Systematic Review

Measurement instruments to assess basic functional mobility in Parkinson's Disease: A systematic review of clinimetric properties and feasibility for use in clinical practice

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ABSTRACT

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Objective: To systematically review the evaluation of clinimetric properties and feasibility of the "Modified Parkinson Activity Scale (M-PAS)" and the "Lindop Parkinson's Disease Mobility Assessment (LPA)," which are Parkinson's Disease (PD)-specific measurement instruments to assess basic functional mobility, and to discuss their considerations for use in clinical practice.

Methods: A systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. A risk of bias assessment was also performed.

Results: Eleven studies were included: five studies used M-PAS (45%), five studies used LPA (45%), and one study used M-PAS and LPA (13%). The risk of bias was low for all evaluated studies.

Conclusion: M-PAS and LPA showed adequate reliability, validity, and responsiveness in detecting intervention changes. M-PAS has more detailed qualitative scoring options, a lack of ceiling effect, and can be used by a non-expert in PD.

In contrast, the drawback of M-PAS is that it is time-consuming to apply in everyday clinical practice. On the other hand, LPA with greater simplicity may lead to lower burdens for both patients and raters in situations with strict time limitations. Further research is required to identify new resources.

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Introduction

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by the degeneration of dopamine neurons in the substantia nigra; the four cardinal signs include resting tremor, rigidity, bradykinesia, and postural instability [1]. Aging is a risk factor for developing PD [2], and thus the number of people diagnosed with PD is expected to increase in some countries with an aging society [3].

Transferring and gait are basic functional mobility items and are the main targets of rehabilitation therapy [4–7]. However, even though these movements are a prerequisite for functional independence, it has been reported that most patients with PD commonly present with difficulties in bed mobility [6–8].

It is crucial to use standardized measurement instruments to enable healthcare professionals to evaluate the effectiveness of rehabilitation therapy and share information among staff members [9].

The Movement Disorder Society–Unified Parkinson's Disease Rating Scale (MDS-UPDRS) is currently the most widely used measurement instrument for PD, but it may have some shortcomings in the clinical use of rehabilitation medicine, as suggested by previous studies.

First, the motor examination (MDS-UPDRS Part III) does not sufficiently include items of basic functional mobility in core areas of rehabilitation treatment [10–12]. Second, motor experiences of daily living (MDS-UPDRS Part II) are self-reported measures, which can be unreliable in PD patients with memory impairment as the rating relies on the participant's memory [13]. Furthermore, a floor effect (the clustering of participants' scores toward the bottom end of the instrument) has been observed in the

MDS-UPDRS Part III, resulting in insensitivity in detecting clinical change [14]. Measurement bias has also been reported [15]. In addition, recent studies using wearable sensors have attempted to objectively quantify the difficulties of transferring [16,17] and gait [18] in patients with PD. However, it is often used for research purposes rather than clinical practice because the cost of the sensor system is not trivial (approximately US$ 800 [19]) and computational signal processing is required, and its reliability and validity in assessing PD patients have not been established [18, 20].

Recently, specialists in rehabilitation medicine have developed the Modified Parkinson Activity Scale (M-PAS) and Lindop Parkinson's Disease Mobility Assessment (LPA) [11, 12].

Both M-PAS and LPA are measurement instruments widely used across the world and are specifically designed to evaluate basic functional mobility in patients with PD [21, 22].

M-PAS consists of three domains (*Chair Transfer, Gait Akinesia,* and *Bed Mobility*) with 16 sub-items [11], while LPA consists of two domains (*Gait Mobility* and *Bed Mobility*) with 10 items [12]. These domains and items describe core activities related to basic functional mobility for patients with PD to target rehabilitation therapy.

Each item is scored on a 5-point ordinal scale (ranging from 0 to 4 points), with higher scores indicating greater independence and lower scores indicating worse performance difficulties.

It is essential to conduct thorough evaluations using measurement instruments with adequate clinimetric properties (i.e., validity and reliability) to provide more effective and high-quality rehabilitation therapy [23]. Despite its importance, to the best of our knowledge there have been no detailed reports on the clinimetric properties and feasibility of M-PAS and LPA in rehabilitation practice. Thus, a systematic review of their clinimetric properties and feasibility is important to provide effective and high-quality rehabilitation therapy.

