp and carers, ICC=0.78; Reliability pre-post video good for pwp (ICC=0.88) and excellent for carers (ICC=0.97) <sup>113</sup> High internal consistency: Cronbach's 0.84, equal loading factors <sup>113</sup>	Unknown in pwp	Assessment time 10 min; Required materials: video; Current use: unknown  Benefits: a golden standard to assess FOG lacks; watching the video improves scoring FOG duration; items 2-6 provide a structured means to gain insight into the circumstances of freezing and are therefore included in the PIF  Drawbacks: usefulness for clinical practice unknown

NOTE: Compared to the original, 6-item FOGQ, the NFOG-Q has extra the video explaining freezing, Part I (1 item), item 2 of Part II (to assess overall FOG, frequency only) and Part III; the 2 items for gait were removed

**14. Patients Specific Index PD (PSI-PD)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
Patient-centred problems in all ICF components	Questionnaire: interview & (partly) self-report to identify, prioritise and rate severity of patient relevant limitations	Good content validity: predefined list of impairments based on the 2004 KNGF Guideline <sup>114-116</sup>	High test-retest agreement for domains (core areas: 74%-82%), but with low Kappa values (0.43 to 0.60) as positive and negative outcomes were not equally distributed <sup>116</sup>	Unknown in pwp	Assessment time 10 min; No materials or costs; Current use <10%  Benefits: provides insight into quality of performance, targets for treatment; Drawbacks: assistance required for ranking

NOTE: In this Guideline, the items of this tool are included in the Pre-assessment Information Form (PIF)

**15. Push and Release Test (P&R Test)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Body functions:</i> Involuntary movement reaction functions	Measure reactions to external perturbation: 1 unexpected trial: clinician stands behind patient, hands against patient's scapulae; active or passive lean back; suddenly removes hands; 5 point ordinal scale: 0 (recovers independently with 1 step of normal length and width) to 4 (falls without attempting a step or unable to stand without assistance)	Good convergent validity with self-report history of falls (r=0.6) <sup>117</sup> Discriminative validity fallers vs non-fallers: OFF phase sens P&R Test 89% vs Pull Test 69%; ON phase sens P&R Test 75% vs Pull Test 69%; OFF phase spec P&R Test 85% vs Pull Test 98%; ON phase spec P&R Test 98% vs Pull Test 83% <sup>118</sup>	Good inter-rater reliability: ICC=0.84 <sup>117</sup>	Unknown in pwp	Assessment time: 2 min; No materials or costs; Current use unknown Benefits: Compared to Pull Test: more gentle & safer in frail pwp, more sensitive in pwp with low balance confidence (but less so for those with high balance confidence), higher inter-rater reliability (due to more consistent forces applied) and higher sensitivity than in the off phase (comparable in the on phase); Drawbacks: unknown by neurologists

**16. Rapid turns test**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Body functions:</i> Gait pattern functions	Dichotomous measure to assess freezing: pwp are asked to repeatedly make rapid 360° narrow turns from standstill, on the spot, in both directions; if required add dual task	Sensitivity to provoke freezing 0.65; sensitivity entire battery of three trials (normal speed, fast speed, and with dual tasking) & turning variants (180° vs. 360° turns; both directions, wide and narrow; slow and fast) 0.74 <sup>119</sup>	Unknown in pwp	Not applicable: used for the assessment of freezing only	Assessment time 2 min; No materials or costs; Current use: unknown  Benefits: easy and best test available to provoke freezing  Drawback: does not always provoke freezing, dual tasking may still need to be added (M-PAS Gait Akinesia)

**17. Six-Minute Walk Distance (6MWD)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Walking	Distance in meters walked in 6 minutes, at fast speed, as a measure for functional fitness. <sup>120,121</sup> Assistive devices can be used if kept consistent from test to test; pwp should not exercise vigorously 2hr before the test and relax 10 min on a chair before starting the 6MWD (such as during history taking)	Good convergent validity: regular physical activity $r = 0.56$ , $R^2 = 0.32$ <sup>122</sup> ; H&Y $r = 0.38$ ; BBS $r = 0.64$ ; TUG $r = 0.64$ ; FOGQ $r = 0.43$ and UPDRS $r = 0.27$ <sup>123</sup> ; score accounted for 43% of variance UPDRS motor and UPDRS total <sup>64</sup> Decreases with disease duration: 173m HY3 vs HY1-1.5 <sup>124</sup> Impaired balance & fall risk influence 6MWD <sup>123</sup>	Excellent test-retest reliability: ICC=0.96 <sup>66</sup> , 0.93 <sup>125</sup> , 0.95 <sup>67</sup>	HY1-4, mean baseline 316m: MDC <sub>95</sub> 82 m <sup>66</sup>	Assessment time: 10 min; Required materials: stopwatch; ≥ 30m, flat, straight hard surface (indoors or outdoors), marked every 3m, with a bright coloured tape at the starting point; 2 cones to mark the turn-around points; pen, paper; Current use >35% Benefits: can be used as treatment; Drawbacks: large space required and large variation in 'average' distances : 300-600m <sup>66,67,122,126,127</sup> ; learning effect noted in COPD (improvement through practice 6%) <sup>120</sup>

NOTE: A 2MWD is insufficient in picking up the endurance problems in earlier stage pwp<sup>124</sup>

**18. Timed Get-up and Go (TUG)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of functional mobility (that is changing body position and walking)	Time (s) to: rise from arm chair, walk (3m), turn and sit down to the chair; mobility, balance, walking ability, fall risk	Good convergent validity: BBS, $r = -0.78$ , fast gait speed, $r = -0.69$ ; comfortable gait speed, $r = -0.67$ ; UPDRS total, $r = 0.50$ <sup>79</sup> ; H&Y, $r = 0.75$ <sup>128</sup> Adequate discriminative validity fallers vs non-fallers, at risk: HY 2-3, TUG ≥ 7.95s (sens 0.93, spec 0.30) <sup>82</sup> ; HY1-4, TUG ≥ 8.5s (sens 0.68, spec 0.53) <sup>84</sup> ; H&Y 1.5-4: AUC 0.68 (ON) to 0.80 (OFF), More accurate in OFF <sup>95</sup> ; HY mean 2.8, TUG >16s (OR 3.86) <sup>73</sup> ; early stage PD (AUC 0.65, sens 0.69; spec 0.62) <sup>86</sup> ; Score increase with disease severity: 2.5sec difference HY3 vs HY1-1.5 <sup>124</sup>	Poor to good test-retest reliability: ICC=0.85 <sup>66</sup> ; ICC=0.80 <sup>91</sup> ; ICC=0.69 <sup>70</sup> Excellent inter rater reliability experienced PTs and inexperienced PTs in ON phase, ICC=0.99; good in inexperienced PTs in OFF phase ICC=0.87 <sup>129</sup> SEM= 1.75 s <sup>70</sup>	H&Y 1-4, mean baseline 15 s: MDC <sub>95</sub> 11 s <sup>66</sup> H&Y 1-3, mean baseline 10,6 s: MDC <sub>95</sub> 4,85 s <sup>70</sup> H&Y 1-4, mean baseline 9.88 s: MDC 0.67 s <sup>88</sup> H&Y 1-3, mean baseline 11.8s: MDC 3.5 s <sup>91</sup> H&Y 1-3, mean baseline unknown: SDD 1.63 <sup>88</sup>	Assessment time 5 min; Required materials: stopwatch, chair, track mark; Current use >35%  Benefits: well known, easy to administer; add TUG <sub>cog</sub> and TUG <sub>man</sub> for dual tasks; Drawbacks: treatment goal often safety, not velocity; not for pwp with walking aids

**a. 2-Minute step test**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Body functions:</i> Exercise tolerance functions	Measure for aerobic endurance (alternative to 6MWD): number of times knees are raised up to level of tape on wall in 2 min; in case of balance problems hands can be placed on the wall <sup>130</sup>	In HY1-3: due to fatigue 2min into 1 min test, mean score 23 steps <sup>131</sup>	Unknown in pwp	Unknown in pwp	Assessment time <5 min; Required materials: tape, stopwatch, wall; Current use unknown Benefits: easy to administer; Drawbacks: not validated for pwp (only high test-retest reliability and discriminative validity in community dwelling elderly <sup>130,132</sup> )

NOTE: Alternative: 1 min stairs step test: safe and feasible test for lung problems, similar info to 6MWD

