

Benchmarking Balance Application against the BBS

dated: Monday, 7 March 2016

Funder: Stannah Stairlifts, Address: Watt Cl, Andover, Hampshire SP10 3SD

Chief Investigator(s): Catherine Holloway

Proposed Research Site: Prince Charles Hospital, NHS Wales

Background Information

More than a third of people over the age of 65 fall every year in the UK and those who fall once are two or three times more likely to fall again¹. Falls represent over half of hospital admissions for accidental injury, particularly hip fracture. Half of those with hip fracture never regain their former level of function and one in five die within three months²

The broad category of gait problems and weakness is the second commonest specific precipitating cause for falls³. Qualitative research conducted by the investigators (Jan 2014 - May 2014) indicates that people do not consider balance health to be an actionable component of their over all health. This is because they do not have the vocabularies or tools to objectively define it on an every day basis. In the clinical setting, balance is often assessed through qualitative tests like a Berg Balance Test.

'Project Balance' aims to make balance an actionable component of an individuals health, allowing a long term intervention via a monitoring and training of balance health much before a fall happens. The balance application provides a Sway Score (calculated on the basis of RMS), information about symmetry (which side is stronger?) and distribution of sway path (whether there is more movement in the anterior posterior plane or the media lateral)

Towards this end, we have designed an iOS application and a belt. The phone is kept stable against the lower back of the participant using the belt. The application turns on the accelerometer in the phone to sample acceleration along x (media lateral) and z (anterior posterior) axis. These displacements from the mean are used to calculate the Root Mean Square of a person which acts a proxy score for Postural Sway. (Postural sway is defined as the phenomenon of constant displacement and correction of the position of the center of gravity within the base of support. It is typically measured on Force Platforms and has been found to be a predictor of falls.⁴) To calculate symmetry, combined RMS (media lateral and anterior posterior) of the left leg is compared to the combined RMS of the right leg.

Studies in the past have compared the use of accelerometers to the use of the clinical measured of Timed Up (TUG) test and Berg Balance Scale (BBS) in the assessment of postural stability and indicated that there is a high correlation between BBS, TUG and Accelerometry. Accelerometry has also found to be able to distinguish between sway responses to differing balancing conditions and between fallers and non-fallers.⁵

Goals and objectives

¹ Department of Health (2009). Falls and fractures: effective interventions in health and social care. London: Department of Health, available at: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_103146

² Age UK (2012) Don't mention the f-word, available at: www.ageuk.org.uk/professional-resources-home/services-and-practice/health-and-wellbeing/falls-prevention-resources/

³ Rubenstein, L. Z. (2006). Falls in older people: epidemiology, risk factors and strategies for prevention. Age and ageing, 35(suppl 2), ii37-ii41. Chicago

⁴ Pajala, S., Era, P., Koskenvuo, M., Kaprio, J., Törmäkangas, T., & Rantanen, T. (2008). Force platform balance measures as predictors of indoor and outdoor falls in community-dwelling women aged 63–76 years. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 63(2), 171-178. Chicago

⁵ O'Sullivan, Maura, Catherine Blake, Conal Cunningham, Gerard Boyle, and Ciarán Finucane. "Correlation of accelerometry with clinical balance tests in older fallers and non-fallers." Age and ageing 38, no. 3 (2009): 308-313.

We are interested in testing the efficacy of our iOS application with physiotherapy patients between the ages of 18-69

at the Prince Charles Hospital under the Cwm Taf University Health Board. The study would last for two weeks.

Participants who are being administered the Berg Balance Test by a trained physiotherapist would be simultaneously

tested on the iOS application while wearing a belt.

In this study, the iOS application will be placed at the back of the subject at the approximate height of the centre of mass.

The aims of the study are:

Primary: To examine the correlation between the Berg Balance Scale and the iOS application

Secondary: To understand the perception of Balance Health amongst the cohort of the participants who are going to a physiotherapist.

