

# Use and validation of the Balance Outcome Measure for Elder Rehabilitation in acute care

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## ABSTRACT

This paper reports on the concurrent validity of the Balance Outcome Measure for Elder Rehabilitation (BOOMER) while investigating balance, mobility, and perceived confidence to undertake daily activities experienced by patients at discharge from an Internal Medicine Unit; and seeks to determine if there are differences between patients discharged to rehabilitation to those discharged to their usual residence. Forty-four adults (30 female) average age 77 (SD 7) years, admitted with an acute illness to hospital consented to participate in this study. Balance was measured using the BOOMER and the Berg Balance Scale (BBS). Mobility was measured using the de Morton Mobility Index (DEMMI) and participants' perceived confidence in balance to undertake daily activities determined using the Activities-specific Balance Confidence (ABC) scale. BOOMER scores were highly associated with BBS scores ( $r = .93$ ,  $p < 0.001$ ) and raw DEMMI scores ( $r = .89$ ,  $p < 0.001$ ) while moderate associations with perceived confidence ( $r > .52$ ,  $p < 0.001$ ) were determined. Participants discharged to their usual residence had significantly higher balance and mobility scores compared to those requiring further rehabilitation; no difference was found for ABC scores. Concurrent validity of the BOOMER, BBS and DEMMI was established, supporting use of these tools to measure balance and mobility of patients at discharge from acute care.

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## INTRODUCTION

Following hospitalisation for an acute illness many older adults experience functional decline (Covinsky et al 2003). This decline is likely multifactorial in nature; associated with the reason for the hospital admission, the subsequent reduced activity levels (Kuys et al 2012) and the patient's pre-existing functional level (Buttery and Martin 2009). Typically, acute care wards are not set up to offer extensive rehabilitation to ameliorate this functional decline. In fact, a recent study highlighted the difficulties associated with implementing an exercise programme in an acute care setting (Brown et al 2006). In addition, there appears to be a perception among staff and patients, that neither is interested in the patient getting up and out of bed (Brown et al 2007). Although an association between perceived confidence, balance, and mobility has been established for community dwelling older adults (Hatch et al 2003), the association between older adults perception of their confidence in their balance to perform everyday tasks when hospitalised with an acute illness has

not been investigated. For those who experience the greatest functional decline or are at greatest risk of functional decline, early transfer to inpatient rehabilitation is the preferred option to maximise functional ability and minimise activity limitations.

One simple strategy associated with improved clinical outcomes, shorter length of stay (Harari et al 2007), and greater likelihood of remaining living at home in 12 months (Barer 2011) is the use of a comprehensive geriatric assessment for older adults hospitalised with an acute illness. It appears that such assessments result in early and appropriate geriatric intervention and management and have been associated with health outcomes such as mortality, functional decline, and quality of life (Abellan van Kan et al 2009; Graham et al 2008). Mobility and balance are key elements of a comprehensive geriatric assessment (Hubbard et al 2011). Using tools that measure balance and mobility and differentiate between those patients requiring further inpatient rehabilitation from those able to be discharged to their usual residence would help staff in acute medical settings prioritise use of resources.

The Berg Balance Scale (BBS) was originally developed as a clinical balance measure specific for older adults (Berg et al 1989). Despite its use in acute care settings (Graham and Norton 1999, Wee 2003), clinical utility of the BBS has been questioned with up to 20 minutes required to complete the measure (Blum and Korner-Bitensky 2008) and a lack of meaningfulness of the scores (Downs et al 2013) potentially limiting its use. Two recently developed tools of mobility and balance specifically target older hospitalised inpatients. The de Morton Mobility Index (DEMMI) comprises 15-items measuring mobility of all older adults regardless of mobility status (de Morton et al 2008). The Balance Outcome Measure for Elder Rehabilitation (BOOMER) (Haines et al 2007, Kuys et al 2011) appears to be a valid measure of the standing balance construct comprising common measures of static stance (feet together eyes closed) (Cohen et al 1993), functional reach (Duncan et al 1990), step test (Hill et al 1996) and timed up and go test (Podsiadlo and Richardson 1991). The BOOMER which can be administered in approximately 5 minutes, has been previously validated for use with geriatric rehabilitation inpatients (Kuyss et al 2011) but further testing is required in the acute in-patient setting. It is not known if the BOOMER is valid to use in an acute care setting and if it is able to differentiate between the balance and mobility of patients able to be discharged to their usual residence compared to those requiring further inpatient rehabilitation.

