Feasibility and outcomes of the Berg Balance Scale in older adults with intellectual disabilities

Running head: Berg Balance Scale adults with ID

Authors: Alyt Oppewal[a], Thessa I.M. Hilgenkamp[a,b],
Ruud van Wijck[c], Heleen M. Evenhuis[a]

[a] Intellectual Disability Medicine, Department of General Practice, Erasmus Medical Center Rotterdam, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands
[b] Abrona, Amersfoortseweg 56, 3712 BE Huis ter Heide, The Netherlands
[c] Center for Human Movement Sciences, University of Groningen, University Medical Center Groningen, A. Deusinglaan 1, 9713 AV Groningen, The Netherlands

Corresponding author:
Alyt Oppewal at Erasmus Medical Center, Department of General Practice, Intellectual Disability Medicine, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands.
Tel.: +31 107043611
E-mail address: a.oppewal@erasmusmc.nl (A. Oppewal).

Abstract

High incidence of falls and increased risk of fall-related injuries are seen in individuals with intellectual disabilities (ID). The Berg Balance Scale (BBS) is a reliable instrument for balance assessment in the population of (older) adults with ID. The aims of this study were to assess the balance capacities of a large group of older adults with ID with the BBS and look for gender and age effects, as well as reasons for drop-out on separate items, and to identify feasible subtests for subgroups in which the complete BBS is not feasible. The balance capacities of 1050 older clients with borderline to profound ID of three Dutch care-provider services (mean age 61.6 [*sd* = 8.0]) were assessed with the BBS. The participants who completed all items of the BBS (*n* = 508) were the functionally more able part of the study sample. Results showed that even this functionally more able part had poor balance capacities, with a mean BBS score of 47.2, 95% CI [46.3, 48.0], similar to adults in the general population aged around 20 years older. Balance capacities decreased with increasing age and females had poorer balance capacities than males. Difficulties understanding the task and physical limitations were most often the reasons for drop-out. Feasible subtests were identified for the subgroups with very low cognitive levels and wheelchair users. Low balance capacities of older adults with ID show the need for regular screening and the urge for fall prevention programs for individuals with ID.

Keywords: Balance capacities, Berg Balance Scale, feasibility, intellectual disabilities, older adults

1. Introduction

A high incidence of falls and increased risk of fall-related injuries is seen in individuals with intellectual disabilities (ID) (Cox, Clemson, Stancliffe, Durvasula, & Sherrington, 2010; Hale, Bray, & Littmann, 2007; Hsieh, Rimmer, & Heller, 2012; Sherrard, Tonge, & Ozanne-Smith, 2001). The broad age range of participants in these studies indicates that falling is not restricted to older individuals with ID. However, the risk of falling increases with advancing age (Cox et al., 2010; Hsieh, Heller, & Miller, 2001; Wagemans & Cluitmans, 2006; Willgoss, Yohannes, & Mitchell, 2010), with notable increases in falls found for individuals with ID in their 40's and 50's (Cox et al., 2010). Chiba et al. (2009) reported a 2.5 times (odds ratio = 2.46) higher fall risk in those over 50 years of age compared to those younger than 50 years of age (Chiba et al., 2009), and Hsieh et al. (2001) reported a 10-fold risk (odds ratio = 10.63) in those over 70 years of age for falls and related injuries in comparison to those younger than 70 years of age (Hsieh et al., 2001). Furthermore, falling seems to lead more often to injury and hospitalization in individuals with ID than in the general population (Sherrard et al., 2001; D. Wang, McDermott, & Sease, 2002).

Balance assessment instruments are used in the general population to identify fall risk and target and evaluate fall prevention programs. However, not all of these instruments are applicable to individuals with ID, because of their limited cognitive ability and comorbidities (Enkelaar, Smulders, van Schrojenstein Lantman-de Valk, Geurts, & Weerdesteyn, 2012; Hale et al., 2007; Hilgenkamp, van Wijck, & Evenhuis, 2010). Based on a review by Hilgenkamp et al. (2010), the Berg Balance Scale (BBS) was proposed as the most applicable instrument to assess balance capacities and fall risk in older adults with ID (Hilgenkamp et al., 2010). The BBS is a 14 item performance-based instrument that measures balance capacities (Berg, Wood-Dauphinee, Williams, & Maki, 1992). A higher score corresponds to better balance capacities. A score of 45 (of the maximum score of 56) has been proposed as a cut-off to differentiate between those at risk for falls (< 45) and those not at risk for falls (≥ 45) (Berg et al., 1992). Residents of a home for the elderly without ID with a score below 45 had a 2.7 times (relative risk = 2.7, 95% CI [1.5, 4.9]) greater risk to fall over the next 12 months, than those with a score above 45 (Berg et al., 1992). However, the BBS is better at identifying non-fallers than fallers (Riddle & Stratford, 1999). The BBS was found valid for balance assessment in residents of a home for the elderly without ID, with significant correlations with other balance scales such as the Timed Up & Go (r = -0.76) and the Tinetti Balance subscale (r = 0.91) and reliable, with high inter-rater reliability (ICC = 0.98), intra-rater reliability (ICC = 0.97), and internal consistency (ICC = 0.83) (Berg, Wood-Dauphinee, & Williams, 1995; Conradsson et al., 2007; C. Y. Wang et al., 2006).

In the population with ID, the BBS was found to be a reliable instrument (de Jonge, Tonino, & Hobbelen, 2010; Sackley et al., 2005) and feasible for older adults with mild to moderate ID who are able to walk for at least 10m and understand simple instructions (Enkelaar, Smulders, van Schrojenstein Lantman-de Valk, Weerdesteyn, & Geurts, 2013). Validity has not yet been investigated in this group.

