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The Reliability and Validity of the Elderly Mobility Scale in the Acute Hospital Setting

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ABSTRACT

This study aimed to evaluate the psychometric properties of the Elderly Mobility Scale (EMS) in an acute hospital setting. Intra-rater (n=15) and inter-rater (n=18) reliability were investigated using physiotherapists who viewed and scored video-recorded mobility assessments using the EMS on two occasions, one week apart. Latent class analysis of EMS scores showed that neither the occasion of testing (intra-rater reliability) (R^2=0.0035, p=0.72), therapist (inter-rater reliability (R^2=0.0051, p=1.00), years of experience (R^2=0.0058, p=1.00) nor number of EMS assessments previously completed (R^2=0.0048, p=1.00) had any impact on the EMS scores. The only factor which impacted on clustering was the EMS score (R^2=0.8263, p=0.000). Concurrent validity was assessed by comparison with the Modified Rivermead Mobility Index (MRMI) in patients aged ≥ 55 years (n = 32) and demonstrated that EMS scores were highly correlated with the MRMI (Spearman's ρ=0.887). Therefore intra-rater reliability of the EMS has been reported for the first time, and inter-rater reliability and concurrent validity of the EMS have been further supported and extended into a younger patient group for mobility assessment in acute hospital patients.

INTRODUCTION

In the acute hospital setting, physiotherapists are frequently required to assess older patients' mobility, specifically their ability to move between and maintain postures as required to complete activities of daily living.[1,2] Regaining functional mobility is often a patient's primary goal following hospitalization and is a critical factor in discharge planning.[1,3]

A clinically convenient and psychometrically sound mobility outcome measure has the potential to support high quality patient care by assisting in identification of specific problems requiring intervention to measure changes in performance over time, and to demonstrate cost-effectiveness of interventions across a range of health settings from acute hospital to community care.[4] This is important considering the increasing cost of hospitalization of older people and the aging population demographic in Australia and other countries.[5] While numerous mobility outcome measures exist for patients with neurological impairment, there is no recognized gold-standard outcome measure for mobility assessment in older people.[6]

Physiotherapists need to be confident that any mobility outcome measure used has sound psychometric properties and is appropriate for the setting and patient population in which it is used[6]. Important psychometric properties include concurrent validity, inter-rater reliability (the degree to which scores obtained by one tester agree with scores obtained by another tester), intra-rater reliability (the degree to which scores obtained by one tester agree with scores obtained by the same tester at a different time), and responsiveness to change.[7,8]

The Elderly Mobility Scale (EMS) was devised for assessing mobility in frail, elderly people, and contains seven items considered essential for performing the basic activities of daily living. These items include transfer, gait, and balance tasks, scored from 0 (totally dependent) to 20 (representing independent mobility in the hospital environment).[9] While good inter-rater reliability of the EMS has been demonstrated in mixed populations of inpatients and outpatients, and in geriatric inpatients, the generalization of these studies is limited to the population in which it had been investigated.[9,10] To date, there has been no data collected on the older middle-aged population as opposed to the geriatric population. No studies have examined the intra-rater reliability of the original EMS, although good intra-rater reliability has been reported in a modified EMS (M-EMS).[11] In older day-hospital patients, the EMS was better able to detect mobility improvements than Barthel Index (BI), or functional ambulation classification (FAC), supporting the psychometric property of being responsive to change.[6]

Concurrent validity should be established by comparison of the scale to be validated (in this case the EMS) with a gold-standard.[7] Previously, the EMS has been compared with more global, functional ability measures such as the BI and Functional Independence Measure (FIM), rather than another measure of mobility.[9,10] In the absence of a gold-standard for mobility outcome measurement, the MRMI was chosen for its clinical utility and documented measurement properties including validity, inter-rater reliability, test-retest reliability, responsiveness, minimal detectable change, and internal consistency.[3,12,13]

To address these identified criticisms of the EMS, the aims of this study were to evaluate the concurrent validity and intra and inter reliability properties of the EMS for patients ≥ 55 years with a range of conditions in an acute hospital setting.

METHOD

Inter-rater and Intra-rater Reliability

All physiotherapists employed at a 500 bed acute care hospital in metropolitan Adelaide, South Australia, during February and March 2005, were invited to participate in the reliability study. Those who were familiar with the EMS assessments were eligible for participation, were recruited, and consented for the intra-rater and inter-rater reliability testing. On enrolment, demographic data, including years of clinical experience, and number of EMS assessments completed in clinical practice was obtained. These therapists attended two sessions, one week apart, to view and score the previously recorded EMS assessments. Participants were blinded to each other's scores.