The main purpose of this study was to determine concurrent validity of the BOOMER with measures of balance, mobility, and patients' perception of confidence in their balance to undertake daily activities at discharge from an Internal Medicine Unit. A second purpose was to determine if balance, mobility, and perceived confidence differed between older adults requiring inpatient rehabilitation and those discharged to their usual residence.

## METHOD

A prospective cohort study was conducted over a six month period with a convenience sample of acute inpatients discharged from the Internal Medicine Unit of a tertiary referral teaching hospital in Brisbane, Australia. This Internal Medicine Unit comprised 76 beds across three wards. Typically patients admitted were at least 65 years old with a range of diagnoses including falls and related injuries, dementia and/or delirium, chronic diseases or acute infections such as urinary tract infections (Kuyss et al 2012). Institutional Ethics Committees approved this study and all participants provided written informed consent.

Participants were eligible to be recruited to this study if aged at least 65 years old, scored at least 24 on the Mini Mental State Exam (Folstein et al 1975) and were discharged to their usual residence or inpatient rehabilitation. Patients were excluded if they were unable to provide informed consent. Participants were assessed within 48 hours prior to hospital discharge by a blinded assessor who was not involved in the care of the patient. Assessments were conducted over two days to minimise the effect of fatigue. Clinical information and demographics were recorded on the first day, along with the DEMMI assessed at the bed side. Perceived confidence (ABC) and balance measures (BBS and BOOMER) were assessed on the second

day. Relevant clinical and demographic information recorded included age, sex, admission diagnosis, home support at admission, falls history in last 6 months, length of hospital stay, and discharge destination to inpatient rehabilitation or to usual residence.

Balance was measured using the BOOMER and the BBS. Mobility was measured using the DEMMI and perceived confidence determined using the Activities-specific Balance Confidence (ABC) scale. The BOOMER includes four balance measures - static stance with feet together and eyes closed, functional reach, step test and the timed up and go - with the performance of each task rated (0-4) resulting in a maximum possible score of 16 (Haines et al 2007). The BBS comprises 14 items of static and functional balance tasks, scored on a five-point scale with a maximum score of 56 (Berg et al 1992, Berg et al 1996). The DEMMI, developed and validated for use with older patients in acute medical inpatient settings (de Morton et al 2008, de Morton et al 2010, de Morton et al 2011), comprises 15-items including bed mobility, sitting balance, static and dynamic standing balance, and walking. The tool is scored out of 19 and this score is then converted to an interval scale ranging from 0 to 100. The ABC scale (Myers et al 1998, Myers et al 1996, Powell and Myers 1995) includes 16 everyday tasks with participants required to identify their perceived confidence to undertake these tasks (0-100%) with a maximum score of 100% able to be calculated.

## Data analysis

Descriptive analyses were conducted for all measures at discharge from the Internal Medicine Unit. Concurrent validity of the BOOMER with the BBS and the DEMMI was determined using correlational analyses. A clinically meaningful result was determined a priori as achieving a correlation coefficient of at least 0.7, which has been suggested to demonstrate evidence of validity between measures of a similar construct (Fitzpatrick et al 1998). Differences in balance, mobility, and perceived confidence for those participants discharged to their usual residence compared with those requiring inpatient rehabilitation were determined using independent t-tests or nonparametric equivalent as necessary. Balance and mobility measures were also correlated with perceived confidence. Data were analysed using SPSS Statistic Package, V19.0. Significance was set at 0.05.

## RESULTS

### Participant characteristics

Forty-four patients consented to participate in this study across the study period; 14 males and 30 females (Table 1). The most common reason for admission was falls, with more than one-third of recruited patients admitted following a recent fall. Approximately 70% of participants (n = 31) were discharged to their usual residence, three of whom received domiciliary rehabilitation, and 30% were discharged to inpatient rehabilitation. Participants discharged to inpatient rehabilitation were significantly more likely to have had a fall as the reason for their hospital admission than those discharged to their usual residence (Chi Square 7.452, p <0.001). The average (SD) length of stay for the entire cohort was 9 (5) days.

