Journal of Rehabilitation Practices and Research

Comparison of the Validity of the Timed Up and Go Test (TUG) and Activities-specific Balance Confidence Questionnaire (ABC) to the 'Gold Standard' Berg Balance Scale (BBS) in Assessing Fall Risk in the Elderly Population

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Article Details
Article Type: Research Article
Received date: 05th July, 2022
Accepted date: 02nd August, 2022
Published date: 04th August, 2022

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Citation: Leger, H., Tittle, R., Dowdell, S., & Thompson, C., (2022). Comparison of the Validity of the Timed Up and Go Test (TUG) and Activities-specific Balance Confidence Questionnaire (ABC) to the 'Gold Standard' Berg Balance Scale (BBS) in Assessing Fall Risk in the Elderly Population. *J Rehab Pract Res, 3*(2):133. https://doi.org/10.33790/jrpr1100133

Abstract

Background: Falls are ranked as the leading cause of death from unintentional injury among older adults in the United States. Approximately 25% of the older adults in the U.S. experience a fall each year, which leads to excessive healthcare costs. Falls lead to serious injuries such as broken bones and head injuries hospitalizing 800,000 patients a year [1]. Based on those statistics, identifying fall risk accurately and efficiently using balance assessments is pertinent to fall prevention in the geriatric population. Therefore, the purpose of this study is to compare the validity of the Timed Up and Go Test (TUG) and Activities-Specific Balance Confidence Questionnaire (ABC) to the Berg Balance Scale (BBS) in assessing the risk of falls in the elderly population.

Methods: The systematic review was conducted to highlight balance assessments including the Berg Balance Scale, Timed Up and Go Test, and Activities-specific Balance Confidence Questionnaire. Databases used in the electronic search were PubMed, Google Scholar, MedlinePlus, PTNow, PEDro, and EBSCOhost, and parameters were set at studies published from 2010 to 2021. All relevant studies were reviewed by assessing abstracts for inclusion. Studies in which participants completed and were scored on the three balance assessments were included. All participants completing the tests were required to be 65 years of age or older in order for the respective study to be included.

Results: 62 studies were identified for further review after the initial search. After a more extensive screening process, several studies were excluded for reasons such as study design, age of participants, or insufficient testing measures. 16 studies were included for data analysis with a total of 1,376 participants. The validity of the BBS, TUG, and ABC were measured in the 16 studies with strong negative correlation between BBS and TUG (*rho* (22) = -.756, $p < .01$), and moderate positive correlation between BBS and ABC (*rho* (22) = .591, $p < .01$).

Conclusions: The Timed Up and Go test may be an effective and valid tool assessing balance and a participant's fall risk. It has been shown to have a strong correlation with the Berg Balance Scale. Meanwhile, the Activities-specific Balance Confidence Questionnaire, a subjective measure, has a moderate correlation with the Berg Balance Scale indicating that it is capable of identifying fall risk but not as accurately or efficiently as the Timed Up and Go Test. This research advocates for the appropriateness of the TUG test and ABC questionnaire, and therefore widens clinicians' choices of valid balance assessment tools during fall risk examinations.

Keywords: Berg Balance Scale, Timed Up and Go Test, Activities-specific Balance Confidence Questionnaire, Elderly, Balance, Falls

Background

Falls are ranked as the leading cause of death from unintentional injury among older adults in the United States. Approximately 25% of the older adults in the U.S. experience a fall each year, which leads to excessive healthcare costs. Consequently, health-care spending topped $50 billion in 2015 for fall related injuries, 6% of all Medicare payments and 8% of all Medicaid payments [1-3]. Therefore, one would suggest that if this problem is not addressed through improving fall risk assessments and prevention the healthcare cost will continue to climb. Along with an extensive financial burden, falls cause serious injuries for the elderly population. One out of five falls causes a serious injury such as broken bones or a head injury. Also, 3 million older people are treated in the emergency departments for fall-related injuries and 800,000 patients are hospitalized due to a hip fracture or head injury [6]. Every 20 minutes, an older adult dies from a fall [7]. It was reported in 2018 more than 30,000 older adults died from falls, which is approximately 88 older adults every day [8-11]. Based on those statistics, identifying fall risk accurately and efficiently using balance assessments are pertinent to fall prevention in the geriatric population. One would suggest that there is a specific urge for clinicians to improve in identifying fall risk in the geriatric population in order to implement evidence-based interventions to decrease that risk. If the TUG test and the ABC questionnaire are found to be similar in validity to the BBS, both assessments could be used by clinicians in

