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Kelly Lambert

University of Wollongong, klambert@uow.edu.au

Emily Taylor

University of Wollongong

Steven Bowden

Sutherland Hospital

Karen E. Charlton

University of Wollongong, karenc@uow.edu.au

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Abstract

This retrospective observational study evaluated the association between nutritional status, functional ability and discharge outcomes. Data from 1430 older rehabilitation patients (43% male, median age 79 years, interquartile range: 74–84) were analyzed. One fifth (20.6%, $n = 294$) of patients were malnourished on admission to rehabilitation. Three important findings were evident. Firstly, nutritional status on admission to rehabilitation was associated with reduced functional, motor, cognitive and feeding scores on admission and discharge (all $P < 0.05$). Secondly, malnutrition at admission was associated with significantly slower gains in rehabilitation. Finally, malnutrition at admission was associated with significantly higher odds of a decline in functional ability during admission (OR 3.95; 95% CI: 2.14–7.27), and almost three times greater odds of additional care requirements on discharge (OR: 2.9 (95% CI: 1.02–8.3). The nutritional status of patients on admission to inpatient rehabilitation is a predictor of both the speed and degree of rehabilitation gains and discharge outcomes.

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Title page

Title: Nutritional status according to the Mini Nutritional Assessment predicts speed and degree of functional improvement and discharge outcomes in rehabilitation patients

Kelly Lambert ^{a*}, Emily Taylor ^a, Steven Bowden ^b and Karen Charlton ^a

^a Discipline of Nutrition and Dietetics, School of Medicine, Faculty of Science, Medicine and Health, University of Wollongong, Wollongong, New South Wales, Australia

^b Healthcare Improvement Analytics, Sutherland Hospital, New South Wales, Australia,

*Corresponding Author: Discipline of Nutrition and Dietetics, School of Medicine, Faculty of Science, Medicine and Health, University of Wollongong, Wollongong, New South Wales, Australia 2522 Email: klambert@uow.edu.au

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This retrospective observational study evaluated the association between nutritional status, functional ability and discharge outcomes. Data from 1430 elderly rehabilitation patients (43% male, median age 79 years, interquartile range: 74 to 84) were analysed. One fifth (20.6%, n = 294) of patients were malnourished on admission to rehabilitation. Three important findings were evident. Firstly, nutritional status on admission to rehabilitation was associated with reduced functional, motor, cognitive and feeding scores on admission and discharge (all $p < 0.05$). Secondly, malnutrition at admission was associated with significantly slower gains in rehabilitation. Finally, malnutrition at admission was associated with significantly higher odds of a decline in functional ability during admission (OR 3.95; 95% CI:2.14-7.27), and almost three times greater odds of additional care requirements on discharge (OR: 2.9 ((95% CI:1.02-8.3)). The nutritional status of patients on admission to inpatient rehabilitation is a predictor of both the speed and degree of rehabilitation gains and discharge outcomes.

Keywords: nutritional status; physical function, hospital-discharged; health outcomes, malnutrition; rehabilitation; observational retrospective study

Introduction

Rehabilitation services and programs aim to help a patient recover and/or adapt from an injury or illness. According to the World Health Organisation (1), the goal of a

1 rehabilitation programme may be to improve self-care, mobility, functional
2 independence, social participation, education, or return to work. To achieve these goals,
3 rehabilitation personnel develop treatment plans based on a series of assessments of the
4 patient and their environment. Two of these assessments include evaluation of an
5 individual's nutritional status, and evaluation of their physical capability and level of
6 independence in the activities of daily living (2).

7
8 Malnutrition is a major concern in the health system, as the effects are costly and far-
9 reaching (3). In the rehabilitation health care setting, the prevalence of malnutrition
10 ranges between 30 and 50% (4). Malnutrition has been found to increase morbidity,
11 mortality, and the incidence of complications (5). Furthermore, these effects can lead to
12 increased treatment costs, length of stay, and admission to a higher level of care (5).
13 Hence, it is necessary to accurately identify, manage, and monitor malnutrition in order
14 for patient outcomes to be improved (6). Nutritional assessment tools enable a registered
15 dietitian, or medical staff, to make a diagnosis of malnutrition (7). Two tools that have
16 been validated for the rehabilitation setting (8) include the Mini Nutritional Assessment
17 (MNA)(9) and the Subjective Global Assessment (SGA)(10).