**Table 1: Participant characteristics**

Characteristic	All participants (n = 44)	Discharged to usual residence (n = 31)	Discharged to inpatient rehabilitation (n = 13)
Sex n (%)			
Males	14 (32)	13 (30)	1 (2)
Females	30 (68)	18 (41)	12 (27)
Age (years) Mean (SD)	77 (7)	78 (7)	77 (8)
Diagnosis, n (%)			
Falls	16 (36)	7 (16)	9 (21)
Geriatric condition including delirium, malaise, Reduced mobility	10 (23)	6 (14)	2 (5)
Pneumonia	5 (11)	5 (11)	0
Other	13 (30)	10 (23)	3 (7)
Residence on admission, n (%)			
Home alone	23 (52)	18 (41)	5 (11)
Home with carer / spouse	15 (34)	9 (20)	6 (14)
Low-level Aged Care Facility	6 (14)	4 (9)	2 (5)
Falls history			
None in last 6 months	17 (39)	16 (32)	1 (2)
At least one fall in last 6 months	27 (61)	15 (34)	12 (27)
Length of stay / Days Mean (SD)	9 (5)	8.7 (5.4)	8.6 (4)
Mini Mental State Exam /30 Mean (SD)	27 (2)	27 (2)	26 (2)

**Validity of using the BOOMER in acute care setting**

BOOMER scores were significantly associated with BBS ( $\rho = .93, p < 0.001$ ), raw DEMMI ( $\rho = .89, p < 0.001$ ) and converted DEMMI scores ( $\rho = .82, p < 0.001$ ) when both tools were applied in the acute care setting. Balance performance measured using the BOOMER and the BBS achieved moderate, but significant associations with ABC scores relating to perceived confidence to carry out everyday tasks ( $\rho > .55, p < 0.001$ ).

**Balance, mobility, and perceived confidence at discharge**

Table 2 illustrates participant balance, mobility, and perceived confidence scores to carry out everyday tasks of participants discharged to their usual residence compared to those discharged to inpatient rehabilitation. Those participants discharged to their usual residence had significantly higher DEMMI and balance (BBS and BOOMER) measures but had similar scores on the ABC compared to those referred for inpatient rehabilitation services.

**Patients hospitalised following a fall**

Given the high proportion of fallers admitted to hospital compared to those with other medical reasons for their hospital admission, further analyses were undertaken for the two groups. Table 3 shows the differences between balance, mobility, and perceived confidence scores for these groups of participants. Significantly lower scores for all measures were found for those adults living in community who had recently had a fall which required them to be admitted to hospital.

**DISCUSSION**

This study determined that the BOOMER was valid to use in an acute care setting with hospitalised older adults. The BOOMER has not previously been used in an acute care setting although discharge scores were similar to those reported for patients discharged from an inpatient rehabilitation unit (Kuys et al 2011, Haines et al 2008). In line with the DEMMI and BBS, the BOOMER differentiated between patients discharged to their usual residence compared to those discharged to inpatient rehabilitation; supporting the view that the tool has concurrent validity in an acute care setting. This view is further supported by the very high correlations between BOOMER scores with BBS and DEMMI scores. Thus the BOOMER could be recommended for use in the acute care setting as a tool to guide referral for rehabilitation or to determine those who could safely be discharged to their usual residence with recommendations to access community based education and falls prevention programmes.

Unexpectedly we determined that significant balance and mobility deficits were experienced by this group of older adults on discharge from an acute care medical inpatient setting. Balance performance in our study cohort was quite limited considering the BBS score (median 37, IQR 24-47), even for those discharged to their usual residence (BBS 43, IQR 31-49). Previous studies have reported that a BBS score of 45 or lower is indicative of a falls risk for older adults hospitalised in acute care settings (Scott et al 2007) as well as community-dwelling older adults (Perell et al 2001). Indeed a recent study reported that many older adults with BBS scores above 45 still have falls

**Table 2: Participant balance, mobility, and perceived confidence scores at discharge to carry out everyday tasks**

Measures	All participants (n = 44)	Discharged to usual residence (n = 31)	Discharged to inpatient rehabilitation (n = 13)
de Morton Mobility Index raw / 19: Median (IQR)*	14 (9-16)	15 (12-16)	7 (3-10)
DEMMI scaled / 100%: Mean (SD)*	50 (19)	57 (14)	732 (19)
Berg Balance Scale /56: Median (IQR)*	37 (24-48)	43 (31-49)	16 (5-30)
Balance Outcome Measure for Elder Rehabilitation /16: Median (IQR)*	8 (5-12)	10 (6-12)	1 (0-6)
Activities Balance Confidence Scale /100: Mean (SD)	65 (21)	67 (20)	59 (25)

IQR: Interquartile range

\* Statistical significant difference between those discharged to their usual residence compared to those discharged to inpatient rehabilitation,  $p < 0.001$ .