place of the BBS while yielding similar results. This could also allow for improved time management for the clinician and improved patient adherence. The assessments used in this study included the BBS, TUG, and ABC questionnaire. According to Langley and Mackintosh, the Berg Balance Scale shown in (Figure 1) is considered to be the "gold standard" for assessing balance [12-17]. It involves static and dynamic activities with 14 items that are scored from 0-4 with a total score of 56. It takes 15-20 minutes to administer and has a 91% sensitivity and 82% specificity for older adults [29] and the intraclass correlation coefficient (ICC) is .97 [4,5]. The Timed Up and Go test shown in (Figure 2) assesses balance and strength. The participant is instructed to sit in a straight back armchair and on the command "go" the participant stands up, walks 3 meters at a comfortable safe pace, turns, and returns to the chair and sits down [18-20]. The participant should have one trial run before the timed test, however multiple trials may lead to skewed results. The time to administer the test is less than 3 minutes with a cut-off score of greater than 13.5 seconds in community-dwelling adults [31]. The reliability index is ICC=.90 [5] and it has a 87% sensitivity and specificity [30]. Lastly, the Activities-specific Balance Confidence Questionnaire shown in (Figure 3), is a self- report (subjective) measure of a patient's level of confidence in performing various activities without losing balance or becoming unsteady (balance self-efficacy). It consists of 16 various ambulatory activities, on a 11-point scale, ranging from 0-100% for each of 16 items [21-24]. A score of 0 = no confidence and a score of 100 = complete confidence. 80% equals high level of physical functioning , 50-80% equals moderate level and less than 50% equals low level [25-28]. It has a 84.4% sensitivity & 87.5% specificity, and the cut-off score for fall risk equals less than 67% [16]. The expected outcome for this study is for the findings to demonstrate a strong correlation of the TUG and ABC with the BBS resulting in a significant relationship between the assessments. This could add to the body of knowledge within rehabilitative research on balance assessment tools to detect fall risk in the elderly population. Therefore, the objective of this study is to compare the validity of the Timed Up and Go Test (TUG) and Activities-Specific Balance Confidence Questionnaire (ABC) to the Berg Balance Scale (BBS) in assessing the risk of falls in the elderly population [32-33].

Berg Balance Scale

Name: ---------- Date: ----------
Location: ---------- Rater: ----------

ITEM DESCRIPTION	SCORE(0-4)
Sitting to standing	----------
Standing unsupported	----------
Sitting unsupported	----------
Standing to sitting	----------
Transfers	----------
Standing with eyes closed	----------
Standing with feet together	----------
Reaching forward with outstretched arm	----------
Retrieving object from floor	----------
Turning to look behind	----------
Turning 360 degrees	----------
Placing alternate foot on stool	----------
Standing with one foot in front	----------
Standing on one foot	----------

Total ----------

GENERAL INSTRUCTIONS

Please document each task and/or give instructions as written. When Scoring, Please record the Lowest response category the apples for each item.