18
19 In addition to nutritional status, functional ability is assessed as an outcome indicator of
20 progress in patients in rehabilitation settings (11). The ability to perform activities of
21 daily living indicates functional status and the Functional Independence Measure (FIM)
22 is used to provide a basic indicator of the severity of disability. The tool is used to track
23 changes in a patient's functional ability during a rehabilitation episode (11).

1 The extent to which the conditions malnutrition and reduced functional ability coexist has
2 not been extensively researched. This study therefore aims to determine the association
3 between nutritional status; as measured by the MNA; and functional status; as measured
4 by the FIM; in a large population of Australian rehabilitation patients. The secondary
5 objective is to explore the strength of any relationship between malnutrition and
6 functional impairment sub categories, length of stay, impairment type and discharge
7 destination after adjustment for key covariates.

9 **Materials and method**

10 This was an observational retrospective study. Data was analysed from all patients
11 admitted to one of three dedicated rehabilitation wards within one local health district
12 [removed for peer review] between July 2010 and June 2013. Two of the rehabilitation
13 wards were at one hospital site, while the third ward was at another location within the
14 same health district. All patients were evaluated by the same rehabilitation physician as
15 to their suitability for admission to rehabilitation. The location of ward admission was
16 dictated by the proximity of the ward to the patient's home address. Each rehabilitation
17 ward consists of a 20-22 inpatient bed ward staffed by a range of health professional
18 staff including rehabilitation physicians, nurses, dietitians, physical therapists, speech
19 pathology, occupation therapists and social workers. FIM scores are completed by
20 trained staff, usually the occupational therapist or nurse on admission and discharge.

Ethical approval for this study was obtained from the University of [removed for peer review] Human Research Ethics Committee (HE16/213).

Functional ability was assessed using the 18-item FIM tool. The FIM tool has been demonstrated to be a valid tool in the geriatric rehabilitation population (12,13), with high interrater reliability (14,15). The items in the FIM are divided into two groups: 5 cognitive items and 13 motor items (including feeding status). Each item is assessed against a seven point ordinal scale, where the higher the score indicates greater independence to perform the activity assessed by the item. (11) The highest score achievable is 126 and lowest 18 (indicating complete dependence on others for all activities of daily living). The FIM is completed by nursing staff in conjunction with physiotherapy and occupational therapy staff on admission and discharge. FIM gain was also investigated in this study, which is the change in total FIM score from admission to discharge, and FIM efficiency, which is FIM gain divided by length of stay. FIM efficiency indicates the rate of functional improvement and is expressed as points per day. The outcomes of interest in this study were FIM gain and FIM efficiency, as well as total FIM score, and the subdomains of motor FIM score, cognitive FIM score, and feeding ability FIM score. The FIM data was extracted from the health district wide rehabilitation database (Synaptix Database). This software system records all episodic data relating to all admissions to rehabilitation in the health district.

The MNA tool was used to assess nutritional status (9). The MNA is a validated, reliable nutrition assessment tool specifically designed for older adults aged 65y and older(16-18). The MNA is an 18-item questionnaire, consisting of six questions that

are primarily used as a screening tool (maximum score of 14 points), and twelve questions (items G to R), which are used in addition to fully assess a patient for the presence of, or risk of, malnutrition (maximum possible score of 30 points). Nutritional status is categorised as follows: Malnourished (< 17 points), At Risk of Malnutrition (17 to 23.5 points), and Well Nourished status (≥ 24). In this study, the association between MNA items B (weight loss) and E (neuropsychological problems) and FIM scores were also explored. At the time, of the study all patients admitted to rehabilitation had an MNA completed by the ward dietitian as part of routine clinical care. Interrater reliability of the MNA tool is known to be high (>90%)(19,20) and the MNA is used routinely in the health district where the study occurred as a nutrition assessment tool by the dietitians for all geriatric patients (those >65 years old). MNA data was obtained from the [health district name removed] Nutrition Department Rehabilitation Assessment Database.

