

Balance: Tests and Measures

Prior to engaging in an exercise and balance training program, each client should be evaluated to assist the therapist in developing an individualized program to address the specific needs and impairments of that client. In addition to providing baseline information, to guide treatment plans, these tests establish objective measures in which to demonstrate progression overtime towards therapeutic goals. Because sometimes there are variations to these named tests it is important to use the same instructions and set up each time especially when comparing to norm values or re-testing a client. Avoid confusion by documenting the variation you chose.

We do not perform all tests on each client. When choosing a balance test the therapist should consider:

- A test that reflects a similar population
- Easy to perform in your setting and between therapists
- Should be responsive to change
- Should have strong measurement properties
 - Reliability (consistent in testing)
 - Validity (tests what it purposes to test)
 - Large likelihood ratios

Clinical Pearl:

Fatigue will affect how a person performs during balance testing. It is important to note levels of fatigue during testing and when comparing baseline measures to follow up scores. When determining functional impact (especially Medicare G-codes) document and factor in fatigue levels at the time of testing. This is especially relevant if a client is prone to fluctuating fatigue levels, for example, someone with multiple sclerosis.

The following is a list of common balance tests used in a therapy setting.

You can find out more about some of these tests at:

<http://www.rehabmeasures.org>

<http://geriatrictoolkit.missouri.edu/>

Individual/ single tests

Romberg/ Sharpened Romberg (O'Sullivan & Schmitz 2007)

Narrow stance feet together (or tandem stance in sharpened version) eyes open hold 20-30 seconds if minimal sway perform with eyes closed. The test is positive when minimal sway occurs with eyes opened but falls or has significant instability with eyes closed. Positive test is indicative of loss of proprioception.

4-Stage Balance Test:

http://www.cdc.gov/homeandrecreationalafety/pdf/steady-2015.04/4-Stage_Balance_Test_a.pdf

Is part of the CDC program STEADI (Stopping Elderly Accidents, Deaths & Injuries) fall risk checklist. The person is asked to stand in progressively more difficulty positions for 10 seconds, if they are unable to hold tandem stance for more than 10 seconds they are considered at risk for falls.

Sit to stand/ Chair raise test (Jones, Rikli, Beam, 1999)

of times a person with arms across their chest can sit to stand in 30 seconds

13+ = low fall risk, 9-12 = moderate fall risk, 8 or less = high risk

95% of average healthy males age 60-64 perform 23 reps, and females 21 reps

5 rep chair raise variation = time it takes to sit to stand 5 times and compare to norms

For the 5 times sit to stand version when looking at all ages the mean was 7.6 seconds (ranging from 4-16 seconds). For more details, statistics, norms per age and Minimal Detectable change in various patient populations go to:

<http://www.rehabmeasures.org/Lists/RehabMeasures/DispForm.aspx?ID=1015>

Heel Rise Test

Purpose to measure functional strength of the gastroc-soleus muscle group

Standing on non-dominant leg the person is asked to rise up on the ball of the foot at a rate of one rep every 2 seconds. Test is terminated if the person pushes down on tester's hands, the knee flexes or the plantarflexion range decreases more than 50% of the initial range.

Scoring based on 25-45 year olds:

5/5= 25 reps

3/5= able to rise body up one rep

2/5= able to resist maximal manual resistance but unable to achieve a single heel rise.

Step test (2 minute version)

geriatrictoolkit.missouri.edu/cv/2min-step-rikli-jones.doc

The patient raises each knee to a point midway between their patella and iliac crest for 2 minutes. The score is the number of times the right knee reaches the required height. Compare to norms, watch movement and remember this factors in endurance and fitness levels. Take vital signs before and after. In a study by Riki and Jones (1999) a score of less than 65 was associated with lower levels of functional ability.

Variation of step test for testing anticipatory postural adjustments = #12 of the Berg Balance Scale where top score is at least 8 steps in 20 seconds and #12 on the BESTest alternate stair touching where normal is classified as complete 8 steps (6 inch height) in less than 10 seconds.

