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ORIGINAL REPORT

OUTCOMES OF REHABILITATION IN OLDER PEOPLE – FUNCTIONING AND COGNITION ARE THE MOST IMPORTANT PREDICTORS: AN INCEPTION COHORT STUDY

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Objective: **To explore the influence of level of functioning and cognitive status on outcome after rehabilitation for older people with different types of impairment.**
Design: **An inception cohort study.**
Subjects: **A total of 560 older people, mean age 80.0 years, participating in rehabilitation programmes in the Sydney area.**
Methods: **Level of functioning using the Functional Independence Measure (FIM™), the Barthel Index, cognitive status using the Mini Mental State Examination (MMSE), and type of impairment were assessed on admission. Level of functioning and length of hospital stay were assessed on discharge and after 6 months.**
Results: **Disability on admission was the strongest independent predictor for functioning at discharge (B = 0.35, R^2 = 0.49 p < 0.001) and follow-up (B = 0.22, R^2 = 0.27, p < 0.001), and for length of hospital stay (B = –0.63, R^2 = 0.12, p < 0.001). Cognitive status at admission (mean MMSE 25 (standard deviation 5.3)) was also a significant predictor of functioning at discharge and at follow-up (B = 0.30, R^2 = 0.42, p < 0.01). Functional status prior to injury, joint replacement impairment category, and type of hospital had marginal, but statistically significant, impacts on functioning after discharge.**
Conclusion: **Functional status on admission to a rehabilitation facility has stronger predictive value than type of impairment for rehabilitation outcome for older people. Cognitive impairment may have a small adverse effect on rehabilitation outcome.**

Key words: rehabilitation; Barthel Index; cognitive function; older people.

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INTRODUCTION

Older people who are admitted to a rehabilitation facility may have major limitations in functioning and can also have mild to severe cognitive impairment. As the older population continues to grow, it becomes more important to re-examine to what extent these factors, and the underlying type of impairment, have an influence on rehabilitation outcomes (1–6). The value of early prediction of rehabilitation outcome for older people is important for several reasons: it may assist in goal-setting, coordinating patients' and caregivers' expectations, efficiently allocating resources, and planning future care (2, 5, 7–9).

Because of its importance, numerous studies analysed the prediction of rehabilitation outcome for different types of impairment (2, 4, 10–19). For example, Chumney et al. (19) performed a systematic review on this topic for post-stroke patients and found limited evidence that the Functional Independence Measure (FIM™) can be used as accurate predictor of rehabilitation outcomes. However, the mean age of patients in their review was 50 years. Other studies predicting rehabilitation outcome have focused on other patient characteristics, such as age, gender or weight, in relation to a particular impairment, such as arthroplasty (20). For hip fracture patients, not only pre-fracture functional status, but also serum albumin levels have been acknowledged to influence rehabilitation outcomes (21). For patients with amputations, pre-amputation functional status measured with the FIM™ was not very useful in predicting rehabilitation outcomes (22, 23). So far, few studies have focused on the prediction of rehabilitation outcome for older people in general with different types of impairment, but taking into consideration both level of functioning and cognitive status at the time of admission to a rehabilitation ward.

The relationship between cognitive function and rehabilitation outcome in elderly patients has been acknowledged in several studies, showing better discharge functional level among cognitively intact patients. It has also been suggested that cognitive impairment may limit functional gains during inpatient rehabilitation (24). This does not necessarily imply that cognitively impaired patients do not benefit from a rehabilitation programme, but rather that their improvement may be limited. Cognitive impairment can affect an individual's ability to participate effectively in rehabilitation thereby impacting on the delivery of care (9). On the other hand, studies have demonstrated that older people with mild to moderate cognitive

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impairment are capable of gaining functional improvement from inpatient rehabilitation and able to maintain the functional gains up to 12 months, or have even shown that there was no difference in functional gain between those with and without cognitive impairment (1).

This multi-centre prospective study sought to explore the effect of different levels of functioning pre- and on admission, type of impairments, and cognitive abilities on rehabilitation outcome for older people.

