



# Reliability and validity of Turkish version of pediatric balance scale

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## Abstract

Assessment tool is a key point to evaluate balance disturbances in children. The aim of this study was to analyze reliability and validity of Turkish version of pediatric balance scale. The present study included 34 children (13 girls; 21 boys) with balance impairments. The scale consists of 14 items. Eight observers assessed the video records of the participants for interrater agreement. One observer evaluated the records twice in 2 weeks for intrarater agreement. Intraclass correlation coefficient was used for the interobserver and intraobserver agreement. The Functional Reach Test was used to calculate concurrent validity. Mean age of the sample was  $11.68 \pm 3.53$  years. The Turkish version of the scale was found to be reliable, perfectly (intraclass correlation coefficient for interobserver agreement = 0.915). Intraobserver agreement was also reliable, perfectly (ICC = 0.927). The strong correlation between pediatric balance scale and functional reach test was found ( $r = 0.692$ ;  $p < 0.001$ ). The Turkish version of the scale is a valid and reliable tool to evaluate children with balance impairments. Moreover, it is easy to use for health providers working with disabled children.

**Keywords** Children · Balance · Assessment · Reliability and validity

## Abbreviations

<i>BBS</i>	Berg Balance Scale	<i>ICC</i>	Intraclass correlation coefficient
<i>CI</i>	Confidence interval	<i>N</i>	Numbers
<i>FRT</i>	Functional Reach Test	<i>O</i>	Observer
<i>GMFCS</i>	Gross Motor Function Classification System	<i>PBS</i>	Pediatric Balance Scale
		<i>SD</i>	Standard deviations

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## Background

Disability is an umbrella term which includes impairments, activity limitations, and participation restrictions. Balance impairment is a very common condition leading to a disability. Balance and coordination problems are caused by several pathologies affecting central and peripheral nervous systems. In some cases, if the problem is not associated with muscle weakness, there should be a pathology in the central nervous system, including cortex, basal ganglia, diencephalon, cerebellum and brainstem, vestibular system and/or peripheral nerves. Deficiency in the balance control mechanisms significantly affects the rhythmic and coordinated motor activity. Especially children with motor delay may complain of muscle weakness or feeling of imbalance on the onset. Thus, balance evaluation should be performed in the early stage of the illness. Symptoms undetected soon can increase the disability of the child and lead to social participation restrictions. The related literature shows that the

prevalence of the vertigo or balance impairment reported as ranged between 0.40% and 0.45% [1–4]. However, the rate among preschool and school children is ranged between 8 and 18% [5, 6]. In another study, conducting with 3.3 million children showed that the rate of balance impairments among the children receiving treatment reported as 5.3% [7].

Evaluation is important to clarify the balance impairments. In the literature, there are some tests [8] as Pediatric Evaluation of Disability Inventory [9], Gross Motor Functional Measurement [10], Pediatric Reach Test [11], Functional Reach Test (FRT), Bruininks and Oseretsky Test for Motor Proficiency [12], and Peabody Developmental Motor Scale [13], have been defined to evaluate balance impairments in children. Pediatric Balance Scale (PBS) is one of the most common scales and it is also easy to use. There is no need for special equipment for the test. It is completed within less than 20 min. It was developed by modifying the Berg Balance Scale (BBS) to evaluate balance level in pediatric cases [14]. In the PBS scale, the ranking of the items has been arranged according to the BBS as sorting from easy to difficult. The directions have been made more simplified. Time parameters for the items regarding the continuation of static posture were decreased for children. Time parameters in the items regarding standing unsupported, sitting unsupported, and standing with feet together was decreased to 30 s in children. Moreover, the dimensions of the materials such as the bench used in the test were also adapted for children [14]. That's why, the PBS highly valid and reliable scale. It has been used widely. However, the Turkish version of the scale has been not studied in countries speaking Turkish, yet. The pragmatic aim of the study was to translate the PBS from English to Turkish and to show reliability and validity of the Turkish version of the scale in children with balance impairments.