Four Square step test:

Patient steps over four canes set-up like a cross on the floor with the tips of the canes facing together. Beginning in square one, facing square 2 the subject moves to square number in the following sequence: 2 to 3 to 4 to 1 to 4 to 3 to 2 to 1, facing forward for the whole sequence.

2	3
1	4

Cut off scores:

older adults: > 15 second = at risk for multiple falls

acute stroke: Failed attempt or > 15 seconds = increased risk for falls

Parkinson's: > 9.68 seconds = increased risk for falls

TUG/ Timed Up and Go (Podsiadlo & Richardson, 1991) focuses on functional mobility

Fall risk >13.5 seconds (3 meters/ 9.8 feet)

< 10 seconds = independent

20-29 sec = normal for frail or disabled

>30 sec dependent in mobility and ADL

Minimal detectable change in Parkinson's disease 3.5 seconds/ in chronic stroke 2.9 seconds

Norms for community dwelling healthy individuals

TUG Normative Data for Community-Dwelling Adults:					
Age	Gender	n	Mean	SD	95% CI
60-69	Male	15	8	2	7-9
	Female	22	8	2	7-9
70-79	Male	14	9	3	7-11
	Female	22	9	2	8-10
80-89	Male	8	10	1	9-11
	Female	15	11	3	9-12

Timed Up and Go Cognitive or Dual Task TUG

Individuals were asked to complete the test while counting backward by threes from a randomly selected number between 20 and 100.

Elderly subjects who completed the TUG (Cognitive) in > 15 seconds were classified as fallers with an overall correct prediction rate of 87%.

Dual task with TUG enhanced identification of fall risk in people with PD. (Vance et al. *Physical Therapy*, January 2015). The cutoff score in this study for the TUG-cognitive was 14.7 seconds and was better at discriminating between fallers and non-fallers in individuals with PD compared to the original TUG test.

SLS (Briggs et al. 1989)

Standing on one leg with arms crossed over chest for time.

Item # 14 on Berg but can be a quick test by itself (> 10 seconds is highest score on Berg)

Compare to norms. When testing persons age 60-86 years old the average time was 20 seconds for whole group. However time decreased with age and average for age groups spanned 11-38 seconds.

Note the quality of the test and stability not just the amount of time.

Functional Reach Test:

- The patient is instructed to stand close to, but not touching, a wall and position the arm that is closer to the wall at 90 degrees of shoulder flexion with a closed fist
- The assessor records the starting position at the 3rd metacarpal head on the yardstick
- Instruct the patient to "Reach as far as you can forward without taking a step"
- The location of the 3rd metacarpal is recorded
- The difference between the start and end position is the reach distance, usually measured in inches
- Three trials are done and the average of the last two is noted

Interpretation

Normal 15 inches

< 10 inches: increased risk of fall

5 inches: x 5 increased risk of fall

For every inch less than 10 x 1 increased risk of fall

Multi-task tests

Berg Balance Scale *multi-task test with 6 static and 8 dynamic tests focus on maintenance of position and postural adjustment to voluntary movement. A predictor for falls in the elderly.*

< 45 = risk for falling

< 36 fall risk for falling within 6 months close to 100%

< 48 threshold for those safe, independent ambulators vs. those who may require assistive device/ supervision

Declining score between 46-54, 1 point drop increase fall risk 6-8%

Maximum score 56

POMA (Tinetti) Performance Oriented Mobility Assessment

Lower reliability compared to Berg

Predictive of falls in the elderly (especially for those in long term care)

>24 low risk of falls

19-24 moderate risk for falls

18 > high risk for falls

Max score 28

Focus on maintenance of position, postural response to voluntary movement, postural response to perturbation, and gait mobility.

Dynamic Gait Index (Shumway-Cook & Woollacott 2001)

Designed to test eight facets of gait. 8 item index is based on rating gait performance from 0-3 with maximum score of 24.