Therefore, the aims of this study were to clarify 1) clinimetric properties (floor or ceiling effect, validity, reliability, and responsiveness) and feasibility of M-PAS and LPA, and 2) commonalities and differences between M-PAS and LPA, and also to discuss the advantages, drawbacks, and considerations for use in clinical practice.

Methods

This systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [24].

1. Search strategy

A literature search was carried out in August 2022 using electronic databases (PubMed, Web of Science, and Cochrane Library). A sample search strategy on PubMed is presented in Supplementary Table 1. A manual search was also performed to identify additional relevant articles (title and abstract of citations that fulfilled the inclusion criteria, and full-text search if necessary). Collected papers and references were managed using EndNote 20 (Clarivate Analytics, Philadelphia, Pennsylvania, USA).

2. Inclusion/exclusion criteria

The literature was selected based on the following inclusion criteria: (i) studies involving patients with PD and (ii) studies reporting one of the following: floor effect, ceiling effect, validity, reliability, or responsiveness of M-PAS or LPA. The exclusion criteria were studies in which detailed data could not be retrieved (e.g., conference abstracts). In addition, any research design, language, or publication period was included.

After removing duplicates, the abstracts and titles were screened to identify relevant studies, and the full texts were subsequently screened to identify measurement instruments. Any disagreement between the two reviewers was discussed before making the final decision. Two postdoctoral researchers (ST and AY) independently performed the literature search and risk bias assessment.

3. Data extraction

The following data were extracted from the identified literature: authors, year of publication, sample size and age, Hoehn & Yahr stages, structure of measurement instruments (domains and items) and scoring criteria, clinimetric properties (presence of floor and ceiling effects, reliability, validity, and responsiveness), and feasibility (assessment time, expertise, and available languages).

To evaluate the clinimetric properties of the measurement instruments, we followed the COnsensus-based Standards for the selection of health status Measurement Instruments (COSMIN) [25].

4. Risk of bias assessment

To assess the risk of bias and the methodological quality of studies, an adapted version of the Appraisal of Cross-sectional Studies (AXIS) tool was used by the two reviewers (ST and YY) [26]. Based on a previous study, the scores ranged from 0 to 13 points for each paper, which were interpreted as follows: 11−13 points (low risk), 8−10 points (medium risk), 0−7 points (high risk) [27].

Results

1. Results of literature search

Figure 1 presents the literature screening process; 11 studies fulfilled the inclusion criteria [10–12, 28–35].

2. Risk of bias assessment

The risk of bias in the identified studies is presented in Table 1. The risk of bias was low for all studies assessed (with scores ranging from 11 to 13 points). The quality of the study by Janssens et al. [31] could not be assessed as detailed data could not be retrieved.

3. General information

Table 2 summarizes the characteristics of the measurement instruments used in the included studies. Sample sizes ranged from 3 to 49 patients. Of these identified studies, five studies used M-PAS (45%) [10,11,28,29,35], five studies used LPA (45%) [12, 30, 31, 33, 34], and one study used both M-PAS and LPA (13%) [32]. As for the study design, five studies (45%) were cross-sectional and interventional studies [28, 29, 31, 33, 34], while the rest were prospective longitudinal and non-interventional studies [10–12, 30, 32, 35].

4. Structure, clinimetric properties, and feasibility of the measurement instruments

Table 3 summarizes the structure, clinimetric properties, and feasibility of M-PAS and LPA.

4.1 Modified Parkinson Activity Scale (M-PAS)
Test description of M-PAS

M-PAS was developed by Nieuwboer et al. (2000) [10] and revised by Keus et al. (2009) [11]. It consists of three domains of basic functional mobility and 16 sub-items.

The quality of movement is scored on a 5-point ordinal scale (ranging from 0 to 4 points), with higher scores indicating greater independence and lower scores indicating worse performance difficulties.