Demographic and clinical variables such as age, gender, and length of rehabilitation stay were obtained from internal ministry of health databases (the Synaptix Database). This included intended and actual discharge location, which are recorded by admitting hospital staff (usually the occupational therapist or nurse). For the purposes of this study the dependent variable of discharge location was created by comparing intended discharge location with actual discharge location. Scores were then aggregated into one of three groups: no change in the level of care on discharge; a decrease in the level of care on discharge; and an increase in the level of care on discharge.

Statistical analysis was performed using the SPSS (version 21, 2012, IBM Corporation). The Shapiro Wilk test was used to ascertain normality of continuous data. Parametric data were reported as the mean $\pm$ standard deviation, and nonparametric data were reported as

the median and interquartile range. One-way analysis of variance was performed to analyse the relationship between FIM efficiency and the three nutrition status categories (Well Nourished, At Risk of Malnutrition and Malnourished). The Kruskal Wallis test was used to determine differences in FIM score between nutritional status categories. Spearman's correlation was used to analyse the strength of association among the four MNA components (total MNA screen score; MNA part B score; MNA part E score; and total MNA score) with the FIM scores at admission and discharge (total FIM score; feeding FIM score; cognitive FIM score; and motor FIM score). The strength of the association was evaluated using a rho of ≤ 0.30 as a weak association; 0.3-0.5 as a moderately strong association; and >0.5 as a strong association (21). Chi squared tests were performed to ascertain the association between nutritional status and change in FIM scores. Binary logistic regression models were used to explore the relationship between nutritional status and outcomes such as FIM score, length of hospital stay, and care needs after discharge. Analyses were adjusted for age, gender and length of stay. Length of stay was included as a binary rather than continuous variable and the median length of stay for the cohort of 21 days was selected as the cut off (ie less than 21 days or not). Multiple linear regression analysis was used to test if the MNA score significantly predicted discharge FIM scores, subcomponent scores, and FIM efficiency scores after controlling for age and LOS. A p value of <0.05 was considered statistically significant.

Results

A total of 1530 patients were included on the Nutrition Department Rehabilitation Assessment Database. Of these 7.6% (117) did not contain length of stay, discharge outcome or other data (such as all FIM score components or details of admission diagnosis). This left a total of 1430 patients eligible for analysis. Table 1 shows the

demographic and clinical characteristics of the patients included in the study. Of the 1430 elderly rehabilitation patients (42.7% male), the median age was 79 years (interquartile range IQR: 74 – 84y). Approximately one fifth of individuals (20.6%, n = 294) were classified as malnourished, 53 % were at risk of malnutrition (n= 763), and 372 were well nourished (26.1%) according to the MNA score.

LOS was significantly different between nutritional status categories, with the MN group having the longest LOS after adjustment (median 26 days, Interquartile Range 15-39 days, $p<0.0001$). The FIM scores on hospital admission were also significantly lower for malnourished individuals. The Malnourished group had the lowest FIM scores on admission (median 65, IQR: 48-80, $p<0.0001$), and the lowest motor FIM, cognitive FIM and feeding FIM scores on admission (all $p<0.0001$). The Malnourished group had a significantly greater proportion of patients with a pulmonary diagnosis or were classified as for reconditioning compared to the Well Nourished or At Risk groups ($p<0.0001$).

The strength and direction of the association between nutritional status and FIM scores on admission and discharge are shown in Table 2. Overall there was a moderately strong positive association between nutritional status and functional status (including total, feeding and motor subdomains) on discharge. The association between MNA score on admission and the total FIM and motor FIM scores on admission were also moderately strong (total FIM score $r_s = 0.34$, $p<0.01$; motor FIM score on admission $r_s = 0.33$, $p<0.01$). The association between MNA Part B and functional status was a positive weak one and not statistically significant. The only association significant association between MNA Part E and functional status was for motor FIM score on admission ($r_s = 0.33$, $p<0.01$).