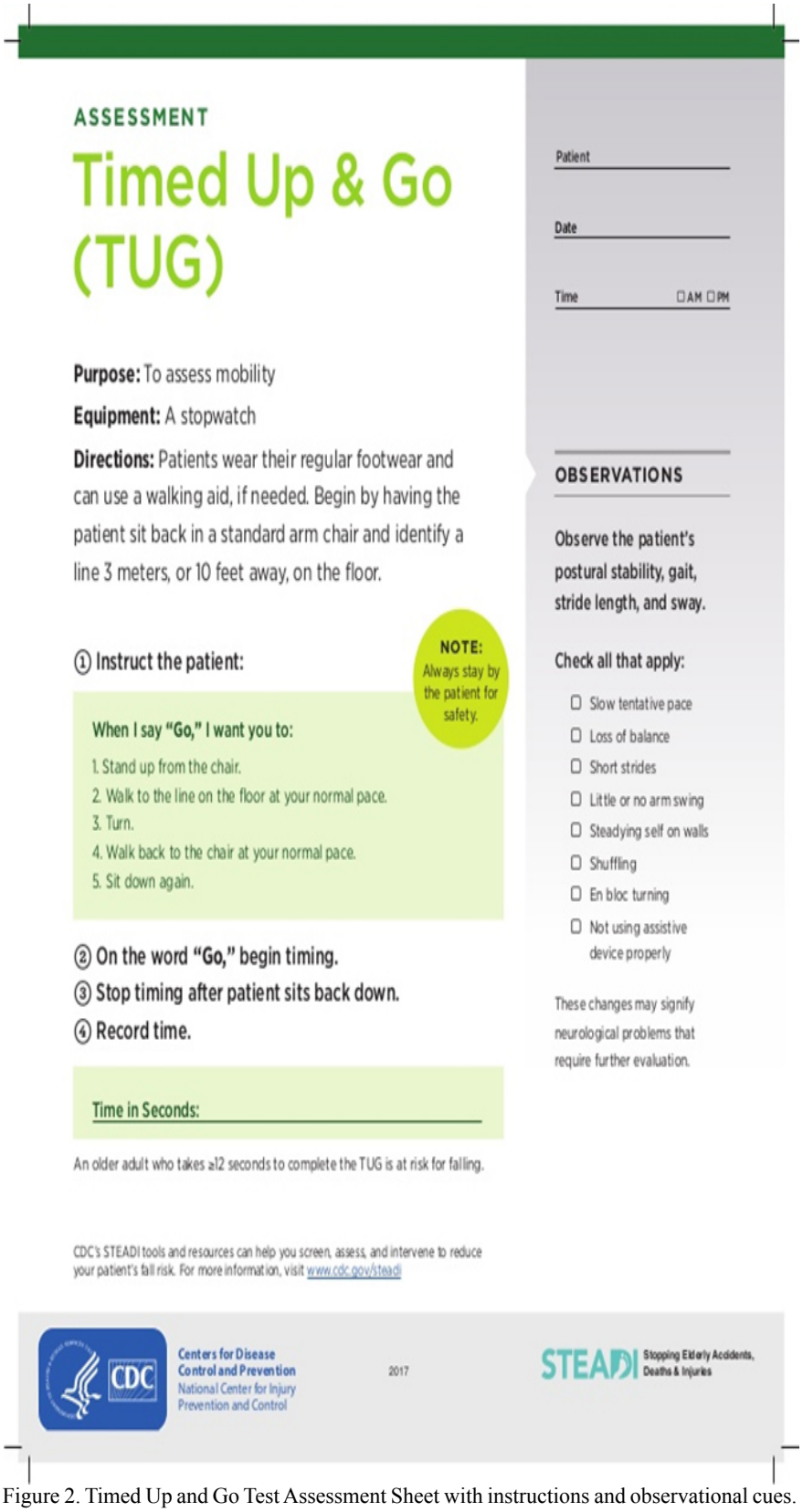
In most items the subject is asked to maintain a given position for a specific time. Progressively More points are deducted if:

- the time or distance requirements are not met
- the subject's performance warrants supervision
- the subject touches an external support or receives assistance from the examiner

Subject should understand that they must maintain their balance while attempting the tasks. The Choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will Adversity influence the performance and the scoring.

Equipment required for testing is a stopwatch or watch with a second hand and a ruler or other Indicator of 2, 5, and 10 inches. Chairs used during testing should be a reasonable height. Either A step or a stool of average step height may be used for item it 12.

Figure 1. Berg Balance Scale Scoring Sheet with description of conditions and general instructions



ASSESSMENT

Timed Up & Go (TUG)

Patient

Date

Time ☐AM ☐PM

Purpose: To assess mobility

Equipment: A stopwatch

Directions: Patients wear their regular footwear and can use a walking aid, if needed. Begin by having the patient sit back in a standard arm chair and identify a line 3 meters, or 10 feet away, on the floor.

NOTE: Always stay by the patient for safety.

① **Instruct the patient:**

When I say "Go," I want you to:

1. Stand up from the chair.
2. Walk to the line on the floor at your normal pace.
3. Turn.
4. Walk back to the chair at your normal pace.
5. Sit down again.

② **On the word "Go," begin timing.**

③ **Stop timing after patient sits back down.**

④ **Record time.**

Time in Seconds: _____

An older adult who takes ≥12 seconds to complete the TUG is at risk for falling.

OBSERVATIONS

Observe the patient's postural stability, gait, stride length, and sway.