Microsoft® Excel 97, LatentGOLD® Version 4.0, and Statistica Version 7 were used for reliability data analysis. Latent Class Analysis (LCA) was used to analyse data because it looks for groupings of data and then sorts these groups into clusters.[14] Variables that may affect the clustering are then able to be investigated. Even though interclass coefficients (ICC) are normally used to analyse reliability data, the study design with the use of multiple therapists would have generated hundreds of ICC scores, especially for inter-rater reliability. So, LCA was preferred.

Ethical approval was granted from the University of South Australia Divisional Ethics Committee and the Flinders Clinical Research Ethics Committee.

Concurrent Validity

To assess concurrent validity, both the EMS and MRMI were performed on patients admitted to an acute care hospital in metropolitan Adelaide, South Australia, referred to physiotherapy for a mobility assessment, aged 55 years or older, able to speak and understand English, and provided informed consent during February and March 2005. Potential participants were excluded if they were admitted under psychiatric care or if mobilization was contraindicated. Participants were also asked for permission to video-record their EMS assessment for use in the reliability component of the study.

The treating physiotherapist assessed each participant's ability to perform all items of the EMS and items one to seven of the MRMI. The final MRMI item, stair-climbing, was not functionally relevant for the majority of this patient group, and was therefore assessed subjectively, as allowed by the tool. To minimize the potential effects of fatigue in acutely ill patients, the EMS and MRMI items were ordered sequentially so that no task was repeated as shown in Table 1. Videoing of those participants who consented was done at this time.

TABLE 1 Item Testing Order

Starting Position	Item to be scored	Location of item
Lying in bed	Lying to sitting	EMS, MRMI
	Sitting to lying	EMS
	Rolling in bed	MRMI
	Sitting on edge of bed for 10 sec.	MRMI
	Transfer from bed to chair	MRMI
	Sitting in chair to standing	EMS, MRMI
	Standing for 10 sec.	EMS, MRMI
	Gait/walking indoors	EMS, MRMI
	Timed 6m walk	EMS
	Functional reach	EMS
Sitting in a chair	Sit to stand	EMS, MRMI
	Standing for 10 sec.	EMS, MRMI
	Transfer from chair to bed	MRMI
	Sitting to lying	EMS
	Rolling in bed	MRMI
	Lying to sitting	EMS, MRMI
	Sitting on edge of bed for 10 sec.	MRMI
	Gait/walking indoors	EMS, MRMI
	Timed 6m walk	EMS
	Functional reach	EMS

EMS = Elderly Mobility Scale, MRMI = Modified Rivermead Mobility Index

Data Analysis

SPSS Version 11.5 for Windows and Statistica Version 7 were used for concurrent validity data analysis. Since EMS and MRMI are ordinal scales, a non-parametric statistical test (Spearman rank correlation coefficient) was used. For this study, correlations of 0.25 to 0.5 were considered fair, 0.5 to 0.75 moderate to good, and 0.75 to 1.0 good to excellent.[8]

RESULTS

Participant Flow

The flow of participants is outlined in Figure 1. *(See Page 4.)*

Inter-Rater and Intra-Rater Reliability

Eighteen physiotherapists consented to participate in reliability testing. All 18 completed one data-set collection that was analysed for inter-rater reliability, and 15 completed two data-set collections, analysed for intra-rater reliability. Clinical experience ranged from four weeks to 24 years (average 14.2 years, SD±23.1, with reported completion of EMS assessments ranging from zero to 100 (indicating that one therapist believed that familiarity with the assessment was possible without having clinically used the tool).

While there were 12 videos recorded to use for reliability testing, nine were able to be viewed for inter-rater and intra-rater reliability testing within the time available. The first video viewed on each occasion was used to demonstrate data collection procedures, and the remaining eight videos were scored for data analysis. The videos viewed included 2 males and 7 females, age range 60-90 years (mean 73.22 SD±8.98). They were recruited from medical (3), acute rehabilitation (3), and orthopaedic (3) wards. Living arrangements prior to admission included independent living (4), living with spouse (4), and high level care (1).