Table 3 shows the difference between each nutrition category for FIM gain, FIM efficiency, and FIM scores at discharge. The discharge outcome is recorded as either a level of care better or the same as on admission or worse than admission. There were significant differences between FIM scores at discharge according to nutritional status. In each FIM subscore component, malnourished individuals on admission had lower FIM scores on discharge ($p<0.0001$ for all FIM score components). More importantly, FIM gain scores were also lowest in the malnourished group ($p=0.0004$). Similarly, those in the malnourished group had a significantly smaller gain in FIM score (8.4% compared to 9.9% gain in the at risk group and 14.1 % gain in the well-nourished group, $p=0.008$). This concept of the MCID for nutritional status warrants further investigation.

Table 3 also displays FIM efficiency scores. Well-nourished patients had greater FIM efficiency than poorly nourished counterparts for total FIM score and the domains of motor, cognitive and feeding FIM efficiency ($p<0.0001$, $p<0.0001$, $p=0.03$ and $p=0.03$ respectively). The Malnourished group had a negative mean cognitive FIM efficiency (mean efficiency per day: -0.01, 95% CI: 0.03-0.06, $p=0.03$) (indicating they lost FIM points over time) and had a neutral mean feeding FIM efficiency (mean efficiency per day: 0.00, 95% CI: -0.01-0.02, $p=0.03$), indicating no improvement in feeding FIM over the length of stay.

Table 4 reports the results of multiple linear regression analyses to determine if MNA score significantly predicted discharge FIM scores, subcomponent scores, and FIM efficiency scores after controlling for age and LOS. The results in all models were significant except for cognitive FIM efficiency. MNA score accounted for 16% of the

variance in total discharge FIM score and resulted in a 2.1-point increase in discharge total FIM score for every 1 unit increase in the MNA score on admission.

Logistic regression analysis showed that individuals who were malnourished or at risk of malnutrition were nearly twice as likely to have a length of stay longer than 21 days (OR: 1.84, CI: 1.45 – 2.34) (Table 5). These individuals were also more likely to experience a reduction in total FIM score (OR: 3.95, CI: 2.14-7.27)). Malnutrition was also associated with an increase in the level of care required on discharge (OR: 2.9, CI: 1.02 – 8.3, Table 5); a worse motor FIM (OR: 3.27, CI: 1.84-5.8), and feeding FIM (OR: 3.21, CI: 1.52-8.81) on discharge, but not cognitive FIM (Table 5).

Discussion

This retrospective analysis of 1430 older patients that had been admitted to rehabilitation hospitals in regional New South Wales, Australia between 2010 and 2013 found that nutritional status at hospital admission predicted functional status on admission as well as improvement in functional ability during their hospital stay. Patients who were well-nourished had a significantly greater gain in FIM scores than their malnourished counterparts while those that were malnourished or at risk of malnutrition were significantly more likely to have a decrease in both total and motor FIM scores.

This finding agrees with several previous studies. For example, Nishioka et al reported that FIM gain was significantly higher in patients who had the greatest improvement in nutritional status, compared to those with no improvement in their nutritional status (22). Schrader et al. similarly showed that functional ability scores decreased with the deterioration of nutritional status (23). In contrast, Nii et al. did not find a difference in

functional performance between malnourished and at-risk of malnutrition patients, but reported that well-nourished patients had a significantly higher cognitive score (24). The present study strengthens the evidence base regarding improvements during rehabilitation as previous studies were restricted to small datasets (< 200 patients) or were limited to specific subtypes of rehabilitation patients (such as stroke or only acute geriatric patients).

Our study also found that malnourished patients were between 3 and 4 times more likely to have a reduction in the total FIM score, as well as motor and feeding sub-domains. Moreover, even being at risk of malnutrition significantly increased how likely an individual was to have a reduction in their total and motor FIM scores. Those with a hospital stay of longer than 21 days were almost twice as likely to be malnourished or at risk of malnutrition compared to those with shorter stays. Similarly, a study of stroke patients in rehabilitation, Finestone et al. found that the Modified Barthel Index scores (a test similar to the FIM, that assesses activities of daily living) were highly predictive of length of stay and also that malnutrition was related to lower Modified Barthel Index scores) (25). More recently this relationship between malnutrition and functional status on discharge was also described in several smaller cohorts of patients on discharge from acute care (26,27).