In the 'Healthy ageing and intellectual disabilities' (HA-ID) study, the health of 1050 older adults (50+) with borderline to profound ID was investigated (Hilgenkamp et al., 2011). The BBS was used to assess the balance capacities and was found feasible for this group, except for the subgroups with severe to profound ID and older adults who use a wheelchair inside their homes (Hilgenkamp, van Wijck, & Evenhuis, 2013). Completions rates of these subgroups were lower than 25% (Hilgenkamp et al., 2013). In order to interpret BBS results correctly for the subgroups with a large drop-out, more detailed analysis of the reasons for drop-out of these subgroups is necessary. Furthermore, analysis on item level is important to identify subtests that are feasible in these individuals.

Therefore, the aims of this study were (a) to assess the balance capacities of older adults with ID with the BBS, and look for gender and age effects (b) to assess the reasons for drop-out on item level for subgroups with low completion rates (< 25%), and (c) to identify feasible subtests of the BBS for these subgroups.

2. Methods

2.1 Study design and participants

This study was part of the large Dutch cross-sectional HA-ID study executed by a consort consisting of three ID care-provider services in collaboration with two university departments (Intellectual Disability Medicine, Erasmus Medical Center at Rotterdam and the Center for Human Movement Sciences, University Medical Center at Groningen). All 2150 clients with ID, aged 50 years and over, of the three care-provider services were invited to participate, resulting in a near-representative sample of 1050 clients. Details about design, recruitment, and representativeness of the sample have been presented elsewhere (Hilgenkamp et al., 2011). Data collection took place between February 2009 and July 2010.

Ethical approval was provided by the Medical Ethical Committee at Erasmus Medical Center (MEC 2008-234) and by the ethical committees of the participating ID care-provider services. Informed consent was obtained from all participants; however, unusual resistance was a reason for aborting measurements at all times. This study followed the guidelines of the Declaration of Helsinki (Helsinki, 2008).

2.2 Procedure

Data were collected as part of an extensive physical fitness assessment, which was conducted at locations familiar or close to participants: a large room within their home, a familiar daycare center, or a gym. Assessments were guided by test instructors, who all were physiotherapists, occupational therapists, or physical activity instructors with experience with individuals with ID. They all received an instruction manual and followed two days of training for the execution of all assessments.

Standardized encouragement provided by test instructions for testing individuals with normal intellectual capabilities is unsuitable for individuals with ID. To keep this motivational aspect as equal as possible, we prescribed ‘maximal motivation’ to the test instructors for all tests. In some cases, this meant that participants were motivated to engage in the assessments by constant verbal encouragement and verbal rewarding, in other cases the test instructor had to remain very calm and quiet to motivate the participant as much as possible and to prevent stress or anxiety. The specific background, knowledge, and experience of the test instructors were important conditions for ensuring the most suitable ‘maximal motivation’ for every participant, while regarding safety as well.

2.3 Measurements

2.3.1 General information

Gender, age, and residential status (central setting providing intensive care and support, community-based setting providing support of independence, independent living with outreaching support, or with relatives) were collected from the administrative systems of the ID care-provider services. Depending on the residential status, the care and support participants received ranged from complete care and support in basic activities of daily living to only minimal support instrumental activities of daily living, for example managing finances. Additional treatment is only deployed when indicated by a medical diagnosis, just as in the general population. The presence of Down syndrome (DS), spasticity of the legs and arms (unilateral, bilateral), scoliosis, Parkinson’s disease, cerebrovascular accident, and visual and hearing problems were collected through the medical files. Professional caregivers provided information about mobility (independent, walking with an aid, or wheelchair-bound). Level of ID was categorized by psychologists or behavioral therapists as borderline (IQ = 70 – 84), mild (IQ = 50 – 69), moderate (IQ = 35 – 49), severe (IQ = 20 – 34), or profound (IQ < 20) based on International Classification of Diseases (ICD-10) criteria (World Health Organization, 1996).

Height and weight was measured by trained medical assistants during physical examination; detailed methods have been described elsewhere (de Winter, Bastiaanse, Hilgenkamp, Evenhuis, &

Echteld, 2012). The body mass index (BMI) was calculated by weight divided by squared height (World Health Organization, 1995). Physical activity was measured with the NL-1000 pedometer (New Lifestyles, Missouri, USA) as part of the extensive physical fitness assessment (Hilgenkamp, Reis, van Wijck, & Evenhuis, 2012; Hilgenkamp, Van Wijck, & Evenhuis, 2012).

2.3.2 Balance

The BBS consists of 14 static and dynamic functional balance tasks varying in difficulty, ranging from unsupported sitting in a chair to tandem stance and standing on one leg (Table 1) (Berg, 1989; Berg et al., 1992). The original test instructions were followed with some aids to enhance understanding of the tasks: two carpet feet and a carpet circle on the floor, to point out where the participant had to stand or turn around on. Walking aids were not allowed. The items were scored on a 5-point scale from 0 (inability to complete the task) to 4 (completion of the task) points. A modified version of the forward reach (item 8) was added, called item 8a, to make the reaching task easier to understand. Participants had to reach forward with their arms stretched holding a ring, and place the ring around a standing stick. The stick was placed further away until the participant could no longer place the ring around the stick. The result was calculated by subtracting the arm length (distance of the acromion to the inside of the ring) from the distance between the ankles (malleolus exterior) and the stick.

