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Kettle test efficacy in predicting cognitive and functional outcomes in geriatric rehabilitation

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Kettle Test Efficacy in Predicting Cognitive and Functional Outcomes in Geriatric Rehabilitation.

Abstract

Introduction: Limited research has been available to support the use of the Kettle Test in subacute rehabilitation with patients diagnosed with a variety of medical conditions. The Kettle Test is an occupation based performance measure designed to detect cognitive processes and function. The aim of this research was to measure the correlation between three cognitive tests, the Mini-Mental State Examination (MMSE), Cognitive Functional Independence Measure (Cognitive FIM) and the Kettle Test. Secondly, to assess the efficacy of these tests in predicting functional outcomes via the motor subscale of the Functional Independence Measure (mFIM).

Methods: A prospective single-centre cohort study in a subacute rehabilitation setting of 97 patients.

Results: The mean age of patients was 81.7 years with 16.5% previously experiencing delirium. Correlation coefficients between the tests were statistically significant and moderately strong, with values ranging from -0.508 to -0.589. The Kettle Test was significantly associated with the MMSE and Cognitive FIM at admission and discharge measures ($p<0.001$), univariately and after adjusting for age and gender. The Kettle Test had a stronger relationship with mFIM (r=-0.40; $p<0.01$) at post discharge measures, compared with the Cognitive FIM (r=0.33; $p<0.01$) and MMSE (r=0.26; $p<0.05$). Both the Cognitive FIM and Kettle Test scores at admission were significant predictors of change in mFIM, with the association holding after adjusting for age and gender. There was no significant association between MMSE and change in mFIM.

Conclusion: The Kettle Test was significantly associated with the MMSE, Cognitive FIM and Kettle Test. The Kettle Test had the strongest relationship to patient functional outcomes. This research supports use of the Kettle Test to screen cognition and function in a general elderly subacute rehabilitation population.

Introduction

Cognitive impairment in older people can have a detrimental impact on functional performance (Johnson, Lui, & Yaffe, 2007; Zwecker, Levenkrohn, Fleisig, Zeilig, Ohry, & Adunsky, 2002). There is now a growing body of literature suggesting that, although many standardised cognitive tests have established psychometric properties and are good indexes of isolated cognitive and executive components, they may not be effective in predicting real world functional ability of patients (Brown, Mapleston, Nairn, & Molloy, 2012). Conventional “tabletop” measures of cognition are valuable diagnostically but have limited ecological validity and do not fully address the functional implications of cognitive deficits (Hartman-Maeir, Harel, & Katz, 2009; Zwecker et al., 2002).

One primary concern for occupational therapists is predicting a patient’s ability to function independently after discharge from hospital (Hartman-Maeir et al., 2009). The Person-Environment-Occupation (PEO) Model can guide therapists to conceptualise, assess and predict occupational performance post discharge from hospital (Strong, Rigby, Stewart, Law, Letts, & Cooper, 1999). As part of the assessment process, the Kettle Test is a practical cognitive assessment that may further contribute to identifying the functional implications of cognitive deficits in a hospital setting (Hartman-Maeir et al., 2009).

The Kettle Test is a real-life everyday performance measure designed to detect cognitive processes needed for independent community living (Wall, Cumming, & Copland, 2017). Limited literature has been reported on the Kettle Test since its conception in 2005 (Hartman-Maeir, A., Armon, N., & Katz, N. 2005). The initial data examined the convergent and ecological validity in a sample of 41 elderly clients and found small to moderate significant correlations between the Kettle Test and conventional measures of cognition (Hartman-Maeir, Katz, & Armon, 2004). Another study with stroke survivors supported the reliability and validity of the Kettle Test as a top-down measure of cognition-in-function in patients at discharge from stroke rehabilitation (Hartman-Maeir, et al., 2009). Wall et al. (2017) found that the Kettle Test may be appropriate for individuals with aphasia, but patients needed adequate motor skills to complete the assessment tasks.

