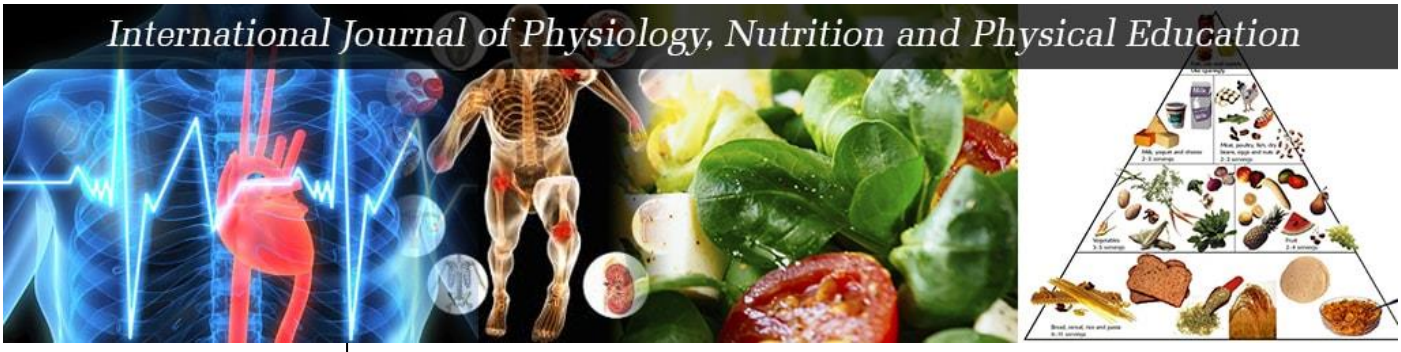

ISSN: 2456-0057
IJPNPE 2021; 6(2): 159-164

www.journalofsports.com
Received: 22-05-2021
Accepted: 24-06-2021

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Reliability & validity of mini-bestest scale in Parkinson's disease

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Abstract
Background: Parkinson's disease (PD) is a progressive neurodegenerative disorder of the aging population and affects mobility, locomotion, and balance. There are multiple tools available for assess balance parameters in PD. BBS, POMA, Mini-BES Test scale and PIGD are most important and recommended tools to assess balance parameters. Mini-BES Test scale assess all 4 components of the balance parameters but psychometric properties of this scale on parkinson's disease population was not found. Need of the study: There is no valid data available for reliability and con-current validity of Mini-BES Test scale on Indian population of PD. Methodology: 61 patient of PD stage 1 to 3 were included in this study. They were assessed by two scale (1=Mini-BES Test scale, 2 = Tinetti Performance Oriented Mobility Assessment scale (POMA)) for test-retest reliability, interrater reliability and con-current validity by 2 different raters. The data was analysed with ICC value and Cronbach's Alpha for reliability and spearmen's correlation for validity. Result: Mini-BES Test scale has excellent test-retest and interrater reliability and moderate to high correlation for con-current validity. Conclusion: Mini-BES Test scale is valid and reliable tool for assess balance in PD.

Keywords: test-retest reliability, interrater reliability, Parkinson's disease (PD), Indian population

