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Validity and Reliability of the 12-item Berg Balance Scale in an Italian Population with Parkinson's Disease: a cross sectional study

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Validity and Reliability of the 12-item Berg Balance Scale in an Italian Population with

Parkinson's Disease: a cross sectional study

Over the past generation, the number of individuals with Parkinson's disease (PD) globally has more than doubled to over 6 million (1). In 2016, the estimated regional incidence rate of PD in Italy was 0.28 new cases/1000 person-years, with a prevalence of 3.89/1000 persons (2) The disease incidence increases with older age and is more common among males than females(3,4). Impairment of postural control increases the risk of falls (5,6), and people with PD experience two to three times more falls than healthy older adults (7).

In the last few years, in Italy, the interest for evaluating both motor and non-motor symptoms of PD is increasing. Italian health professionals and researchers can now use different assessment tools such as the Parkinson's Disease Questionnaire 39 (8), the Non Motor Symptoms Scale (9), the Parkinson's Disease-Cognitive Rating Scale (10), Freezing of Gait Questionnaire (11) and the Geriatric Depression Scale (12).

Specifically, for balance evaluation different assessment tools are used. The Berg Balance Scale (BBS) (13) is widely used in different settings and the psychometric properties for PD population have been validated in different languages, such as Brazilian-Portuguese (14), Persian (15) and in the American English (16).

The BBS is a 14-items tool for assess balance ability (13). The items examine a subject's ability to maintain positions or movements of increasing difficulty by diminishing the base of support from sitting and standing to single-leg stance (13)(17).

In 2005, Franchignoni and colleagues administered the BBS on a sample of 57 individuals with PD (18). In 2012, a Rasch Analysis study verified internal validity and reliability of the BBS in individuals with different neurological diseases re-defining the questionnaire from 14 to 12 items. The study (19) supported clinometric properties of the 12-items BBS (BBS-12) as a measurement tool independent from the etiology of the neurologic disease causing the balance impairment.

Considering that in the study validating the BBS-12 there were no people with extrapyramidal diseases, the primary objective of the present investigation is to evaluate validity and reliability of the BBS-12 in a PD population.

Methods

To investigate the psychometric properties of the BBS-12, a cross-sectional study was set-up. A research group of the Sapienza University of Rome and Rehabilitation & Outcome Measures Assessment (ROMA) association conducted the study. The research group has dealt with the validation of different outcome measures in Italy (20–23). The institutional review board of the Sapienza University of Rome approved the study and guaranteed ethical standards and procedures.

The pre-established sample size was determined by analyzing others validation studies on PD population (sample range 38-53), thus a probability non-convenience sample of a minimum of 46 individuals was required. To be enrolled in the study, participants had to fit the following inclusion criteria: clients of the Department of Human Neurosciences of Sapienza University of Rome, diagnoses of PD according to the clinical diagnostic criteria of the Movement Disorder Society for PD (24), age $\geq$ 40 years, a Mini-Mental State Examination score $\geq$23 points.

Data measurements

The BBS-12 is a specific tool for evaluating balance. Item 2 and 3 of the BBS (Sitting unsupported and Standing unsupported, respectively) were deleted from the original version (19). The BBS-12 results, therefore, composed as follow: Transfers, From standing to sitting, From sitting to standing, Standing with eyes closed, Turning trunk (feet fixed), Standing with feet together, Reaching forward while standing, Retrieving object from floor, Tandem standing, Standing on 1 leg, Turning 360°, Placing alternate foot on stool. The total score of the BBS-12 ranged from 0 to 35. For more information on calibrations and rescoring pattern refers to La Porta and colleagues' study (19).

The Physical Activity Scale for the Elderly (PASE) (25) consists of 10 items that focus on

three domains of activity over a period of seven days: leisure (5 components), household (4

components), and work-related (1 component) activities. Participation in leisurely activities is

recorded by frequency (e.g., never, seldom, sometimes, and often) and duration (e.g., less than an

hour, 2–4 hours, or more than 4 hours); paid or unpaid work is recorded by total hours of work per

week; and housework, lawn work, home repair, outdoor gardening, and care for others are recorded

with yes or no answers (25,26). For the present study, the Italian version of the PASE (PASE-I)

(27) was used.

The Tinetti test is a performance-oriented assessment of mobility problems. It consists of the

nine components of initiation of gait, step height and length, step symmetry and continuity, path

deviation, trunk stability, walking stance, and turning while walking(28). Each component was

scored as 1 (normal) or 0 (abnormal).