Reasons for drop-out on each item were recorded by test instructors using the categories: difficulties understanding the task, physical limitations (involving the lower limbs, e.g., spasticity, mobility problems, foot deformations), concentration problems, does not feel like participating, anxiety, and reasons unknown to the investigators.

Table 1. Items of the Berg Balance Scale

Item	**Description**
1	Sitting to standing
2	Standing unsupported
3	Standing to sitting
4	Sitting unsupported
5	Transfers
6	Standing unsupported with eyes closed
7	Standing unsupported with feet together
8	Reaching forward with arms stretched while standing
8a	Reaching forward to place a ring around a standing stick
9	Pick up object from floor
10	Look behind while standing with feet fixed
11	Turning 360 degrees
12	Alternating placing foot on step
13	Tandem stance
14	Standing on one leg

2.4 Statistical analysis

Characteristics of the study sample were described. Based on participation on the original 14 items of the BBS, differences between participants and non-participants of the BBS were analyzed with an independent *t* test and Pearson's chi-square tests. For the group who did not complete the original 14 items of the BBS, the number of items performed was described. The reasons for drop-out were presented as the number of times a specific reason for drop-out was reported for any one of the 14 items of the BBS, divided by the total number of times any reason for drop-out was reported for any one of the 14 items of the BBS.

The scores of the BBS were calculated for the participants who completed all the original 14 items of the BBS. Results are presented as mean scores with 95% confidence intervals for the overall group and for females and males in age categories of 5 years. The percentage that had a score of 45 or higher was calculated. The differences between the age categories for females and males were analyzed with Kruskal-Wallis tests. When significant, post hoc tests were performed using a Bonferroni correction. The difference in BBS results between men and women was analyzed with an independent *t* test.

Feasibility of the BBS items for the subgroups (who participated on at least one item of the BBS) with severe to profound ID and wheelchair users were assessed. These subgroups had low completion rates on the original BBS (< 25%) (Hilgenkamp et al., 2013). Reasons for drop-out were described. Subtests for these subgroups were composed with the items which were considered feasible. Subtests were considered feasible with completion rates of 25% or higher according to the previously used cut-off score by Hilgenkamp et al. (2013) (Hilgenkamp et al., 2013). We considered individual items feasible if at least 50% of the participants could perform the item. Scores were calculated for these subtests and presented as mean scores with 95% confidence intervals. Feasibility of item 8 compared to item 8a was analyzed with Pearson's chi-square tests for the subgroups with severe to profound ID and wheelchair users.

Both confidence intervals and p-values are reported (du Prel, Hommel, Rohrig, & Blettner, 2009) and *p*-values smaller than 5% ($p < 0.05$) were considered statistically significant. Analyses were performed with the Statistical Package for Social Sciences (SPSS) version 20.0 (IBM Corporation, New York).

3. Results

3.1 Participants

Of the total study population of the HA-ID study ($n = 1050$), 811 participants completed at least one item of the BBS and 508 participants performed all 14 items. The characteristics of these three groups are shown in Table 2. Compared to the total HA-ID study population, participants who completed the BBS ($n = 508$) were taller ($t(868.15) = -6.96$, $p < 0.001$), heavier ($t(897) = -7.60$, $p < 0.001$), had higher BMI ($t(891) = -3.16$, $p = 0.002$), lived more often in the community (χ^2 [4, $n = 1050$] = 206.99, $p <$ 0.001), had more often borderline to moderate ID (χ^2 [5, $n = 1050$] = 229.50, $p < 0.001$), less Down syndrome diagnoses (χ^2 [2, $n = 1050$] = 18.28, $p < 0.001$), less spasticity of the legs (χ^2 [3, $n = 1050$] =

14.88, $p = 0.002$) and arms (χ^2 [3, $n = 1050$] = 14.02 $p = 0.003$), less scoliosis (χ^2 [2, $n = 1050$] = 15.19, $p = 0.001$), less visual (χ^2 [3, $n = 1050$] = 39.57, $p < 0.001$) and hearing impairments (χ^2 [4, $n = 1050$] = 42.48, $p < 0.001$), and less mobility impairments (χ^2 [2, $n = 1050$] = 95.16, $p < 0.001$).

3.2 Drop-outs

Of the total HA-ID study population ($n = 1050$), 150 participants were absent on the day of the physical fitness assessment. Reasons for absence were illness, lack of cooperation, logistic reasons, or no consent for the physical fitness assessment (Hilgenkamp, Reis, et al., 2012). Of the participants present, 392 (900 – 508) did not complete all 14 original items of the BBS. The distribution of the number of items of the original BBS performed by this group is shown in Figure 1. The reasons for drop-out on the separate items of the BBS were difficulties understanding the task (38.8%), physical limitations (32.6%), concentration problems (3.0%), did not feel like participating (7.8%), anxiety (3.8%), and reasons unknown to the investigators (11.9%).