A literature review of performance-based tools for the assessment of stroke-specific executive function, reported that the Kettle Test may be useful as a screening tool to assist in identifying patients who require further assessment (Poulin, Korner-Bitensky, & Dawon, 2013). There are other functional cognition assessments including the Assessment of Motor and Process Skills (AMPS) (Robinson & Fisher, 1996), Large Allen's Cognitive Level Screen (Allen, Austin, David, Earhart, McCraith, & Riska-Williams, 2007) and the Kitchen Task Assessment (KTA) (Baum & Edwards, 1993). However many of these assessments are time intensive compared to the Kettle Test. No specific assessment tool was recommended in a recent systematic review of 21 identified instruments (Wesson, Clemson, Brodaty, & Reppermund, 2016). They reported that evidence of psychometric properties is lacking and an urgent need for further evaluation of instruments for use with older people with suspected cognitive impairment. Best practices for measuring functional cognition remain unclear (Skidmore, 2017).

The focus of this research was to build on the literature available regarding the Kettle Test and to assess if the Kettle Test could be used as a quick performance measure to predict cognition and function in subacute rehabilitation. This study aimed to determine whether performance on the Kettle Test was consistent with that of performance on other established cognitive assessment tools including the MMSE (Folstein, Folstein, & McHugh, 1975) and the Cognitive FIM (Adunsky, Fleissig, Levenkrohn, Arad, & Noy, 2002). Secondly, to determine if performance on the Kettle Test related to patient functional abilities post discharge.

Methods

Aim

To study the correlation between three cognitive tests, the MMSE, Cognitive FIM and the Kettle Test and to assess the efficacy of these tests in predicting functional outcomes post discharge.

Design

A prospective single-centre cohort study. Reporting adheres to the STROBE statement for observational studies (von Elm, Altman, Egger, Pocock, Gotzsche, & Vandenbroucke, 2007).

Settings, Participants and Recruitment

The study was conducted at a major metropolitan adult tertiary hospital in 2015/2016. The participants were receiving subacute rehabilitation under the Geriatric Evaluation and Management Team (GEM). Participants were aged 65 years and over, with a range of diagnoses (falls, gastrointestinal, respiratory, neurological or cardiac conditions) and previously lived independently in the community. Participants were excluded if they were non-English speaking or unable to provide consent. Participants were recruited by the senior occupational therapist on their admission to the inpatient ward.

Assessment of Cognitive Status

Cognitive status was assessed by the MMSE, Cognitive FIM and the Kettle Test, at admission and discharge (Adunsky et al., 2002; Folstein et al., 1975; Hartman-Maeir et al., 2009). The alternate tests (MMSE and Cognitive FIM) were selected to identify cognitive deficits in comparison with the Kettle Test and are routinely used in our hospital. The measurement of the FIM is mandated in all GEM and rehabilitation units in Australia for benchmarking purposes through the Australasian Rehabilitation Outcome Centre (AROC). The MMSE is the most commonly used cognitive assessment in aged care at our hospital. The MMSE is a well-established, reliable, valid and brief cognitive screening instrument (Adunsky et al., 2002; Folstein et al., 1975). It assesses orientation, attention, immediate and short-term recall, language and the ability to follow simple verbal and written commands. It provides a total score that places the individual on a scale of cognitive function (Adunsky et al., 2002; Crum, Anthony, Bassett, & Folstein, 1993; Folstein et al., 1975). Any score greater than or equal to 24 points (out of 30) indicates normal cognition. Below this, scores can indicate severe (≤9 points), moderate (10–18 points) or mild (19–23 points) cognitive

impairment (Adunsky et al., 2002; Folstein et al., 1975; Mungas, 1991). The purpose of the MMSE in this research was to provide a baseline for a patient's cognitive function.

The Cognitive FIM is composed of five cognitive items. Each of these items consists of seven levels ranging from 1 point (total dependence) to 7 points (total independence). The range of scoring for the cognitive subscales is 5 to 35 points. The test is composed of communication (comprehension and expression) and social cognition (social interaction, problem solving and memory) with 35 points representing optimal performance (Adunsky et al., 2002; Lincare, Heinemann, Wright, Granger, & Hamilton, 1994).