**b. Balance Evaluation Systems Test (BESTest)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Changing & maintaining body position. <i>AND</i> <i>Body functions:</i> Involuntary movement reaction functions	Observation of balance during 36 activities, such as sit to stand and stand 1 leg (from BBS), challenged gait tasks (from TUG, DGI), FR and dual-task items: 3 point ordinal scale: 0 (severe) to 2 (normal), max 108	Good concurrent validity with Mini-BESTest $r = 0.96$ <sup>106</sup> ; ABC ( $r = 0.76$ ), BBS ( $r = 0.87$ ), FGA ( $r = 0.88$ ) <sup>72</sup> Good discriminative validity fallers vs non fallers, AUC 0.84; average score 19% difference; cut-off scores: 69% (sens=0.84, spec=0.76); 84% (sens=1.0, spec=0.39) <sup>106</sup> ; AUC 0.85, cut-off score 69% <sup>72</sup>	Mostly HY2-3 Good test-retest reliability ICC=0.88 <sup>72</sup> ; ICC=0.88 <sup>106</sup> ; Inter-rater reliability adequate for section II, ICC=0.79 and good for other sections ICC=0.91 <sup>106</sup> ; excellent for total ICC=0.96 <sup>72</sup>	Unknown in pwp	Assessment time 35 min; Required materials: shoe box, 2 cones, stairs, stopwatch, 0.5m wide walkway; Current use unknown  Benefits: discriminates fallers vs non fallers better than FGA and BBS <sup>72</sup> ; Drawbacks: time consuming and complex; both activities & body function included in one balance score, difficult to interpret; not widely used yet

**c. Freezing of Gait Questionnaire (FOGQ)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of Walking	Clinician-administered questionnaire assessing clinical aspects of freezing of gait (4 items) and gait (2 items); 5-point ordinal scale: 0 (absence of symptoms) to 4	Adequate discriminative validity fallers vs non-fallers: AUC .0.73 (sens 0.75; spec 0.59) <sup>86</sup> ; accuracy 65% <sup>133</sup> Adequate concurrent validity with UPDRS ADL ( $r = 0.42$ ), walking capacity ( $r = 0.41$ ), ADL ( $r = 0.45$ ) <sup>64</sup> ; UPDRS ADL ( $r = 0.43$ ), UPDRS motor ( $r = 0.40$ ) <sup>111</sup> ; correlations, better in off than on phase: UPDRS ADL (off $r = 0.66$ ; $r = 0.40$ ), UPDRS motor (off $r = 0.49$ , on $r = 0.28$ ), and "freezing when walking" (off $r = 0.74$ , on $r = 0.43$ ) <sup>134</sup>	Good test-retest reliability (10wks different): ICC=0.84 <sup>134</sup> ; Good inter-rater reliability: ICC=0.84 <sup>135</sup> ; Good to excellent internal consistency : $\alpha$ 0.89 to 0.96 <sup>134,136</sup> FOGQ(S) Excellent reliability, ICC=0.93 <sup>137</sup>	Unknown in pwp	Assessment time 5 min; No materials or costs; Current use 10-35%  Benefits: Item 3 ('Do you feel that your feet get glued to the floor while walking, making a turn or when trying to initiate walking (freezing)?) is associated with frequency of freezing; <sup>112,134,138</sup> and more sensitive in detecting freezers than UPDRS item 14 (85.9% vs. 44.1%) <sup>134</sup> Drawbacks: contains general gait items only, reducing its FOG-specificity <sup>134</sup>

NOTE: Swedish, self-administered version, FOGQ(S): Higher median scores for fallers than non-fallers (12.5 vs 5.0; n=37)<sup>139</sup>, also on the self-administered from (8 vs 2; n=225)<sup>137</sup>; Adequate concurrent validity with UPDRS part II (ADL), UPDRS item 14 (freezing), and HY ( $r = 0.65 - 0.66$ ), UPDRS items 32-35 (dyskinesia) and 36-39 (motor fluctuations) ( $r = 0.62$ ); UPDRS motor ( $r = 0.59$ ), FES ( $r = 0.59$ ), UPDRS items 15 (walking) ( $r = 0.56$ ), 13 (falling not related to freezing) ( $r = 0.55$ ) and 29 (gait) ( $r = 0.54$ ), TUG ( $r = 0.40$ )<sup>139</sup> Excellent correlation between clinician-administered and self-administered versions (ICC 0.91). Correlations were higher in the self-administered form for UPDRS 14 (0.76) and FES (-0.74)<sup>137</sup>

**d. Functional Reach (FR)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of Changing & maintaining body position	Measuring forward reach while standing in a fixed position: performance: Three trials are done and the average of the last two is noted <sup>140</sup>	Correlation with UPDRS ADL $r=-0.52^{64}$ Poor to adequate discriminative validity fallers vs non-fallers: HY2-3, $FR \leq 31.75\text{cm} = \text{at risk}$ (sens 0.86, spec 0.52) <sup>82</sup> ; HY1-4, $FR \leq 19$ (sens 0.77, spec 0.65) <sup>84</sup> ; <25.4cm (sens 30%, spec 92%) <sup>141</sup> ; AUC 0.52 (sens 0.52; spec 0.53) <sup>86</sup> fallers mean (sd) = 23.11 (8.12)cm vs non-fallers mean (sd) = 31.70 (5.61) cm <sup>82</sup>	Poor to excellent test-retest reliability: in pwp with fall history $ICC=0.93$ ; in pwp without fall history $ICC=0.42^{142}$ ; $ICC=0.73^{66}$ ; $ICC=0.84^{67}$ Poor inter rater reliability: $ICC=0.64^{68}$ Moderate intra rater reliability: $ICC=0.74^{68}$	HY1-4, mean baseline 21 cm: MDC 9 cm <sup>86</sup> ; HY 1-3: SDD 11.5 <sup>68</sup> MDC: 4cm for pwp with history of falls; 8cm for pwp without history of falls; general 12cm <sup>68,142</sup>	Assessment time 5 min; Required materials: corner, duct tape, yardstick mounted horizontal to the wall; Current use high  Benefits: widely used, easy to administer  Drawbacks: questionable reliability

**e. Global Perceived Effect (GPE)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
Patient-centred treatment effects in all ICF components	Questionnaire: interview or self-report of perceived treated effect. 1 item, score: 1 (worse than ever) to 7 (greatly improved)	Unknown in pwp	Unknown in pwp	Unknown in pwp	Assessment time 1 min; No materials or costs; ; Current use <10%  Benefits: easy to administer  Drawbacks: no psychometric data available for pwp; scores are strongly influenced by current status: do transition ratings truly reflect change?

**f. LASA Physical Activity Questionnaire (LAPAQ)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of physical activity	Questionnaire: interview or self-report to gain insight into level of physical activity	Discriminative validity: decreases with age (-3% for each year) and with disease severity (-3% for each point on the UPDRS) <sup>143</sup>	Unknown in pwp	Unknown in pwp	Assessment time 30 min; No materials or costs; Current use: <10%  Benefits: time-consuming; Drawbacks: no reliability and responsiveness known for pwp (in community dwelling elderly, good convergent validity with physical activity and predictive validity for time spent daily on physical activity <sup>144</sup> )

**g. Lindop Scale**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of functional mobility (that is changing body position and walking)	Observation performance functional mobility (6 gait; 4 bed) alike TUG and PAS; 4 point ordinal scale based on seconds or number of steps: 0 (worst)-3	Good face validity: covers core areas KNGF Guideline <sup>115,145</sup> Moderate concurrent validity UPDRS-motor, $r=0.67^{145}$	Inter-rater reliability: LOA total score (mean difference) 0.041 <sup>145</sup> Agreement & between raters 82% to 100% for all 10 items <sup>145</sup> Adequate internal consistency: Cronbach's $\alpha=0.86^{145}$	Unknown in pwp	Assessment time 20 min; Required materials: stopwatch, chair; track mark, bed; Current use <10%  Benefits: specifically designed for physiotherapy for pwp; Drawbacks: comparable to M-PAS, but less established data on psychometric properties and less detailed qualitative scoring options