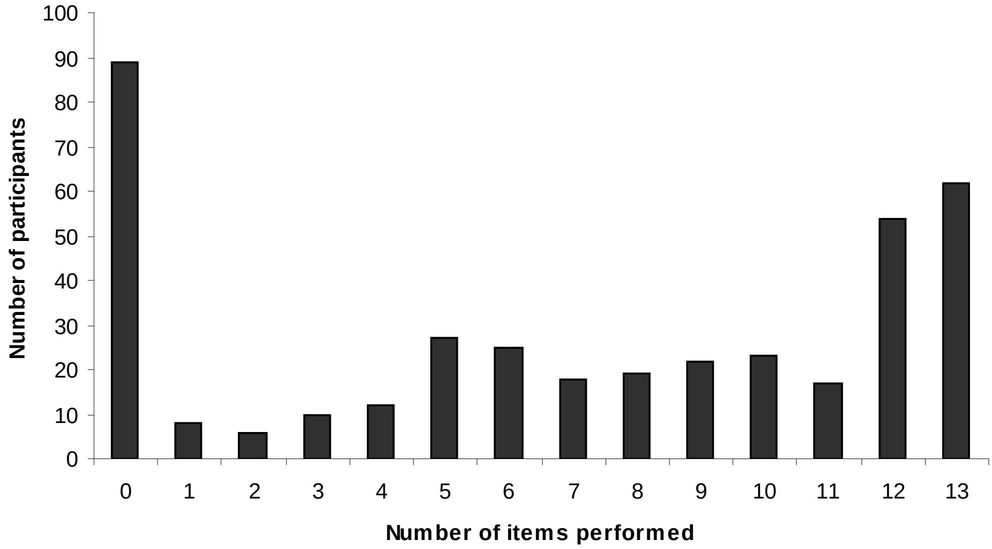

Figure 1. Distribution of the number of items performed by the participants who did not complete the original 14 items of the Berg Balance Scale ($n = 392$).

Table 2. Characteristics of the HA-ID study sample and participants on the Berg Balance Scale.

Characteristics	***n* (%)**	**HA-ID**	**BBS (≥ 1 item)**	**BBS (14 items)**
Total		1050	811	508
Age	Years (*m* ± *sd*)	61.6 ± 8.0	61.4 ± 7.8	61.3 ± 7.6
Gender	Female	511 (48.7)	398 (49.1)	248 (48.8)
	Male	539 (51.3)	413 (50.9)	260 (51.2)
Height	cm (*m* ± *sd*)	161.6 ± 11.6	162.1 ± 11.5	164.0 ± 10.7
Weight	kg (*m* ± *sd*)	71.1 ± 15.7	71.7 ± 15.6	74.6 ± 15.4
BMI	kg/m^2 (*m* ± *sd*)	27.2 ± 5.2	27.2 ± 5.1	27.7 ± 5.0

Type of setting	Central setting	557 (53.0)	392 (48.3)	156 (30.7)
	Community-based	432 (41.1)	363 (44.8)	301 (59.3)
	Ambulatory support	43 (4.1)	41 (5.1)	40 (7.3)
	With relatives	7 (0.7)	7 (0.9)	5 (1.0)
	Unknown	11 (1.0)	8 (1.0)	6 (1.2)
Level of ID	Borderline	31(3.0)	30 (3.7)	28 (5.5)
	Mild	223 (21.2)	193 (23.8)	164 (32.3)
	Moderate	506 (48.2)	403 (49.7)	267 (52.6)
	Severe	172 (16.4)	121 (14.9)	31 (6.1)
	Profound	91 (8.7)	43 (5.3)	1 (0.2)
	Unknown	27 (2.6)	21 (2.6)	17 (3.3)
Down syndrome	Yes	149 (14.2)	113 (13.9)	44 (8.7)
	No	724 (69.0)	552 (68.1)	344 (67.7)
	Unknown	177 (16.9)	146 (18.0)	120 (23.6)
Mobility	Independent	731 (69.6)	630 (77.7)	416 (81.9)
	Walking aid	151 (14.4)	119 (14.7)	55 (10.8)
	Wheelchair	107 (10.2)	30 (3.7)	10 (2.0)
	Unknown	61 (5.8)	32 (3.9)	27 (5.3)
Spasticity legs	Unilateral	26 (2.5)	20 (2.5)	12 (2.4)
	Bilateral	69 (6.6)	31 (3.8)	16 (3.1)
	No	799 (76.1)	327 (77.3)	372 (73.2)
	Unknown	156 (14.9)	133 (16.4)	108 (21.3)
Spasticity arms	Unilateral	23 (2.2)	18 (2.2)	10 (2.0)
	Bilateral	53 (5.0)	27 (3.3)	11 (2.2)
	No	818 (77.9)	633 (78.1)	379 (74.6)
	Unknown	156 (14.9)	133 (16.4)	108 (21.3)
Scoliosis	Yes	95 (9.0)	60 (7.4)	25 (4.9)
	No	800 (76.2)	621 (76.6)	376 (74.0)
	Unknown	155 (14.8)	130 (16.0)	107 (21.1)
Parkinson	Yes	8 (0.8)	677 (83.5)	4 (0.8)
	No	891 (84.9)	6 (0.7)	399 (78.5)
	Unknown	151 (14.4)	128 (15.8)	105 (20.7)
CVA	Yes	52 (5.0)	646 (79.7)	22 (4.3)
	No	850 (81.0)	38 (4.7)	380 (74.8)
	Unknown	148 (14.1)	127 (15.7)	106 (20.9)
Visual problems	Yes	219 (20.9)	146 (18.0)	61 (12.0)
	No	666 (63.4)	528 (65.1)	335 (65.9)
	Unknown	165 (15.7)	137 (16.9)	112 (22.0)
Hearing problems	Yes	409 (38.9)	307 (37.9)	140 (27.6)
	No	470 (44.8)	366 (45.1)	257 (50.6)

	Unknown	171 (16.3)	138 (17.0)	111 (21.8)
Physical activity	> 7500 steps/day	93 (8.9)	89 (11.0)	80 (15.7)
	< 7500 steps/day	164 (15.6)	161 (19.9)	141 (27.8)
	Unknown	793 (75.5)	561(69.2)	287 (56.5)

m = mean; *sd* = standard deviation; *n* = number of participants; ID = intellectual disability; CVA = cerebrovascular accident.