METHODS

Subjects

We studied patients aged 65 years or older who were enrolled in 3 rehabilitation units in the Northern Sydney area of Australia (Greenwich Hospital, Hornsby Ku-ring-gai Hospital and Mount Wilga Private Hospital) between 1992 and 1993. Participants were enrolled at the time of admission to each of the rehabilitation units after informed consent was obtained. Prior to admission patients had been assessed by rehabilitation physicians and admission had been arranged because the assessing physician concluded they would benefit from a multidisciplinary inpatient rehabilitation programme (rather than an ambulatory rehabilitation programme or no rehabilitation programme). In a few cases there was doubt that the purpose of admission for the patient was participation in a rehabilitation programme. If so, confirmation was sought from the attending rehabilitation physician.

Design

An inception cohort design was used, in which participants were followed for 6 months after admission to the rehabilitation unit. The study was approved by the research ethics committees of the participating hospitals. Patient data was collected by 3 trained research nurses employed specifically for the study. Each nurse was primarily responsible for data collection at one of the hospitals, and also collected the follow-up data for the patients from that hospital. There was close collaboration to ensure comparability of data collection and coverage for leave. Inter-rater reliability was formally assessed by blinded rating of videotaped patient interviews. Acceptable inter-rater reliability was confirmed.

Data collection and measurements

Information concerning pre-morbid level of physical independence, accommodation status, and demographic details including socioeconomic status were collected at entry to the rehabilitation ward. These items were assessed by recall of the patient (except in the case of major intellectual impairment when a proxy, usually the family carer, was used).

The level of disability on admission was assessed within 36 h of entry to the ward. The Barthel Index (25) and the FIM™ (26) were used to assess the level of functional restriction and therefore disability. The FIM contains a total of 18 items. Thirteen of these items constitute the motor subscale and the remaining 5 items form the cognitive subscale (26). In this analysis we used the FIM total score, which ranges from 18 to 126 (higher scores on the FIM denote patients who have a higher level of independence and require less assistance) in combination with two other instruments (26). The Barthel Index was used to assess disability status and includes 15 self-care, sphincter-control, and mobility factors. A Barthel score of 40 or less is defined as very severely dependent; a score of 60 or less was defined as markedly dependent, while a score of 61–80 demonstrates less need for assistance (25). The Mini Mental State Examination (MMSE) (27) was used to assess cognitive function on admission. This test is a brief, standardized method to grade patients' cognitive status. 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 (28).

On admission to the rehabilitation ward the patient was classified into an impairment group that best specified the type of impairment that contributed to the need for the rehabilitation programme. These impairment groups were: stroke, hip fracture, joint replacement, lower extremity amputation, "other orthopaedic" and "other rehabilitation". These categories were based on FIM impairment codes. "Stroke" comprised all stroke impairment codes, "hip fracture" included the unilateral hip fracture code, "joint replacement" included post-elective hip and knee arthroplasty codes, "lower extremity amputation" included all lower extremity amputation codes, while "other orthopaedic" included all other fractures and "other rehabilitation" included the reconditioning category. There were no participants with traumatic brain injury or spinal cord injury in the study.

At the time of discharge from the rehabilitation ward, the Barthel Index and FIM scores were measured again. Rehabilitation efficiency was calculated as the average increase in Barthel Index score or the FIM score divided by the duration of rehabilitation stay (29). Finally, at 6 months after admission patients were interviewed to assess long-term health status. During the last follow-up the FIM scores, the duration of hospital stay and the type of accommodation to which patients were discharged were noted.

Statistical analysis

Differences in baseline characteristics between the impairment groups were analysed using Kruskal–Wallis analyses for differences in age and χ^2 analysis for differences in gender, marital status and living setting prior to the current illness. Accommodation pre-admission and after discharge was dichotomized into home plus living in an independent unit of a retirement village vs other (semi) dependent living to analyse for differences between the impairment patient groups and between the different FIM or Barthel score groups. For the latter we used a χ^2 analysis for trend, and calculated the odds ratios per FIM or Barthel score group. We also analysed differences in scores on the MMSE, length of hospital stay and improvement in disability per week during hospital stay.

Correlations between disability, as measured with the FIM and MMSE scores, were calculated with Spearman's rank correlation analysis. Multivariate linear regressions were used to identify the most important factors predicting discharge and follow-up scores on disability (FIM at discharge and FIM at follow-up) and length of stay in hospital. Predictor variables were hospital, type of impairment, FIM on admission, FIM pre-admission, age, MMSE, and living alone pre-admission were applied in a forward stepwise procedure in selecting the variables for the regression model. For the regression analysis we created dummy variables for the type of impairment using the "other rehabilitation group" as reference group, and dummy variables for the hospital, with Greenwich Hospital as reference group.