**h. Movement Disorder Society's (MDS) revision of the UPDRS (MDS-UPDRS)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
Composite score for disease severity	Observation & (Part I & II) patient report, mainly functions: Part I, non-motor experiences of daily living; Part II, motor experiences of daily living; Part III, motor examination; Part IV, motor complications	Good to excellent concurrent validity: with original UPDRS AUC 0.99 <sup>146</sup> ; Total score, $r=0.96$ ; Part I, $r=0.76$ ; Part II, $r=0.92$ ; Part III, $r=0.96$ ; Part IV (items 32-39: dyskinesias & motor fluctuations on UDPRS vs. total Part IV MDS-UPDRS), $r=0.89^{147}$ ; Part I, $r=0.81$ ; validated non-motor scales (HADS, SCOPA-COG), $r=0.72-0.89^{148}$	Adequate to good internal consistency: Cronbach's $\alpha$ Parts I & IV 0.79, Part II 0.90, Part III 0.93 <sup>147</sup> ; Part I 0.85 <sup>148</sup>	Unknown in pwp	Assessment time: 30 min ( $\leq 10$ min for interview Part I, 15min for part III. Motor and 5 min part IV); Costs: training and certification required: free for MDS members (membership health professionals = \$100; non-members: \$250 USD); Required materials: paper, chair, app; Current use unknown  Benefits: see UPDRS; non-English translations ongoing  Drawbacks: see UPDRS; not widely used yet

**i. Nine Hole Peg Test**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of carrying, moving and handling objects	Time (s) to complete task: visuomotor control, fingertip pinch, and release <sup>149</sup>	Good sensitivity to detect motor dysfunction in the early stages <sup>150</sup>	Good to excellent test-retest reliability: dominant ICC-dominant hand 0.88; ICC non-dominant hand $ICC 0.91^{151}$  SEM 1.02s dominant hand (average time to complete 31.4s); 0.82s non dominant hand (average 32.2s) <sup>151</sup>	MDC 2.6s dominant hand; 1.3s non dominant hand	Assessment time: 5 min; Costs: need to buy the test or can be made (time consuming) assuring standardised specifications <sup>152</sup> Required materials: peg test, stopwatch; Current use: unknown  Benefits: easy to administer; can be used for evaluation. Drawbacks: gives no insight into quality of performance or what to target in treatment, which questions its validity for physiotherapy practice

**j. Parkinson Activity Scale (PAS)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Capacity measure of functional mobility (that is changing body position and walking)	10-item observation performance functional activities: chair transfer (2 items); gait akinesia (2 items); bed mobility (6 items). <sup>153</sup> Quantitative and qualitative scoring on an ordinal scale from 4 (best) to 0 (impossible/help depending)	Good face validity: covers core areas KNGF Guideline. <sup>115;153</sup> Concurrent validity: moderate with UPDRS III (motor function; r=0.64) and good with VAS-Global Functioning (r=0.79). <sup>153</sup>	Measurement error for total score 2.6, consisting of 1.3 inter-rater error and 2.3 patient-induced error. <sup>153</sup> No significant difference experts and non-experts, with a 1hr training. SEM 0.23 <sup>153</sup>	SDD <sub>diff</sub> 7.2 points <sup>153</sup>	Assessment time 30 min; Required materials: chair, cup, water, bed, bed cover; Current use 10-35%  Benefits: supportive for gaining insight into quality of movement specific for physiotherapy in pwp  Drawbacks: cannot be used for evaluation; ceiling effect; ambiguous scoring options

**k. Parkinson's Disease Questionnaire (PDQ-39)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
Quality of life (QOL)	Questionnaire: aspects of functioning & well-being of pwp. <sup>154</sup> : 39 questions on mobility (10 items); ADL (6 items); emotional well-being (6 items); stigma (4 items); social support (3 items); cognition (4 items); communication (3 items); bodily discomfort (3 items). 5 point ordinal scale: 0 (never) to 4 (always or cannot do at all). Total: 0-100.	Grouping of items into subscales not supported by analyses <sup>155</sup>	Good test-retest reliability and ICC=0.84-0.89 <sup>154</sup>	MCID for 'a little worse': Mobility 0.11; ADL 0.18; overall 0.10 <sup>156</sup>	Assessment time 20 min; Costs: book with instructions must be bought; No materials required; Current use 10-35%  Benefits: Parkinson's specific QOL measure; GDG recommends to address items of relevance in history taking  Drawbacks: items address limitations correlated to QOL, however, score interpretation is difficult; construct multi dimensional <sup>157</sup> ; grouping of items into scales complex, meaning of scale scores unclear, hampering interpretation. <sup>155</sup> ; responsiveness is questionable; floor effects in many pwp; not all items are of importance to, or can be improved by physiotherapy; particularly appropriate for use in clinical trials to assess treatments and interventions (www.dph.ox.ac.uk/research/hsru/PDQ/Intropdq)

NOTE: Swedish version: moderate test-retest reliability: ICC=0.76-0.93; adequate internal consistency: Cronbach's  $\alpha = 0.72-0.95$ <sup>155</sup>

**l. PHONE FITT**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of physical activity	Interview: type, frequency & intensity of physical activities <sup>158</sup>	Unknown in pwp	Unknown in pwp	Unknown in pwp	Assessment time 10 min; No materials or costs; Current use unknown  Benefits: easy to administer  Drawbacks: no psychometric data available for pwp (in elderly (over 65's) the Phone-FITT was found valid and reliable <sup>158</sup> )

**m. Physical Activity Scale for the Elderly (PASE)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of physical activity	12-question interview: time (hours/week) spent in each activity or participation (yes/no) : weight summed for all activities <sup>159</sup>	Unknown in pwp	Unknown in pwp	Unknown in pwp	Assessment time: 5 min; No materials or costs; Current use unknown  Benefits: easy to administer  Drawbacks: no psychometric data available for pwp (in elderly, the PASE is a valid & reliable tool to classify elderly into categories of physical activity <sup>159-163</sup> )

**n. Pull Test**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Body functions</i> <i>Movement functions</i> Involuntary movement reaction functions	Balance performance to external perturbation in steady-stance (retropulsion) Unexpected, quick and firm jerk on the shoulder preferred; 2 steps allowed <sup>164</sup> , as recommended in the 2004 KNGF Guideline <sup>115</sup> MDS-UPDRS pull test (2007): scoring options: 0, Normal: No problems: Recovers <3 steps; 1, Slight: 3-5 steps, but recovers unaided; 2, Mild: > 5 steps, but recovers unaided; 3, Moderate: Stands safely, but absence of postural response; falls if not caught; 4, Severe: Very unstable, tends to lose balance spontaneously or with just a gentle pull on the shoulders; <3 steps for recovery considered normal	Concurrent validity to interview based 'unstable'(≥2 (near) falls in the previous 6 months or using an (walking) to prevent falling) vs 'stable' group: on 1 <sup>st</sup> execution, 'unstable' significant higher than 'stable' on all tests, except the steady stance positions; 'unstable' higher than 'controls' on 1 <sup>st</sup> execution, except for Pastor rating <sup>164</sup> Predictive validity: <u>Nutt</u> : sens 0.63, spec of 0.88, positive 0.86, negative 0.69; overall accuracy 0.75; <u>Bloem</u> : sens 0.65, spec 0.85, positive 0.83, negative 0.69; overall accuracy 0.74; <u>UPDRS</u> : sens 0.66, spec 0.82, pos. 0.83, neg. 0.67; overall accuracy 0.71; <u>SPES</u> : sens 0.55, spec 0.92, pos. 0.88, neg. 0.65; overall accuracy 0.72; <u>Pastor</u> : sens 0.70, spec 0.69, pos. 0.72, neg. 0.67, overall accuracy 0.69; <u>steady stance-positions (right/left)</u> : sens 0.45/0.50, spec 0.79/0.73, pos. 0.71/0.70, neg. 0.56/0.55; overall accuracy 0.61/0.61 <sup>164</sup>	Inter-rater excellent for steady stance positions (k 0.98), Nutt (k 0.98) and Pastor (k 0.93); good for SPES (k 0.87) and Bloem (k 0.85); Poor for UPDRS (k 0.63) <sup>164</sup> Inter-rater excellent for steady stance positions (k 0.98), Nutt (k 0.93) Pastor (k 0.98); good for SPES (k 0.87) and Bloem (k 0.85); Poor for UPDRS (k 0.63) <sup>164</sup>	Unknown in pwp	Assessment time 1 min; No materials or costs; Current use 10-35% Benefits: widely used, known amongst neurologists (communication); Drawbacks: physiotherapist interest in backward walk above external perturbation

**o. Purdue Pegboard Test**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> performance measure of carrying, moving and handling objects: visuomotor control, fingertip pinch, and release <sup>165</sup>	Pegs count, or count of assembly items in final task	Excellent correlations with UPDRS III (r=-0.65) and UPDRS total score (r=-0.61) <sup>166</sup>	Unknown in pwp	Unknown in pwp	Assessment time: 10 min; Costs: need to buy the material; Required materials: pegboard test; Current use unknown Benefits: easy to administer; Drawbacks: only validity data available for pwp; gives no insight into quality of performance or what to target in treatment