The focus of this study was primarily on exploring the association between nutritional status score and functional ability in the rehabilitation setting. The main outcomes measured in this study were the association between FIM sub-domains and MNA sub-domains, the FIM gain (the change in FIM score from admission to discharge), and the FIM efficiency (the FIM gain divided by length of stay). FIM efficiency is a metric that considers rate of functional improvement according to patient's length of stay. The

1 current study found that well-nourished patients had the greatest total FIM score
2 efficiency, while malnourished patients had the smallest. This finding was consistent
3 across sub-domains of the FIM score (motor, feeding, cognitive). Finestone et al. found
4 that well-nourished patients had a significantly better rate of functional improvement than
5 that of the malnourished patients (25) at the time of discharge well-nourished and
6 malnourished patients had improved in functional ability to a similar level, but that well-
7 nourished patients had accomplished this in significantly less time. (25). Similarly, recent
8 work by Tanaka et al found that FIM efficacy was also related to nutritional status in a
9 small cohort of Japanese patients admitted for rehabilitation due to spinal cord injury (28).
10 Our study further describes this relationship by outlining where the FIM efficiency gains
11 may be made. For example, we identified a decline in cognitive ability in patients that
12 were malnourished over their rehabilitation stay, while feeding ability did not change over
13 rehabilitation.

14
15 Few studies in the geriatric rehabilitation literature have used datasets as large as ours to
16 explore the relationship between nutritional status and outcomes during and after
17 rehabilitation. While this is an important strength, there were several limitations with this
18 study. First, only one MNA was performed, at hospital admission, therefore the extent to
19 which a patient's nutritional status changed during rehabilitation could not be described.
20 Previous studies have suggested that malnutrition is highly prevalent in the rehabilitation
21 setting, from 30% to 50% (10). This study had a lower prevalence of malnutrition, at
22 20.6%, however over half the population were at risk of malnutrition (53.4%), which is
23 consistent with previous studies published by our research group (17,29). The
24 observational nature of the study design cannot rule out unmeasured confounding.
25 Secondly, some patients were excluded due to a lack of necessary information meant that

1 some selection bias could have been present. Further studies are therefore necessary in
2 rehabilitation settings to explore the relationship between changes in nutritional status
3 and its influence on functional recovery. Additional exploration is also warranted
4 investigating the minimal clinically important difference for the MNA. No studies appear
5 to have investigated this point and would be useful for clinicians.

6
7 This secondary analysis of data on older patients admitted to a rehabilitation hospital has
8 demonstrated that malnutrition is modestly associated with reduced functional ability
9 during their hospital rehabilitation stay. Malnourished patients also demonstrate slower
10 gains in functional ability and have increased care needs on discharge, compared to their
11 peers that were well-nourished or those classified as being at risk of malnutrition. The
12 finding that a 1 unit increase in MNA score on admission results in a 2.1 unit increase in
13 FIM score on discharge has important implications for clinicians. For example, improving
14 the nutritional status of a patient to result in a change from malnourished to at risk
15 category could result in a potential gain of more than 13 points on the FIM score. This is
16 substantially more than the 3 point minimal clinically important difference cited in other
17 studies. This data reinforces the need for nutrition screening in acute care, close
18 monitoring of nutritional intake and nutritional status during hospital admission and for
19 targeted nutritional interventions prior to and during rehabilitation (to improve/prevent
20 decline) to optimise the functional recovery of patients.

21 22 **Take away points**

- 23 • The relationship between nutritional status and rehabilitation outcomes has been
24 described in many studies. However, these studies are often small or restricted to
25 specific subtypes of rehabilitation patients.