Introduction
Parkinson's disease (PD) is a progressive neurodegenerative disorder of the aging population and affects mobility, locomotion, and balance [1, 2]. Patients with PD can have both motor and non-motor symptoms. The cardinal motor features include rest tremor, bradykinesia, rigidity, loss of postural reflexes, flexed posture, and freezing. Non-motor symptoms may precede the onset of motor symptoms by several years. These early pre-motor symptoms include hyposmia, constipation, rapid eye movement sleep behaviour disorder, depression, anxiety, and orthostatic hypotension. Patients may have other non-motor symptoms such as excessive daytime sleepiness, fatigue, pain, bladder dysfunction, erectile dysfunction, drooling of saliva, integumentary changes, apathy, and cognitive decline (reduced concentration and attention, slowed thinking, confusion, and in some cases dementia) [1, 2]. According to Global, regional, and national burden of Parkinson's disease, 1990–2016: a systematic analysis for the Global Burden of Disease Study published in the Lancet Neurology journal in 2016, the worldwide burden of PD has more than doubled over the past two decades from 2.5 million patients in 1990 to 6.1 million patients in 2016. India is home to nearly 0.58 million people living with PD as estimated in 2016. Young-onset PD is classified as onset between 21 and 50 years of age, and juvenile-onset PD affects individuals less than 21 years of age. Men are affected 1.2 to 1.5 times more frequently than women, but this varies across the globe [7]. Multiple tools are available for assessing different aspects of balance in PD. Those scales are DYPAGS (Dynamic Parkinson's Gait Scale), PIGD (Postural instability and Gait Difficulty), POMA (Tinetti-Performance Oriented Mobility Assessment), BBS (Berg Balance Scale), BESTest scale (Balance Evaluation Systems Test), Mini-BESTest scale (MINI-Balance Evaluation Systems Test), DGI (Dynamic Gait Index), Gait & Balance Scale, and Trunk Impairment Scale [4]. The most recommended scales for balance assessment are the BBS, Mini-BESTest, POMA, and PIGD. Other scales are less reliable and not much recommended for assessing different aspects of balance [4]. There are Multiple study available that assessed psychometric properties of Mini-BESTest scale but major limitation of those studies were improper methodology or

small sample size, although they failed to generalised the statement and provide a real value of reliability and validity. The need of the study: 1) There is no valid data available for reliability of the Mini-BESTest scale in the Indian population of Parkinson's disease. 2) There is no valid data available for concurrent validity of the Mini-BESTest scale compared with the POMA scale in the Indian population of Parkinson's disease. The aim of the study is to find out reliability and concurrent validity of Mini-BESTest scale in the Indian population of Parkinson's disease.

Methodology

A cross sectional observational study was conducted. institutional ethical committee of Shree B G Patel college of physiotherapy approved this study. The patients were recruited from Shree B. G. Patel College of Physiotherapy, Jiwandeep Hospital and Movement Disorders Clinic at The Vadodara Institute of Neurological Sciences.

Sample size was calculated according to success run theorem published by the Institute of Quality and Reliability. With confidence interval 95%, reliability 95% and 5% type-1 error, the calculated sample size is 60 [15].

Inclusion Criteria

1) Age: 40 to 80 years
2) Patients d with Parkinson's disease (PD) according to Gelb's criteria [16].
3) Hoehn and Yahr stages 1 to 3 [17].

Exclusion Criteria:

1) Other neurological conditions which affect balance like Parkinson Plus syndrome, diabetic neuropathy, stroke, cerebellar ataxia, etc.
2) A pre-morbid condition that alters balance.
3) Musculoskeletal conditions which affect balance.

We assessed 78 patients for this study. From that, 17 patients were excluded (8 patients had Parkinson Plus syndrome, 4 patients had sensory neuropathy, and 5 patients who had Hoehn and Yahr stage 4 PD couldn't walk independently). Thus, we included 61 patients for the analysis.

Outcome Measures

1) Mini-BESTest scale: Mini-BESTest scale includes 4 components to assess static and dynamic balance. Those 4 components are 1) anticipatory 2) reactive postural control 3) sensory orientation and 4) dynamic gait. The total scoring of this scale is 28. Interpretation of this scale is, lower the score higher the risk of fall. Scoring between 25-28 is a low risk of fall, 19 – 24 is a medium risk of fall, and < 19 is a higher risk of fall [18].
2) POMA scale: Tinetti Performance Oriented Mobility Assessment (POMA) scale contains 2 components to assess static and dynamic balance. Those 2 components are 1) balance tests 2) gait tests. The total scoring of this scale is 28. Interpretation of this scale is, lower the score higher the risk of fall. Scoring between 25-28 is a low risk of fall, 19-24 is a medium risk of fall, and <19 is a higher risk of fall [6].