**p. Survey of Activities and Fear of Falling in the Elderly (SAFFE)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure Changing & maintaining body position	6-page interview-based questionnaire : 22 items assessing feared consequences of falling: fear and avoidance towards specific activities. <sup>167</sup>	Unknown in pwp	Unknown in pwp	Unknown in pwp	Assessment time 15 min; No materials or costs; Current use unknown  Benefits: modified Swedish version has good validity & reliability; Drawbacks: no psychometric data for pwp

NOTE: Swedish translation of modified version (Yardley), mSAFFE(S): 1-page, self-administered, 17 items assessing avoidance only (scored 1, never, to 3, always).<sup>168</sup>; mSAFFE(S): Correlations with physical functioning (SF-36)  $r=-0.76$ ; FES(S)  $r=-0.74$ ; TUG  $r=0.67$ ; fast gait speed,  $r=-0.64$ ; comfortable gait speed,  $r=-0.52$ ; UPDRS Parts II  $r=0.52$  and III  $r=0.50$ ; disease duration,  $r=0.28$ ; and age  $r=0.08$ .<sup>93</sup>; Discriminative validity: higher scores for females vs men and for pwp reporting previous falls, FOF or unsteadiness for than those not reporting this<sup>93</sup>; Excellent test-retest reliability. ICC=0.92; Adequate internal consistency:  $\alpha=0.95/0.96$ , SEM=2.4<sup>93</sup>

**q. Tinetti Performance Oriented Mobility Assessment (POMA) , Gait (G) and Balance (B)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> capacity measure Walking (POMA-G) and Changing & maintaining body position (POMA-B) Body functions: involuntary mov. reaction functions	POMA-B: Observation balance when performing 9 activities and external perturbation (push to sternum; function); POMA-G: Observation gait in 7 activities & body functions; on a 3-point ordinal scale: 0 (unsafe) to 2 (safe)	Moderate concurrent validity with gait speed ( $r=0.53$ , POMA-B $r=0.52$ , POMA-G $r=0.50$ ) and UPDRS motor ( $r=0.45$ ) <sup>169</sup> Adequate discriminative validity fallers vs non-fallers AUC 0.72 (sens 0.67; spec 0.59) <sup>86</sup> POMA-B independent predictor (sens 0.71, spec 0.79), OR 0.84 <sup>170</sup> ; sens 0.76, spec 0.66 <sup>169</sup>	Moderate to good intra-rater reliability experienced raters, ICC=0.79-0.86 <sup>169</sup> POMA-G: Excellent intra-rater reliability mixed group (pwp and controls) ICC=0.95 <sup>171</sup> Good inter-rater reliability experienced raters ICC=0.84 <sup>169</sup>	Unknown in pwp	Assessment time: 15 min (POMA-B 2 min); Required materials: armless chair, walking track $\geq 3m$ , stopwatch; Current use >35% Benefits: widely used in elderly; Drawbacks: floor effects, possibly due to exclusion of freezing and dual tasks; combines activities and body function in one balance score, difficult to interpreted

NOTE: There are various versions of the POMA, with variations for both the name of the test and means of scoring

**r. Unified Parkinson's Disease Rating Scale (UPDRS)**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
Composite score for disease severity	Observation & patient report, ordinal scale 0 (normal ) to 4: Part I Mentation, behaviour and mood (max 16 points); Part II ADL (max 52); Part III Motor (max 108); Part IV Complications (max 23)	Adequate face validity: constructed by experts Satisfactory convergent validity with HY, Schwab & England scales, timed motor tests <sup>172</sup> Discriminative validity fallers vs non-fallers: UPDRS II, III and total: AUC 0.68, 0.67, 0.70, sens 0.64, 0.64, 0.74 <sup>86</sup>	Moderate to Excellent test retest reliability: Total ICC=0.92; Mentation ICC=0.74; ADL ICC=0.85; motor ICC=0.90 <sup>173</sup> ; Total ICC=0.84, Motor ICC=0.74 <sup>88</sup> Poor to moderate inter-rater reliability: Total ICC=0.78, Motor ICC=0.68 <sup>88</sup> NOTE: After watching official UPDRS Teaching Tape, many differences UPDRS scores trained neurologists on first attempt <sup>174</sup>	SDD: Part III 13 points, Total score 15 points <sup>68</sup> MDC for Mentation 2 points; Part II 4 points; for Part III 7 points to 13 points <sup>68</sup> ; Total 9 points <sup>173</sup> to 15 points <sup>68</sup> ; for Part I 2/16; for Part II 4/52; Part III 11/108; Total 13/176 <sup>66</sup> MCID: Part III 2.3-2.7 points; Total 4.1 to 4.5 points; MCID motor 4.5-6.7 points ; total 8.5-10.3 points; motor 10.7-10.8 ; total 16.4-17.8 <sup>175</sup>	Assessment time 30 min (10 min Part I; 15 min part III; 5 min part IV); Required materials: paper, chair; Costs required training: \$250; Current use 10-35% Benefits: provides insight asymmetry, dyskinesias, off state predictability (motor part); Drawbacks: mainly assesses impairments which cannot be targeted by physiotherapy, is time consuming, difficult, costly

**s. WALK-12 Questionnaire**

ICF	Scoring	Validity	Reliability	Responsiveness	Feasibility <sup>1)</sup>
<i>Activities &amp; Participation:</i> Performance measure of Walking	12-item questionnaire: limitations reported when walking at home / local community. Original: 5 point ordinal scale (1 to 5); max 60 (or transformed to a scale from 0 to 100), higher scores greater limitations	Unknown in pwp	Unknown in pwp	Unknown in pwp	Assessment time 5 min; Required materials: pen; Current use: unknown Benefits: good validity and reliability Modified Swedish version

NOTE: Modified Swedish version: Item 1-3 ordinal 0-2, item 4-12 ordinal 0-4; total score 0 (best) to 42; moderate to strong concurrent validity with measures for physical functioning and gait (FOG, TUG, 10wt, FES) ( $>0.6$ )<sup>176</sup>; Good convergent validity: explains 68% of the variance in scores of a Swedish version FES.<sup>177</sup>; Excellent test-retest reliability: ICC0.92; SEM 2.6<sup>176</sup>



# Appendix 17

## Evidence-grading tables to the intervention recommendations

Appendix provides detailed information on the recommendations developed using the GRADE method, categorised per intervention:

- 17.1 Conventional physiotherapy
- 17.2 Treadmill
- 17.3 Whole body vibration
- 17.4 Massage of trigger points
- 17.5 Cueing
- 17.6 Strategies for complex motor sequences supported by cueing
- 17.7 Dance (tango)
- 17.8 Tai Chi

### Recommendations for and against - strong and weak

For each intervention and outcome, recommendations can be for or against and strong or weak (Table 6.2). The classification reflects the quality of the evidence (high, moderate, low or very low, depending on the influence of study limitations on the outcome) and the outcome of the meta-analyses, weighted against the burden of the specific intervention. In case of a recommendation against an intervention for a specific outcome, benefits probably do not outweigh risks and burdens. Most commonly, effects show a positive trend, but the (wide) confidence interval of the effect includes 0. It does not mean that the specific intervention has negative effects on that outcome. Risk and burdens are often very low.