Procedures and Data Analysis

First, the researchers (a neurologist, a physical therapist and an occupational therapist) assessed

participants according to the inclusion criteria. Recruitment strategies included the use of brochures

and the organization of face-to-face meeting within the Department for both inpatient and outpatient

care. Once explained the objectives of the study, an informed written consent was obtain from

people who agreed to participate. All participants were asked to complete a socio-demographic

questionnaire followed by the administration of the BBS-12, PASE-I and Tinetti scale; the data

collected regarded age, gender, education and employment status.

Internal consistency is a measure based on the correlations between different items on the same test.

Internal consistency was examined using Cronbach's Coefficient Alpha; as recommended by

Nunually (29) the significant coefficient was set ≥ 0.70.

The intraclass correlation coefficient (ICC) was calculated to assess reproducibility. To evaluate intra-observer reproducibility the same participant was evaluated twice by the same rater; to ensure that no clinical changes occurred, the second evaluation was scheduled within seven days after the first evaluation. To assess inter-observer reproducibility, two raters assessed participants at the same time. The two raters were blinded. Two-way random ICC for absolute agreement was adopted to evaluate reproducibility. ICC ranges from 0 (no agreement) to 1 (perfect agreement) and was interpreted as follows: 0.00–0.25 = little, if any, correlation; 0.26–0.49 = low correlation; 0.50–0.69 = moderate correlation; 0.70–0.89 = high correlation; and 0.90–1 = very high correlation (30). To evaluate concurrent validity, BBS-12 score was compared with PASE-I and Tinetti values. The three assessment tools were administered together and the Pearson Correlation Coefficient (PCC) was calculated. PCC can be interpreted as follow: 0 indicates no linear relationship; +1/-1 = perfect positive/negative linear relationship; between 0 and ±0.3 = weak relationship; between ±0.3 and ±0.7 = moderate relationship; between ±0.7 and ±1.0 = strong relationship (31). All statistical analyses were carried out using Statistical Package for Social Sciences (SPSS).

Results

Participants were recruited in the period ranging 1 March to 31 December 2018, through the Department of Human Neurosciences of Sapienza University of Rome. The BBS-12 were administered to 50 people, together with PASE-I and Tinetti. The demographic characteristics of the sample are summarized in Table 1.

INSERT Table 1: Demographic characteristics of the sample

The internal consistency showed an Alpha Coefficient of 0.886. Item-total correlation analysis revealed positive and statistically significant values (range 0.872-0.889), as reported in Table 2.

INSERT Table 2: Total-Item correlation analysis of the BBS-12

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The reliability study showed an ICC of 0.986 and 0.987 for intra-observer and inter-observer reproducibility, respectively. Results for each item are reported in Table 3.

INSERT Table 3: Results of reproducibility study for 50 people of the sample with PD

The person' correlation coefficient analysis showed good linear correlation with the Tinetti ($p<0.01$) and with the Sport ($p<0.01$) and Home ($p<0.01$) subscales of the PASE-I. Values are synthetized in Table 4.

INSERT Table 4: Results for the concurrent validity: Pearson's Correlation

Coefficient

Discussion

The study investigated the psychometric properties of the BBS-12 (19) in PD population. Internal consistency analysis revealed an Alpha Coefficient of 0.866 (0.872-0.889), slightly lower than the original study (0.972) (19). Internal Consistency measures whether several items that propose to measure the same general construct produce similar scores. Our finding demonstrated a good internal consistency of the scale.

The reliability study showed high significant value for both inter-observer (0.986) and intra-observer (0.987) reproducibility. Values of the BBS-12 indicate high stability over the time and between raters, as in the original version (19).

As expected, a strong relationship (0.817) of the BBS-12 with the Tinetti score was found ($p<0.01$). This because both measure balance abilities. On the contrary, this correlation was not found for the PASE-I. Despite results showed a correlation with Sport and Home sub-scales of the

PASE-I, the total score is probably influenced by a very poor correlation (0.021) with the Work sub-scale.

Despite these encouraging results, the present study has some limitations. In fact, the absence of similar studies that use the BBS-12 makes it difficult doing comparisons. A second limit is due to the small sample size that does not allow understanding differences between people with heterogeneous levels of impairment. It would be useful investigate how BBS-12 works in different stage of PD.