Procedure

Inform consent was taken from the all included patient. All included patients were assessed with Mini-BESTest scale and POMA scale by rater A1 and rater A2 1st time for inter-rater reliability. After 48 hours, both scale is again taken 2nd time by rater A2 for test-retest reliability.

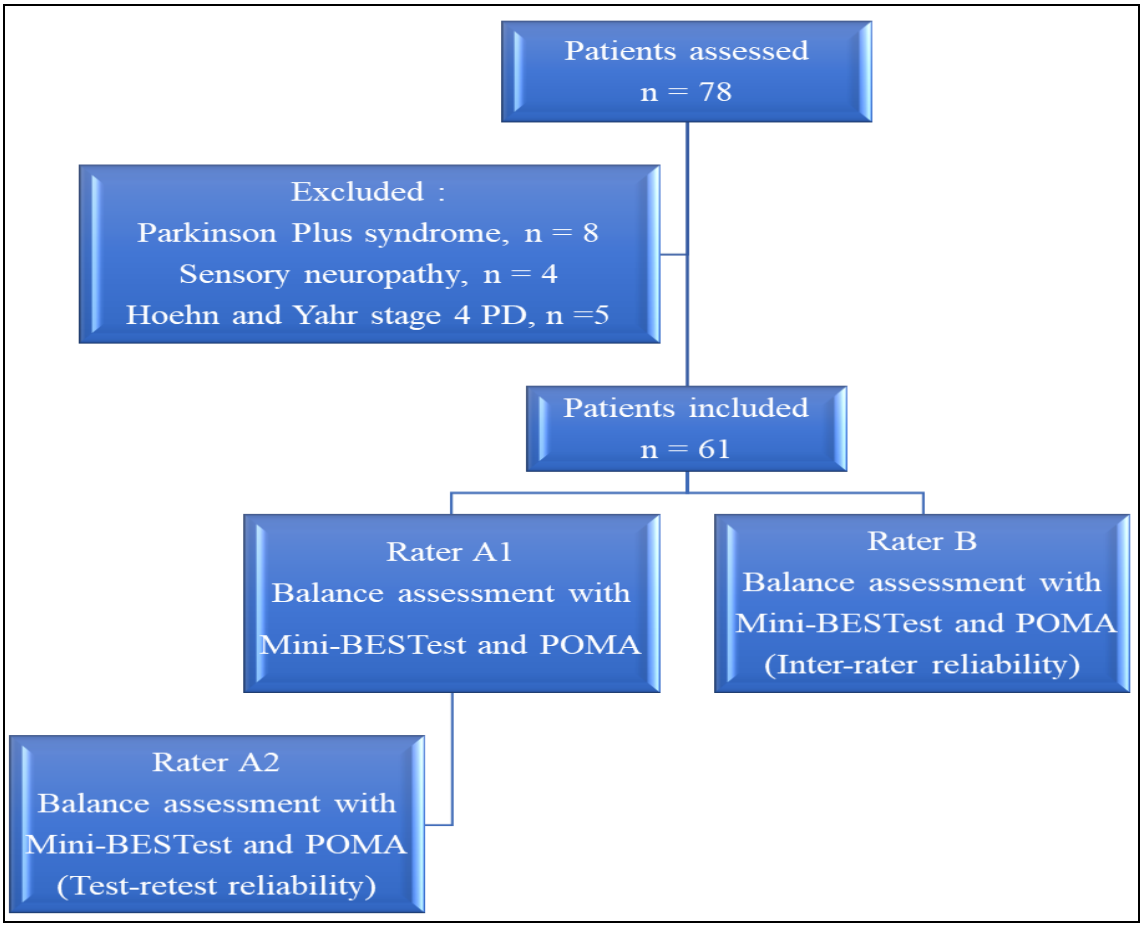

Fig 1: Flow-chart showing study protocol

Data Analysis

Data analysis was done in SPSS version 26. Reliability analysis was done with the Cronbach's alpha and the ICC value. Validity analysis was done with the Spearman's correlation.