Check all that apply:

- ☐ Slow tentative pace
- ☐ Loss of balance
- ☐ Short strides
- ☐ Little or no arm swing
- ☐ Steadying self on walls
- ☐ Shuffling
- ☐ En bloc turning
- ☐ Not using assistive device properly

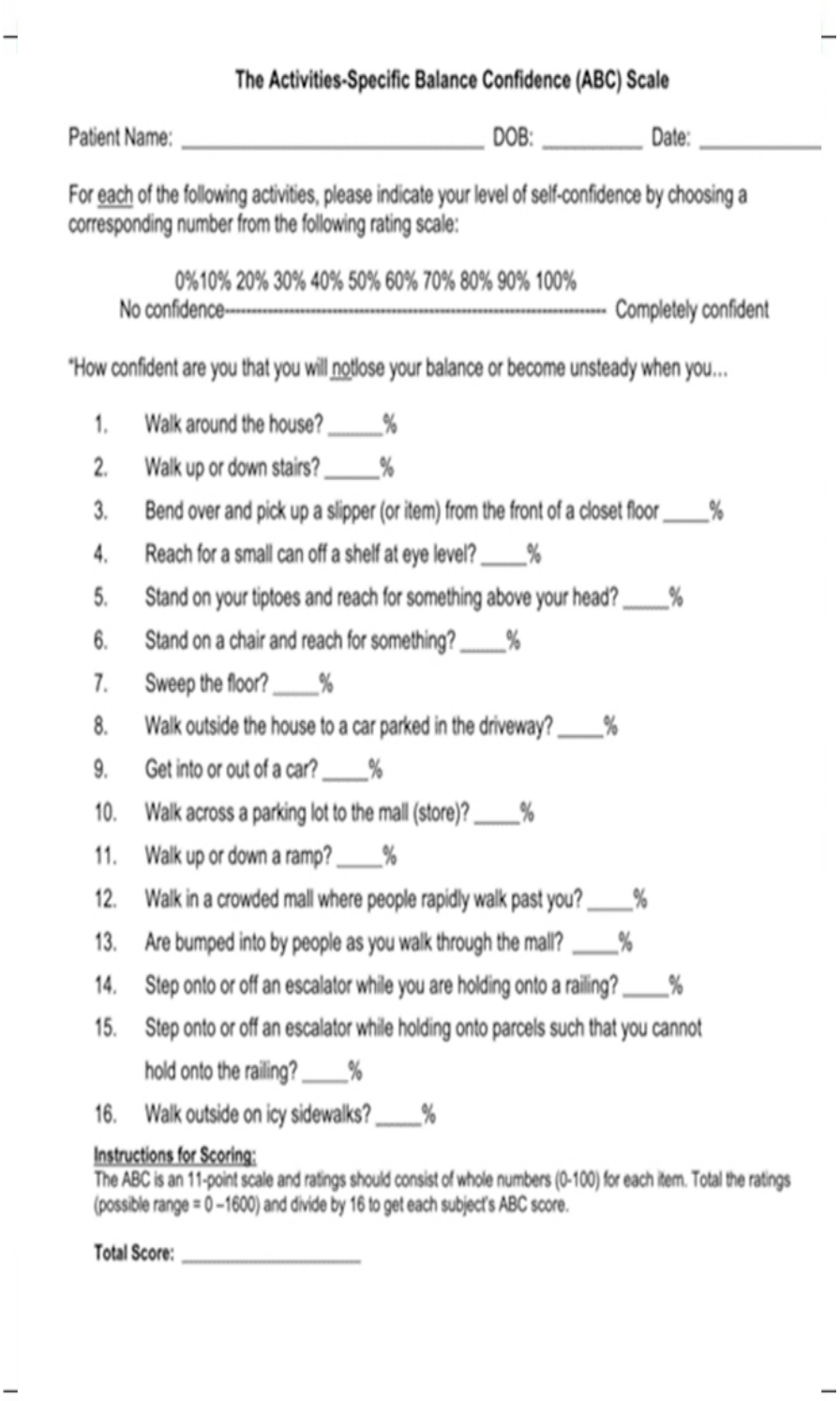
These changes may signify neurological problems that require further evaluation.

CDC's STEADI tools and resources can help you screen, assess, and intervene to reduce your patient's fall risk. For more information, visit www.cdc.gov/steadi

CDC Centers for Disease Control and Prevention National Center for Injury Prevention and Control 2017

STEADI Stopping Elderly Accidents, Deaths & Injuries

Figure 2. Timed Up and Go Test Assessment Sheet with instructions and observational cues.