## Methods

The present study was performed in a special education center for disabled children in Trabzon, Turkey between May 2018 and March 2019. Thirty-four children (13 girls, 21 boys) suffering from balance impairments older than 4 years were included. Their parents gave permission to participation in the study and signed the declaration documents. Socio-demographics of the participants (gender, body weight, and height) were recorded. Gross motor function levels of the children were examined using the Gross Motor Function Classification System (GMFCS). Functional Reach Test (FRT) was used to evaluate balance level of the children and was compared with PBS. Inclusion criteria were as follows: be able to follow verbal and visual instructions, standing up independently, and having a balance impairment. The children who had underwent any surgical operations in the

past 6 months or having severe cognitive impairment were excluded from this study. The study was approved by the Scientific Research Ethics Committee of Karadeniz Technical University, Faculty of Medicine (Date: May 7, 2018; Protocol no: 2018/88).

## Study design/procedure

All the measurements were performed in a pediatric rehabilitation room. To avoid mistakes, each subject was evaluated by the same physiotherapist in the same room. Video record was taken for each item for each children. Each task was demonstrated, and instructions were given as written. Children received practice trial on each item. When the child was unable to complete the task based on their ability to understand the directions, a second practice trial was given. Verbal and visual directions were clarified through the use of physical prompts. The child's performance was scored based upon the lowest criteria, which described the child's best performance. Several items required the child to maintain a given position for a specific time. Progressively, more points were deducted when time or distance requirements were not met; when the child's performance warrants supervision; or when the child touched an external support or received the assistance from the examiner. The children should understand that they had to maintain their balance while attempting the tasks. The choice, of which leg stand on or how far to reach, was left to the child.[14]. The data obtained recorded in a file and saved in the computer. Followed by, eight observers who were experienced in pediatric neuro-rehabilitation (mean working duration:  $9.6 \pm 4.17$  years) evaluated the video records belonging to the children, separately.

## Instrument

### Pediatric balance scale (PBS)

It is a comprehensive and effective scale evaluating the balance in the following three dimensions: static balance, anticipatory balance, and functional movement transitions. The scale comprises 14 items including sitting balance, standing balance, sitting to standing/standing to sitting, transfers, stepping, reaching forward with outstretched arm, reaching the floor, turning, and placing foot on stool items. Each item ranked from 0 to 4. 0 shows inability to perform the instruction, while 4 shows the ability to perform without any difficulty. Maximum total score is 56 [14]. The PBS was designed to require minimal use of specialized equipment. These are: adjustable height bench, chair with back support and arm rests, stopwatch, masking tape, a step stool, chalkboard eraser, ruler, a small level, 2 child size footprint, blindfold, a brightly colored object, and foot strips.

## Translation process of pediatric balance scale

The PBS was originally written in English. Turkish translation of the PBS has been made in accordance with the standard protocol of the World Health Organization [15]. Turkish translation was made by three Turkish native speakers. Back translation from Turkish to English was also made by English native speakers. Followed by, the team came together for agreement on the final version. Relevant corrections and changes have been made to adopt and modify the original scale for the Turkish version (Table 1). All changes made the scale more understandable and objective. As it is now, the scale is more suitable to use in Turkish language (Online Appendix).

## Outcome measurements

**Functional reach test (FRT)** The test measures the bending trunk forward distance by the subject without arm support. In the previous studies, the inter-rater, intra-rater, and test–retest reliability of the FRT has been reported to be 0.98, 0.83, and 0.75, respectively [16, 17].

**Gross motor function classification system (GMFCS)** The functional level of the participants was evaluated using the GMFCS which is the most suitable system to classify the disabled children. It has ranges from Level 1 to 5 [18, 19].

## Interobserver reliability analyses

The measurements were analyzed using the video recorder. Eight observers performed the scoring by watching the video records, independently. Interobserver agreement between the observers was calculated with two-way random effects

intraclass correlation coefficient (ICC) and was presented with 95% confidence interval (CI). The ICC was accepted as perfect agreement  $\geq 0.80$ , moderate agreement = 0.60–0.79, or poor agreement  $< 0.60$  [20]. Agreement between PBS total scores obtained by the most experienced and less experienced observers was also compared with the ICC.

## Intrarater reliability analyses

One observer evaluated the records twice in 2-week interval for intrarater agreement and intraclass correlation coefficient was used.

## Validity analysis

The FRT was used for concurrent validity. Spearman correlation coefficient was used to calculate association between The PBS and FRT.