Table 1: Demographics of study patients

Age (Mean ± SD)	**66.42 ± 8.24**
Gender	
Male (n)	36
Female (n)	25
Total (n)	61

Statistical analysis for reliability of the Mini-bestest scale:

Anticipatory

Table 2: Reliability of anticipatory component of the mini-bestest

Icc Value		**95% Confidence Interval**		**Cronbach's Alpha**	**P- Value**
Lower Bond		**Upper Bond**			
Test-Retest	0.916	0.864	0.949	0.956	0.000*
Inter-Rater	0.918	0.866	0.950	0.957	0.000*

*P < 0.05 shows significant correlation

Reactive Postural Control

Table 3: Reliability of reactive postural control component of the Mini-BES Test

Icc value		**95% Confidence Interval**		**Cronbach's alpha**	**P- Value**
		Lower bond	**Upper bond**		
Test-Retest	0.907	0.850	0.953	0.951	0.000*
Inter-Rater	0.920	0.871	0.951	0.959	0.000*

*P < 0.05 shows significant correlation

Sensory orientation

Table 4: Reliability of sensory orientation component of the Mini-BESTest

	Icc Value	**95% Confidence Interval**		**Cronbach's alpha**	**P- Value**
		Lower bond	**Upper bond**		
Test-retest	0.950	0.919	0.970	0.975	0.000*
Inter-rater	0.964	0.940	0.978	0.982	0.000*

*P < 0.05 shows significant correlation

Dynamic Balance

Table 5: Reliability of dynamic balance component of the Mini-BESTest

	Icc value	**95% confidence interval**		**Cronbach's Alpha**	**P- VALUE**
		Lower bond	**Upper bond**		
Test-retest	0.928	0.883	0.956	0.963	0.000*
Inter-rater	0.917	0.866	0.949	0.957	0.000*

*P<0.05 shows significant correlation

Total score of Mini-Bestest Scale

Table 6: Reliability of the Mini-BESTest]

	Icc value	**95% confidence interval**		**Cronbach's alpha**	**P- value**
		Lower bond	**Upper bond**		
Test-retest	0.968	0.947	0.981	0.984	0.000*
Inter-rater	0.970	0.951	0.982	0.985	0.000*

*P < 0.05 shows significant correlation

Statistical analysis for validity of mini-bestest scale compared with POMA scale
Correlation analysis was done with the Spearman's correlation coefficient.

Table 7: Concurrent validity of the Mini-BESTest compared to the POMA

	POMA	
Mini-BESTest	Spearman's rho	0.703*
	Significance (2-tailed)	0.000
	n	61

*Correlation is significant at the 0.01 level (2-tailed)