The Activities-Specific Balance Confidence (ABC) Scale

Patient Name: _____ DOB: _____ Date: _____

For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale:

0%10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
No confidence---------- Completely confident

"How confident are you that you will not lose your balance or become unsteady when you...

1. Walk around the house? _____%
2. Walk up or down stairs? _____%
3. Bend over and pick up a slipper (or item) from the front of a closet floor _____%
4. Reach for a small can off a shelf at eye level? _____%
5. Stand on your tiptoes and reach for something above your head? _____%
6. Stand on a chair and reach for something? _____%
7. Sweep the floor? _____%
8. Walk outside the house to a car parked in the driveway? _____%
9. Get into or out of a car? _____%
10. Walk across a parking lot to the mall (store)? _____%
11. Walk up or down a ramp? _____%
12. Walk in a crowded mall where people rapidly walk past you? _____%
13. Are bumped into by people as you walk through the mall? _____%
14. Step onto or off an escalator while you are holding onto a railing? _____%
15. Step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing? _____%
16. Walk outside on icy sidewalks? _____%

Instructions for Scoring:
The ABC is an 11-point scale and ratings should consist of whole numbers (0-100) for each item. Total the ratings (possible range = 0 –1600) and divide by 16 to get each subject's ABC score.

Total Score: _____

Figure 3. Activities-Specific Balance Confidence Questionnaire Assessment Sheet.

Methods

Search strategy

A literature search was conducted to locate studies that met the eligibility requirements. Databases used in the electronic search were PubMed, Google Scholar, MedlinePlus, PTNow, PEDro, and EBSCOhost, and parameters were set at studies published from 2010 to 2021. Search terms were as follows: Berg Balance Scale, BBS, Timed Up Go, TUG, ABC, elderly, balance. There was no methodological filter used for study design. All relevant studies were reviewed by assessing abstracts for inclusion. The reference lists of each study were also assessed using backwards searching to discover additional relevant articles. The three student researchers conducting this study independently searched the literature and extracted data from the included studies. The final studies included in this review were 100% agreed upon by all three student researchers and the research advisor.

Inclusionary and exclusionary criteria

Studies in which participants completed and were scored on the

three balance assessments were included. All participants completing the tests were required to be 65 years of age or older in order for the respective study to be included. All participants also had to be able to complete each test independently. Studies were excluded if all three tests were not completed or if any alternative form of either test was used. Although a methodological filter was not used in the literature search, studies were excluded from this research if they were designed as systematic reviews or meta-analyses. Studies were also excluded if any of the participants had a cognitive impairment that hindered their participation or if they had undergone any form of lower extremity arthroplasty within the 12 weeks prior to completion of the balance assessments.

Data extraction and analysis

The following information was extracted from each study: number, sex, and mean age of participants with standard deviation, and mean BBS, TUG, and ABC scores with standard deviation. The student researchers independently extracted information from the final studies. Since the tests observed in this review included a combination of ordinal and interval data, a Spearman's rho correlation was utilized to determine the statistical significance of the relationship between tests. Scores of 0 to 0.3 were considered to show no relationship, 0.3 to 0.5 were weak, 0.5 to 0.7 were moderate, and 0.7 and above were strong.

Results

This section will provide an overview of the findings from the systematic review including a summary of the included studies (Table 1) presenting the authors, number of participants, number of male and female participants included in each study, and mean age of participants with standard deviations. The mean scores and standard deviations for the BBS, TUG, and ABC in each included study are provided in (Table 2). The study selection and validity between the balance assessments are also analyzed and reported on.