A binary logistic regression model was used to find the most predictive variables for returning home. We dichotomized accommodation into dependent living or living at home, and this was considered the dependent variable. The same predictors from the linear regression were used in this analysis. We checked for multicollinearity and tested for outliers. Similar procedures were carried out using the Barthel scores as predictor or as outcome measure in the regression analyses, but as the results were similar to the analysis with the FIM, only the analyses with the FIM scores are described here.

RESULTS

From the 3 rehabilitation units 645 patients were considered potentially eligible for this study. Of this group 85 patients declined to participate (62 Mt Wilga Hospital, 11 Hornsby Hospital and 12 Greenwich Hospital). In total 560 patients participated in the study, which included $n = 200$ at Greenwich Hospital, $n = 184$ at Hornsby Hospital and $n = 176$ at Mt Wilga Hospital. Follow-up of patients at 6 months after admission

Table I. *Demographic data by type of impairment (*n = *560)*

	Total $n=560$	Stroke $n=87$	Hip fracture $n=103$	Joint replacement $n=96$	Lower extremity amputation $n=12$	Other orthopaedic $n=170$	Other rehabilitation $n=92$	Kruskal–Wallis χ^2
Age, years, mean (SD)	80.0 (7.1)	79.7 (7.0)	82.3 (6.6)	77.1 (5.8)	78.3 (7.2)	80.2 (7.1)	80.4 (7.1)	28.3, $p<0.001$
Gender, *n* (% female)	419 (74.8)	46 (52.9)	92 (89.3)	81 (84.4)	5 (41.7)	141 (82.9)	54 (58.7)	64.0, $p<0.001$
Marital status, *n* (% currently married)	163 (29.1)	36 (41.4)	20 (19.4)	29 (30.2)	5 (41.7)	45 (26.5)	28 (30.4)	3.2, $p=0.67$
Lived alone prior to illness or injury, *n* (%)	279 (49.8)	39 (44.8)	58 (56.3)	54 (56.2)	4 (33.3)	84 (49.4)	40 (43.5)	7.0, $p=0.22$

was achieved for 517 (92%) patients. During the 6 months follow-up 25 patients (4.5%) had died. The other 18 participants not followed up either could not be traced or declined the follow-up interview. Follow-up was best for Greenwich Hospital (91.8% follow-up) compared with the other two hospitals (78.8% follow-up at Hornsby, 80.8% at Mt Wilga, Pearson $\chi^2=0.001$).

Three-quarters (74.8%) of patients were women. The mean age of study subjects was 80.0 years. Half of the patients (55.2%) were widowed, while 29.1% were married and 12.1% were single. Only 3.6% of participants were separated or divorced. Only 1.6% of subjects did not have English as their preferred language. Prior to admission to hospital 75.7% of subjects lived in a private home, while 14.8% lived in a hostel (an aged care facility providing some assistance with activities of daily living, as well as accommodation) and 7.7% lived in an independent living unit in a retirement village. Very few subjects lived in a nursing home (2 only). Admission to the rehabilitation ward was overwhelmingly from an acute hospital, with only 7.3% of patients admitted from home for rehabilitation.

Patients were classified by cause of the major impairment. The groups were “stroke” 16%, “hip fracture” 18%, “joint replacement” 17%, “lower extremity amputation” 2%, “other orthopaedic” 30% and “other rehabilitation” 16%. Men were over-represented in the small lower extremity amputation group (58%), while this occurred for women in each of the 3 orthopaedic impairment groups, with women particularly predominant in hip fracture patients (89% women). Patients with a hip fracture tended to be older than the other impairment groups (mean age 82.5 years) (Table I). After 6 months there was a significant difference in follow-up between the 6 groups (Pearson $\chi^2<0.001$), with the best follow-up for the group with joint replacement (100%) and worst follow-up for the group of stroke patients (74%).

Overall patient outcomes

Limitation of functioning as measured by the FIM or the Barthel Index lessened significantly during the rehabilitation ward admission (Table II). Disability on admission was greater for stroke and hip fracture patients and least for patients with joint replacement. By discharge, disability was similar for 5 of the 6 impairment groups studied with joint replacement patients discharged with least disability.