Score < 19 on the 8 item test indicates the person is at risk for falls

Score > 22 = safe ambulator

Minimal detectable change in Parkinson Disease is 2.9 points/ Multiple Sclerosis 4.19-5.54 points/ Stroke 4 points and vestibular disorders 3.2 points

Sensitive in predicting likelihood of falls with older adults and individual with vestibular dysfunction

Clinical Test for Sensory Integration in Balance (CTSIB): Study by Woollacott et al. (1986), found healthy older adults do not sway significantly more than young people where there is a reduction in the availability or accuracy of a single sense for postural control. However in contrast to younger adults reducing the availability of two senses appears to have a significant effect on postural steadiness in even apparently healthy older adults. Further investigation found possible early CNS dysfunction

The test provides a generalized assessment of how well a patient can integrate various senses in respect to balance and compensate when one or more is compromised.

The test involves a series of tests with feet together, arms across chest hold 30 seconds, eyes open (EO), eyes closed (EC), and with a visual conflict (dome/ prism goggles) , and same is repeated while the patient is standing on dense foam.

There is a modified version **m-CTSIB** that has eliminated visual conflict condition and is recommended for older community adults.

Condition 1= eyes open firm surface: incorporate visual, vestibular and somatosensory inputs. If accurate info is available to all 3 sensory systems the norm = vary stable. Patient should use ankle strategy.

Condition 2 = eyes closed firm surface: eliminates visual input to evaluate vestibular and somatosensory systems. Somatosensory is the primary input (vestibular is

secondary) high sway indicative of problems with somatosensory input. In normal there is very little difference between condition 1 and 2, again patient should use ankle strategy

Condition 4 = eyes open firm surface: used to evaluate somatosensory interactions with visual inputs. Primary inputs are visual with vestibular secondary. Can bring in hip strategy

Condition 5 = eyes closed foam surface: evaluate somatosensory interactions with vestibular input. Focuses on vestibular input. Again can bring in hip strategy.

Subjects are scored by observing changes in amount of postural sway (or by computerized postural sway equipment)

1= min sway

2 = mild sway

3 = moderate sway

4 = fall

BESS test (Balance Error Scoring System)

Used more in the athletic population and for pre and post-concussion testing. The individual stands under six different conditions with their hands on their hips and eyes closed. Balance is maintained on firm surface then foam surface with narrow stance, single leg stance and tandem stance. For details and norms see the following link:

<http://www.humankinetics.com/excerpts/excerpts/measure-balance-and-stability>

BESTest (Balance Evaluation Systems Test) (Horak, Wrisley, Frank 2009)

There are 28 items with aims to target 6 different balance control systems so that specific rehabilitation approaches can be designed. There is a Mini-BESTest which is a condensed version of 14 items and the Brief-BESTest with only 8 items.

Test items under each system category:

Biomechanical constraints

Base of support

Center of mass alignment

Ankle strength

Hip/ trunk lateral strength*

Sit on floor and stand up

Stability limits/ verticality

Sitting vertically: left right lateral lean

Functional forward reach*

Functional reach lateral

Anticipatory Postural Adjustments

Sit to stand

Rise to toes

Stand on one leg (left and right)*

Alternate stair touching

Standing arm raise

Postural responses

In place response, forward

In place response, backward

Compensatory stepping correction, forward

Compensatory stepping correction, backward

Compensatory stepping correction, lateral (left and right)*

Sensory orientation

Modified CTSIB

Stance on firm surface, eyes open

Stand on firm surface, eyes closed

Stand on foam surface, eyes open

Stand on foam eyes closed*

Incline, eyes closed

Stability in gait

Gait level surface

Change in gait speed

Walk with head turns, horizontal

Walk with pivot turns

Step over obstacles

Timed “get up and go” test

Timed “get up and go” test with dual task*

Items in bold listed above are used in the Mini-BESTest

***indicates test used in the Brief-BESTest**

If a patient shows difficulty in one section therapy should not be limited to practicing the specific tasks that were difficult for the patient but should aim therapeutic tasks and exercises at the underlying system deficit

Although each section is to help identify a specific sub-system affecting a person’s balance, remember each test may involve more than one system and a single pathology can have interaction among systems.

For more information and copies of the tests: <http://www.bestest.us/>