Construction and scoring criteria of M-PAS

M-PAS consists of 16 sub-items arranged into three domains of basic functional mobility ((i) Chair Transfer, (ii) Gait Akinesia, and (iii) Bed Mobility).

(i) The Chair Transfer domain consists of the items of rising and sitting down with or without using the hands (item 1-A to 2-B). The assessor analyzes the participants' ability to rise with or without their hands. The items of rise with using the hands and sit down with using the hands are only to be scored if rising without using the hands is impossible.

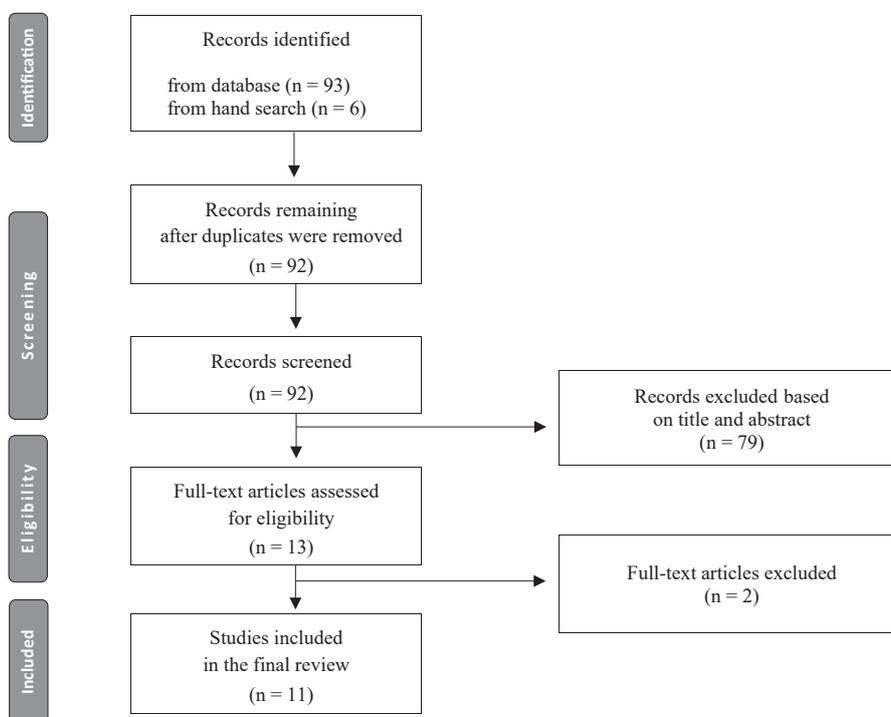(ii) The Gait Akinesia domain consists of the items of starting akinesia and turning 180° with or without

Figure 1. Results of screening process for systematic literature review.
The PRISMA flowchart shows the screening process. Altogether, 99 papers were identified, and 92 papers were screened after removing duplicates. Of these, 13 papers were identified as relevant after screening the abstracts and titles, and finally 11 articles fulfilled the inclusion criteria.

Table 1. Risk of bias assessment.

Author	Item													Score
(year)	1	2	3	4	5	6	7	8	9	10	11	12	13	
Nieuwboer (2000)	1	1	0	1	1	0	1	1	1	1	1	1	1	11
Nieuwboer (2001)	1	1	0	1	1	1	1	1	1	1	1	1	1	12
Keus (2009)	1	1	1	1	1	1	1	1	1	1	1	1	1	13
Shujaat (2014)	1	1	1	1	1	1	1	1	1	1	1	1	1	13
Pearson (2009)	1	1	0	1	1	1	1	1	1	1	1	1	1	12
Verheyden (2014)	1	1	0	1	1	1	1	1	1	1	1	1	1	12
Santos (2017)	1	1	0	1	1	1	1	1	1	1	1	1	1	12
Spagnuolo (2018)	1	1	1	1	1	1	1	1	1	1	1	0	1	12
Sankarapandiani (2019)	1	1	0	1	1	1	1	1	1	1	1	1	1	12
Taniguchi (2021)	1	1	0	1	1	1	1	1	1	1	1	1	1	12