Rehabilitation efficiency, as measured by increase in FIM points (or Barthel Index) per week during the rehabilitation ward admission rehabilitation programme, varied to a limited extent between the impairment groups (24). The overall mean was 6.7 FIM points and 9.6 Barthel Index points per week (Table II).

Patients with lower extremity amputation stayed significantly longer in hospital compared with the other impairment groups (mean 79 days vs mean 30 days) and were less likely to be discharged to their homes (33% vs 58%). Patients with elective joint replacement were most likely to be discharged to home (77% vs 58%) (Table III).

Table II. *Disability data by type of impairment (*n=*560)*

	Total $n=560$ Mean (SD)	Stroke $n=86$ Mean (SD)	Hip fracture $n=103$ Mean (SD)	Joint replacement $n=105$ Mean (SD)	Lower extremity amputation $n=12$ Mean (SD)	Other orthopaedic $n=168$ Mean (SD)	Other rehabilitation $n=96$ Mean (SD)	Kruskal–Wallis χ^2
MMSE	25.0 (5.3)	22.4 (6.8)	24.4 (5.5)	27.6 (3.0)	26.0 (3.4)	25.7 (4.6)	23.9 (5.6)	55.9, $p<0.001$
FIM pre-admission	115.9 (13.3)	118.7 (13.2)	115.8 (13.6)	119.5 (6.8)	116.8 (6.5)	114.9 (14.2)	111.3 (15.3)	30.5, $p<0.001$
FIM at admission	88.8 (17.7)	79.9 (23.1)	83.5 (15.1)	97.5 (11.0)	84.0 (13.1)	90.6 (16.1)	91.3 (18.5)	57.1, $p<0.001$
FIM at discharge	107.9 (16.6)	103.4 (20.9)	104.8 (19.9)	115.1 (5.7)	107.7 (7.9)	108.7 (14.7)	106.7 (17.4)	24.7, $p<0.001$
FIM at follow-up	109.8 (18.1)	105.1 (23.1)	106.2 (21.1)	118.7 (7.3)	111.6 (5.2)	110.3 (15.9)	105.4 (20.3)	40.2, $p<0.001$
Barthel pre-admission	91.3 (13.7)	95.1 (10.3)	93.4 (9.3)	93.6 (8.3)	88.3 (9.8)	90.4 (15.9)	84.7 (18.4)	32.9, $p<0.001$
Barthel admission	57.9 (19.2)	50.5 (24.1)	53.1 (13.1)	64.3 (12.2)	48.8 (13.8)	59.7 (19.1)	61.1 (23.1)	41.0, $p<0.001$
Barthel discharge	84.7 (19.4)	80.7 (25.7)	82.3 (20.8)	93.0 (6.8)	68.2 (18.8)	85.9 (17.1)	80.7 (19.1)	31.0, $p<0.001$
FIM per week	6.7 (6.0)	6.7 (5.2)	6.5 (6.6)	7.6 (4.4)	2.5 (1.1)	6.9 (6.7)	6.2 (6.4)	26.8, $p<0.001$
Barthel per week	9.6 (8.6)	10.5 (9.4)	8.2 (7.6)	13.1 (8.4)	2.5 (4.0)	9.4 (9.1)	7.8 (7.3)	39.2, $p<0.001$

SD: standard deviation; MMSE: Mini Mental State Examination score; FIM: Functional Impairment Measure™; Barthel: Barthel Index.

Table III. *Outcomes (length of stay in the rehabilitation ward, and accommodation) by type of impairment*