## Data analysis

SPSS (Statistical Package for the Social Sciences) version 23.0 was used. Statistical significance level was set as  $p < 0.05$ . Categorical variables presented as numbers ( $n$ ) and their percentages (%). Continuous variables presented as mean and standard deviation (mean  $\pm$  SD), their median and minimum–maximum (min–max) scores. Reliability was tested using the interobserver and intraobserver agreements. Intra-class correlations coefficient (ICC) with 95% CI was for interobserver agreement and intraobserver agreement. For concurrent validity, spearman correlation coefficient was used because data were non-parametric. Cronbach alpha coefficient was used for

**Table 1** Changes have been made in the translation of the PBS

Item	English definition	Turkish definition
1	Stabilize independently	Stand in balance without holding on
2	Descent	Sitting down
3	None	None
4	Unassisted	Without assistance
5	None	None
6	Keep them closed Keep from falling	Do not open Not to fall
7	None	None
8	None	None
9	Prevent fall	Not to fall
10	Turn completely around in a full circle	Turn around yourself from a complete circle
11	None	None
12	1–2 inches	2–5 cm
13	Placing alternate foot on stool “> 20 s	Placing foot on a stool sequentially (step) More than 20 s
14	“> 10 inches, > 5 inches, > 2 inches	More than 25 cm, more than 12 cm, more than 5 cm

internal consistency. Cronbach's alpha coefficient was accepted above 0.70 as high reliability [21]. Sample size was calculated according to the reference article.

## Results

### Socio-demographics

The study was completed with 34 children (13 girls and 21 boys). The mean age of the sample was  $11.68 \pm 3.53$  years. According to GMFCS, 68% of the children were at level 1 and 32% were at level 2. Details regarding socio-demographics and clinical features of the sample were showed in Table 2.

### Interobserver reliability analysis

Interobserver agreement of eight observers was found as reliable, perfectly. The result was demonstrated by an ICC value of 0.915 for the total score of the PBS. ICC scores of the interobserver agreement for each item were shown in Table 3. Eight observers rated the fifth item as 4. Reliability was perfect for items 7, 9, 13, moderate for items 8, 10, 14, and poor for items 1, 2, 3, 4, 6, 11, 12 (Table 3). Perfect agreement was found between the PBS scores obtained by the most experienced observer (O6) and the less experienced observer (O3) (ICC = 0.970; 95% CI 0.942–0.985).

**Table 2** Sociodemographic data

Variables	Total ( <i>n</i> = 34) Median (min–max)
Age (years)	12 (4–18)
Body height (cm)	143 (97–167)
Body weight (kg)	38 (13–82)
FRT	23 (0–32)
GMFCS	<i>N</i> (%)
Level I	23 (68)
Level II	11 (32)
Diagnosis	
Cerebral palsy	24 (63)
Autism	5 (13)
Spina bifida	1 (3)
Down syndrome	3 (8)
Prader–Willi syndrome	1 (3)

*n* number, % percentage, FRT functional reach test, GMFCS gross motor functional measurement

### Intraobserver reliability analysis

The total scores acquired by the evaluation of the video records in a two-week interval by the same observer were also compared. The intraobserver agreement of the PBS total score was high, perfectly (ICC = 0.927). All participants were rated as 4 for the items 2, 4, 5 of PBS. The agreement between the measurements was equal to 100% as shown in Table 4. Reliability was perfect for items 1, 3, 8, 9, 13, moderate for items 6, 7, 11, 12, 14, and poor for items 10 (Table 4).

### Internal consistency

Cronbach's alpha coefficient for the internal consistency of the 14 item scale was 0.857 (95% CI: 0.775–0.919). This result showed that the Turkish-language adaptation of the scale showed a good level of consistency.

### Concurrent validity analysis

Correlation level was evaluated as weak between 0 and 0.49, moderate between 0.5 and 0.74, and strong between 0.75 and 1 (20). The correlation between the FRT and total score of PBS was found as strong ( $r = 0.692$ ;  $p < 0.001$ ).

## Discussion

In the Turkish-related literature, Turkish version of the PBS has been not studied. Turkish speaking researchers have to use the BBS. That's why; we planned to translate the PBS from English to Turkish. In the present study, the original PBS has been translated to Turkish. Reliability and validity of the Turkish version of the PBS were also studied. The results showed that the Turkish version is valid and reliable in accordance with the interobserver agreement (ICC = 0.915), intraobserver agreement (ICC = 0.927), internal consistency (Cronbach alpha coefficient = 0.857), and concurrent validity analysis ( $r = 0.692$ ;  $p < 0.0005$ ). When we check the literature, we noticed that the PBS has been translated into 13 languages. We believed that at the end of this present study, Turkish speaking researchers will have opportunity to use the PBS to evaluate the disabled children.