**Table 3: Participant balance, mobility, and perceived confidence scores at discharge for patients grouped by reason for admission (admission following a fall or management of an acute medical condition)**

Outcome Measures	Patients admitted to hospital following a fall (n = 16)	Patients admitted for management of an acute medical condition (n = 28)
de Morton Mobility Index raw / 19: Median (IQR)*	9 (6-12)	15 (13-16)
de Morton Mobility Index scaled / 100: Mean (SD)*	38 (12)	56 (19)
Berg Balance Scale /56: Median (IQR)*	24 (7-30)	43 (33-50)
Balance Outcome Measure for Elder Rehabilitation /16: Median (IQR)*	4 (0-6)	10 (7-13)
Activities Balance Confidence Scale /100: Mean (SD)*	50 (23)	74 (14)

IQR: Interquartile range

\* Statistical significant difference between those admitted following a fall compared to those admitted for management of an acute medical condition,  $p < 0.001$ .

and suggested that the tool may be better used for predicting multiple falls risk (Muir et al 2008). With approximately one-third of the total study cohort admitted to hospital following a fall, it is not surprising to find that balance performance was impaired. Balance impairment and prevalence of fallers in the study cohort suggest that even those discharged to their usual residence would possibly benefit from education and community based interventions to prevent a fall or recurrent falls.

Unlike the BBS, the BOOMER has not been investigated for its use as a falls prediction tool (Perell et al 2001, Scott et al 2007). Analysis of the balance impairment at hospital discharge of those who presented to hospital following a fall in the current study revealed that BOOMER scores differentiated between those admitted following a fall compared to other medical conditions. It is possible, therefore, that the BOOMER could be a predictive tool for falls within hospitalised and community dwelling older adults. Further prospective work needs to be conducted to investigate this premise.

It is interesting to note that perceived confidence to carry out everyday activities for the total cohort was similar for participants discharged to their usual residence and those transferred for inpatient rehabilitation and well under the reported scores for healthy older adults (Myers et al 1998, Myers et al 1996). It is possible, that these findings are due to our small sample size. However, as the balance and mobility measures were significantly lower for the inpatient rehabilitation group, it is also possible that this group had more insight into their reduced balance control as the majority (70%) were admitted following a fall. It is likely that those admitted for a medical reason – rather than a fall – may be the group with less insight into their balance ability, as those admitted following a fall reported significantly less confidence to carry out everyday tasks and were more likely to be transferred for inpatient rehabilitation than those admitted for a medical reason. The reduced confidence of the faller has been reported (Myers et al 1996), but studies exploring the tendency of the non-faller to overestimate their ability to manage everyday tasks were not



identified. Further research into perceived confidence of people with high medical needs but without a falls history is warranted.

The BOOMER has some potential advantages for use in acute care settings. It is quick and easy to administer (Kuys et al 2011), is able to be used at the bedside, and appears to be able to differentiate between patients requiring inpatient rehabilitation as well those hospitalised following a fall. This makes the BOOMER an attractive measure for use in the acute care setting. Our findings suggest that those hospitalised following a fall, those who achieve a low score on balance and mobility tests towards discharge, and those who perceive reduced confidence to carry out everyday tasks should be considered for rehabilitation. Based on the evidence of our study findings, other patients with medical conditions may manage at home with or without the support of transition care services but would likely benefit from accessing community based education and falls prevention programmes.

Several limitations to this study need to be acknowledged. This study included a small sample of convenience and only participants who were willing and able to consent to participate were included which may limit the generalisation of our findings. We did not track all patients admitted to the Internal Medicine Unit during our recruitment period due to time constraints in this busy setting. The sample recruited to the study however, appears to be representative of those older adults without cognitive decline or dementia admitted to acute care settings. Another limitation to consider is the grouping of those participants discharged to their usual residence but who required domiciliary rehabilitation. A closer look at the balance and mobility measures of these three participants, revealed similar scores to those discharged to usual residence. However, our findings cannot be generalised to those older adults who receive domiciliary rehabilitation following discharge from hospital.