The Kettle Test was developed as a brief performance based assessment of an instrumental activity of daily living (IADL) (Hartman-Maeir et al., 2009). The test was designed to tap into a broad range of cognitive skills, including working memory, concentration, attention, problem solving, praxis, safety judgement and executive functioning, within a functional context. The assessment involves preparing two hot beverages (Hartman-Maeir et al., 2005; Hartman-Maeir et al., 2009). Fixed instructions are provided and performance is based on 13 indices such as assembling the kettle, attaching electric cord, turning on the tap and filling the kettle, etc. Each item is scored on a 4-point scale based on how much support or cueing is required. There is a score range from 0-52, where 0 indicates total independence (Hartman-Maeir et al., 2005; Hartman-Maeir et al., 2009). The purpose of the Kettle Test was to assess cognitive functional ability via a performance based test to see if this was consistent with the MMSE and Cognitive FIM.

Two previous research studies on the Kettle Test have found inter-rater reliability to be high with significant and moderate correlation with conventional cognitive and functional

outcome measures including MMSE (r = -0.478; Folstein et al., 1975); Clock Drawing Test (r = -0.566; Freedman, Leach, Kaplan, Winocur, Shulman, & Delis, 1994); Cognitive FIM (r=-0.659) and Motor Scale of Functional Independence Measure (mFIM) (r = -0.759; Adunsky et al., 2002) (Hartman-Maeir et al., 2004; Hartman-Maeir et al., 2009).

The Cognitive FIM was completed by nursing staff in the rehabilitation team. All nursing staff that administered the FIM were credentialed and the inter-rater agreement of FIM items in the communication and social cognition subsections have been considered as substantial with a kappa statistic of 0.75 (Daving, Andrén, Nordholm, & Grimby, 2001). The MMSE and Kettle Test were completed by one senior occupational therapist, although independent rater checks were completed by an additional occupational therapist with agreement in results found.

Assessment of Functional Status

The mFIM was used to assess functional status and improvement. The FIM is a validated instrument for documenting the severity of disability and assessing the outcome of rehabilitation treatment (Zwecker et al., 2002). Patients were assessed on admission, discharge, one week post discharge and one month post discharge. The post discharge assessments were completed by a senior occupational therapist blinded to the previous assessment scores.

The mFIM was used to examine functional outcomes because this score isolates functional activities from cognitive ratings, which are combined in the total FIM score (Cournan, 2011). The mFIM consists of 13 items measuring self-care, sphincter control,

transfers and locomotion, each scored from 1 point (total dependence) to 7 points (total independence) (Cournan, 2011; Toglia, Fitzgerald, O'Dell, Mastrogiovanni, & Lin, 2011).

The primary outcome measure was the admission and discharge cognitive scores assessed by the MMSE, Cognitive FIM and the Kettle Test. Secondary outcome measures consisted of mFIM to assess functional capacity and improvement.

Data analysis

Data were summarised using frequency distributions for categorical data and means and standard deviations or medians, interquartile range and range for continuous data. Gender group comparisons for patient sample characteristics including age, education, LOS, history of delirium and presenting diagnosis were done using independent t-tests and Mann-Whitney U tests, as appropriate, for continuous data and Chi-squared or Fisher Exact tests, as appropriate, for categorical data. Paired t-tests were used to compare differences in cognitive test (MMSE, Cognitive FIM, Kettle Test, Total FIM) mean scores from admission to discharge, for all participants and stratified by gender. Repeated measures ANOVA were used to compare difference in mean scores across four timepoints (admission, discharge, one week post-discharge and one month post-discharge for the mFIM cognitive test). Posthoc pairwise comparisons were examined for differences between timepoints. Pearson correlation coefficients were used to measure correlations between MMSE, Cognitive FIM and Kettle Tests at admission and discharge and between MMSE, Cognitive FIM and Kettle Test (at admission) and post-discharge motor function at one week and one month post discharge. Multivariable linear regression was performed to examine the association between change in motor function score from admission to one month post discharge and cognitive tests at

admission (MMSE, Cognitive FIM, Kettle Test), adjusting for baseline motor function, age and gender. Coefficient of determination (R^2) was used to measure the proportion of variance explained by cognitive test predictors, age and gender in the linear regression models. Normality of the outcome variable was assessed graphically. Statistical analysis was conducted using IBM SPSS version 24.0 (Armonk, NY). *P* values of <.05 were considered statistically significant.