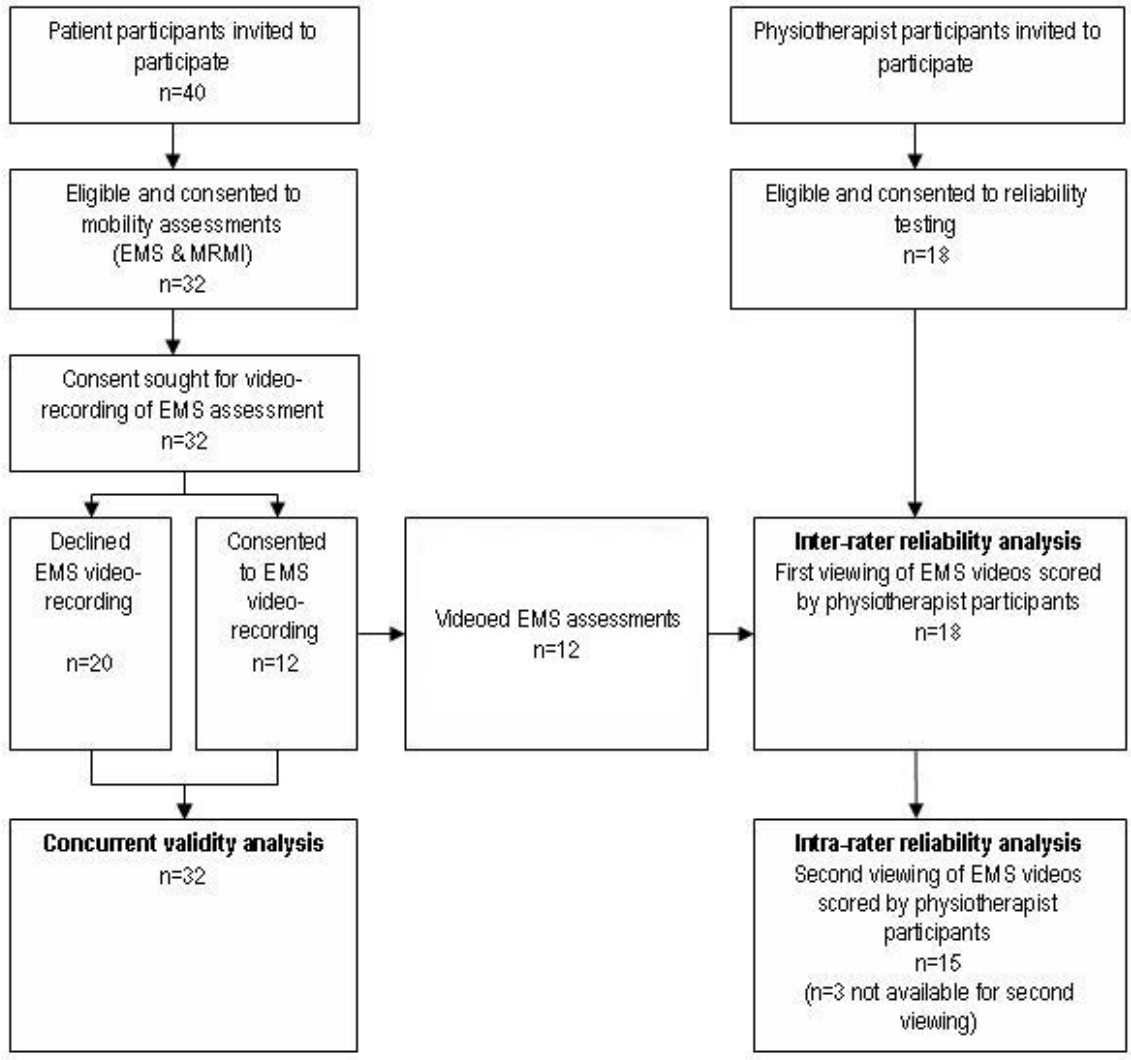

FIGURE 1 Flow chart of patient participants (concurrent validity) and physiotherapist participants (reliability studies)

The EMS scores, allocated by the therapists, ranged from zero to 19 (mean 14.5, median 15.5, SD±5.27), but lacked any patient scoring from one to six. All therapists scored one video as zero; hence these scores were not included in the analysis, as LCA does not deal with absolute zero. Using LCA on the remaining EMS data, three clusters (7-14, 15-17, and 18-19) were formed indicating that there were three distinctive groups identified. Data was further analysed to investigate the variables which may have influenced the clustering, including the occasion of testing (intra-rater reliability), the therapist (inter-rater reliability), the experience of the therapist, and number of previous EMS assessments completed.