Quality assessment performed using the AXIS appraisal tool [26] for cross-sectional studies.
The results indicate that 1 = Yes, and 0 = No/ not known.
The criteria were as followings:
1) Were the aims/objectives of the study clear?
2) Was the study design appropriate for the stated aim(s)?
3) Was the sample size justified, clearly defined, and taken from an appropriate population?
4) Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?
5) Were the outcome variables measured appropriate to the aims of the study?
6) Were the outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?
7) Is it clear what was used to determined statistical significance and/or precision estimates?
8) Were the methods (including statistical methods) sufficiently described to enable them to be repeated?
9) Were the basic data adequately described?
10) Were the results presented for all the analyses described and presented in the methods?
11) Were the authors' discussions and conclusions justified by the results?
12) Were the limitations of the study discussed?
13) Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the result?

an extra task (item 3 to 8), where participants are asked to rise from the chair and walk straight ahead for 3 m at their own pace, turn around at a turning point, and then return to the chair and sit down based on the timed up and go test. Scoring criteria include festination or freezing of gait; for more details, "normal, without apparent difficulties" (4 points), "hesitation or short festination lasting up to 2 seconds" (3 points), "unwanted arrest of movement with or without festination lasting 2 to 5 seconds" (2 points), "unwanted arrest of movement with or without festination lasting more than 5 seconds" (1 point), and "dependent on physical assistance to start walking after freezing" (0 point). A motor dual task (carrying a plastic cup with water; item 5 and 6) and a cognitive dual task (counting backwards; item 7 and 8) are given as evoked tasks for freezing of gait [11] in this domain.

(iii) The Bed Mobility domain consists of the items of lying down (item 9 and 12), rolling over (item 10a/10b, 13a/13b), and getting out of bed (item 11 and 14) with or without a cover. Scoring criteria include difficulty with adjusting the cover, difficulty with turning the trunk/pelvis, or difficulty with reaching an adequate end position.

Clinimetric properties and feasibility of M-PAS

The results of the clinimetric evaluation showed excellent inter-rater reliability (intraclass correlation coefficient [ICC] = 0.97; range 0.95−0.98) and high internal consistency for the Bed Mobility domain with/without covers (Cronbach's α = 0.79/0.89), and excellent test-retest reliability in the "on" medication cycle (ICC = 0.81) and "off" medication cycle (ICC =

Table 2. Summary of the included studies.

Source	Studied Population (age)	Disease severity	Instrument used	Outcomes measures	Floor/ceiling effect	Reliability	Validity	Responsiveness
Nieuwboer (2000)	29 PD (mean 64.1 yr)	HY II-III	"PAS"	Domains of chair transfer, gait akinesia, and bed mobility	NE	Adequate internal consistency (Cohen's kappa=0.85) Good to excellent inter-rater reliability (Kappa=0.86-0.98) "ON-OFF" variability (ICC=0.81 in ON, ICC=0.93 in OFF)	NE	NE
Nieuwboer (2001)	33 PD (mean 66.2 yr)	HY II-IV	"PAS"	Domains of chair transfer, gait akinesia, and bed mobility	NE	NE	NE	Significant mean effect sizes were shown as Baseline effect (β=1.61 [SE 0.64] ; p=0.02), Treatment effect (β=5.16 [SE0.60] ; p=0.0001). Information on the minimal detective changes is lacking
Keus (2009)	15 PD (median 68.4 yr)	HY II-IV	"M-PAS"	Domains of chair transfer, gait akinesia, and bed mobility	No ceiling effect was reported	Good inter-rater reliability with no differences between specialist and non-specialist in PD (p=0.28).	Good concurrent validity with UPDRS motor scores (Rs=.64) and with Global Functioning (Rs=.79)	smallest detectable difference=7.2 points
Shujaat (2014)	48 PD (mean 56 yr)	HY I-III	"M-PAS"	Domain of bed mobility	NE	NE	NE	Bed mobility on MPAS scales the effectiveness of Kayaking exercises (p<0.001) Information on the minimal detective changes is lacking
Pearson (2009)	49 PD (mean 75.8 yr)	HY I-IV	"LPA"	Domains of gait and bed mobility	NE	Adequate internal consistency (Cronbach's α=0.86) and inter-rater reliability (LOA total score=0.041).	Good concurrent validity with the UPDRS motor in both raters (Rs=−0.67 and −0.63; p<0.001).	NE
Verheyden (2014)	38 PD (mean 69 yr)	HY I-IV	"LPA"	Domains of bed mobility	NE	Excellent intrarater reliability (ICC =0.99), and interrater reliability (ICC=0.97)	Good to moderate construct validity with the UPDRS motor (Rs=0.63, p≤0.001), and the Hoehn and Yahr scale (Rs=0.54, p≤0.001).	NE