Sample size calculation

Sample size adequacy was determined by the guidelines set by Bland and Altman (1996), where the standard error of the within-subject standard deviation (s_w), is shown to depend on both number of subjects (n), and number of observations per subject (m). The 95% confidence interval (CI) for s_w is determined to be sw +/ $1.96s_w/\sqrt{(2n(m-1)}$. With 3 repetitions (m = 3), and requiring that the width of this interval is no more than +/- $0.1s_w$ (so that we are confident that we know s_w within 10%), the minimum sample size required to assess the agreement between the Kettle Test, MMSE and Cognitive FIM was 97.

Ethical considerations

The study was approved by the Sir Charles Gairdner Hospital Human Research Ethics Committee (HREC 2015-034). All patients provided informed consent. All patients cohort data was de-identified and analysed in aggregate form. This research has been registered with the Australian New Zealand Clinical Trials Registry (ACTRN12616001202459).

Results

One hundred and seventeen patients were approached, 11 (9%) declined to participate and 9 (8%) did not meet inclusion criteria, resulting in a sample population of 97 (83%) patients. Table 1 outlines the general characteristics of the study population. On average patients had three other comorbidities. Given the differences in the number of males versus females, gender specific trends were reviewed. There was a higher number of females represented in cardiac, falls, respiratory and other diagnoses (nausea, gastroenteristis, etc.) ($p=0.043$). Six (6%) patients received no community services prior to admission to GEM and 24 (25%) were using only family members for support. Sixty one (63%) patients received a formal community service to manage at home prior to admission. The need for post discharge services increased (Table 1). Thirteen patients (13%) had a hospital readmission. Males had significantly more readmissions at one week post discharge, with 5 out of the 6 readmissions being males ($p=0.025$).

All cognitive and functional assessments were able to be completed with the majority of patients on admission and discharge with a response rate ranging between 100% (97) to 84.5% (82). Follow up post discharge was available for 80.4% (70) of patients. Table 2 outlines the mean scores at admission and discharge for the MMSE, Cognitive FIM and the Kettle Test. The MMSE identified that 26.5% (22/83) of the patients who were tested at both admission and discharge exhibited cognitive impairment (score 24 or lower). There was a significant improvement in the Cognitive FIM and the Kettle Test scores between admission and discharge ($p<0.001$) (Table 2).

Functional improvement was encountered in the majority of the patients and reflected by total mFIM gains. There was a 13.0 point mean improvement in the total FIM score

between admission and discharge (SD=8.0) (t[93]=-15.85, p<0.001). Patients mean (SD) admission mFIM score was 60.7 (8.8) which improved by 13.2 points to 73.9 (6.9) at discharge. Steady gains in the mFIM were noted at 1 week post discharge (mean [SD]=77.0 [6.8]) and at the 1 month review (mean [SD]=79.8 [6.3]) with improvements of 16.3 points and 19.1 points from admission, respectively. There were statistically significant improvements when comparing admission mFIM to all subsequent measurements (F[3,231]=237.07, p<0.001) (discharge [p<0.001], at one week [p<0.001] and at one month [p=<0.001]). These significant improvements were seen in both males, with mean (SD) at admission, discharge, 1 week and 1 month post discharge equal to 60.3 (7.9), 74.1 (8.4), 78.0 (7.7), 80.6 (7.2), respectively, (F[3,84]=104.78, p=<0.001) and females equal to 60.9 (9.4), 73.9 (5.9), 76.4 (6.2) and 79.3 (5.7), respectively, (F[3, 144]=133.62, p=<0.001).