- This retrospective observational study evaluated the association between nutritional status, functional ability and discharge outcomes in a large data set of 1430 elderly rehabilitation patients in one health district.
- One fifth (20.6%, n = 294) of patients were malnourished and 53 % were at risk of malnutrition (n= 763) on admission to rehabilitation.
- Nutritional status on admission was modestly associated with reduced functional, motor, cognitive and feeding ability on admission and discharge (all p<0.05).
- Malnutrition was associated with significantly slower gains in rehabilitation and significantly higher odds of a decline in functional ability during the admission (OR 3.95; 95% CI:2.14-7.27), and almost three times greater odds of additional care requirements on discharge (OR: 2.9 ((95% CI:1.02-8.3).
- The nutritional status of patients on admission to inpatient rehabilitation is a predictor of both the speed and degree of rehabilitation gains and discharge outcomes.
- The finding that a 1 unit increase in MNA score on admission results in a 2.1 unit increase in FIM score on discharge reinforces the need for close attention to nutritional status in order to optimise rehabilitation potential and discharge outcomes.

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All authors participated in the drafting and approval of the final manuscript submitted for publication.

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Table 1: Characteristics of 1430 patients aged 65 years or older on admission to rehabilitation.

Characteristic	Well Nourished n=372	At Risk of Malnutrition n=763	Malnourished n=294	P value
Age (y) Mean ($\pm$ SD)	78.0 ($\pm$ 16.9)	79.3 ($\pm$ 7.1)	78.9 ($\pm$ 7.3)	0.06
Gender n (%)	145 (39.0)	326 (42.7)	140 (47.5)	0.08
Male,	228 (61.0)	437 (57.3)	154 (52.2)	
Female				
Length of stay (days) median (IQR)	18 (11-28)	21.5 (14-35)	26 (15-39)	P<0.0001
FIM on admission median (IQR)				
Total FIM (tFIM)	86 (73-97)	76 (62 - 89)	65 (48 –80)	P<0.0001
Motor FIM	58(48 – 67)	52 (39-61)	43 (28-56)	P<0.0001
Cognitive FIM	27 (23-31)	25 (20 – 30)	23 (17-28)	P<0.0001
Feeding FIM	6 (5 – 7)	6 (5 – 7)	5 (5-6)	P<0.0001
Impairment Type n (%)				P<0.0001
Amputation	4 (1.1)	31 (4.1)	11 (3.7)	
Arthritis	4 (1.1)	8 (1.1)	3 (1.0)	
Brain	4 (1.1)	20 (2.6)	6 (2.0)	
Cardiac	5 (1.3)	14 (1.8)	5 (1.7)	
Multiple Trauma	0 (0.0)	1 (0.1)	0(0)	
Neurological	16 (4.3)	22 (2.9)	9 (3.1)	
Orthopedic	182 (48.9)	280 (36.7)	94 (31.9)	
Other disabling impairment	0 (0.0)	2 (0.3)	0 (0)	
Pain	23 (6.2)	36 (4.7)	8 (2.7)	
Pulmonary	1 (0.3)	5 (0.7)	6 (2.0)	
Reconditioning/Restorative	61 (16.4)	184 (24.1)	89 (30.2)	
Spinal Cord	4 (1.1)	12 (1.6)	7 (2.4)	
Stroke	68 (18.3)	148 (19.4)	57 (19.3)	

Range for total FIM score is a minimum of 18 to a maximum of 126.

Chi Square tests used to evaluate differences for categorical data (gender, impairment type). ANOVA used to evaluate differences in age between nutritional status categories.

The Kruskal Wallis test was used to determine differences in FIM score between nutritional status categories.

Table 2: The unadjusted association between nutritional status scores and Functional Independence Measure scores on admission and discharge

	Total MNA score	MNA Part B (weight loss)	MNA Part E (neuropsych)
FIM on admission			
Total FIM	0.34*	0.16	0.20
Feeding FIM	0.27	0.15	0.14
Cognitive FIM	0.23	0.12	0.26
Motor FIM	0.33*	0.15	0.33*
FIM on discharge			
Total FIM	0.37*	0.18	0.23
Feeding FIM	0.33*	0.17	0.18
Cognitive FIM	0.26	0.14	0.29
Motor FIM	0.37*	0.18	0.18

MNA Part E indicates questions relating to neuropsychological status.