The ICC was used to calculate the interobserver reliability analysis. According to the interrater reliability analysis, the agreement between the PBS total score of eight observers were reliable, perfectly (ICC = 0.982–0.994). The same results have been reported by Franjoine [14] (ICC = 0.997), Her de et al. [22] (ICC = 0.901), and Beatriz et al. [23] (ICC = 0.986).

Cognitive level was taken into consideration in the previous studies [14]. The participants just evaluated in the

**Table 3** Interobserver agreement for the Turkish version of the PBS

Items	Observers' points Median (Min–Max)								ICC
	O1	O2	O3	O4	O5	O6	O7	O8	
1	4.00 (2–4)	4.00 (4–4)	4.00 (3–4)	4.00 (2–4)	4.00 (2–4)	4.00 (2–4)	4.00 (2–4)	4.00 (1–4)	0.429 (0.296–0.577)
2	4.00 (3–4)	4.00 (4–4)	4.00 (4–4)	4.00 (3–4)	4.00 (3–4)	4.00 (4–4)	4.00 (4–4)	4.00 (2–4)	0.339 (0.214–0.502)
3	4.00 (3–4)	4.00 (3–4)	4.00 (3–4)	4.00 (3–4)	4.00 (2–4)	4.00 (2–4)	4.00 (2–4)	4.00 (2–4)	0.375 (0.247–0.538)
4	4.00 (4–4)	4.00 (3–4)	4.00 (3–4)	4.00 (4–4)	4.00 (4–4)	4.00 (2–4)	4.00 (2–4)	4.00 (2–4)	0.588 (0.457–0.724)
5	4.00 (4–4)	4.00 (4–4)	4.00 (4–4)	4.00 (4–4)	4.00 (4–4)	4.00 (4–4)	4.00 (4–4)	4.00 (4–4)	1.000*
6	4.00 (1–4)	4.00 (3–4)	4.00 (1–4)	4.00 (1–4)	4.00 (1–4)	4.00 (1–4)	4.00 (2–4)	4.00 (3–4)	0.485 (0.351–0.639)
7	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	0.885 (0.826–0.932)
8	2.50 (0–4)	3.00 (0–4)	1.00 (0–4)	1.00 (0–4)	2.00 (0–4)	3.00 (0–4)	3.00 (0–4)	3.00 (0–4)	0.673 (0.554–0.790)
9	2.5 (0–4)	2.00 (0–4)	1.00 (0–4)	2.00 (0–4)	2.00 (0–4)	2.50 (0–4)	2.50 (0–4)	2.50 (0–4)	0.804 (0.715–0.880)
10	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	0.675 (0.556–0.791)
11	4.00 (0–4)	4.00 (0–4)	4.00 (2–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	0.530 (0.396–0.677)
12	4.00 (3–4)	4.00 (3–4)	4.00 (3–4)	4.00 (3–4)	4.00 (0–4)	4.00 (3–4)	4.00 (3–4)	4.00 (3–4)	0.543 (0.409–0.688)
13	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	4.00 (0–4)	0.972 (0.956–0.984)
14	3.00 (0–4)	3.0 (0–4)	3.50 (0–4)	3.00 (0–4)	3.00 (0–4)	3.00 (0–4)	3.00 (0–4)	3.00 (0–4)	0.600 (0.465–0.730)
Total score	50.00 (26–56)	51.50 (28–56)	49.00 (26–55)	49.50 (26–56)	49.00 (19–56)	50.50 (23–56)	50.00 (21–56)	49.00 (18–56)	0.915 (0.870–0.951)

O observer, *min* minimum, *max* maximum, ICC intraclass correlation coefficient

95% CI; \*ICC: 1.00 assigned to the items with absence of variability (SD=0.0) and agreement of 100% between the observers

present study were children with mild-to-moderate cognitive and motor impairments similar to the study by Franjoine et al. [14]. They showed that PBS was reliable and valid scale for children with mild to moderate cognitive and motor impairments. In another study by Her de et al. children with cerebral palsy were included [22]. In the present study, 63% of the participants had had CP.