The Kettle Test is significantly associated with both the MMSE and Cognitive FIM at admission and discharge measures (p<0.001), univariately and after adjusting for age and gender (Table 3). Univariate correlation coefficients were moderately strong and significant for Kettle Test scores with MMSE and Cognitive FIM scores at admission and discharge (*r*=-0.589 and -0.508 respectively at admission, *r*=-0.542 and -0.567 respectively at discharge, all p<0.001). Univariate models showed that at admission MMSE and Cognitive FIM scores contributed to 35% and 26% of variance in the Kettle Test score, while the discharge MMSE and Cognitive FIM scores contributed to 29% and 32% of variance in the discharge Kettle Test score. The adjusted models showed that at admission MMSE and Cognitive FIM scores contributed to 42% and 35% of variance in the Kettle Test score, respectively, while the discharge MMSE and Cognitive FIM scores both explained approximately 47% of variance in the discharge Kettle Test score, with age significant in the models at admission and both age and gender significant in the models at discharge.

Correlations between admission MMSE, Cognitive FIM and Kettle Test scores and post discharge mFIM scores were also assessed. Significant positive correlations were seen between admission MMSE, Cognitive FIM and the mFIM and significant negative correlations between Kettle Test and the mFIM. At one week post discharge the Kettle Test had a slightly stronger relationship with mFIM (r=-0.39; p<0.01) compared with the Cognitive FIM (r=0.28; p<0.05) and MMSE (r=0.31; p<0.01). At one month post discharge again the the Kettle Test had a stronger relationship with the mFIM (r=-0.40; p<0.001) compared with the Cognitive FIM (r=0.33; p<0.01) and MMSE (r=0.26; p<0.05).

Linear regression was used to assess whether cognitive tests at admission were predictors of change in motor function. Both the Cognitive FIM and Kettle Test scores at admission were significant predictors of change in mFIM, with the association holding after adjusting for age and gender (B=0.40, p=0.030 and B=-0.27, p=0.023 respectively). There was no significant association between MMSE and change in mFIM (p=0.164). Coefficients of determination for Cognitive FIM and the Kettle Test were 0.174 and 0.215, indicating that these cognitive tests accounted for 17.4% and 21.5% of variance in mFIM change, respectively. The addition of age and gender into the models only accounted for 7% and 4% of model variation, respectively (Table 4).

Discussion

The Kettle Test was significantly associated with both the MMSE and Cognitive FIM. The correlation coefficients in our research are similar to others reported in the literature involving stroke patient populations. Our results support the Kettle Test as a feasible and

practical tool, to be used with a wider general elderly subacute rehabilitation population, not limited to patients with a stroke diagnosis.

The Kettle Test correlated with the mFIM providing support for predictive ability. The Kettle Test appeared to show a greater assocication with functional outcome than the MMSE. The reason for the stronger relationship between the mFIM and Kettle Test may be the performance component in comparison to MMSE. This research utilised the mFIM to measure functional outcomes because it allowed comparison with previous research and is well used our hospital setting. Although the Kettle Test's functional outcomes may be more relevant for complex IADL than basic activities of daily living (BADL) as assessed by the mFIM. Further research should consider comparison of the Kettle Test with functional outcome measures more indicative of cognition such as the Assessment of Motor and Process Skill (AMPS), this would enhance the development of the test (Robinson & Fisher, 1996). The AMPS is well researched, reliable and valid assessment method of motor and process skills in IADL's (Robinson & Fisher, 1996). There are a number of other performance-based measures in occupational therapy that incorporate cognitive challenges in a functional IADL context (Hartman-Maeir et al., 2009). However some including the AMPS require intensive and expensive training and others may be considered as time consuming (Hartman-Maeir et al., 2009; Poulin et al., 2013).

For clinical use in subacute rehabilitation the Kettle Test has a short administration time (i.e. less than 20 minutes) and requires limited equipment (Brown et al., 2012; Poulin et al., 2013). Also the test's task of preparing two hot beverages was chosen because of its functional significance, broad cultural relevance and feasibility in multiple settings (Hartman-Maeir et al., 2009). Further evaluation of the role of quick functional cognitive tests; such as

the Kettle Test, in various clinical settings is warranted. The clinical implications of this research highlight the Kettle test as an additional, valid and time efficient assessment tool for measuring functional cognition. It is useful within subacute rehabilitation with older people experiencing any diagnosis. Impaired performance on the Kettle Test would highlight the need for further comprehensive assessment and intervention and would contribute to predicting care resource needs and avoiding hospital readmissions.