In conclusion, balance and mobility deficits were exhibited by patients discharged from an acute care setting. Those patients discharged to inpatient rehabilitation had greater balance and mobility impairments, yet did not report lower levels of perceived confidence, compared to those discharged to their usual residence. Those participants hospitalised following a fall also experienced greater balance and mobility impairments and also reduced perceived confidence compared to those admitted for some other medical reason. The BOOMER is valid for use in acute care settings; making it an alternative measure to the DEMMI and BBS. Additionally, the BOOMER can also be used to guide the referral process when discharging these older adults.

## KEY POINTS

- The BOOMER is a valid measure for use in an acute care setting and could be used to guide the referral process when discharging these older adults.
- Significant balance and mobility deficits are experienced by older adults discharged from an acute care setting.
- There was no difference in perceived confidence experienced by older adults requiring rehabilitation compared to those discharged to their usual residence suggesting less insight or willingness to acknowledge underlying balance issues

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## REFERENCES

- Abellan van Kan G, Rolland Y, Andrieu S, Bauer J, Beauchet O, Bonnefor M, Cesari M, Donini LM, Gillete Guyonnet S, Inzitari M, Nourhashemi F, Onder G, Ritz P, Salva A, Visser M, Vellas B (2009) Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people. *Journal of Nutrition, Health and Aging* 13:881-889.
- Barer D (2011) Inpatient comprehensive geriatric assessment improves the likelihood of living at home at 12 months. *Annals of Internal Medicine* 155:JC602
- Berg K, Wood-Dauphinee S, Williams JI, Gayton D (1989) Measuring balance in the elderly: preliminary development of an instrument. *Physiotherapy Canada* 41:304-311.
- Berg KO, Wood-Dauphinee SL, Williams JI, Maki B (1992) Measuring balance in the elderly: validation of an instrument. *Canadian Journal of Public Health* 83:57-11.
- Berg K, Norman KE (1996) Functional assessment of balance and gait. *Clinics in Geriatric Medicine* 12:705-723.
- Blum L, Korner-Bitensky N (2008) Usefulness of the Berg Balance Scale in stroke rehabilitation: a systematic review. *Physical Therapy* 88:559-566.
- Brown CJ, Peel C, Bamman MM, Allman RM (2006) Exercise program implementation proves not feasible during acute care hospitalization. *Journal of Rehabilitation Research and Development* 43:939-946.
- Brown CJ, Williams BR, Woodby LL, Davis LL, Allman RM (2007) Barriers to mobility during hospitalization from the perspectives of older patients and their nurses and physicians. *Journal of Hospital Medicine* 2:305-313.
- Buttery AK, Martin FC (2009) Knowledge, attitudes and intentions about participation in physical activity of older post-acute hospital inpatients. *Physiotherapy* 95:192-198.
- Cohen H, Blatchly CA, Gombash LL (1993) A study of the clinical test of sensory interaction and balance. *Physical Therapy* 73:346-351.
- Covinsky KE, Palmer RM, Fortinsky RH, Counsell SR, Stewart AL, Kresevic D, Burant CJ, Landefeld CS (2003) Loss of independence in activities of daily living in older adults hospitalized with medical illnesses: increased vulnerability with age. *Journal of the American Geriatrics Society* 51:451-458.
- de Morton NA, Davidson M, Keating JL (2008) The de Morton Mobility Index (DEMMI): an essential health index for an ageing world. *BMC Health Quality of Life Outcomes* 6:63. doi:10.1186/1477-7525-6-63.
- de Morton NA, Davidson M, Keating JL (2010) Validity, responsiveness and the minimal clinically important difference for the de Morton Mobility Index (DEMMI) in an older acute medical population. *BMC Geriatrics* 10:72. doi:10.1186/1471-2318-10-72.
- de Morton NA, Davidson M, Keating JL (2011) Reliability of the de Morton mobility index (DEMMI) in an older acute medical population. *Physiotherapy Research International* 16:159-169.
- Downs S, Marquez J, Chiarelli P (2013) The Berg Balance Scale has high intra- and inter-rater reliability but absolute reliability varies across the scale: a systematic review. *Journal of Physiotherapy* 59:93-99.
- Duncan PW, Weiner DK, Chandler J, Studenski S (1990) Functional reach: a new clinical measure of balance. *Journals of Gerontology Biological Sciences and Medical Sciences* 45:M192-197.
- Fitzpatrick R, Davey C, Buxton MJ, Jones DR (1998) Evaluating patient based outcome measures for use in clinical trials. *Health Technology and Assessment*: 1-74.
- Folstein MF, Folstein SE, McHugh PR (1975) Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research* 12:189-198