	Total $n=560$	Stroke $n=87$	Hip fracture $n=103$	Joint replacement $n=96$	Lower extremity amputation $n=12$	Other orthopaedic $n=170$	Other rehabilitation $n=92$	Kruskal–Wallis χ^2
Length of stay, days, mean (SD)	30.2 (22.6)	32.8 (27.5)	32.7 (17.1)	23.8 (15.7)	79.0 (30.9)	30.3 (23.5)	25.0 (17.1)	19.7, $p<0.001$
Accommodation pre-admission, *n* (%)								10.9, $p<0.001$[a]
Home	424 (5.7)	70 (80.5)	77 (74.8)	80 (83.3)	9 (75.0)	129 (5.9)	59 (64.1)	
Hostel	83 (14.8)	13 (14.9)	20 (19.4)	7 (7.3)	3 (25.0)	18 (10.6)	22 (23.9)	
Independent unit	43 (7.7)	3 (3.4)	5 (4.9)	6 (6.2)	0	18 (11.8)	9 (9.8)	
Other	10 (1.8)	1 (1.2)	1 (0.9)	3 (3.2)	0	3 (1.7)	2 (2.2)	
Accommodation after discharge, *n* (%)								19.1, $p<0.001$[a]
Home	327 (8.4)	52 (60.9)	54 (52.4)	74 (77.1)	3 (33.3)	(97 (57.1)	45 (48.9)	
Hostel	83 (15.2)	10 (11.5)	20 19.4)	7 (9.4)	2 (16.7)	18 (12.4)	22 (25.0)	
Independent unit	37 (6.6)	3 (3.4)	5 (4.9)	3 (6.2)	0	16 (9.4)	7 (7.6)	
Nursing home/hospital	58 (10.4)	12 (13.7)	17 (16.5)	0	1 (8.3)	19 (11.1)	8 (8.7)	
Died	12 (2.5)	6 (6.9)	1 (1.0)	0	1 (25.0)	1 (0.6)	3 ((3.3)	
Other	39 (6.9)	4 (3.6)	6 (5.8)	7 (7.3)	2 (16.7)	16 (9.4)	6 (6.5)	

[a]Analysis is based on home vs other accommodation, and did not include the lower extremity amputation group.
SD: standard deviation.

Outcomes by functioning status

Disability groups can be defined by grouping patients into strata based on disability at admission to the rehabilitation ward. Demographic data for the different disability groups, as defined by Wade & Collin (30), is similar to that of the impairment groups. However, outcome, as determined by length of stay and accommodation after discharge, is linked directly to the severity of the disability (Table IV). The odds ratio for living independently after discharge increased with higher FIM scores on admission. Patients with serious disability (FIM less than 45, $n=13$) on admission did not stay longer, but were more likely to be discharged to nursing home care. This suggests that the limited progress towards recovery was recognized at a relatively early stage and arrangements were made quite promptly for appropriate discharge. However, it is recognized that the number of participants in this group is very small.

Outcomes by cognitive impairment

The effect of mild to moderate cognitive impairment on rehabilitation outcome was evaluated. Data were available for 532 older people who participated in inpatient rehabilitation programmes.

Six percent of 532 patients had MMSE scores of less than 15, and 21% had MMSE scores between 15 and 24. The majority of patients (73%) had MMSE scores of more than 24 points, which is in line with the mean score for people between 80 and 84 years with an education of up to 9–12 years (23). There was no significant correlation between cognitive function and rehabilitation outcome. Rehabilitation outcome was measured as the improvement in FIM score per week between admission and 6 months follow-up. If MMSE was less than 15, mean improvement in FIM score was 6.8 (standard deviation (SD) 9.3) points, if MMSE was between 15 and 24, mean improvement in FIM score was 5.6 (SD 9.6), and if MMSE was 24 or more points, mean improvement in FIM score was 7.4 (SD 7.8) points.

However, there was a significant, but small, correlation between cognitive function and rehabilitation efficiency (Rho $=0.12$, $p=0.02$). For those with MMSE less than 15, mean improvement in FIM score during hospitalization was 3.8 (SD 9.0) points, for those with MMSE between 15 and 24,

Table IV. *Outcomes, length of stay and accommodation, based on disability on admission to the rehabilitation ward (as assessed using FIM)*

	Total $n=555$	FIM on admission 0–45 $n=13$	FIM on admission 46–72 $n=81$	FIM on admission 73–99 $n=300$	FIM on admission 100–126 $n=161$	Kruskal–Wallis χ^2
Length of stay, days, mean (SD)	30.2 (22.5)	31.7 (20.2)	43.2 (30.8)	32.7 (21.0)	18.7 (14.1)	99.9, $p<0.001$
Accommodation after discharge, *n* (%)						38.0, $p<0.001$[a]
Home	324 (58.4)	2 (15.4)	32 (39.5)	171 (7.0)	119 (3.9)	
Hostel	85 (15.3)	2 (15.4)	17 (21.0)	50 (16.7)	16 (9.9)	
Independent unit	37 (6.7)	0	3 (3.7)	19 (6.3)	15 (9.3)	
Nursing home/hospital	58 (10.5)	6 (46.2)	24 (29.7)	27 (9.0)	1 (0.6)	
Died	12 (2.2)	3 (23.1)	1 (3.7)	6 (2.0)	0	
Other	39 (7.0)	0	2 (2.5)	27 (9.0)	10 (6.2)	

[a]χ^2 analysis is based on home vs other accommodation.
FIM: Functional Impairment Measure™; SD: standard deviation.

mean improvement was 6.7 (SD 5.9), and for those with MMSE above 24, mean improvement was 6.9 (SD 5.7) points.