Studies	Number of Participants	Male	Female	Mean Age (SD)
Anson et al., 2018	16			
Anson et al., 2018	41			
Covill et al., 2017	15	4	11	72.2(7.0)
Covill et al., 2017	17	3	14	75.1 (5.8)
Gras & Rea, 2015	17	5	12	84.59(4.65)
Gras & Rea, 2015	10	2	8	83.40(6.75)
Kwak et al., 2016	15	5	10	80.1(4.7)
Kwak et al., 2016	15	6	9	77.4(5.5)
Kumar et al., 2018	25	16	9	66.64(2.49)
Kumar et al., 2018	25	10	15	68.28(2.92)
Lugade et al., 2014	56	22	34	76.1(6.5)
Tsonga et al., 2016	68	11	57	73.00(5.28)
Mirelman et al., 2012	256	99	156	76.4(4.5)
Balasubramanian et al., 2015	39	13	26	73.3(6.9)
Elboim-Gabyzon et al., 2019	60	26	34	74.1(6.23)
Lurie et al., 2020	253	134	119	78
Lurie et al., 2020	253	134	119	78
Lurie et al., 2013	26	13	13	81.1(6.53)
Lurie et al., 2013	33	11	22	79.2(7.65)
Dorfman et al., 2014	10	3	7	78.1(5.81)
Roller et al., 2018	27	8	19	78.52(7.57)
Roller et al., 2018	28	9	19	76.68(6.79)
Mathis et al., 2019	31	11	20	81.1(8.3)
Balasubramanian et al., 2014	40	14	26	73.3(6.9)

Table 1. Descriptive Data

Studies	Berg Balance Scale (BBS)	Timed-up and Go (TUG)	Activities-specific Balance Confidence Questionnaire (ABC)
Anson et al., 2018	51.5 (5.0)	9.7 (2.6)	82.3 (12.8)
Anson et al., 2018	50.0 (3.0)	11.4 (2.5)	75.0 (25.7)
Covill et al., 2017	45.1 (6.3)	16.1 (6.0)	63.4 (20.3)
Covill et al., 2017	42.1 (10.4)	16.9 (3.8)	49.7 (19.4)
Gras & Rea, 2015	41.6 (4.8)	14.1 (4.3)	72.0 (13.5)

Table 2. to be cont...

Gras & Rea, 2015	40.4 (5.9)	17.2 (8.1)	68.5 (24.3)
Kwak et al., 2016	36.9 (12.9)	11.4 (2.2)	67.0 (14.7)
Kwak et al., 2016	42.0 (8.0)	12.3 (2.0)	70.5 (11.8)
Kumar et al., 2018	35.04 (3.54)	18.56 (2.63)	60.975 (3.125)
Kumar et al., 2018	36.88 (3.24)	19.16 (2.86)	61.95 (3.708)
Lugade et al., 2014	53.4 (3.8)	9.0 (2.0)	85.7 (13.6)
Tsonga et al., 2016	44.29 (5.80)	13.05 (4.13)	63.76 (20.14)
Mirelman et al., 2012	54.19 (2.26)	9.48(1.61)	92.11 (9.89)
Balasubramanian et al., 2015	53.13 (2.53)	10.36 (2.18)	87.76 (12.09)
Elboim-Gabyzon et al., 2019	43.52 (12.45)	15.13 (7.34)	77.5 (24.79)
Lurie et al., 2020	42.7 (7.0)	14.4 (5.3)	62.0 (18)
Lurie et al., 2020	42.5 (7.9)	14.9 (7.0)	61.0 (19.7)
Lurie et al., 2013	45.91 (6.84)	14.64 (8.69)	61.80 (14.87)
Lurie et al., 2013	43.54 (5.90)	14.29 (4.40)	56.55 (16.07)
Dorfman et al., 2014	49.60 (4.45)	12.69 (4.44)	66.37 (16.82)
Roller et al., 2018	50.63 (5.48)	12.84 (4.56)	68.28 (16.67)
Roller et al., 2018	52.11 (3.59)	11.99 (2.49)	66.17 (20.84)
Mathis et al., 2019	45.6 (8.2)	11.4 (4.7)	71.3 (19.5)
Balasubramanian et al., 2014	53.13 (2.53)	10.36 (2.18)	87.76 (12.09)

Table 2. BBS, TUG, and ABC scores for Included Studies

Study Selection

62 studies were identified for further review after the initial search. After a more extensive screening process, several studies were excluded for reasons such as study design, age of participants, or insufficient testing measures. Researchers narrowed it down to 20 studies, and then excluded 4 more: one for utilization of the ABC-Short form, two for insufficient presentation of data, and one for utilization of a modified Berg Balance Scale. 16 studies were included for data analysis with a total of 1,376 participants. The flow of studies is presented in (Figure 4).