### Reading information to the tables:

#### General explanation abbreviations:

- N, number of participants
- CI, confidence interval
- (S)MD, (standardised) mean difference

#### GRADE levels for strength of evidence: high, moderate, low and very low

CCTs start at the 'high' level. Reasons for downgrading in our selection of CCTs:

- a) One level downgrading, because of small sample size, questions on randomisation procedures or (single) blinding, without influence effects expected (otherwise two levels downgrading would occur)
- b) One level downgrading, because of inconsistency results or result of single CCT

App. 17.1 Conventional physiotherapy versus no intervention or placebo									
Outcome	Author & year included CCTs	Intervention targeting: Gait (G), Balance (B), Range of motion (ROM), Strength (S)	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Walking capacity: speed	Chandler 1999 <sup>178</sup> Ellis 2005 <sup>179</sup> Fisher 2008 <sup>180</sup> Sage 2009 <sup>181</sup> Caglar 2005 <sup>182</sup> Ebersbach 2010 <sup>183</sup> Schenkman '98 <sup>184</sup> Reuter 2011 <sup>185</sup>	G, B, ROM G, B, ROM G, B, ROM, S G, B; sensory feedback G, B, ROM; home, check ROM, B: high amplitude* B, ROM G (uphill, 50% Nordic W)	No intervention No intervention Education No intervention No intervention* No intervention ROM	N=378 HY1-3	Median 8 wks (range 4-52): 3/wk (range 2-7), 60" (range 45-90)	MD 0.15 (0.10;0.19)	Moderate <sup>a</sup>	Strong for	Consistent effects, except for Schenkman (addressed only B, ROM); MD may ensure safe street crossing
Gait patt.: Stride (m)	Fisher 2008 <sup>180</sup> Hass 2012 <sup>186</sup>	G, B, ROM, S S; progressive	Education No intervention	N=38, HY1-2	8-10wks: 2-3/wk, 45"	MD 0.00 (-0.14;0.13)	Low <sup>a,b</sup>	Weak against	Inconsistent; 2 very small CCTs
Walking capacity Step length (m)	Caglar 2005 <sup>182</sup> Fisher 2008 <sup>180</sup> Sage 2009 <sup>181</sup>	G, B, ROM; home, check G, B, ROM, S G, B; sensory feedback	No intervention Education No intervention	N=86, HY1-3	Median 8 wks: 3/wk, 50"	MD 0.02 (-0.02;0.07)	Low <sup>a,b</sup>	Weak against	Inconsistent, small effects; CI includes 0
Walking capacity: Cadence	Fisher 2008 <sup>180</sup> Sage 2009 <sup>181</sup>	G, B, ROM, S G, B; sensory feedback	Education No intervention	N=56 HY1-3	8-12 wks: 3/wk, 45-50"	MD-0.28 (-5.17;4.62)	Low <sup>a,b</sup>	Weak against	Inconsistent effects; two small CCTs
Walking capacity: distance (m)	Meek 2010 <sup>187</sup> Schenkman '98 <sup>184</sup> Schilling 2010 <sup>39</sup> Dibble 2006 <sup>188</sup>	ROM, S; at gym B, ROM S; progressive, high load S; eccentric, high force	No intervention No intervention No intervention G, ROM	N=117 HY1-3	Median 10-12 wks: 2-3/wk, 60"	MD 9.72 (-11.55;31.00)	Moderate <sup>a</sup>	Weak against	Consistent effects, CI includes 0; best: high intensity progressive training
Walking perform: FOGQ	Allen 2010 <sup>189</sup>	S, B; mainly at home	No intervention	N=45, HY?	26 wks: 3/wk, 50"	MD-2.40 (-5.76;0.96) <sup>190</sup> best: low	Low <sup>a,b</sup>	Weak against	Single CCT positive effect, CI includes 0
Capacity Functional mobility: TUG (s)	Goodwin 2011 <sup>31</sup> Klassen 2007 <sup>191</sup> Sage 2009 <sup>181</sup> Schilling <sup>39</sup> Stozek 2003 <sup>192</sup> Ebersbach 2010 <sup>183</sup> Christofoletti <sup>10</sup> <sup>193</sup>	S, B ; & home exercises S, B, ROM, aerobic G, B; sensory feedback S; progressive, high load G, B, ROM; sensory fb ROM, B: high amplitude* B, ROM, S; cognition	No intervention No intervention No intervention No intervention No intervention <sup>1</sup> No intervention	N=333 HY1-4	Median 10 wks (range 4-26): 3-4/wk, 60"	MD-1.07 (-1.61;-0.52) best: low	Moderate <sup>b</sup>	Weak for	Small MD; partly inconsistent effects <sup>31,39</sup> ; large CI
Timed Turn (s)	Caglar 2005 <sup>182</sup> Schenkman '98 <sup>184</sup>	G, B, ROM; home, check B, ROM	No intervention No intervention	N=76, HY1-3	8-10 wks: 3-7/wk, 45-60"	MD-1.28 (-2.82;0.26)	Moderate <sup>a</sup>	Weak against	

App. 17.1 Conventional physiotherapy versus no intervention or placebo									
Outcome	Author & year included CCTs	Intervention targeting: Gait (G), Balance (B), Range of motion (ROM), Strength (S)	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Balance Capacity1: No of Falls	Ashburn 2007 <sup>194</sup> Goodwin 2011 <sup>31</sup>	G, B, S, ROM; at home S, B ; plus 2/wk at home	No intervention No intervention	N=142, HY2-4 N=130, HY1-4	6wks: 7/wk, 60" 10wks: 3/wk, 60"	IRR 0.87 (0.66;1.14) IRR 0.68 (0.43;1.07)	Moderate <sup>b</sup>	Weak against	Consistent, non significant effect, also at 10- to 20-week follow-up
Balance Capacity: BBS best: high	Goodwin 2011 <sup>31</sup> Ashburn 2007 <sup>194</sup> Christofoletti 10 <sup>193</sup>	S, B ; plus 2/wk at home G, B, S, ROM; at home B, ROM, S; cognition	No intervention No intervention No intervention	N=279, HY1-4	Median 10 wks (range 6-26): 3-7/wk, 60"	MD3.83 (1.96;5.69)	Moderate <sup>b</sup>	Weak for	Inconsistent effects; small MD
Balance Capacity: FR best: high	Ashburn 2007 <sup>194</sup> Schenkman '98 <sup>184</sup> Stozek 2003 <sup>192</sup> Schenkman '12 <sup>195</sup>	G, B, S, ROM; at home B, ROM G, B, ROM; sensory fb B, ROM	No intervention No intervention No intervention Home exercises	N=311 HY1-4	Median 10wks (range 4-17): 3-7/wk, 45-120"	MD1.82 (0.24;3.39)	Moderate <sup>a</sup>	Weak for	Small MD (without Schenkman: 2.7); effects inconsistent
Balance perform*** FES best=low	Allen 2010 <sup>189</sup> Goodwin 2011 <sup>31</sup>	S, B; mainly at home S, B ; plus 2/wk at home	No intervention No intervention	N=169, HY1-4	Range 8-10wks: 2-3/wk, 30-60"	MD-2.35 (-5.38;0.69)	Moderate <sup>a</sup>	Weak against	Consistent effects, CI includes 0
ABC best=high	Klassen 2007 <sup>191</sup> Schilling 2010 <sup>39</sup>	S, B, ROM, aerobic S; progressive, high load	No intervention No intervention	N=38, HY 1-2	Mean 10wks: 2/wk, 75"	MD3.63 (-2.09;9.36) <sup>190</sup>	Moderate <sup>a</sup>	Weak against	
Muscle functions Strength: kg	Allen 2010 <sup>189</sup> Schilling 2010 <sup>39</sup> Hirsch 2003 <sup>196</sup>	S, B; mainly at home S; progressive, high load S <sup>2</sup>	No intervention No intervention No intervention <sup>2</sup>	N=75, HY1-2	Range 8-26 wks: 2-3/wk, 15-50"	SMD*0.63 (0.13;1.13)	Low <sup>a,b</sup>	Strong for	Consistent effects; Allen and Hirsch MD 13.9
Strength: torque best=high	Bridgewater '97 <sup>25</sup> Toole 2000 <sup>29</sup> Dibble 2006 <sup>188</sup>	G, B, ROM, S S, B S; eccentric, high force	Social events No intervention G, ROM	N=52, HY1-3	12wks: 3/wk, 60"	MD29.42 (25.84;32.99)	Moderate <sup>a</sup>	Strong for	Consistent effects; change 19-30%
Movement functions: UPDRS-motor best: low	Chandler 1999 <sup>178</sup> Ellis 2005 <sup>179</sup> Fisher 2008 <sup>180</sup> Comella 1994 <sup>197</sup> Sage 2009 <sup>181</sup> Ebersbach 2010 <sup>183</sup> Schenkman '12 <sup>195</sup>	G, B, ROM G, B, ROM G, B, ROM, S G, B, ROM G, B; sensory feedback ROM, B: large amplitude B, ROM	No intervention No intervention Education No intervention No intervention No intervention* Home exercises	N=328 HY1-3	Median 8 wks (range 4-52): 3/wk, 50"	MD-3.39 (-4.96;-1.82)	Moderate <sup>a</sup>	Strong for	Consistent effects; MD larger than MCIC (2.7 <sup>175</sup> )

