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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.

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3 Considering that in the study validating the BBS-12 there were no people with
4 extrapyramidal diseases, the primary objective of the present investigation is to evaluate validity
5 and reliability of the BBS-12 in a PD population.
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10 11 12 **Methods**

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14 To investigate the psychometric properties of the BBS-12, a cross-sectional study was set-
15 up. A research group of the Sapienza University of Rome and Rehabilitation & Outcome Measures
16 Assessment (ROMA) association conducted the study. The research group has dealt with the
17 validation of different outcome measures in Italy (20–23). The institutional review board of the
18 Sapienza University of Rome approved the study and **guaranteed** ethical standards and procedures.
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26 The pre-established sample size was determined by analyzing others validation studies on
27 PD population (sample range 38-53), thus a probability non-convenience sample of a minimum of
28 46 individuals was required. To be enrolled in the study, participants had to fit the following
29 inclusion criteria: clients of the Department of Human Neurosciences of Sapienza University of
30 Rome, diagnoses of PD according to the clinical diagnostic criteria of the Movement Disorder
31 Society for PD (24), age ≥ 40 years, a Mini-Mental State Examination score ≥ 23 points.
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42 **Data measurements**

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44 The BBS-12 is a specific tool for evaluating balance. Item 2 and 3 of the BBS (Sitting
45 unsupported and Standing unsupported, respectively) were deleted from the original version (19).
46
47 The BBS-12 results, therefore, composed as follow: Transfers, From standing to sitting, From
48 sitting to standing, Standing with eyes closed, Turning trunk (feet fixed), Standing with feet
49 together, Reaching forward while standing, Retrieving object from floor, Tandem standing,
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51 Standing on 1 leg, Turning 360°, Placing alternate foot on stool. The total score of the BBS-12
52 ranged from 0 to 35. For more information on calibrations and rescoring pattern refers to La Porta
53 and colleagues' study (19).
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3 The Physical Activity Scale for the Elderly (PASE) (25) consists of 10 items that focus on
4 three domains of activity over a period of seven days: leisure (5 components), household (4
5 components), and work-related (1 component) activities. Participation in leisurely activities is
6 recorded by frequency (e.g., never, seldom, sometimes, and often) and duration (e.g., less than an
7 hour, 2–4 hours, or more than 4 hours); paid or unpaid work is recorded by total hours of work per
8 week; and housework, lawn work, home repair, outdoor gardening, and care for others are recorded
9 with yes or no answers (25,26). For the present study, the Italian version of the PASE (PASE-I)
10 (27) was used.

11
12 The Tinetti test is a performance-oriented assessment of mobility problems. It consists of the
13 nine components of initiation of gait, step height and length, step symmetry and continuity, path
14 deviation, trunk stability, walking stance, and turning while walking(28). Each component was
15 scored as 1 (normal) or 0 (abnormal).

32 **Procedures and Data Analysis**

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34 First, the researchers (a neurologist, a physical therapist and an occupational therapist) assessed
35 participants according to the inclusion criteria. Recruitment strategies included the use of brochures
36 and the organization of face-to-face meeting within the Department for both inpatient and outpatient
37 care. Once explained the objectives of the study, an informed written consent was obtain from
38 people who agreed to participate. All participants were asked to complete a socio-demographic
39 questionnaire followed by the administration of the BBS-12, PASE-I and Tinetti scale; the data
40 collected regarded age, gender, education and employment status.

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42 Internal consistency is a measure based on the correlations between different items on the same test.
43 Internal consistency was examined using Cronbach's Coefficient Alpha; as recommended by
44 Nunually (29) the significant coefficient was set ≥ 0.70 .

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3 The intraclass correlation coefficient (ICC) was calculated to assess reproducibility. To evaluate
4 intra-observer reproducibility the same participant was evaluated twice by the same rater; to ensure
5 that no clinical changes occurred, the second evaluation was scheduled within seven days after the
6 first evaluation. To assess inter-observer reproducibility, two raters assessed participants at the
7 same time. The two raters were blinded. Two-way random ICC for absolute agreement was
8 adopted to evaluate reproducibility. ICC ranges from 0 (no agreement) to 1 (perfect agreement) and
9 was interpreted as follows: 0.00–0.25 = little, if any, correlation; 0.26–0.49 = low correlation; 0.50–
10 0.69 = moderate correlation; 0.70–0.89 = high correlation; and 0.90–1 = very high correlation (30).
11 To evaluate concurrent validity, BBS-12 score was compared with PASE-I and Tinetti values. The
12 three assessment tools were administered together and the Pearson Correlation Coefficient (PCC)
13 was calculated. PCC can be interpreted as follow: 0 indicates no linear relationship; +1/-1 = perfect
14 positive/negative linear relationship; between 0 and ± 0.3 = weak relationship; between ± 0.3 and
15 ± 0.7 = moderate relationship; between ± 0.7 and ± 1.0 = strong relationship (31). All statistical
16 analyses were carried out using Statistical Package for Social Sciences (SPSS).
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38 Results