3.3 Results of the BBS

The mean total score of the BBS (n = 508) was 47.2, 95% CI [46.3, 48.0]. Of the 508 participants, 78.9% had a score of or above the cut-off value of 45. The results for the 5-year age categories are presented in Table 3. Males had a significantly better mean BBS score than females ($t(506) = 2.76$, $p = 0.006$). The BBS scores deteriorated significantly with increasing age for both females and males, $H(5) = 16.22$, $p = 0.006$ and $H(5) = 28.38$, $p < 0.001$, respectively. However, post hoc tests did not show significant differences between the consecutive age categories.

Table 3. Results of the Berg Balance Scale for age categories of 5 years (n = 508).

Age-category (years)	***n***	**BBS score** mean [95% CI]	**Score ≥ 45 (%)**
Female	**248**	**46.0 [44.6, 47.3]**	**72.2**
50-54	65	47.7 [44.8, 50.5]	76.9
55-59	66	47.3 [45.1, 49.5]	78.8
60-64	41	45.9 [42.7, 49.0]	73.2
65-69	34	42.6 [37.5, 47.6]	64.7
70-74	25	43.6 [38.7, 48.5]	68.0
75+	17	44.5 [38.7, 50.2]	76.5
Male	**260**	**48.3 [47.4, 49.3]**	**83.5**
50-54	47	49.4 [46.7, 52.2]	93.6
55-59	59	50.6 [49.2, 51.9]	93.2
60-64	70	49.5 [48.3, 50.6]	84.3
65-69	46	46.4 [43.6, 49.1]	73.9
70-74	22	44.6 [39.6, 49.6]	63.6
75+	16	42.8 [36.7, 48.9]	68.8

n = number of participants; BBS = Berg Balance Scale; CI = confidence interval.

3.4 Feasibility for subgroups

The feasibility of the BBS items and reasons for drop-out of the subgroups with low completion rates (< 25%) on the original BBS (Hilgenkamp et al., 2013) are presented in Table 4. The reasons 'concentration problems', 'does not feel like participating', and 'anxiety' were taken together in the table because they overall represented small proportions (< 5%) of the reasons for drop-out.

Of individuals with severe ID, less than 50% participated on item 8. The main reason for drop-out on this item was difficulties with understanding the task (53.3%) (Table 4).

Of individuals with profound ID, less than 50% participated on the items 6 to 14. The main reasons for drop-out on these items were difficulties understanding the task (25.6% to 76.7%) and physical limitations (9.3% to 14.0%) (Table 4).

In the subgroup of individuals who used a wheelchair inside their home, less than 50% participated on the items 6 and 8 to 12. The main reasons for drop-out were physical limitations (30.0% to 43.3%) and difficulties understanding the task (6.7% to 23.3%) (Table 4).

Item 8 was problematic for all three subgroups. The modified version (item 8a) had a significantly higher participation rate in the subgroup of individuals with severe ID (χ^2 [1, n = 121] = 45.58, p < 0.001) and the subgroup of wheelchair users (χ^2 [1, n = 30] = 26.05, p < 0.001), mostly explained by less drop-out due to difficulties understanding the task.

3.5 Results of the BBS subtests

For individuals with severe ID, a BBS subtest can be composed by omitting item 8. Of the 121 individuals with severe ID, 33 participants (27.3%) completed this subtest. The mean score was 39.7, 95% CI [36.2, 43.2] of the maximum score of 52.

The BBS subtest for individuals with profound ID consists of the items 1 to 5. Of the 43 individuals with profound ID 16 (37.2%) completed this subtest. The mean score was 14.4, 95% CI [10.9, 18.0] of the maximum score of 20.

The subtest of the BBS for individuals who are in a wheelchair inside their home consists of items 1 to 5, 7, 13, and 14. Of this subgroup 43.3% (13/30) completed this subtest. The mean score was 8.3, 95% CI [3.9, 12.7] of the maximum score of 32.

Table 4. Feasibility of the BBS items and reasons for drop-out for individuals with severe (*n* = 121) and profound (*n* = 43) ID and wheelchair users (*n* = 30), presented in percentages.

	Severe ID					Profound ID					Wheelchair				
Item	Part	Reason DiffUnd	Reason PhysL	Reason CFA	Unknown	Part	Reason DiffUnd	Reason PhysL	Reason CFA	Unknown	Part	Reason DiffUnd	Reason PhysL	Reason CFA	Unknown
1	97.5	0.8	1.7	-	-	88.4	7.0	2.3	-	2.3	86.7	3.3	10.0	-	-
2	86.0	7.4	1.7	4.2	0.8	53.5	27.9	4.7	11.6	2.3	76.7	6.7	16.7	-	-
3	98.3	-	1.7	-	-	93.0	4.7	-	-	2.3	90.0	-	10.0	-	-
4	94.2	5.0	-	0.8	-	81.4	14.0	-	2.3	2.3	96.7	3.3	-	-	-
5	93.4	5.0	0.8	0.8	-	74.4	18.6	2.3	2.3	2.3	86.7	-	10.0	3.3	-
6	57.9	36.4	2.5	3.3	-	16.3	65.1	9.3	4.6	4.7	43.3	23.3	30.0	3.3	-
7	58.7	28.9	3.3	5.8	3.3	25.6	51.2	11.6	4.7	7.0	50.0	13.3	36.7	-	-
8	37.9	53.3	3.3	3.3	-	7.0	76.7	11.6	2.3	2.3	36.7	16.7	40.0	6.6	-
8a	56.2	33.9	3.3	5.8	0.8	11.6	67.4	14.0	2.3	4.7	40.0	16.7	40.0	3.3	-
9	86.0	8.3	3.3	2.5	-	48.8	25.6	11.6	9.4	4.7	46.7	6.7	43.3	3.3	-
10	51.2	40.5	4.1	4.1	-	9.3	65.1	14.0	7.0	4.7	40.0	16.7	40.0	3.3	-
11	71.1	19.8	4.1	5.0	-	23.3	51.2	14.0	7.0	4.7	43.3	13.3	43.3	-	-
12	54.5	36.4	4.1	4.9	-	7.0	67.4	11.6	9.3	4.7	43.3	16.7	40.0	-	-
13	50.4	36.4	5.0	8.3	-	4.7	67.4	9.3	14.0	4.7	50.0	16.7	33.3	-	-
14	64.5	25.6	4.1	5.8	-	14.0	60.5	11.6	9.3	4.7	50.0	13.3	36.7	-	-