Multivariate models

Multiple regression analysis with pre-admission FIM, FIM on admission, age, sex, MMSE, type of impairment, hospital, and living alonge pre-admission as predictor variables and FIM at discharge as dependent variable showed that restriction in functioning at admission, as measured with the FIM was the strongest predictor of disability at discharge. Approximately 68% of the variance in disability at discharge could be explained by a regression model containing disability at admission (B = 0.35, $R^2 = 0.485$, $p < 0.001$) explaining 48% of variance, disability prior to current illness (B = 0.38, $R^2 = 0.610$, $p < 0.001$) explaining 12%, and cognitive function (B = 0.92, $R^2 = 0.686$, $p < 0.001$) explaining 7%. The type of hospital added another 0.4% to explaining variance (B = –5.78, $R^2 = 0.702$, $p < 0.001$, and B = –2.59, $R^2 = 0.706$, $p < 0.009$, respectively).

In a similar multiple regression analysis with FIM at follow-up as dependent variable we found that 44% of variance could be explained in a model with FIM pre-admission, FIM on admission, patients with joint replacement, cognitive status and age as predictor variables. Low disability on admission, low disability prior to current illness, high cognitive status, having a joint replacement and being a patient in Greenwich Hospital instead of Hornsby Hospital were significantly related to a higher FIM score after 6 months. Sex, age and living at home prior to current illness had no significant influence on disability scores at discharge or follow-up. Table V provides further details.

Length of hospital stay as dependent variable in a multiple linear regression with similar predictor variables again showed that functional ability at admission, as measured with the FIM was the strongest predictor (B = –0.63, standard error (SE) = 0.06, $R^2 = 11.6$, $p < 0.001$) explaining 11.6% of the variance. Other significant predictors of length of hospital stay were patients with an amputation, FIM score pre-admission, patients from Hornsby Hospital and Mount Wilga Hospital (compared with Greenwich Hospital), and MMSE score (Table V). Similar results were found when using Barthel scores on (or prior to) admission (data not shown).

A binary logistic regression analysis with accommodation status (home vs (semi) dependent living) at discharge as dependent variable and similar predictor variables showed that mainly living at home before current illness (odds ratio (OR) = 72.8 (95% confidence interval (CI) 30.6–173.0), $p < 0.001$), but also a high FIM score on admission (OR = 1.04, (95% CI 1.03–1.06), $p < 0.001$) were the two significant predictors for accommodation status at discharge.

DISCUSSION

The major improvement in the level of functioning that occurred during the admission to the rehabilitation ward occurred despite advanced age (mean 80 years) and significant disability on admission (FIM score 90 and Barthel Index 58) and irrespective of type of impairment. The great majority of patients (80%) were able to return to independent or semi-independent living. Disability at admission was the strongest predictor for functioning at discharge, for functioning after 6 months follow-up, and for length of hospital stay. Cognitive impairment, as assessed by the MMSE, had smaller but significant predictive values for all these factors as well. The type of impairment had no influence on disability at discharge, but having a joint replacement was predictive for a better functional status after 6 months. The type of hospital in this study also had a significant effect on the FIM after discharge, FIM after 6 months and length of stay in hospital.

Of the 6 impairment groups studied, patients with stroke and hip fracture had slightly more disability and, despite improvements in disability similar to the other groups, greater numbers were discharged to institutional accommodation. Patients who needed rehabilitation following arthroplasty were younger and scored relatively higher on rehabilitation efficiency. This group also had the highest chance to live independently after discharge. In contrast, the patients who needed rehabilitation after lower extremity amputation scored worse on rehabilitation efficiency as they stayed relatively long (± 79 days) in the rehabilitation facility. This shows that this particular group, although small in numbers, does use a lot of resources.