Fifteen physiotherapists scored nine randomly selected videos on two occasions, and data was analysed to investigate the effect of occasion (i.e. intra-rater reliability) on the clustering. As no statistically significant difference (R^2=0.0035, p=0.72) was found between the two occasions, this indicates good intra-rater reliability and that the EMS scores given by the therapists on the two separate occasions had no effect on the clustering.

Eighteen physiotherapists scored eight videos and data was analysed to ascertain whether it was the individual therapists that determined the clustering. This analysis showed that the EMS score of an individual was the variable that placed them in a cluster (R^2=0.8263, p=0.000), rather than the influence of particular therapists (R^2=0.0051, p=1.00) indicating high inter-rater reliability.

This can be seen in Figure 2 where none of the therapists or the occasions of testing were closely associated with any of the clusters, which are located at the apices of the triangle. The therapists' scores and occasion of testing are closely grouped together visually in the centre of the triangle demonstrating consistency and reliability.

Neither the years of clinical experience (R^2=0.0058, p=1.00) nor number of EMS assessments completed in clinical practice (R^2=0.0048, p=1.00) had a statistically significant influence on the reliability of the EMS.

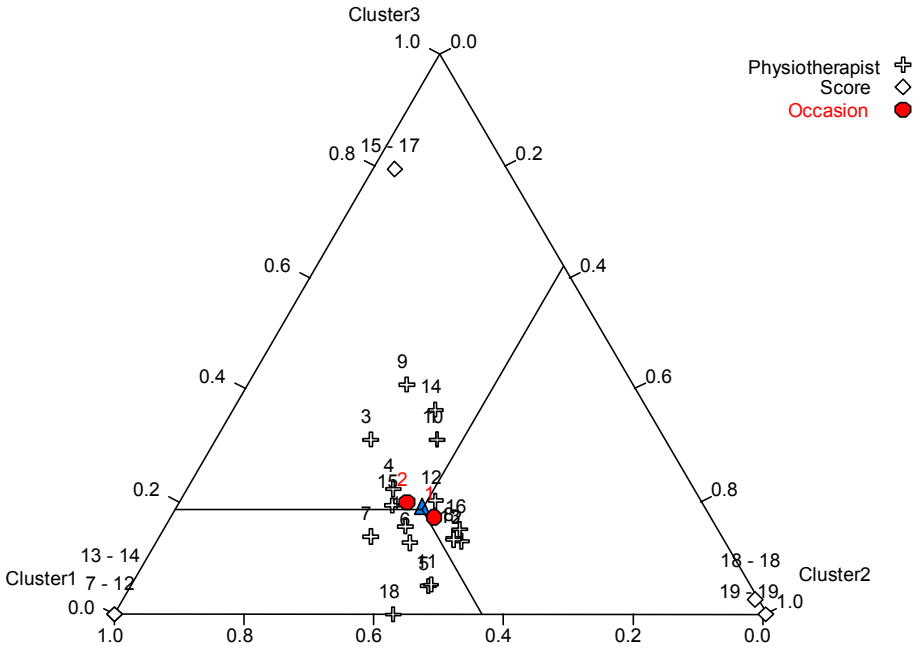

FIGURE 2: LCA of the influence of individual EMS score, therapist and occasion of testing on clustering

It is clear that most of the patient participants who agreed to be videoed attained EMS scores in the middle to upper range. This may reflect either a recruitment bias or a ceiling effect of the EMS. Other authors added stair-climbing and an increased walking distance to their modified EMS tool (M-EMS) to counter the ceiling affect on clients in the rehabilitation setting.[11] However, it was considered that the key reason for the distribution of EMS scores was not the ceiling effect, but rather the self selection of clients who agreed to be videoed, as it is hypothesized that those patients with lower independence may have been more reluctant to have their performance recorded. Therefore, recording of performance may not be the best way to obtain the full spectrum of abilities that would be needed to assess test-retest reliability across the entire EMS range.