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

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53 The internal consistency showed an Alpha Coefficient of 0.886. Item-total correlation
54 analysis revealed positive and statistically significant values (range 0.872-0.889), as reported in
55 Table 2.
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INSERT Table 2: Total-Item correlation analysis of the BBS-12

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5 The reliability study showed an ICC of 0.986 and 0.987 for **intra-observer and inter-observer**
6 **reproducibility**, respectively. Results for each item are reported in Table 3.
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12 INSERT Table 3: Results of reproducibility study for 50 people of the sample with PD
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17 The person' correlation coefficient analysis showed good linear correlation with the Tinetti
18 (p<0.01) and with the Sport (p<0.01) and Home (p<0.01) subscales of the PASE-I. Values are
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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

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3 PASE-I, the total score is probably influenced by a very poor correlation (0.021) with the Work
4 sub-scale.
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8 Despite these encouraging results, the present study has some limitations. In fact, the
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10 absence of similar studies that use the BBS-12 makes it difficult doing comparisons. A second limit
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12 is due to the small sample size that does not allow understanding differences between people with
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14 heterogeneous levels of impairment. It would be useful investigate how BBS-12 works in different
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16 stage of PD.
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20 In conclusion, our finding demonstrates preliminary evidence on validity and reliability of
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22 the BBS-12 in PD population. Now Italian healthcare professionals can use it with more
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24 confidence.
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28 **Ethical approval:** All procedures performed in studies involving human participants were
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30 in accordance with the ethical standards of the institutional and/or national research committee
31
32 (include name of committee + reference number) and with the 1964 Helsinki declaration and its
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34 later amendments or comparable ethical standards.
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38 **Informed consent:** Informed consent was obtained from all individual participants included
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40 in the study.
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43 **Data availability:** The datasets generated during and/or analysed during the current study
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45 are available from the corresponding author on reasonable request.
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1. Ray Dorsey E, Elbaz A, Nichols E, Abd-Allah F, Abdelalim A, Adsuar JC, et al. Global, regional, and national burden of Parkinson's disease, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Neurol.* 2018;
2. Valent F, Devigili G, Rinaldo S, Del Zotto S, Tullio A, Eleopra R. The epidemiology of Parkinson's disease in the Italian region Friuli Venezia Giulia: a population-based study with administrative data. *Neurol Sci.* 2018;
3. Baldacci F, Policardo L, Rossi S, Ulivelli M, Ramat S, Grassi E, et al. Reliability of administrative data for the identification of Parkinson's disease cohorts. *Neurol Sci.* 2015;
4. Pringsheim T, Jette N, Frolkis A, Steeves TD. The prevalence of Parkinson's disease: a systematic review and meta-analysis. *Mov Disord.* 2014;
5. Carpenter MG, Allum JHJ, Honegger F, Adkin AL, Bloem BR. Postural abnormalities to multidirectional stance perturbations in Parkinson's disease. *J Neurol Neurosurg Psychiatry.* 2004;
6. Kerr GK, Worringham CJ, Cole MH, Lacherez PF, Wood JM, Silburn PA. Predictors of future falls in Parkinson disease. *Neurology.* 2010;
7. Pickering RM, Grimbergen YAM, Rigney U, Ashburn A, Mazibrada G, Wood B, et al. A meta-analysis of six prospective studies of falling in Parkinson's disease. *Mov Disord.* 2007;
8. Galeoto G, Colalelli F, Massai P, Berardi A, Tofani M, Pierantozzi M, et al. Quality of life in Parkinson's disease: Italian validation of the Parkinson's Disease Questionnaire (PDQ-39-IT). *Neurol Sci.* 2018;39(11):1903–9.
9. Cova I, Di Battista ME, Vanacore N, Papi CP, Alampi G, Rubino A, et al. Validation of the Italian version of the Non Motor Symptoms Scale for Parkinson's disease. *Park Relat Disord.* 2017;
10. Santangelo G, Barone P, Abbruzzese G, Ferini-Strambi L, Antonini A. Validation of the Italian version of Parkinson's Disease-Cognitive Rating Scale (PD-CRS). *Neurol Sci.* 2014;
11. Tambasco N, Simoni S, Eusebi P, Ripandelli F, Brahimi E, Sacchini E, et al. The validation