Limitations

Our study has several limitations including patients with moderate to severe language impairments were excluded due to their inability to provide consent. Bias needs to be reported in that the senior occupational therapist completing the inpatient assessments also recruited all patients. There may be some rater bias in that the same senior occupational therapist completed the MMSE and the Kettle Test assessments. However this was addressed through independent rater checks. Additionally different nurses completed the admission and discharge FIM assessments, although they were FIM credentialed.

Conclusion

There were statistically significant inter-test correlations between the MMSE, Cognitive FIM and the Kettle Test. Our findings reaffirm that the Kettle Test can add value to patient assessment when compared with conventional cognitive assessment measures utilised in subacute rehabilitation. The Kettle Test had the strongest relationship to patient functional outcomes and can assist in contributing to the prediction of functional outcomes post discharge.

Key Points for Occupational Therapy

- The Kettle Test is a valid assessment tool for screening cognition and function in all older patients with any diagnosis.
- The Kettle Test is suitable for use in subacute rehabilitation.
- This research provides evidence to support the use of performance and occupation based assessment.

Declaration of Authorship

All authors were involved in the inception and original planning of the study. KL and KH completed the data collection. KH and AJ completed the data analysis and interpretation. KH drafted the manuscript. All authors contributed to writing and revision of the manuscript and are in agreement with all aspects of the work.

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Table 1: General and post discharge characteristics of study population by gender

	All *n=97*	Males *n=34*	Females *n=63*	
General characteristics	**n (%)**	**n (%)**	**n (%)**	**p-value**
Age (years) *Mean (SD) [Min-Max]*	81.7 (8.1) [65 - 98]	81.5 (7.6) [66 - 96]	81.8 (8.4) [65 - 98]	0.831
Hospital length of stay (days) *Median (IQR) [Min-Max]*	16 (13, 21) [0 - 52]	16 (12,19) [9 - 41]	17 (13, 21) [0 - 52]	0.462
Subacute rehabilitation length of stay (days) *Median (IQR) [Min-Max]*	9 (7, 11) [2 - 41]	9 (7, 11) [3 - 23]	9 (7, 12) [2 - 41]	0.956
Previous medical diagnosed delirium *(yes/no)*	16 (16.5)	4 (11.8)	12 (19.0)	0.267
Post discharge characteristics	**n (%)**	**n (%)**	**n (%)**	**p-value**
Readmissions to hospital *(discharge +1week)*	6 (7.7)	5 (17.2)	1 (2.0)	**0.025**
Readmissions to hospital *(discharge +1month)*	10 (12.8)	5 (17.2)	5 (10.2)	0.287
Number of patients using community services *(discharge +1week)*	75 (96.2)	28 (96.6)	47 (95.9)	0.690
Median number of community services accessed *(discharge +1week) (Median (IQR) [Min-Max]*	6 (2, 7) [1-8]	6 (3, 7) [1-8]	5 (1, 7) [1-8]	0.439
Number of patients using community services *(discharge +1month)*	73 (93.6)	27 (93.1)	46 (93.9)	0.619
Median number of community services accessed *(discharge +1month) Median (IQR) [Min-Max]*	5 (3, 6) [1-8]	5 (3, 6) [1-8]	5 (3, 6) [1-7]	0.475
Number of deceased *(discharge +1month)*	2 (2.1)	-	2 (3.2)	0.403