CONCLUSION

Concurrent Validity

Thirty-two participants (13 males and 19 females) aged 57 to 94 years (mean 76.6, SD±9.1) were recruited from medical (14), acute rehabilitation (13), and orthopaedic (5) wards following acute admissions, and were assessed using EMS and MRMI measures. EMS scores ranged from 0 to 20 (mean 12.75, median 14, SD±5.95) and MRMI scores from 5 to 39 (mean 25.47, median 30, SD±9.1). The scores revealed a high correlation between the two scales (Spearman's ρ = 0.887, p<0.05, 95% CI:779 to 0.944), thus demonstrating concurrent validity (Fig 3).

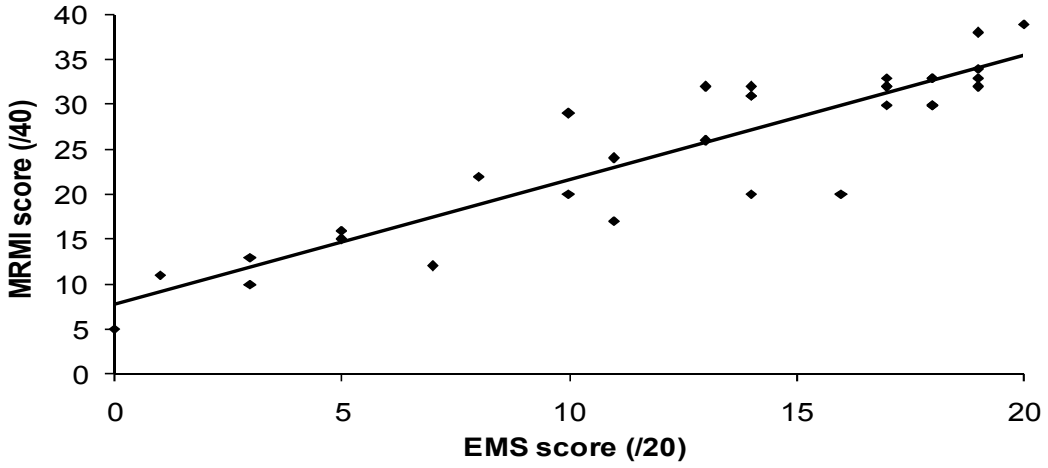

FIGURE 3 : Scatter Plot of Concurrent Validity Scores
NOTE: Some scatter plot points represent more than one participant.

DISCUSSION

The most significant finding is that intra-rater reliability of the EMS has been demonstrated for the first time. As an important psychometric property, this adds new evidence to support the use of the EMS. Strong inter-rater reliability was also shown, which strengthens the findings of previous work.[9,10]

Another important finding is a statistically significant correlation (Spearman's $\rho = 0.887$, $p<0.05$) between the EMS and the MRMI, a robust mobility outcome measure for medical and orthopaedic patients aged 55 and older admitted to an acute tertiary hospital. This supports the concurrent validity of the EMS to a greater extent than studies which compared the EMS with two measures of activities of daily living, the BI and FIM.[9, 10] These results extend and support the use of the EMS in the hospital setting for these patients with a range of medical and orthopaedic conditions.

Further important findings were that neither years of experience of the therapist nor the number of EMS assessments completed in clinical practice affects the reliability of the tool. These findings are significant in so far as the EMS can be used with confidence by all clinicians regardless of years of clinical experience or familiarity with the EMS.

As patient participants for this study came from all sections of the acute care hospital, the high validity and reliability scores demonstrates wider applicability of the EMS than previously identified, especially as other mobility outcome measures have been primarily evaluated on neurological participants.[15,16]

The clinical utility of the EMS and the finding that it is both valid and reliable in the general acute hospital setting means that clinicians can be confident of using it to determine mobility status in the acute care patients aged 55 and older, in addition to other settings in which reliability has already been established. This will facilitate provision of patient care by providing physiotherapists with an outcome measure to assist in the identification of specific problems requiring intervention, and to measure changes in performance over time. Further investigation into the interpretation of EMS scores is now necessary to enable scores to be used to identify meaningful change and potential predictive ability for discharge planning.

Key Points

- EMS is a psychometrically sound mobility outcome measure for use in the acute hospital setting, which can be used with confidence across a range of pathologies.
- EMS has excellent concurrent validity for hospital patients over 55 when compared with another mobility outcome measure, the MRMI.
- EMS has excellent intra-rater reliability for hospital patients over 55.
- EMS has excellent inter-rater reliability for hospital patients over 55.
- EMS is reliable regardless of the physiotherapists' experience.

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