Table 2. Continued.

Source	Studied Population (age)	Disease severity	Instrument used	Outcomes measures	Floor/ ceiling effect	Reliability	Validity	Responsiveness
Spagnuolo (2018)	30 PD (mean 65.5 yr)	HY I-IV	"LPA"	Domains of gait and bed mobility	NE	NE	NE	Scores in the bed mobility of LPA to group therapy intervention showed moderate change (standardized response mean=0.7)
Janssens (2014)	3 PD (each aged 52, 54, and 70 yr)	HY I-III	"LPA"	Domains of bed mobility	NE	NE	NE	Pre-Post interventional changes in LPA were presented each of 3 PD patients, but the minimal detective changes were not calculated.
Santos (2017)	32 PD (mean 64.68 yr)	HY I-IV	Brazilian version "M-PAS" and "LPA"	Domains of chair transfer, gait akinesia, and bed mobility	LPA had a ceiling effect of 43% in mild patients	Excellent inter-rater reliability, 0.97 in M-PAS, 0.97 in LPA. Excellent test-retest reliability, 0.98 in M-PAS with high internal consistency (Cronbach's α=0.83), excellent test-retest reliability 0.98 with high internal consistency (Cronbach's α=0.94) in LPA.	Good to moderate construct validity with UPDRS motor (ρ=−0.65 in M-PAS, ρ= −0.54 in LPA)	NE
Sankarapandiani (2019)	15 PD; 7 PD (ranged50-60 yr) 6 PD (ranged 60-70 yr) 2 PD (ranged 70-75 yr)	HY I-V	"LPA"	Domains of bed mobility	NE	NE	NE	Scores in the bed mobility of LPA to group therapy intervention showed change (mean differences 2 points, standard deviation 0.669) and (mean 6.25 for pre-intervention, and mean 8.25 points for post-intervention; p<0.001)
Taniguchi (2021)	25 PD (median 71 yr)	HY II-V	Japanese version "M-PAS"	Domains of chair transfer, gait akinesia, and bed mobility	No floor and ceiling effects were reported	Good to excellent inter-rater reliability (Kappa=0.81-0.98)	Good to moderate concurrent validity with the MDS UPDRS Part II (Rs= −0.56, p<0.01), with Part III (Rs=−0.32, p<0.01)	NE

NE, Not Examined; HY, Hoehn & Yahr Stage; PD, Patients with Parkinson's Disease; M-PAS, Modified Parkinson Activity Scale; LPA, Lindop Parkinson's Assessment Scale; Rs, Spearman's rho; ρ, Pearson correlation coefficient; LOA, Limits Of Agreement; SE, Standard Errors.

Table 3. Summary of the clinimetric properties and feasibility of the M-PAS and LPA.

Instrument used	Domain(s) used	Grading	Required Equipment	Time (min)	Floor/ceiling effect	Feasibility	Strength	Weakness
M-PAS	chair transfer, gait akinesia, bed mobility	5-point ordinal scale (0–4)	chair, bed, bed cover	30	unknown/no ceiling effect reported	M-PAS has been available in English, Portuguese, and Japanese.	no ceiling effect, more detailed qualitative scoring options, more available languages, and agreement between experienced and inexperienced raters.	time-consuming to use in everyday clinical practice, require extra equipment such as a blanket
LPA	gait mobility, bed mobility	4-point ordinal scale (0–3)	chair, bed, stopwatch	10	unknown/ceiling effect can occur	Most items involve time recording. LPA is available in English.	shorter assessment time than M-PAS	less detailed qualitative scoring options than M-PAS

M-PAS, Modified Parkinson Activity Scale; LPA, Lindop Parkinson's Assessment Scale.