* = $p < 0.05$

FIM: Functional Independence Measure

1 **Table 3:** Unadjusted Functional Independence Measure (FIM) scores at discharge, FIM gain, FIM efficiency, and discharge outcome according
2 to nutritional status
3

Characteristic	Well Nourished n=372	At Risk of Malnutrition n=763	Malnourished n=294	P value
FIM at discharge				
Median (IQR)				
total FIM score	107 (96-115)	98 (78-108)	83 (58-1-2)	<0.0001
motor FIM score	78 (70-84)	71 (54-79)	59 (36-75)	<0.0001
cognitive FIM score	30 (25-33)	27 (23-31)	25 (18-30)	<0.0001
feeding FIM score	6 (5-7)	6 (5-7)	6 (5 -7)	<0.0001
FIM gain (points)				
Mean ($\pm$ SD)	18.5 ($\pm$ 14.7)	15.9 ($\pm$ 17.0)	13.6 ($\pm$ 19.7)	0.0004
Mean change (%; 95% CI)	14.1 (11.3-17.0)	9.9 (8.2-11.5)	8.4 (6.0-10.8)	0.008
FIM efficiency (points/d)				
Mean (95% CI)				
total FIM points / day	1.15 (0.99-1.29)	0.66 (0.52-0.80)	0.44 (0.27-0.6)	<0.0001
motor FIM points / day	1.04 (0.92-1.16)	0.61 (0.51-0.72)	0.44 (0.31-0.57)	<0.0001
cognitive FIM points / day	0.11 (0.02-0.15)	0.04 (0.02-0.09)	-0.01 (0.03-0.06)	0.03
feeding FIM points / day	0.03 (0.01-0.04)	0.02 (0.01-0.02)	0.00 (-0.01-0.02)	0.03
Discharge Outcome n (%)				
Better / Same	271 (72.9)	482 (63.2)	151 (51.2)	0.02
Worse	101 (27.1)	281 (36.8)	144 (48.8)	

4

1 Table 4. Results of multiple linear regression according to nutritional status (MNA) score. Analyses re adjusted for age and length of stay.

2

	Beta	Adjusted R ²	R ²	P value
Discharge total FIM	2.10	0.16	0.16	<0.001
Discharge motor FIM	1.65	0.16	0.16	<0.001
Discharge cognitive FIM	0.44	0.08	0.08	<0.001
Discharge feeding FIM	0.10	0.12	0.11	<0.001
FIM gain	0.57	0.06	0.06	<0.001
FIM efficiency	0.06	0.03	0.03	<0.001
Motor FIM efficiency	0.05	0.04	0.04	<0.001
Cognitive FIM efficiency	0.009	0.003	0.005	0.06
Feeding FIM efficiency	0.002	0.005	0.007	0.02

3

1 Table 5. Predictors of rehabilitation outcomes after controlling for age, gender and length of stay

	LOS > 21 days	Higher level of care on discharge	Worse total FIM score on discharge	Worse motor FIM score on discharge	Worse cognitive FIM score on discharge	Worse feeding FIM score on discharge
Age	1.00 (0.99-1.02)	1.02 (0.98-1.06)	1.02 (0.99-1.05)	1.02 (0.99-1.05)	1.04 (1.01-1.06)*	1.04 (0.99-1.06)
Length of stay	-	1.03 (1.02-1.04)*	1.69 (1.17-2.45)*	0.98 (0.97-0.99)*	1.14 (0.8-1.61)	0.97 (0.96-0.99)*
Male gender	1.24 (1.01-1.54)*	1.22 (0.65-2.9)	0.98 (0.97-0.99)*	2.03 (1.40-2.94)*	1.00 (0.99-1.01)	1.67 (1.04-2.7)*
Malnourished	1.84 (1.45-2.34)*	2.9 (1.02- 8.3)*	3.95 (2.14-7.27)*	3.27 (1.84-5.8)*	1.51 (0.97-2.35)	3.21 (1.52–8.81)*

2

3 Figures represent Adjusted Odds Ratio and 95% confidence interval;

4 Abbreviations: LOS: length of stay; * $p < 0.05$