Table 2: Score distribution of MMSE, Cognitive FIM and Kettle Test

Participants	**Test**	**N**†	**Admission** *(Day 1)*	**Discharge** *(Day 9)* ‡	**Score Difference**		
			Mean (SD) Min-Max	*Mean (SD) Min-Max*	*Mean (SD)*	t(df)	p-value
All	MMSE	83	26.5 (3.1) 13-30	26.9 (2.8) 15-30	0.4 (1.9)	-1.92 (82)	0.058
	Cognitive FIM	94	29.7 (4.1) 16-35	30.5 (4.2) 17-35	0.9 (2.1)	-3.88 (93)	**<0.001**
	Kettle Test	82	8.9 (6.5) 0-28	6.5 (5.6) 0-24	-2.5 (4.8)	4.64 (81)	**<0.001**
By Gender:							
Males	MMSE	34	26.4 (2.8) 20-30	26.6 (2.8) 19-30	0.1 (1.7)	-0.43 (29)	0.670
	Cognitive FIM	30	29.0 (3.9) 19-35	30.2 (3.9) 21-35	1.2 (2.2)	-3.18 (33)	**0.003**
	Kettle Test	30	7.4 (4.7) 2-26	5.1 (3.1) 0-15	-2.3 (3.3)	3.92 (29)	**0.001**
Females	MMSE	53	26.5 (3.2) 13-30	27.0 (2.9) 15-30	0.6 (2.0)	-2.01 (52)	**0.050**
	Cognitive FIM	60	30.0 (4.2) 16-35	30.7 (4.5) 17-35	0.7 (2.1)	-2.44 (59)	**0.018**
	Kettle Test	52	9.8 (7.2) 0-28	7.3 (6.6) 0-24	-2.5 (5.5)	3.30 (51)	**0.002**

† *number of participants who were tested at both measured time points (admission and discharge)*

‡*median length of stay in the subacute rehabilitation was 9 days (Min-Max, 2-41 days).*

Table 3: Linear regression examining association between cognitive tests and the Kettle Test at admission and discharge, adjusting for age and gender

	Model 1 (univariable)					Model 2 (adjusting for age and gender)				
Predictors	B (SE(B))	95% CI B	p-value	$F(df_{1,2})$	R^2‡	B (SE(B))	95% CI B	p-value	$F(df_{1,2})$	R^2§
MMSE admission	-1.15 (0.16)	-1.48, -0.83	<0.001	49.80 (1, 94)	0.346	-1.06 (0.16)	-1.38, -0.74	<0.001	22.21 (3,92)	0.420
MMSE discharge	-1.07	-1.44, -0.70	<0.001	33.25 (1, 80)	0.294	-0.95 (0.17)	-1.29, -0.62	<0.001	22.99 (3, 78)	0.469
Cognitive FIM admission	-0.81 (0.14)	-1.10, -0.53	<0.001	32.73 (1, 94)	0.258	-0.75 (0.14)	-1.03, -0.47	<0.001	16.47 (3, 92)	0.349
Cognitive FIM discharge	-0.80 (0.13)	-106, -0.54	<0.001	37.82 (1, 80)	0.321	-0.69 (0.12)	-0.94, -0.45	<0.001	22.71 (3, 78)	0.466

†*Model 1: Unadjusted univarible model; Model 2: Adjusting for age, gender*

‡*Proportion variation in model attributed to cognitive tests*

§*Model variation attributed to cognitive tests plus age and gender*

Table 4: Linear regression using cognitive admission tests to predict change in Motor FIM score, adjusting for age and gender

	Model 1					Model 2 (adjusting for age and gender)				
Predictors (admission tests)	B (SE(B))	95% CI B	p-value	$F(df_{1,2})$	R^2‡	B (SE(B))	95% CI B	p-value	$F(df_{1,2})$	R^2§
MMSE	0.41 (0.22)	-0.04, 0.86	0.071	6.37 (2, 75)	0.145	0.31 (0.22)	-0.13, 0.76	0.164	4.99 (4, 73)	0.215
Cognitive FIM	0.44 (0.18)	0.09, 0.79	**0.016**	7.92 (2, 75)	0.174	0.40 (0.18)	0.04, 0.76	**0.030**	5.90 (4, 73)	0.244
Kettle Test	-0.35 (-0.11)	-0.57, -0.13	**0.002**	10.26 (2, 75)	0.215	-0.27 (0.12)	-0.50, -0.04	**0.023**	6.04 (4, 73)	0.249

†*Model 1: Adjusting for baseline Motor FIM score against final Motor FIM score; Model 2: Adjusting for baseline Motor FIM score, age, gender*

‡*Proportion variation in model attributed to admission cognitive tests*

§*Model variation attributed to admission cognitive tests plus age and gender*