App. 17.1 Conventional physiotherapy versus no intervention or placebo									
Outcome	Author & year included CCTs	Intervention targeting: Gait (G), Balance (B), Range of motion (ROM), Strength (S)	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Quality of life: PDQ-39 (summary) <i>best: low</i>	Allen 2010 <sup>189</sup> Klassen 2007 <sup>191</sup> Meek 2010 <sup>187</sup> Chandler 1999 <sup>178</sup> Cruise 2011 <sup>198</sup> Dibble 2009 <sup>199</sup> Ebersbach 2010 <sup>183</sup> Winward '12 <sup>200</sup> Schenkman '12 <sup>195</sup>	S, B; mainly at home S, B, ROM; aerobic ROM, S; at gym G, B, ROM G, S, ROM; aerobic S; eccentric, high force ROM, B: large amplitude ROM, S; at gym B, ROM	No intervention No intervention No intervention No intervention G, ROM No intervention No intervention Home exercises	N=349 HY1-4	Median 12 wks (range 4-52): 3/wk, 60"	MD-0.13 (-2.80;2.54)	Low <sup>a,b</sup>	Weak against	Inconsistent effects; largest effect (MD≥-5.6) for prolonged (Allen) or short, high intensive training (Dibble)
EQ-5D** <i>best: high</i>	Ashburn 2007 <sup>194</sup> Goodwin 2011 <sup>31</sup>	G, B, S, ROM; at home S, B ; plus 2/wk at home	No intervention No intervention						
PDQL <i>best: high</i>	Yousefi 2009 <sup>201</sup>	S, B, ROM	No intervention	N=24	10 wks: 4/wk, 60"	MD17.7 (1.79;33.61)	Low <sup>a,b</sup>	Weak for	Single CCT; combined with EQ-5D & PDQ-39 SMD -0.71 (-3.1; 1.7) (best: low)
Perform. Activity levels	Meek 2010 <sup>187</sup>	ROM, S; at gym	No intervention	N=39, HY?	12 wks: 1/wk, ?"	MD-16.8 (-52.4;18.8)	Low <sup>a,b</sup>	Weak against	Single CCT; CI includes 0

\* Schilling reports kg/kg; \*\*Ashburn used VAS (0-100) only; Goodwin reported adjusted MD, no means – not asked for as pooling will not change conclusion; 1.comparable weekly exercise time in HOME and BIG, next to BIG treatment (2.6 vs 2.53hr); 2.both groups also received a 30 min balance training 3/wk; # not adjusted difference; IRR, incidence rate ratio (adjusted for baseline falls)

App. 17.2 Treadmill versus no treadmill training									
Outcome	Author & year included CCTs	Intervention details	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Capacity walking: Walking speed	Miyai 2000 <sup>202</sup> Miyai 2002 <sup>203</sup> Pohl 2003 <sup>204</sup> Protas 2005 <sup>205</sup> Cakit 2007 <sup>206</sup> Fisher 2008 <sup>180</sup> Kurtais 2008 <sup>207</sup> Canning 2012 <sup>208</sup> Frazzitta 2009 <sup>209</sup> Yang 2010 <sup>210</sup>	BWS 10-20% BWS ≤20% In 50% incremental* Varying directions Incremental* High intensity & BWS ≤3% General treadmill At home Incremental* Downhill, BWS≤40%	Conventional PT Conventional PT 50% PT, 50% Education Not described Conventional PT Not described No intervention No intervention Conventional PT	N=241 HY1-3	Median 4-6 wks: 3/wk, 45"	MD 0.13 (0.05;0.20)	Moderate <sup>a</sup>	Strong for	Consistent effects, except for Kurtais (MD -0.03)
Movement functions, Gait patterns: Stride length (m)	Miyai 2000 <sup>202</sup> Miyai 2002 <sup>203</sup> Pohl 2003 <sup>204</sup> Protas 2005 <sup>205</sup> Fisher 2008 <sup>180</sup> Yang 2010 <sup>210</sup>	BWS 10-20% BWS ≤20% In 50% incremental* Varying directions High intensity & BWS ≤3% Downhill, BWS≤40%	Conventional PT Conventional PT 50% PT, 50% rest Education Conventional PT Conventional PT						
Capacity walking: Walking distance	Miyai 2000 <sup>202</sup> Cakit 2007 <sup>206</sup> Canning 2012 <sup>208</sup>	BWS 10-20% Incremental* At home, incremental*	Conventional PT Not described No intervention	N=59, HY1-3	Median 6 wks: 3/wk, 35"	MD 241.5 (184.8;298.1)	Low <sup>a,b</sup>	Weak for	Inconsistent effects (range MD: -4.8m to 364m)
Capacity walking: Cadence <i>best: low</i>	Miyai 2000 <sup>202</sup> Miyai 2002 <sup>203</sup> Protas 2005 <sup>205</sup> Fisher 2008 <sup>180</sup> Yang 2010 <sup>210</sup>	BWS 10-20% BWS ≤20% Varying directions High intensity & BWS ≤3% Downhill, BWS≤40%	Conventional PT Conventional PT Education Conventional PT Conventional PT	N=108, HY1-3	Median 4 wks: 3/wk, 45"	MD 1.52 (-3.48;6.52)	Low <sup>a,b</sup>	Weak against	Inconsistent effects; CI includes 0 ; 4 of 5 CCTs positive MD
Capacity Functional mobility – timed gait**	Protas 2005 <sup>205</sup> Kurtais 2008 <sup>207</sup>	Incremental* General treadmill	Education Not described						
Capacity Balance BBS	Cakit 2007 <sup>206</sup>	Incremental*	Not described	N=31, HY2-3	8 wks: 2/wk, 30"	MD 8.29 (1.07;15.51) <sup>190</sup> <i>best: high</i>	Low <sup>a,b</sup>	Weak for	Single CCT
Strength (torque, Nm)	Yang 2010 <sup>210</sup>	Downhill, BWS≤40%	Conventional PT	N=33, HY1-3	4 wks: 3/wk, 30"	MD 18.91 (-10.0;47.9)	Low <sup>a,b</sup>	Weak against	Single CCT

### App. 17.2 Treadmill versus no treadmill training

Outcome	Author & year included CCTs	Intervention details	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Movement functions UPDRS III <i>best: low</i>	Fisher 2008 <sup>180</sup> Canning 2012 <sup>208</sup>	High intensity & BWS ≤3%, At home, incremental*	Conventional PT No intervention	N=38, HY1-2	6-8 wks: 3/wk, 35-45"	MD -0.05 (-5.74;5.64)	Low <sup>a,b</sup>	Weak against	Canning MD 0; CI includes 0; best: high intensity

\*incremental walking speed on the treadmill; \*\*Kurtais evaluated climbing up and down a flight of stairs (s), Protas evaluated stepping on and off an 8.8cm step five times (s)

### App. 17.3 Whole body vibration (WBV) versus no WBV

Outcome	Author & year included CCTs	Type of WBV	Control details	No of pwp; mean age*	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Capacity Functional mobility: TUG <i>low=best</i>	Arias 2009 <sup>211</sup> Ebersbach 2008 <sup>212</sup>	WBV 6Hz WBV	Stand, no vibration Active balance exercises	N=42; 70.3yr	3-5 wks: 2-10/wk, 10-15"	MD -0.41 (-1.02;0.21) <sup>213</sup>	Low <sup>a,b</sup>	Strong against	Consistent effects, CI includes 0; safety considerations
Balance Capacity BBS/Tinetti <i>best=high</i>	Arias 2009 <sup>211</sup> Ebersbach 2008 <sup>212</sup>	WBV 6Hz WBV	Stand, no vibration Active balance exercises	N=42; 70.3yr	3-5 wks: 2-10/wk, 10-15"	MD 0.36 (-0.26;0.97) <sup>213</sup>	Low <sup>a,b</sup>	Strong against	Consistent effects, CI includes 0; safety considerations
Balance Capacity FR	Arias 2009 <sup>211</sup>	WBV 6Hz	Stand, no vibration	N=21; 66.7yr	5 wks: 2/wk, 10"	MD 16.15 (-45.5;77.8) <sup>213</sup>	Low <sup>a,b</sup>	Strong against	Single CCT, CI includes 0; safety considerations
Movement functions: UPDRS-motor <i>best=low</i>	Arias 2009 <sup>211</sup> Ebersbach 2008 <sup>212</sup>	WBV 6Hz WBV	Stand, no vibration Active balance exercises	N=42; 70.3yr	3-5 wks: 2-10/wk, 10-15"	MD -0.65 (-3.98;2.68) <sup>213</sup>	Low <sup>a,b</sup>	Strong against	Inconsistent effects, CI includes 0; safety considerations