Study Design

Participants will be tested on all 14 measures of the Berg Balance Scale. Simultaneous measurements with the iOS application will be taken for the the following measures of Berg Balance Test:

STANDING UNSUPPORTED (No 2)

STANDING UNSUPPORTED WITH EYES CLOSED (No 6)

STANDING UNSUPPORTED WITH FEET TOGETHER (No 7)

STANDING UNSUPPORTED ONE FOOT IN FRONT "Tandem" (No 13)

STANDING ON ONE LEG "Unipedal" (No 14)

The results will be calculated to give a balance assessment of the individual.

We aim to ask two qualitative questions to understand the participants:

- a) Self Assessment of importance of balance in their daily life
- b) Self Assessment of scope of improvement in their balance

Number of Subjects

15 - 20 participants Between the ages of 18 - 69, Impairments including : Ankle injures, Knee Replacements, Hip Replacements, Knee injuries, ligament tears etc.

Subjects will be excluded from participation if they have peripheral neuropathy (clinically diagnosed or if they had symptoms of numbness/tingling in the lower extremities); pain of any level presenting simultaneously in both lower extremities; or unilateral lower extremity pain >3 on the 11 point visual analog (box) scale.

Pregnant women will be excluded.

Duration of Study

Each participant will be allocated 45 minutes for briefing and testing. Hence for a sample size of 20, we should allocate 2 days for the testing to take place.

Methodology

The phone will be secured to the participants using a custom made belt (Image 1) as close to the centre of gravity as possible.



The berg balance test will be conducted in the approved order. While conducting No 2, No 6, No 7, No 13 and No 14, the following instructions will be given and simultaneous measurements would take place on the iOS device.

STANDING UNSUPPORTED

Please stand with feet hip width apart. Please relax your hands at your sides, look straight ahead and stand as still as possible.

STANDING UNSUPPORTED WITH EYES CLOSED

Please stand with feet hip width apart. Please relax your hands at your sides, and close your eyes.

STANDING UNSUPPORTED WITH FEET TOGETHER

Please stand with feet together. Please relax your hands at your sides, look straight ahead and stand as still as possible.

STANDING UNSUPPORTED ONE FOOT IN FRONT (L)

Please place the heel of the right foot in front of the left foot. Both feet should be in line with each other. Please relax your hands at your sides, look straight ahead and stand as still as possible.

STANDING UNSUPPORTED ONE FOOT IN FRONT (R)

Please place the heel of the left foot in front of the right foot. Both feet should be in line with each other. Please relax your hands at your sides, look straight ahead and stand as still as possible.

STANDING UNSUPPORTED ONE FOOT IN FRONT (L)

Stand with your feet together. Please raise the heel of your left foot a few inches of the ground. Please relax your hands at your sides, look straight ahead and stand as still as possible.

STANDING UNSUPPORTED ONE FOOT IN FRONT (R)

Stand with your feet together. Please raise the heel of your right foot a few inches of the ground. Please relax your hands at your sides, look straight ahead and stand as still as possible.

After each session, the files from the phone application will be exported to email. The files will record the

Row Labels	Left Leg		Right Leg	
	X Axis (ML)	Y Axis (AP)	X Axis (ML)	Y Axis (AP)
0	-0.6608228	-0.0235815	0.0154962	-0.4309662
1	-0.7846021	-0.1902075	0.2321100	-0.5238007
2	-0.6155957	-0.1211768	0.2249689	-0.4642914
3	-0.4727734	-0.2140112	0.0940485	-0.5476044

displacements in the following format:

RMS would be subsequently calculated by first, converting the uniaxial acceleration values into displacements from centre by subtracting the overall mean uniaxial acceleration value from each individual value. Next, these displacement values would be squared and the mean of these would be taken. Finally the square route would be taken of this mean.

Safety Considerations and Follow up

All participants would be provided with a chair on the side, incase they need support. Adequate instructions during recruitment will be provided to ensure they are aware of the tests to follow. During Follow up, participants would be informed about their balance scores and given a link with videos to improve their balance : www.balancetrainer.co.uk

Expected Outcomes of the Study

If there is found to be a high co-rrleation between the BBS and the iOS device scores, attempts will be made to secure i4i funding to conduct a trial with members of the target group i.e. individuals over the age of 60.

Informed Consent Forms

A specifically tailored informed consent form will be provided for the participants.