- 1
2
3 of an Italian version of the Freezing of Gait Questionnaire. *Neurol Sci.* 2015;
4
5
6 12. Massai P, Colalelli F, Sansoni J, Valente D, Tofani M, Fabbrini G, et al. Reliability and
7
8 Validity of the Geriatric Depression Scale in Italian Subjects with Parkinson's Disease.
9
10 *Parkinsons Dis.* 2018;
11
12 13. Berg KO, Wood-Dauphinee SL, Williams JI, Maki B. Measuring balance in the elderly:
13
14 Validation of an instrument. In: *Canadian Journal of Public Health.* 1992.
15
16
17 14. Scalzo PL, Nova IC, Perracini MR, Sacramento DRC, Cardoso F, Ferraz HB, et al.
18
19 Validation of the Brazilian version of the berg balance scale for patients with Parkinson's
20
21 disease. *Arq Neuropsiquiatr.* 2009;
22
23
24 15. Babaei-Ghazani A, Mohammadi H, Shahidi GA, Habibi SAH, Forogh B, Ahadi T, et al.
25
26 Reliability and validity of the Persian translation of Berg Balance Scale in Parkinson disease.
27
28 *Aging Clin Exp Res.* 2017;
29
30
31 16. Qutubuddin AA, Pegg PO, Cifu DX, Brown R, McNamee S, Carne W. Validating the Berg
32
33 Balance Scale for patients with Parkinson's disease: A key to rehabilitation evaluation. *Arch*
34
35 *Phys Med Rehabil.* 2005;
36
37
38 17. Ottonello M, Ferriero G, Benevolo E, Sessarego P, Dughi D. Psychometric evaluation of the
39
40 Italian version of the Berg Balance Scale in rehabilitation inpatients. *Eura Medicophys.*
41
42 2003;
43
44
45 18. Franchignoni F, Velozo CA, Qutubuddin AA, Cifu DX, Carne W. Use of the Berg Balance
46
47 Scale in rehabilitation evaluation of patients with Parkinson's disease [2] (multiple letters).
48
49 *Archives of Physical Medicine and Rehabilitation.* 2005.
50
51
52 19. La Porta F, Caselli S, Susassi S, Cavallini P, Tennant A, Franceschini M. Is the berg balance
53
54 scale an internally valid and reliable measure of balance across different etiologies in
55
56 neurorehabilitation? A revisited rasch analysis study. *Arch Phys Med Rehabil.* 2012;
57
58
59 20. Galeoto G, Colucci M, Guarino D, Esposito G, Cosma E, De Santis R, et al. Exploring
60
Validity, Reliability, and Factor Analysis of the Quebec User Evaluation of Satisfaction with

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Assistive Technology in an Italian Population: A Cross-Sectional Study. *Occup Ther Heal Care*. 2018 Dec;1–13.

21. Dattoli S, Colucci M, Soave MG, De Santis R, Segaletti L, Corsi C, et al. Evaluation of pelvis postural systems in spinal cord injury patients: Outcome research. *Journal of Spinal Cord Medicine*. 2018;
22. Savona A, Ferralis L, Saffioti M, Tofani M, Nobilia M, Culicchia G, et al. Evaluation of intra- and inter-rater reliability and concurrent validity of the Italian version of the Jebsen–Taylor Hand Function Test in adults with rheumatoid arthritis. *Hand Ther*. 2019;
23. Berardi A, Biondillo A, Márquez MA, De Santis R, Fabbrini G, Tofani M, et al. Validation of the short version of the Van Lieshout Test in an Italian population with cervical spinal cord injuries: a cross-sectional study. *Spinal Cord*. 2018;
24. Litvan I, Bhatia KP, Burn DJ, Goetz CG, Lang AE, McKeith I, et al. Movement disorders society scientific issues committee report: SIC task force appraisal of clinical diagnostic criteria for Parkinsonian disorders. *Mov Disord*. 2003;
25. Washburn RA, Smith KW, Jette AM, Janney CA. The physical activity scale for the elderly (PASE): Development and evaluation. *J Clin Epidemiol*. 1993;
26. Washburn RA, McAuley E, Katula J, Mihalko SL, Boileau RA. The Physical Activity Scale for the Elderly (PASE): Evidence for validity. *J Clin Epidemiol*. 1999;
27. Covotta A, Gagliardi M, Berardi A, Maggi G, Pierelli F, Mollica R, et al. Physical activity scale for the elderly: Translation, cultural adaptation, and validation of the Italian version. *Curr Gerontol Geriatr Res*. 2018;
28. Tinetti ME. Performance-oriented assessment of mobility problems in elderly patients. *J Am Geriatr Soc*. 1986;
29. Nunnally JC. *Psychometric theory*. Psychometric theory. 1979.
30. Hallgren KA. Computing Inter-Rater Reliability for Observational Data: An Overview and Tutorial. *Tutor Quant Methods Psychol*. 2012;

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3 31. Ratner B. The correlation coefficient: Its values range between +1/-1, or do they? J
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5 Targeting, Meas Anal Mark. 2009;
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6 Tab. 1
7 Sample Characteristics of the BBS-12 (total 50)

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9 Age mean (SD) 65.62 ± 11.8

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11 Gender N %

12 Female 12 (24)

13 Male 38 (76)

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15 Education N %

16 Secondary School 10 (20)

17 High School 33 (66)

18 University 7 (14)

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21 Employment N %

22 Office worker 19 (38)

23 Freelance professional 14 (28)

24 Housewife 6 (12)

25 Unemployed 11 (22)

26 BBS-12: Berg Balance Scale 12 Items

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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 Item	Intra-Rater Reliability			Inter-Rater Reliability		
	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;

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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

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