### App. 17.4 Massage of trigger points: neuromuscular therapy versus no neuromuscular therapy

Outcome	Author & year included CCTs	Intervention details	Control details	No of pwp; mean age*	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Walking capacity: speed	Craig 2006 <sup>214</sup>	Trigger point massage	Music relaxation	N=32, HY1.6	8 wks: 2/wk, 45"				no reponse (in text: no effect)
Movement functions: UPDRS-motor <i>best: low</i>	Craig 2006 <sup>214</sup>	Trigger point massage	Music relaxation	N=32, HY1.6	8 wks: 2/wk, 45"				Data requested; no reponse (in text: certain items positive effects)
Patient-based treatment effect Clinical Global Impression (CGI) <i>best: high</i>	Craig 2006 <sup>214</sup>	Trigger point massage	Music relaxation	N=32, HY1.6	8 wks: 2/wk, 45"	MD 0.93 (0.47;1.39)	Low <sup>a,b</sup>	Weak for	Single, small CCT
Quality of life PDQ-39	Craig 2006 <sup>214</sup>	Trigger point massage	Music relaxation	N=32, HY1.6	8 wks: 2/wk, 45"				Data requested; no reponse

App. 17.5 Cueing versus no cueing									
Outcome	Author & year included CCTs	Cueing: auditory (A) visual (V)	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Walking capacity: speed	De Bruin 2010 <sup>215</sup> Nieuwboer '07 <sup>135</sup> Thaut 1996 <sup>216</sup> Imeida 2012 <sup>217</sup>	A, self-paced gait A&V, gait, at home A, gait V, gait, 50% treadmill	No intervention No intervention No intervention No intervention	N=240 HY2-4	Median 4 wks: 3/wk, 30"	MD 0.07 (0.03;0.11)	High	Strong for	Consistent effects; MD expected likely of clinical importance
Gait patt.: Stride (m)	De Bruin 2010 <sup>215</sup> Thaut 1996 <sup>216</sup>	A, self-paced gait A, gait	No intervention No intervention						
Walking capacity Step (m)	Nieuwboer '07 <sup>135</sup> Almeida 2012 <sup>217</sup>	A&V, gait, at home V, gait, 50% treadmill	No intervention No intervention	N=192 HY2-4	3-6 wks: 3/wk, 30"	MD 0.04 (0.02;0.06)	High	Weak for	Very small, consistent effect
Cadence	De Bruin 2010 <sup>215</sup> Nieuwboer '07 <sup>135</sup> Thaut 1996 <sup>216</sup>	A, self-paced gait A&V, gait at home A, gait	No intervention No intervention No intervention	N=201 HY2-4	Median 3 wks: 3/wk, 30"	MD -2.03 (-5.11;1.05) <sup>190</sup>	High	Weak against	Consistent (no) effects, but CI crossing 0
Walking perform: FOGQ	Nieuwboer '07 <sup>135</sup> Kadivar 2011 <sup>218</sup>	A&V, gait, at home A, gait: multidirect	No intervention Self-paced steps	N=169 HY2-4	3-6 wks: 3/wk, 30-60"	MD -1.01 (-2.17;0.15) <i>best: low</i>	High	Weak against  In freezers: Weak for	Consistent effects; CI includes 0; fin freezers-only sign.: 5.5% vs 3.6% <sup>135;219</sup>
Capacity Functional mobility TUG (s)	Nieuwboer '07 <sup>135</sup> Imeida 2012 <sup>217</sup> Kadivar 2011 <sup>218</sup>	A&V, gait, at home V, gait, 50% treadmill A, gait: multidirect	No intervention No intervention Self-paced steps	N=208 HY2-4	6 wks: 3/wk, 30"	MD -0.64 (-1.64;0.35)	Moderate <sup>a</sup>	Cued gait: Weak against	Consistent effects, but CI includes 0
Sit-to-stand (s)	Mak 2008 <sup>220</sup>	A&V, sit-to-stand	No intervention	N=33 HY2-4	4 wks: 3/wk, 20"	MD -0.73 (-1.14;-0.32)	Low <sup>a,b</sup>	Cued transfer: Weak for	Positive effects; single small CCT
Balance Capacity FR	Nieuwboer '07 <sup>135</sup>	A&V, gait, at home	No intervention	N=153 HY2-4	3 wks: 3/wk, 30"	MD 1.46 (-0.32;3.24)* <i>best: high</i>	Moderate <sup>a</sup>	Weak against	Small, positive effect, CI includes 0
DGI	Kadivar 2011 <sup>218</sup>	A, gait: multidirect	Self-paced steps	N=16; HY2-4	6 wks: 3/wk,60"	MD 2.80 (0.29;5.31)	Low <sup>a,b</sup>	Weak for	Positive effects; single small CCT
Balance perform**	Nieuwboer '07 <sup>135</sup> Shankar 2008 <sup>221</sup>	A&V, gait, at home A, comf. gait speed	No intervention No intervention	N=181 HY2-4	3-13wks: 3/wk, 30"	SMD 0.11 (-0.11;0.32)	Moderate <sup>a</sup>	Weak against	Inconsistent; CI includes 0
Movement functions: UPDRS III <i>best: low</i>	De Bruin 2010 <sup>215</sup> Shankar 2008 <sup>221</sup> Almeida 2012 <sup>217</sup> Marchese 2000 <sup>222</sup> Mohr 1996 <sup>37</sup> Kadivar 2011 <sup>218</sup>	A, self-paced gait A, comf. gait speed V, gait, 50% treadmill A&V&T with conv PT Gait & transfers A, gait: multidirect	No intervention No intervention No intervention Conv PT only Role playing Self-paced steps	N=166 HY1.5-4	6 wks: 3/wk, 30"	MD -2.27(-4.24;-0.31)	Moderate <sup>a</sup>	Weak for	Consistent effects; MD smaller than MCIC (2.7 <sup>175</sup> )

App. 17.5 Cueing versus no cueing									
Outcome	Author & year included CCTs	Cueing: auditory (A) visual (V)	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
P&G score <i>best: low</i>	Nieuwboer '07 <sup>135</sup>	A&V, at home, ADL	No intervention	N=153 HY2-4	3 wks: 3/wk, 30"	MD -0.82 (-1.43;-0.21) <sup>***</sup>	Moderate <sup>a</sup>	Weak for	Small change, 5.4%
QOL**** <i>best: low</i>	Nieuwboer '07 <sup>135</sup>	A&V, gait, at home	No intervention	N=153 HY2-4	3 wks: 3/wk, 30"	MD -1.58 (-5.45;2.29) <sup>190</sup>	Moderate <sup>a</sup>	Weak against	Single CCT; CI including 0

\*may ensure safe street crossing. Moreover, as in stoke, an increase of 0.03 and 0.13 m/s could translate into a change from a limited household to an unlimited household walker and from unlimited household to a most-limited community walker respectively<sup>190</sup>; \*\*Nieuwboer used FES (MD: 3.74, best=low), Shankar used ABC (MD -3.10, best=high; \*\*\*data received upon request; \*\*\*\* PDQ-39; FR, Functional Reach; P&G score includes UPDRS III items for balance and gait13-15 and 29-30

App. 17.6 Strategies for complex motor sequences supported by cueing									
Outcome	Author & year included CCTs	Targeted core areas	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects (CI: low to high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Walking capacity: speed	Nieuwboer '01 <sup>223</sup> Morris 2009 <sup>224</sup> Kamsma 1995 <sup>225</sup>	Gait & transfers Gait & transfers Transfers	No intervention Conv. PT: S, ROM No intervention	N=99, HY2-4	2 to 6 wks: 8-3/wk, 45-30 <sup>**</sup>	MD 0.00 (-0.04;0.05)	Moderate <sup>a</sup>	Weak against	Inconsistent effects; CI including 0
Gait patterns: Stride length	Nieuwboer '01 <sup>223</sup>	Gait & transfers	No intervention						
Step length	Kamsma 1995 <sup>225</sup>	Transfers	No intervention	N=38, HY2-4	52 wks : 14 sessions, 60"	MD -0.02 (-0.08;0.04)	Low <sup>a,b</sup>	Weak against	Single CCT; CI including 0
Walking capacity: Cadence	Nieuwboer '01 <sup>223</sup>	Gait & transfers	No intervention	N=33, HY2-3	6 wks: 3/wk, 30"	MD -3.81 (-9.03;1.41)	Low <sup>a,b</sup>	Weak against	Single CCT; CI including 0
Capacity Functional mobility PAS-chair <i>best: high</i>	Stack 2011 <sup>226</sup> Nieuwboer '01 <sup>223</sup>	Transfers Gait & transfers	No intervention No intervention	N=68, HY1-4	4-6 wks: 3/wk, 30-60"	MD 1.02 (0.42;1.63)	Moderate <sup>a</sup>	Strong for	Small CCTs; consistent effects (PAS chair range 0-8)
PAS-total <i>best: high</i>	Nieuwboer '01 <sup>223</sup> Keus 2007 <sup>227</sup> Kamsma 1995 <sup>225</sup>	Gait & transfers Transfers	No intervention No intervention						
Movement functions: UPDRS III (motor)	Mohr 1996 <sup>37</sup>	Gait & transfers	Role playing	N=41; HY1.5-4	10 wks: 2/wk, ??"	MD -3.08 (-10.76;4.6)	Low <sup>a,b</sup>	weak against	Single CCT; positive effect, CI including 0 ; MD larger than MCIC (2.7 <sup>175</sup> )
UPDRS II+III <i>best: low</i>	Morris 2009 <sup>224</sup>	Gait & transfers	Conv. PT: S, ROM	N=38, HY2-4	2 wks: 8/wk, 45"	MD -2.20 (-9.13;4.73)	Low <sup>a,b</sup>	weak against	Single CCT; positive effect, CI including 0
Patient-based effect PSI	Keus 2007 <sup>227</sup>	All	No intervention	N=27, HY1-4	13 wks: 1/wk, 45"	MD 43.78 (9.77;77.79)	Low <sup>a,b</sup>	weak for	Single CCT; large CI