- Graham D, Newton RA (1999) Relationship between balance abilities and mobility aids in elderly patients at discharge from an acute care setting. *Physiotherapy Research International* 4:293-301.
- Graham JE, Ostir GV, Fisher SR, Ottenbacher KJ (2008) Assessing walking speed in clinical research: a systematic review. *Journal of Evaluation in Clinical Practice* 14:552-562.
- Haines T, Kuys SS, Morrison G, Clarke J, Bew P (2008) Balance impairment not predictive of falls in geriatric rehabilitation wards. *Journals of Gerontology Biological Sciences and Medical Sciences* 63:523-528.
- Haines T, Kuys SS, Morrison G, Clarke J, Bew P, McPhail S (2007) Development and validation of the balance outcome measure for elder rehabilitation. *Archives of Physical Medicine and Rehabilitation* 88:1614-1621.
- Harari D, Martin FC, Buttery A, O'Neill S, Hopper A (2007) The older persons' assessment and liaison team 'OPAL': evaluation of comprehensive geriatric assessment in acute medical inpatients. *Age and Ageing* 36:670-675.
- Hatch J, Gill-Body KM, Portney LG (2003) Determinants of balance confidence in community-dwelling elderly people. *Physical Therapy* 83:1072-1079.
- Harari D, Martin FC, Buttery A, O'Neill S, Hopper A (2007) The older persons' assessment and liaison team 'OPAL': evaluation of comprehensive geriatric assessment in acute medical inpatients. *Age and Ageing* 36:670-675.
- Hill KD, Bernhardt J, McGann AM, Maltese D, Berkovits D (1996) A new test of dynamic standing balance for stroke patients: reliability, validity and comparison with healthy elderly. *Physiotherapy Canada* 48:257-262.
- Hubbard RE, Eeles EM, Rockwood MR, Fallah N, Ross E, Mitnitski A, Rockwood K (2011) Assessing balance and mobility to track illness and recovery in older inpatients. *Journal of General Internal Medicine* 26:1471-1478.
- Kuys SS, Dolecka UE, Guard A (2012) Activity level of hospital medical inpatients: An observational study. *Archives of Gerontology and Geriatrics* 55: 417-421.
- Kuys SS, Morrison G, Bew P, Clarke J, Haines TP (2011) Further validation of the Balance Outcome Measure for Elder Rehabilitation. *Archives of Physical Medicine and Rehabilitation* 92:101-105.
- Muir SW, Berg K, Chesworth B, Speechley M (2008) Use of the Berg Balance Scale for predicting multiple falls in community-dwelling elderly people: a prospective study. *Physical Therapy* 88:449-459.
- Myers AM, Fletcher PC, Myers AH, Sherk W (1998) Discriminative and evaluative properties of the activities-specific balance confidence (ABC) scale. *Journals of Gerontology Biological Sciences and Medical Sciences* 53:M287-294.
- Myers AM, Powell LE, Maki BE, Holliday PJ, Brawley LR, Sherk W (1996) Psychological indicators of balance confidence: relationship to actual and perceived abilities. *Journals of Gerontology Biological Sciences and Medical Sciences* 51:M37-43.
- Perell KL, Nelson A, Goldman RL, Luther SL, Prieto-Lewis, N, Rubenstein LZ (2001) Fall risk assessment measures: an analytic review. *Journals of Gerontology Biological Sciences and Medical Sciences* 56A:M761-766.
- Podsiadlo D, Richardson R (1991) The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *Journal of the American Geriatrics Society* 39:142-148.
- Powell LE, Myers AM (1995) The Activities-specific Balance Confidence (ABC) Scale. *Journals of Gerontology Biological Sciences and Medical Sciences* 50A:M28-34.
- Scott V, Votova K, Scanlan A, Close J (2007) Multifactorial and functional mobility assessment tools for fall risk among older adults in community, home-support, long-term and acute care settings. *Age and Ageing* 36:30-139.
- Wee JY, Wong H, Palepu A (2003) Validation of the Berg Balance Scale as a predictor of length of stay and discharge destination in stroke rehabilitation. *Archives of Physical Medicine and Rehabilitation* 84: 731-735.