BBS = Berg Balance Scale; Part = Participation; Reason DiffUnd = Difficulties understanding the task; Reason PhysL = Physical limitations; Reason CFA = Concentration/ does not Feel like participating/ Anxiety; Unknown.

4. Discussion

The results of the BBS reported in this study concern a functionally more able part of the total study sample. Half of the participants of the total HA-ID study sample (*n* = 1050) were not able to complete all 14 items of the BBS, largely due to physical limitations and limited cognitive ability. Since physical limitations and more severe level of ID are associated with poor balance capacities (Hsieh et al., 2012), the BBS results are likely to be an overestimation of the balance capacities of the population of older adults with ID as a whole. Feasible subtests of the BBS were identified for subgroups with low completion rates on the original BBS to enable some balance assessment in these individuals.

For this functionally more able part of the study sample (*n* = 508, mean age 61.3 [*sd* = 7.6]), the mean BBS total score was 47.2, 95% CI [46.3, 48.0]. This result is comparable to the result found by Enkelaar et al. (2013), in a group of 76 older adults with mild to moderate ID (43 males, mean age 63.1 years [*sd* = 7.6]). They found a mean BBS score of 46.8 (*sd* = 6.9), which was significantly lower than the BBS score of 55.8 (*sd* = 0.4) in a control group with normal intelligence (*n* = 20, 14 male, mean age 62.2 years [*sd* = 5.6]) (Enkelaar et al., 2013). As a comparison, 113 residents of a home for the elderly without ID (20 males) with a mean age of 83.5 years (*sd* = 5.3), a mean BBS score of 47.7 (*sd* = 5.5) was also found (Berg et al., 1992). Older adults with ID thus seem to have balance capacities that are comparable to or worse than those in adults without ID who are on average 20 years older and not capable of living independently.

Of the functionally more able part of our study sample, 21% had an increased risk of falling according to the cut-off value of 45. However, we question the use of this cut-off in the population of (older) adults with ID, because it is based on the assumption of a predominantly age-related decline in balance capacities. In the general population, balance capacities decrease with age, along with cognitive decline (Alexander & Hausdorff, 2008; Teixeira-Leite & Manhaes, 2012). Increasing age and cognitive decline are also found as risk factors for falls (American Geriatrics Society, British Geriatrics Society, & American Academy of Orthopaedic Surgeons Panel on Falls Prevention, 2001). This coexistence of decline in balance capacities and cognitive capacities is supported by the finding that cognitive and motor functioning are fundamentally interrelated, with equally long developmental trajectories, and the use of similar brain structures (dorsolateral prefrontal cortex and neocerebellum) (Diamond, 2000). This interrelation, between cognitive and motor functioning, can also be seen in children with developmental disorders such as ADHD, autism, and language disorders, who often have accompanying motor problems, for example problems with motor coordination and timing, balance, and rapidly alternating movements (Diamond, 2000). Individuals with ID have lifelong cognitive impairments which may influence their balance capacities during their entire life, and not just at an older age. The age-related decline in balance capacities and increase in fall risk may therefore be different in individuals with ID, because of this different cognitive component, and leading to possibly different compensation strategies. Therefore, the cut-off at which balance impairments lead to an increased risk of falling may be different in this population, emphasizing the need for validation of the cut-off value of 45 for this population.

This study showed that females have poorer balance capacities than males and that balance capacities decrease with increasing age. Since a poor balance is a risk factor for falling (Berg et al., 1992), these results are in line with previous studies finding a higher prevalence of falls in females and with increasing age, both in individuals with ID (Hsieh et al., 2012) and in the general population (Rubenstein, 2006; Williams, Kool, Robinson, & Ameratunga, 2012; World Health Organization, 2008). Other risk factors for falls in individuals with ID were being female, more severe level of ID, having arthritis, a heart condition, back pain, urinary incontinence, a seizure disorder, polypharmacy, and mobility and strength impairments (Hsieh et al., 2012) older age (Cox et al., 2010; Hsieh et al., 2001), past fractures (Cox et al., 2010), abnormal gait pattern (Hale et al., 2007), and ambulatory status (Hsieh et al., 2001). Identification of risk factors helps to target fall prevention programs to those in need of these programs. Guidelines and recommendations for fall prevention have been developed for the general older population (American Geriatrics Society et al., 2001; Panel on Prevention of Falls in Older Persons, American Geriatrics Society, & British Geriatrics Society, 2011). However, to date there are no fall prevention guidelines for the population of adults with ID. The poor balance capacities found in this study underpin the need for these guidelines.