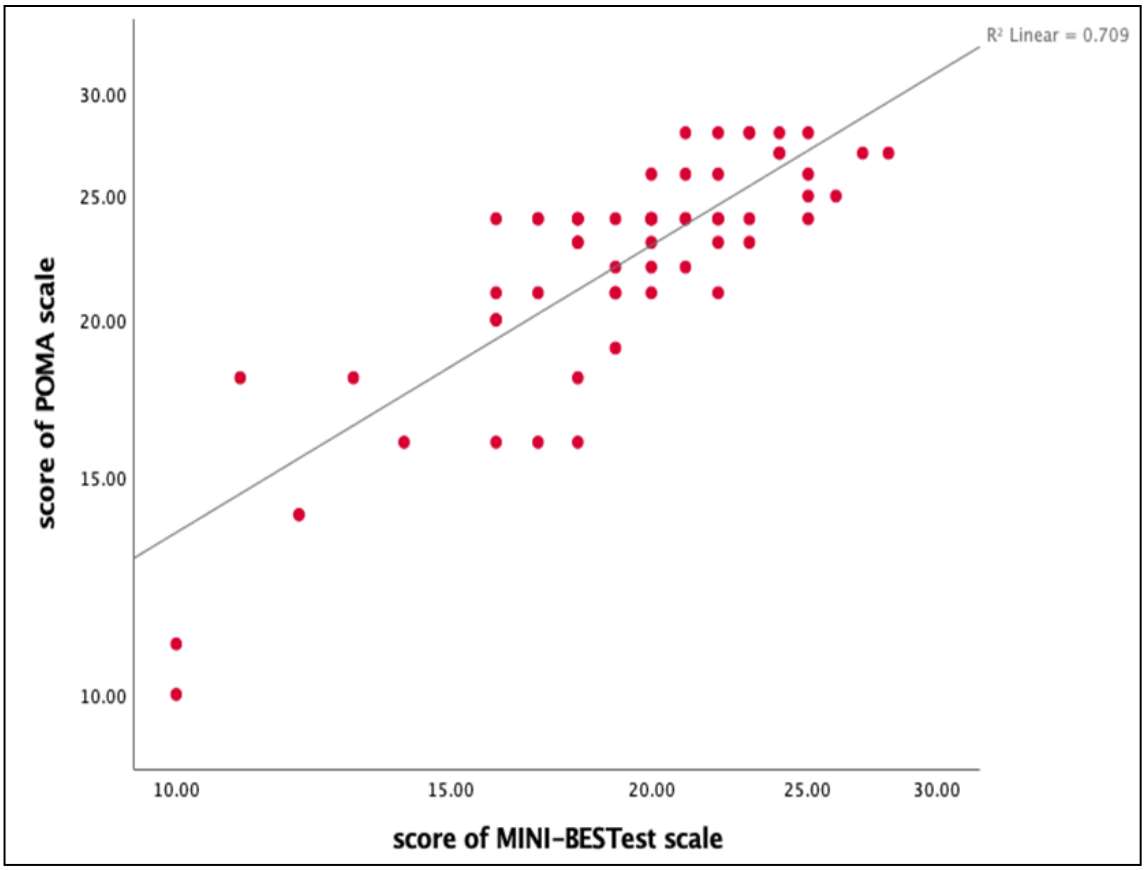

Fig 2: Scatter-plot showing correlation of the Mini-BESTest scores with the POMA scores

Result
In Mini-BESTest scale, Anticipatory test-retest and interrater ICC value is 0.916,0.918 respectively and its Cronbach's alpha value is 0.956 , 0.957 respectively. Reactive postural control test-retest and interrater ICC value is 0.907,0.920 and its Cronbach's alpha value is 0.951,0.959 respectively. Sensory test-retest and interrater ICC value is 0.950,0.964 respectively and its Cronbach's alpha value is 0.975,0.982 respectively. Dynamic test-retest and interrater ICC value is 0.928,0.917 respectively and its Cronbach's alpha value is 0.963,0.957 respectively. Overall total Mini-BESTest scale test-retest reliability and interrater reliability ICC value is 0.968,0.970 respectively and its Cronbach's alpha is 0.984,0.985 respectively. All components of the Mini-BESTest scale had > 0.9 ICC value. This shows that it has excellent test-retest and interrater reliability. For validity, the Mini-BESTest scale was compared with the POMA scale. The Spearman's correlation value was 0.703 (p = 0.000). This shows moderate to high correlation.