In conclusion, our finding demonstrates preliminary evidence on validity and reliability of the BBS-12 in PD population. Now Italian healthcare professionals can use it with more confidence.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (include name of committee + reference number) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Data availability: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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Tab. 1
Sample Characteristics of the BBS-12 (total 50)

Age mean (SD)	65.62	± 11.8
Gender	N	%
Female	12	(24)
Male	38	(76)
Education	N	%
Secondary School	10	(20)
High School	33	(66)
University	7	(14)
Employment	N	%
Office worker	19	(38)
Freelance professional	14	(28)
Housewife	6	(12)
Unemployed	11	(22)

BBS-12: Berg Balance Scale 12 Items

Tab. 2

Total-Item correlation analysis of the BBS-12

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's a if item deleted
Item1	24,20	17,551	0,788	0,783	0,866
Item2	23,22	17,971	0,589	0,643	0,877
Item3	23,22	18,583	0,593	0,557	0,877
Item4	25,14	18,531	0,625	0,663	0,875
Item5	24,46	18,988	0,547	0,671	0,879
Item6	24,66	17,535	0,602	0,503	0,876
Item7	25,12	18,271	0,701	0,759	0,872
Item8	23,40	15,755	0,704	0,763	0,873
Item9	25,52	18,826	0,516	0,712	0,881
Item10	25,48	19,928	0,315	0,533	0,889
Item11	25,16	18,015	0,589	0,510	0,877
Item12	24,78	18,175	0,576	0,423	0,877

BBS-12: Berg Balance Scale 12 Items

Tab. 3

Results of reliability study for 50 people of the sample with PD

BBS12	Intra-Rater Reliability			Inter-Rater Reliability		
Item	Rater 1 (SD)	Rater 2 (SD)	ICC (lower-upper bund)	Rater 1 (SD)	Rater 2 (SD)	ICC (lower-upper bund)
1	2.56 (0.54)	2.52 (0.54)	0.966 (0.938-0.980)	2.56 (0.54)	2.56 (0.50)	0.961 (0.931-0.978)
2	3.54 (0.61)	3.52 (0.61)	0.987 (0.976-0.992)	3.54 (0.61)	3.52 (0.54)	0.918 (0.856-0.954)
3	3.54 (0.50)	3.54 (0.50)	1.00 (1.00-1.00)	3.54 (0.50)	3.52 (0.50)	0.936 (0.888-0.964)
4	1.62 (0.49)	1.64 (0.48)	0.979 (0.962-0.988)	1.62 (0.49)	1.64 (0.48)	0.979 (0.962-0.988)
5	2.30 (0.46)	2.28 (0.45)	0.976 (0.957-0.986)	2.30 (0.46)	2.32 (0.47)	0.977 (0.959-0.987)
6	2.10 (0.68)	2.14 (0.67)	0.978 (0.961-0.987)	2.10 (0.68)	2.18 (0.75)	0.867 (0.766-0.925)
7	1.64 (0.48)	1.64 (0.48)	1.00 (1.00-1.00)	1.64 (0.48)	1.64 (0.48)	0.955 (0.920-0.974)
8	3.36 (0.87)	3.34 (0.89)	0.994 (0.989-0.996)	3.36 (0.87)	3.34 (0.89)	0.980 (0.965-0.989)
9	1.24 (0.52)	1.22 (0.54)	0.982 (0.968-0.990)	1.24 (0.52)	1.28 (0.50)	0.916 (0.851-0.952)
10	1.28 (0.45)	1.30 (0.54)	0.887 (0.801-0.936)	1.28 (0.45)	1.30 (0.50)	0.876 (0.782-0.930)
11	1.60 (0.61)	1.60 (0.67)	0.857 (0.748-0.919)	1.60 (0.61)	1.54 (0.61)	0.745 (0.550-0.855)
12	1.98 (0.59)	2.40 (0.90)	0.785 (0.621-0.878)	1.98 (0.59)	1.94 (0.43)	0.700 (0.471-0.830)
Tot	26.76 (4.63)	27.14 (5.14)	0.986 (0.976-0.992)	26.76 (4.63)	27.12 (5.11)	0.987 (0.978-0.993)

BBS12: Berg Balance Scale 12 items; ICC: Intraclass Correlation Coefficient;

Tab. 4
Results for the concurrent validity: Pearson's Correlation Coefficient

	BBS12	Tinetti	PASE-I TOT	PASE-I SPORT	PASE-I HOME	PASE-I WORK
BBS12	1	0.817**	0.273	0.967**	0.922**	0.021
Tinetti		1	0.266	0.796**	0.755 **	0.129
PASE-I TOT			1	0.285*	0.213	0.382*
PASE-I SPORT				1	0.884*	0.100
PASE-I HOME					1	0.005
PASE-I WORK						1

BBS12: Berg Balance Scale 12-items; Tinetti: ; PASE-I: Italian version of the Physical Activity Scale for Elderly ; **$p<0.01$; *$p<0.05$