Difficulties understanding the task and physical limitations were most often the reasons for drop-out on the BBS for the subgroups of individuals with severe and profound ID and individuals who use a wheelchair inside their home. Subtests consisting of most feasible items were proposed for these subgroups. The independent items of these subtests all had participation rates over 50%. The participation on the subtests varied from 27.3% to 43.3%. These subtests now meet the feasibility demands proposed by Hilgenkamp et al. (2013) (Hilgenkamp et al., 2013). Furthermore, item 8a, reaching forward to place a ring around a standing stick, seemed to be easier to understand than the original reach forward item, and improves this item’s feasibility.

Allowing participants to become familiarized with the test, the tester, and the procedures may help to solve some of the difficulties of participants with understanding the items of the BBS (Hale et al., 2007). A modified and shortened version of the BBS was found feasible in individuals with severe intellectual and visual disabilities. After allowing for five practice sessions, 92% of the participants completed all tasks, supporting the need of familiarization sessions for individuals with more severe disabilities (Waninge, van Wijck, Steenbergen, & van der Schans, 2011).

To interpret tests results, norm-referenced and/or criterion-referenced values are needed. Norm-referenced values are summarizing statistics based on large datasets reflecting the performance of a population. These values provide information about the results that can be expected in individuals at different ages and help understanding the rates of change across various age groups, as opposed to criterion-referenced values which are associated with health or performance outcomes (Rikli & Jones, 2001). To date, no large scale studies have been performed to provide these values for older adults with ID. On the condition that the characteristics of the study sample will be taken into account (functionally more able part of a fairly sedentary population [Table 2]), BBS results of this study can be used as norm-referenced values for older adults with ID.

The next step is to validate the original BBS, the subtests, and item 8a, to allow use for balance assessment and prediction of fall risk in this population. Cut-off values related to an increased fall risk need to be identified for the original BBS and the subtests. Furthermore, criterion-referenced values, based on associations of BBS results with other health and performance outcomes, are needed to improve interpretation of the BBS results and support decision making for treatment and interventions.

This study shows that even the more functionally able older adults with ID have poor balance capacities similar to adults in the general population who are on average 20 years older. Regular screening can help to identify those individuals with poor balance capacities in need for fall prevention programs to reduce the fall risk and to determine what kind of fall prevention programs are suitable for older adults with ID.

Acknowledgments

The authors thank the care-provider services, Abrona at Huis ter Heide, Amarant at Tilburg and Ipse de Bruggen at Zwammerdam, involved in the HA-ID study. This study was carried out with the financial support of ZonMw (No. 57000003).

Conflict of interest

None.

References

Alexander, N. B., & Hausdorff, J. M. (2008). Guest editorial: linking thinking, walking, and falling. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 63*(12), 1325-1328.

American Geriatrics Society, British Geriatrics Society, & American Academy of Orthopaedic Surgeons Panel on Falls Prevention. (2001). Guideline for the prevention of falls in older persons. *Journal of the American Geriatrics Society, 49*(5), 664-672.

Berg, K. O. (1989). Measuring balance in the elderly: preliminary development of an instrument. *Physiotherapy Canada, 41*(6), 304-311.

Berg, K. O., Wood-Dauphinee, S. L., & Williams, J. I. (1995). The Balance Scale: reliability assessment with elderly residents and patients with an acute stroke. *Scandinavian Journal of Rehabilitation Medicine, 27*(1), 27-36.

Berg, K. O., Wood-Dauphinee, S. L., Williams, J. I., & Maki, B. (1992). Measuring balance in the elderly: validation of an instrument. *Canadian Journal of Public Health, 83 Suppl 2*, S7-11.

Chiba, Y., Shimada, A., Yoshida, F., Keino, H., Hasegawa, M., Ikari, H., Miyake, S., & Hosokawa, M. (2009). Risk of fall for individuals with intellectual disability. *American Journal on Intellectual and Developmental Disabilities, 114*(4), 225-236.

Conradsson, M., Lundin-Olsson, L., Lindelof, N., Littbrand, H., Malmqvist, L., Gustafson, Y., & Rosendahl, E. (2007). Berg balance scale: intrarater test-retest reliability among older people dependent in activities of daily living and living in residential care facilities. *Physical Therapy, 87*(9), 1155-1163.

Cox, C. R., Clemson, L., Stancliffe, R. J., Durvasula, S., & Sherrington, C. (2010). Incidence of and risk factors for falls among adults with an intellectual disability. *Journal of Intellectual Disability Research, 54*(12), 1045-1057.

de Jonge, P. A., Tonino, M. A. M., & Hobbelen, J. S. (2010). *Instruments to assess risk of falls among people with intellectual disabilities.* Paper presented at the International congress of best practice in intellectual disability medicine, Bristol, UK.

de Winter, C. F., Bastiaanse, L. P., Hilgenkamp, T. I., Evenhuis, H. M., & Echteld, M. A. (2012). Overweight and obesity in older people with intellectual disability. *Research in Developmental Disabilities, 33*(2), 398-405.

Diamond, A. (2000). Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. *Child Development, 71*(1), 44-56.

du Prel, J. B., Hommel, G., Rohrig, B., & Blettner, M. (2009). Confidence interval or p-value?: part 4 of a series on evaluation of scientific publications. *Deutsches Ärzteblatt international, 106*(19), 335-339.

Enkelaar, L., Smulders, E., van Schrojenstein Lantman-de Valk, H., Geurts, A. C., & Weerdesteyn, V. (2012). A review of balance and gait capacities in relation to falls in persons with intellectual disability. *Research in Developmental Disabilities, 33*(1), 291-306.

Enkelaar, L., Smulders, E., van Schrojenstein Lantman-de Valk, H., Weerdesteyn, V., & Geurts, A. C. (2013). Clinical measures are feasible and sensitive to assess balance and gait capacities in older persons with mild to moderate intellectual disabilities. *Research in Developmental Disabilities, 34*(1), 276-285.