Figure 4. Flowchart of Studies Selection

BBS vs. TUG

A Spearman's rho correlation coefficient was calculated for the relationship between participants' BBS and TUG score. A strong negative correlation was found (*rho* (22) = -.756, p < .01), indicating a significant relationship between the two variables. Participants who score higher on the Berg tend to complete the TUG in less time. Details can be found in (Table 3-1).

BBS vs. ABC

A Spearman's rho correlation coefficient was also calculated for the relationship between participants' BBS and ABC scores. A moderate positive correlation was found (*rho* (22) = .591, p < .01), indicating a significant relationship between the two variables. Participants who score higher on the Berg tend to have higher confidence in not losing their balance during activities on the ABC Questionnaire. Details can be found in (Table 3-2).

Correlations				
			BERG	UG
Spearman's rho	BBS	Correlation Coefficient	1.000	-.756**
		Sig. (2-tailed)	.	.000
		N	24	24
	TUG	Correlation Coefficient	-.756**	1.000
		Sig. (2-tailed)	.000	.
		N	24	24
*** Correlation is significant at the 0.01 level (2-tailed).				

Table 3-1. A Spearman's rho correlation between BBS and TUG.

Correlations				
			BERG	ABC
Spearman's rho	BBS	Correlation Coefficient	1.000	.591**
		Sig. (2-tailed)	.	.002
		N	24	24
	ABC	Correlation Coefficient	.591**	1.000
		Sig. (2-tailed)	.002	.
		N	24	24
*** Correlation is significant at the 0.01 level (2-tailed).				

Table 3-2. A Spearman's rho correlation between BBS and ABC.

Discussion

The purpose of this study was to compare the validity of the TUG and ABC to the BBS in assessing fall risk in the elderly population. The researchers hypothesized, when compared, that the TUG and ABC would yield a strong correlation and significant relationship with the BBS. The results of the TUG against the BBS confirmed the hypothesis, as a significant relationship and strong correlation of (-.756) was found. The ABC also was found to have a significant relationship with the BBS but only yielded a moderate correlation of (.591), which did not fully meet the acceptance criteria of the hypothesis. Overall, the results of this study suggest both the TUG and ABC are appropriate in assessing fall risk in the elderly population when compared to the "gold standard" BBS.

There were several limitations found within the current study. The main limitation of this study was the inability to monitor testing. The researchers suspect issues with interrater and intrarater reliability were present. Interrater reliability being that quantifications could not be made regarding administrators performing testing in the same manner, and intrarater reliability being that quantifications could not be made on the consistency of each administrator's performance throughout the study. Due to the ABC being purely a subjective test, the inability to ensure patient honesty when filling out the questionnaire became a limitation. Along with this, patients may have answered based on overconfidence or under confidence and, in general, may have had limited insight into their overall balance abilities. The researchers also found many inconsistencies in the way the TUG was administered, and therefore were not able to identify and further inspect the consistency of the TUG criteria that was used throughout the study.

In today's aging society, fall prevention is likely one of the most important assets in the medical world. In order to provide the best and most appropriate care, clinicians must have adequate tools to assess which older adults are more likely to experience falls and why. The TUG, which takes approximately three minutes to complete, may be used in the place of more invasive and time-consuming tests, such as the BBS, to yield similar results. The ABC is a simple subjective test that can be completed by the patient and may in fact yield similar results to an objective measure such as the BBS.

Future research on the proposed topic could be beneficial by expanding the body of knowledge available for clinicians regarding adequate tools for assessing fall risk. One recommendation the researchers propose is conducting a more detailed and consistent

controlled trial. Researchers performing testing may improve the reliability of testing, particularly interrater reliability, by decreasing the number of administrators and ensuring a standardized method of testing is being used. Though this study is highly generalizable among the geriatric population, which meets the intended purpose, the researchers suggest future research may benefit from testing more specific diagnoses to determine if the findings are applicable to each, therefore incorporating diagnosis homogeneity into the research.

Conclusion

The TUG and ABC each prove to be valid in assessing fall risk in the elderly population and are advantageous because both are time-efficient and easy to administer with very little equipment required. This research advocates for the appropriateness of the TUG test and the ABC questionnaire, and therefore widens clinicians' choices of valid balance assessment tools during fall risk examinations.

Acknowledgement

The authors would like to thank our research advisor, Cody Thompson, PT, DPT, GCS, and Ladarius Woods, PT, DPT, PhD for his assistance in reviewing the paper and data analysis.

Conflict of interest: The authors declare no conflict of interest.

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