0.93) [10]. Good concurrent validity showed a correlation with UPDRS motor scores (Spearman's rank correlation coefficient [Rs] = 0.64), while no ceiling effects were found [11] and floor effects were not investigated. Although responsiveness has not been formally examined, Keus et al. calculated that the smallest detectable difference in M-PAS total score was 7.2 points [11]. Additionally, the items of the Bed Mobility domain in M-PAS were solely used by one interventional study [29]. Furthermore, M-PAS was recommended in the Physiotherapy Guideline for Parkinson's Disease due to its adequate clinimetric properties [4].

As for feasibility, the assessment time for M-PAS is approximately 30 minutes [4], and it requires a bed, blanket or duvet, and chair [11].

M-PAS can be used by both experts and non-experts in PD, with no significant differences in the mean scores of M-PAS ($p = 0.28$) [11]. M-PAS has been available and validated in English [11], Portuguese [36], and Japanese [35].

4.2 Lindop Parkinson's Disease Mobility Assessment (LPA)
Test description of LPA

LPA was developed by Pearson et al. (2009). It consists of two domains of basic functional mobility and 10 sub-items. The quality of movement is scored on a 4-point ordinal scale (ranging from 0 to 3 points), with higher scores indicating greater independence and lower scores indicating worse performance difficulties.

Construction and scoring criteria of LPA

LPA consists of 10 sub-items arranged into three domains with two domains of basic functional mobility ([a] Gait Mobility and [b] Bed Mobility).

(a) The Gait Mobility domain consists of sit to stand, timed unsupported stand, timed up & go, 180° turn to the right or left, and walking through a doorway (item 1 to 6). Scoring criteria of sit to stand (item 1) includes whether physical assistance is necessary or not, and numbers for physical assistance, if necessary. The analysis of the eight sub-items of two domains (item 2 to 5, item 7 to 10) considers its speed; for instance, the timed up and go test distinguishes between 10 to 20 s (3 points), 21 to 35 s (2 points), 36 to 60 s (1 point), and > 60 s (0 point). The item of walking through a doorway (item 6) is a dual task to evoke freezing of gait in this domain [37].

(b) The Bed Mobility domain consists of the items of sit to lie (item 7), turn to the left or right on the bed (item 8/9), and lie to sit on the bed (item 10).

Clinimetric properties and feasibility of LPA

Concurrent validity of the LPA total score with the UPDRS motor is shown for both raters (Rs = −0.67 and − 0.63, $p<0.001$) [12]; a high level of inter-rater reliability was found for the Bed Mobility domain

(agreement ranged from 82% to 100% in the Bland–Altman analysis) [30]. The items of the Bed Mobility domain in LPA were solely used by three interventional studies [30, 31, 34], and responsiveness has been demonstrated in patients with PD in interventional studies (standardized response mean = 0.7) [33]. However, one study reported that all patients already had a maximum or near-maximum score on the LPA Bed Mobility domain [31, 32], suggesting that it is difficult to detect interventional effects for patients with mild-stage PD. There was no evidence of a floor effect.

As for feasibility, the assessment time of LPA is approximately 10 min [4, 12], and it requires a bed, chair, and stopwatch. Although LPA is available in English [12], Portuguese [32], and Japanese [38], it is validated only in English and Portuguese [12, 32] (September 2022 at present).

Discussion

1. Characteristics of M-PAS and LPA
1.1 Similarities between M-PAS and LPA
The similarities of M-PAS and LPA included adequate reliability and validity, having domains for Gait Mobility based on the timed up and go test, and considering the evoked freezing of gait task (motor/cognitive dual tasks in M-PAS and walking through a doorway in LPA). A previous study suggested that freezing of gait, which is frequently reported in daily life, can disappear in the laboratory setting, resulting from patients shifting from an automatic control of gait toward a more goal-directed control [39]. Thus, it is conceivable that it is crucial to add a dual motor or cognitive task to evoke freezing of gait in evaluating a gait disorder in PD [18].