In the kind of these studies, observer experience is not vital. Moreover, if there is no significant difference between most experienced and less experienced observers, this result shows that the scale is reliable, perfectly. The same results were found in our study too. In the present study, a perfect agreement was found between the most experienced observer 's and the less experienced observer's score (ICC=0.970). Her de et al. [22] found good agreement on both intrarater agreement of the less experienced observer and the most experienced observer.

Turkish version of FRT is the most common scale by the Turkish-speaking researchers [24]. That's why; we used it to calculate concurrent validity of the PBS, but the authors reported that the FRT is suitable to use for children  $\geq 4$  years only. In addition to this, they claimed the FRT should not be used to evaluate children below 3 years old. The FRT can also be used to determine potential balance disorders of the children in Turkey.

There was a strong correlation ( $r=0.692$ ) between FRT and PBS total scores according to the concurrent validity analysis in this present study. That means the Turkish version of the scale is valid strongly. However, there is no Turkish validated scale to compare with the PBS. This was a limitation of our study. To determine concurrent validity, the FRT was used. On the other hand, many observers from different disciplines working in paediatric

**Table 4** Intraobserver agreement for the Turkish version of the PBS

Items	n	Item points		ICC	p
		Evaluation 1st	Evaluation 2nd		
		Mean ± SD	Mean ± SD		
1	34	3.88 ± 0.409	3.91 ± 0.171	0.905 (0.819–0.952)	< 0.0001
2	34	3.94 ± 0.239	3.94 ± 0.239	1.000*	
3	34	3.85 ± 0.359	3.88 ± 0.327	0.875 (0.765–0.936)	< 0.0001
4	34	4.00 ± 0.000	4.00 ± 0.000	1.000*	
5	34	4.00 ± 0.000	4.00 ± 0.000	1.000*	
6	34	3.76 ± 0.741	3.91 ± 0.514	0.618 (0.358–0.789)	< 0.0001
7	34	3.35 ± 0.884	3.38 ± 1.436	0.716 (0.503–0.847)	< 0.0001
8	34	1.94 ± 1.774	1.56 ± 1.599	0.809 (0.650–0.900)	< 0.0001
9	34	2.32 ± 1.471	2.29 ± 1.447	0.893 (0.797–0.945)	< 0.0001
10	34	3.38 ± 1.155	3.38 ± 1.101	0.453 (0.140–0.683)	0.003
11	34	3.24 ± 1.257	3.38 ± 1.155	0.768 (0.585–0.877)	< 0.0001
12	34	3.94 ± 0.239	3.97 ± 0.171	0.660 (0.418–0.814)	< 0.0001
13	34	3.15 ± 1.598	3.12 ± 1.629	0.983 (0.966–0.991)	< 0.0001
14	34	2.74 ± 1.483	2.50 ± 1.482	0.696 (0.472–0.836)	< 0.0001
Total score	34	47.65 ± 8.235	47.29 ± 7.626	0.927 (0.859–0.963)	< 0.0001

n number, SD standard deviation, ICC intraclass correlation coefficient

95% CI; \*ICC: 1.00 assigned to the items with absence of variability (SD=0.0) and agreement of 100% between the observers

rehabilitation evaluated the video records in this study. This is the strong aspect of our study.

## Clinical implications/future directions

Balance assessment is very important in early terms of childhood. Since there are few Turkish version of the balance assessment tools, we planned to enhance possibilities in this field for health providers, including pediatricians, physiotherapists, ergotherapists, and so on. Moreover, our study leads to using the Turkish version widen in Turkish speaking countries. The results obtained from this study indicate that the Turkish version of PBS is valid and reliable tool to assess balance impairments in children. Generally, since most of assessment tools verified by the researchers from English speaking countries, version and adaptation studies of the scales, questionnaires, and tools in non-English speaking countries is vital to improve clinical practice and scientific researches. Therefore, this study provides opportunities for Turkish speaking clinicians and researchers to use most suitable and more sensitive balance assessment scale for children in clinics. On the other hand, this study encourages the researchers to use the Turkish version of the PBS and make its use more common. Namely, it gives also strengths to widely use.

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**Informed consent** All parents read and signed informed consent form to their children participation in the study and signed the declaration documents.

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