Discussion
This study was conducted to find out test-retest and inter-rater reliability and concurrent validity of the Mini-BESTest scale. The results of this study suggest excellent reliability and moderate to high concurrent validity of the MINI-BESTest scale in the Indian population of Parkinson's disease (PD). Balance is a complex motor skill that depends on the interaction between the sensory-motor processes and environmental and functional context.14 The most common scales used to check balance parameters are the Berg Balance Scale (BBS) and the POMA scale.
The BBS contains only two parameters of balance 1) anticipatory balance and 2) sensory components of balance. It does not contain other parameters of balance like postural reaction and dynamic gait.13 Schlenstedt C et al. conducted a study to find the reliability and the validity of the Mini-BESTest scale. They found that the MINI-BESTest scale has excellent test-retest reliability (0.99) and inter-rater reliability (0.98). They also found that both the BBS and the Mini-BESTest have minimum ceiling effects on the balance parameters.9 This study supports our study that shows similar result for reliability and validity.Patients of PD treated with levodopa can have on-off phenomenon which can affect test-retest reliability. To minimize variability in our study related to the on-off phenomenon, we noted down the time of levodopa intake and the assessment while evaluating the patient for the first time. The subsequent assessments by rater 1 and rater 2 were done at a similar time-difference from levodopa intake. However, the parameters of balance can be affected by degree of mobility which depends on several

factors other than just the time-difference between levodopa intake and assessment, such as levodopa dose, amount of levodopa absorbed, etc. For concurrent validity, we compared the Mini-BESTest scale with the POMA scale; we found that there is moderate to high correlation. This correlation value is can be variate from the original value because of high ceiling effects present in the POMA scale where the MINI-BESTest scale has minimum celling effects.11 The major benefit of the Mini-BESTest is that it is a comprehensive scale; different aspects of balance can be checked and measured. The scoring system (0, 1, and 2 format) is easy and not much time-consuming. It does not require special instruments. Thus, the Mini-BESTest is a suitable scale for balance in the Indian population. All the four components of the Mini-BESTest have high reliability and validity. Therefore, the scale can be used for individual components in a specified population.King LA et al. showed that the MINI-BESTest scale compares with Unified Parkinson's Disease Rating Scale (UPDRS) and Hoehn and Yahr scale is also found major predictor as a risk of fall and severity of disease in PD.13 Our study also found that those who have less severity (Hoehn and Yahr stage 1 and 2) also have a risk of fall, which can be identified through assessment with the MINI-BESTest scale. Thus, the MINI-BESTest scale is one of the important assessing tools for balance and coordination in patients with PD.

Conclusion

The positive finding of this study reaffirms that the Mini-BESTest scale has excellent test-retest reliability and moderate to high concurrent validity. It is a very good tool to assess balance parameters in Indian patients with Parkinson's disease.

Limitations of the Study

The study involved assessment of different balance parameters by raters A1, A2, and B through the Mini-BESTest scale. During first assessment with the rater A1, patients had difficulty in understanding some tasks of the scale. Thus, execution can be difficult. With training, this can be resolved. Patients can easily adapt the same task in the subsequent assessments by the raters A2 and B, which can change the results of test- retest and interrater reliability. Both the raters (rater A and rater B) were with the same experience. It can be checked with people of a different experience. The on-off phenomenon of Parkinson's disease was minimized by regulating the time of levodopa intake and assessment, but it can vary from to patient to patient.

Future Scope

The study can be done by controlling other variables which can affect the validity and reliability of the Mini-BESTest scale. A study can be done to find out con-current validity by comparing with a different tool that assesses balance and is the gold standard.

Clinical Implications

The Mini-BESTest scale is a valid and reliable tool which assesses 4 parameters of balance: 1) anticipatory, 2) postural reaction, 3) sensory balance, and 4) dynamic balance. The efficacy of this scale in the assessment of balance and coordination in patients with Parkinson's disease is also very good. The scale doesn't take much time, so it is a good tool to predict the severity of balance impairment and risk of falls, and helps in management accordingly.

Acknowledgements

Special thanks to Dr.Suvorit Subhas Bhowmik[M.D. (Medicine), D.M.(Neurology)], Dr. Rakesh Shah[M.D. (Medicine), D.M. (Neurology)], Dr. Anand Vaishnav [M.D. Stroke Neurology], Dr. Mihir Acharya [M.D. (Medicine), D.M. (Neurology)] ,Dr. Preet Thakor [MPT(Neuro)], Dr. Himanshu Patel [MD (Neurophysician)] for their support and guidance to conduct the study.

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