Hale, L., Bray, A., & Littmann, A. (2007). Assessing the balance capabilities of people with profound intellectual disabilities who have experienced a fall. *Journal of Intellectual Disability Research, 51*(Pt 4), 260-268.

Helsinki. (2008). World Medical Association Declaration of Helsinki, Ethical Principles for Medical Research Involving Human Subjects. Retrieved from http://www.wma.net/en/30publications/10policies/b3/

Hilgenkamp, T. I., Bastiaanse, L. P., Hermans, H., Penning, C., van Wijck, R., & Evenhuis, H. M. (2011). Study healthy ageing and intellectual disabilities: Recruitment and design. *Research in Developmental Disabilities, 32*(3), 1097-1106.

Hilgenkamp, T. I., Reis, D., van Wijck, R., & Evenhuis, H. M. (2012). Physical activity levels in older adults with intellectual disabilities are extremely low. *Research in Developmental Disabilities, 33*(2), 477-483.

Hilgenkamp, T. I., Van Wijck, R., & Evenhuis, H. (2012). Measuring physical activity with pedometers in older adults with intellectual disability: reactivity and number of days. *Intellectual and Developmental Disabilities, 50*(4), 343-351.

Hilgenkamp, T. I., van Wijck, R., & Evenhuis, H. M. (2010). Physical fitness in older people with ID-Concept and measuring instruments: a review. *Research in Developmental Disabilities, 31*(5), 1027-1038.

Hilgenkamp, T. I., van Wijck, R., & Evenhuis, H. M. (2013). Feasibility of eight physical fitness tests in 1,050 older adults with intellectual disability: results of the healthy ageing with intellectual disabilities study. *Intellectual and Developmental Disabilities, 51*(1), 33-47.

Hsieh, K., Heller, T., & Miller, A. B. (2001). Risk factors for injuries and falls among adults with developmental disabilities. *Journal of Intellectual Disability Research, 45*(Pt 1), 76-82.

Hsieh, K., Rimmer, J., & Heller, T. (2012). Prevalence of falls and risk factors in adults with intellectual disability. *American Journal on Intellectual and Developmental Disabilities, 117*(6), 442-454.

Panel on Prevention of Falls in Older Persons, American Geriatrics Society, & British Geriatrics Society. (2011). Summary of the Updated American Geriatrics Society/British Geriatrics Society clinical practice guideline for prevention of falls in older persons. *Journal of the American Geriatrics Society, 59*(1), 148-157.

Riddle, D. L., & Stratford, P. W. (1999). Interpreting validity indexes for diagnostic tests: an illustration using the Berg balance test. *Physical Therapy, 79*(10), 939-948.

Rikli, R. E., & Jones, C. J. (2001). *Senior fitness test manual*. USA: Human Kinetics.

Rubenstein, L. Z. (2006). Falls in older people: epidemiology, risk factors and strategies for prevention. *Age and Ageing, 35 Suppl 2*, ii37-ii41.

Sackley, C., Richardson, P., McDonnell, K., Ratib, S., Dewey, M., & Hill, H. J. (2005). The reliability of balance, mobility and self-care measures in a population of adults with a learning disability known to a physiotherapy service. *Clinical Rehabilitation, 19*(2), 216-223.

Sherrard, J., Tonge, B. J., & Ozanne-Smith, J. (2001). Injury in young people with intellectual disability: descriptive epidemiology. *Injury Prevention, 7*(1), 56-61.

Teixeira-Leite, H., & Manhaes, A. C. (2012). Association between functional alterations of senescence and senility and disorders of gait and balance. *Clinics (Sao Paulo, Brazil), 67*(7), 719-729.

Wagemans, A. M. A., & Cluitmans, J. J. M. (2006). Falls and Fractures: A Major Health Risk for Adults with Intellectual Disabilities in Residential Settings. *Journal of Policy and Practice in Intellectual Disabilities, 3*(2), 136-138.

Wang, C. Y., Hsieh, C. L., Olson, S. L., Wang, C. H., Sheu, C. F., & Liang, C. C. (2006). Psychometric properties of the Berg Balance Scale in a community-dwelling elderly resident population in Taiwan. *Journal of the Formosan Medical Association, 105*(12), 992-1000.

Wang, D., McDermott, S., & Sease, T. (2002). Analysis of hospital use for injury among individuals with mental retardation. *Injury Control and Safety Promotion, 9*(2), 107-111.

Waninge, A., van Wijck, R., Steenbergen, B., & van der Schans, C. P. (2011). Feasibility and reliability of the modified Berg Balance Scale in persons with severe intellectual and visual disabilities. *Journal of Intellectual Disability Research, 55*(3), 292-301.

Willgoss, T. G., Yohannes, A. M., & Mitchell, D. (2010). Review of risk factors and preventative strategies for fall-related injuries in people with intellectual disabilities. *Journal of Clinical Nursing, 19*(15-16), 2100-2109.

Williams, J., Kool, B., Robinson, E., & Ameratunga, S. (2012). Longer term health of young and middle-aged adults following unintentional falls at home resulting in hospitalisation. *Injury, 43*(1), 103-108.

World Health Organization. (1995). *Physical status: The use and interpretation of anthropometry. WHP Technical Report Series 854.* Geneva. Switzerland: World Health Organization.

World Health Organization. (1996). *ICD-10 Guide for Mental Retardation*. Geneva, Switzerland: World Health Organization.

World Health Organization. (2008). *WHO global report on falls prevention in older age*. Geneva, Switzerland: World Health Organization.