\*Kamsma 52 wks, 14 sessions; \*\*SMD as Kamsma used PAS precursor (% effectively performed activities, MD 52);

App. 17.7 Dance versus no dance (tango)									
Outcome	Author & year included CCTs	Type of dance	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects# (CI: low; high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Walking capacity: speed	Hackney 2009 <sup>33</sup> Hackney 2007 <sup>228</sup>	Tango & ballroom Tango	No intervention S, ROM exercises	N=67, HY1-3	10 wks: 2/wk, 60"	MD 0.01 (-0.09;0.11)	Low <sup>a,b</sup>	Weak against	Very small to no effects; CI including 0; Tango only: MD 0.02
Gait patterns: Stride length	Hackney 2009 <sup>33</sup>	Tango & ballroom	No intervention						
Walking capacity Distance	Hackney 2009 <sup>33</sup>	Tango & ballroom	No intervention	N=48, HY1-3	10 wks: 2/wk, 60"	MD 61.25 (-1.60;124.1)	Low <sup>a,b</sup>	Weak against	Single, low quality CCT; Tango only: MD 66.9
Walking perform: FOGQ <i>best: low</i>	Hackney 2007 <sup>228</sup> Hackney 2009 <sup>33</sup>	Tango Tango & ballroom	S, ROM exercises No intervention	N=67, HY1-3	10 wks: 2/wk, 60"	MD 0.03 (-1.36;1.42)	Low <sup>a,b</sup>	Weak against	Inconsistent effects; CI including 0; Tango only: MD 0.06
Capacity Functional mobility: TUG <i>low=best</i>	Hackney 2007 <sup>228</sup> Hackney 2009 <sup>33</sup>	Tango Tango & ballroom	S, ROM exercises No intervention						
Balance Capacity BBS <i>best: high</i>	Hackney 2007 <sup>228</sup> Hackney 2009 <sup>33</sup>	Tango Tango & ballroom	S, ROM exercises No intervention	N=67, HY1-3	10 wks: 2/wk, 60"	MD 2.98 (0.76;5.21)	Low <sup>a,b</sup>	Weak for	Small MD; consistent effects; low quality CCTs; Tango only: MD 2.84
Mini-BESTest* <i>best: high</i>	Duncan 2012 <sup>27</sup>	Tango	No intervention	N=62, HY1-4	12 wks: 2/wk, 60"	MD 1.2 (0.68;1.72)	Low <sup>a,b</sup>	Weak for	Small MD, increased towards 12 months, but with many drop-outs
Movement functions: UPDRS-motor* <i>best: low</i>	Duncan 2012 <sup>27</sup> Hackney 2009 <sup>33</sup> Hackney 2007 <sup>228</sup>	Tango Tango & ballroom Tango	No intervention No intervention S, ROM exercises	N=119, HY1-4	10-12 wks*: 2/wk, 60"	MD -2.22 (-4.85;0.40)	Moderate <sup>a</sup>	Weak against	Consistent positive effects; CI includes 0; equal results when Duncan MD at 12 months used (that is -9); Tango only: MD -1.97
QOL: PDQ39	Hackney 2009 <sup>33</sup>	Tango & ballroom	No intervention						

ROM, range of motion; S, muscle strength; \*Duncan 2012 evaluated the ongoing intervention at 52, but to combine the CCTs, data at 12 wks were used<sup>27</sup>; \*\* data measured from figure

App. 17.8 Tai Chi versus no Tai Chi									
Outcome	Author & year included CCTs	Type of martial arts <sup>a</sup>	Control details	No of pwp; Hoehn & Yahr	Treatment duration, frequency & time	Overall effects# (CI: low; high)	GRADE: evidence summary	GDG: strength recommendation: burden/benefits	Remarks effects
Walking capacity: speed	Hackney 2008 <sup>229*</sup> Li 2012 <sup>230</sup>	Tai Chi Tai Chi	Dance Stretching (ROM)	N=156; HY1-4	10-24 wks: 1-2/wk, 60"	MD 0.09 (0.03;0.15)	Low <sup>a,b</sup>	Weak for	Inconsistent effects
Gait patterns: Stride (m)	Hackney 2008 <sup>229*</sup> Li 2012 <sup>230</sup>	Tai Chi Tai Chi	Dance Stretching (ROM)	N=156; HY1-4	10-24 wks: 1-2/wk, 60"	MD 0.07 (0.01;0.13)	Low <sup>a,b</sup>	Weak for	Inconsistent effects
Walking capacity Distance	Hackney 2008 <sup>229</sup>	Tai Chi	Dance	N=26; HY1-3	10 wks: 2/wk, 60"	MD 43.60 (0.71;86.49)	Low <sup>a,b</sup>	Weak for	Single, low quality CCT
Capacity Functional mobility: TUG <i>low=best</i>	Hackney 2008 <sup>229</sup> Li 2012 <sup>230</sup>	Tai Chi Tai Chi	Dance Stretching (ROM)	N=156; HY1-4	10-24 wks: 1-2/wk, 60"	MD -0.93 (-1.45;-0.41)	High	Weak for	Small MD; consistent positive effects
Balance Capacity BBS	Hackney 2008 <sup>229</sup>	Tai Chi	Dance	N=26; HY1-3	10 wks: 2/wk, 60"	MD 3.80 (1.81;5.79)	Low <sup>a,b</sup>	Weak for	Single, low quality CCT
Balance Capacity FR	Li 2012 <sup>230</sup>	Tai Chi	Stretching (ROM)	N=130; HY1-4	24 wks: 1/wk, 60"	MD 5.0 (2.56;7.44)	Moderate <sup>b</sup>	Weak for	Small MD; 1 high quality CCT
Balance Capacity No of falls	Li 2012 <sup>230</sup>	Tai Chi	Stretching (ROM)	N=130; HY1-4	24 wks: 1/wk, 60"	IRR 0.33 (0.16;0.71)	Moderate <sup>b</sup>	Weak for	Large difference (67% fewer falls) 1 high quality CCT
Muscle functions strength: torque**	Li 2012 <sup>230</sup>	Tai Chi	Stretching (ROM)	N=130; HY1-4	24 wks: 1/wk, 60"	MD 13.9 (1.51;25.29)	Moderate <sup>b</sup>	Weak for	Based on 1 high quality CCT
Movement functions: UPDRS-motor <i>low=best</i>	Hackney 2008 <sup>229</sup> Schmitz-H 2006 <sup>231</sup> Li 2012 <sup>230</sup>	Tai Chi Qigong Tai Chi	Dance No intervention Stretching (ROM)	N=200; HY1-4	10-24 wks: 0 <sup>1</sup> -2/wk, 60"	MD -5.13 (-6.58;-3.67)	High	Strong for	Consistent positive effects; MD larger than MCIC (2.7 <sup>175</sup> )

a.searched is for all martial arts, but except for the Schmitz-Hubsch CCT, only Tai Chi is evaluated and therefore used as heading for this table; ROM, range of motion; \* sd data of change scores used, as in Tomlinson Cochrane review<sup>190</sup>: meters vs centimetres; 1. Schmitz-H 2006<sup>231</sup> provided 8 wks 1/wk, an 8 wks break (0/wk), 8 wks 1/wk; \*\*knee extensors; IRR, Incidence-rate ratio

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