In the Bed Mobility domain, both M-PAS and LPA have the items of lying down, rolling over, and getting out of bed. Earlier work showed a lack of medication effect on spinal flexibility, which contributes to turning difficulty [40]; therefore, rehabilitation treatment has greater importance as a non-pharmaceutical treatment. Of the four interventional studies, the items of the Bed Mobility domain in M-PAS and LPA were used solely and no other objective assessment instrument for impaired bed mobility in PD was found. These may reflect that M-PAS and LPA are limited choices for quantifying impaired bed mobility in patients with PD, but more in-depth work may be needed to clarify this point.

1.2 Differences between M-PAS and LPA
Compared with LPA, M-PAS has one more detailed qualitative scoring option and six more sub-items (LPA with a 4-point ordinal scale and 10 sub-items, M-PAS with a 5-point ordinal scale and 16 sub-items), resulting in more time taken in M-PAS (LPA takes 10 min, M-PAS takes 30 min). This suggests that M-PAS is more detailed and that LPA is a simpler assessment instrument. In addition, while M-PAS had a lack of ceiling effect and excellent test-retest reliability in the "on" and "off" medication cycle, LPA showed the ceiling effect with no report on test-retest reliability in the medication cycle.

These may indicate that M-PAS is suitable for evaluating patients with mild stages of PD in the "on" and "off" phases.

2. Considerations for use of M-PAS and LPA in clinical practice
Given the similarities and differences described above, the suitability of M-PAS and LPA may differ depending on the clinical situation. M-PAS may have some specific advantages, including more detailed qualitative scoring options, lack of a ceiling effect, availability in more languages, usability by inexperienced raters, and high test-retest reliability in the "on" and "off" medication cycle. Conversely, M-PAS is time-consuming to apply in everyday clinical practice.

Therefore, LPA, with its shorter assessment time for less-detailed qualitative scoring options, may lead to lower burdens for both patients and raters in situations with strict time limitations. In particular, PD requires more time for evaluation than other diseases because of its complex pathogenesis [4]. In contrast, M-PAS is considered to be suitable when there is sufficient time for evaluation, to evaluate clinical differentiation between "on" and "off" phase measurements, for inexperienced raters in PD, and for patients with mild to moderate stages of PD in clinical practice.

A potential limitation of this study is that only a few studies were included in our results. Although this systematic review applied wider selection criteria, after removing duplicates a relatively small number of studies (eleven studies) were identified.

Further research is required to identify new resources.

Conclusion

This systematic review evaluated the clinimetric properties and feasibility of M-PAS and LPA and discussed their considerations for use in clinical practice. Eleven studies were included, and the risk of bias was low for all evaluated studies. Both M-PAS and LPA showed adequate reliability and validity. LPA with greater simplicity may be suitable in situations with strict time limitations, which may lead to lower burdens for both patients and raters. In contrast, M-PAS with more detailed qualitative scoring options may be suitable when there is sufficient time available for evaluating patients with mild to moderate stages of PD.

Further work is needed to include new resources.

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Supplementary Table 1. A sample search strategy on PubMed.

1) Keywords related to Parkinson's disease:
("Parkinson disease" [MeSH Terms] OR "parkinson*" [tw] OR Parkinsons)

2) Keywords related to instruments:
AND ("Modified Parkinson Activity Scale" OR M-PAS OR MPAS OR "Lindop Parkinson's Disease Mobility Assessment" OR LPA OR LPAS)

3) Keywords related to clinimetric properties:
AND ("floor effects" OR "floor effect" OR "ceiling effects" OR "ceiling effect" OR Valid* OR Valid OR Validity OR Validities OR Reliability OR Reliabilities OR Reliable OR responsiv* OR responsive OR responsiveness OR clinimetric OR clinimetrics OR clinimetric* OR Psychometry OR Psychometr*)

Search date: 21st August 2022