The strong predictive value of the FIM was also found in the study by Denti et al. (14) for 359 elderly first-stroke pa-

Table V. *Results of the multivariate linear regression analysis with FIM score at follow-up and length of hospital stay as dependent variables*

Dependent variable	Predictor variable	Regression coefficient B	Standard error	ß	*p*-value	Cumulative adjusted R^2
FIM at follow-up	FIM at admission	0.25	0.05	0.22	< 0.001	0.272
	FIM prior to current illness	0.47	0.06	0.31	< 0.001	0.371
	MMSE	0.90	0.16	0.25	< 0.001	0.424
	Patients with joint replacement	4.76	1.68	0.11	0.005	0.435
	Hornsby Hospital	–3.39	1.49	–0.09	0.024	0.440
Length of hospital stay	FIM at admission	–0.63	0.06	–0.48	< 0.001	0.116
	Patients with lower extremity amputation	46.53	5.80	0.29	< 0.001	0.203
	FIM prior to current illness	0.27	0.07	0.15	< 0.001	0.249
	Hornsby Hospital	–13.18	2.07	–0.27	< 0.001	0.284
	Mt Wilga Hospital	–11.17	2.08	–0.23	< 0.001	0.322
	MMSE	0.60	0.19	0.14	0.002	0.334

MMSE: Mini Mental State Examination; FIM: Functional Impairment Measure™.

tients who were admitted to an inpatient rehabilitation ward. The age of these patients was similar to those in our study; however, the total FIM score at admission (< 60) was lower on average compared with the participants with stroke in our study (± 80). No information was found for the pre-admission FIM score. They also found an association between cognitive impairment and discharge accommodation for these patients. We did not find such a relation with cognitive impairment (14). Ottenbacher et al. (13) made an effort to develop statistical models to predict living setting after medical rehabilitation in persons with lower limb joint replacement. In their model they included cognitive and basic motor function associated with activities of daily living, age, length of stay, and marital status to predict if older adults would be living at home after 80–180 days post-rehabilitation. They found that cognitive status at admission measured with the FIM cognitive score was predictive for living at home 3–6 months after discharge. Several studies analysed rehabilitation outcome for hip fracture patients and found similar results with regards to pre-fracture functional status and cognitive status (8, 12, 31, 32). For example, the study of Lieberman et al. included patients with similar pre-admission total FIM score (SD 115) and MMSE score (SD 24) and found that these two variables were predictive for rehabilitation outcome at discharge (8).

The strength of this study is its design, with the inception cohort and careful data collection. Analysing rehabilitation outcomes for a general group of patients with different types of impairment helps to increase the generalizability of the measurement after 6 months, enabling further information about functional gain. The results of this study show that the type of impairment has only minor influence on rehabilitation outcome. However, it must be noted that the lower extremity amputation group was very small in numbers; therefore their influence on rehabilitation outcome may be overruled by the other categories. In particular, the functional status at follow-up showed how important it is to assess functioning at admission and functioning prior to the current illness to be able to predict most accurately what the gains in independence may be after 6 months. For patients and their care-givers this is valuable information and will develop realistic expectations. For directors of healthcare services for older people this information is also very important to reach reasonable decisions relating to rehabilitation strategies (8). Both disability measures used (FIM and Barthel Index) were good predictors of patient outcome at discharge. For geriatric rehabilitation wards the use of the Barthel Index (with the possible addition of a cognitive status measure such as the MMSE) may be more easily implemented and require less staff time than the FIM.

A weakness of this study was the relatively small number of patients in the lower extremity amputation, which may have distorted the results in the regression analyses. Another issue is the effect of the type of hospital on rehabilitation of function. Future studies should try to overcome both the imbalanced number of patients per impairment category and the cluster effect by using either more hospitals or only one hospital. Another issue to address is that the data-collection was done more than 15 years ago. However, the type of patients needing care or being admitted to a rehabilitation facility has not changed over the years and the importance of accurate prediction of resource use has only grown since (33).

The relationship between cognitive status and disability at discharge is in line with the majority of studies that analysed the association between cognitive impairment and disability at discharge (8, 9, 24, 34). For rehabilitation professionals, who are responsible for developing a plan of care for these patients, it is therefore also important to assess cognitive ability to predict rehabilitation outcome at discharge more accurately (3). This appears to be more important than focusing on the type of impairment present at admission. Although it was suggested that certain impairment groups may be more influenced by cognitive disability, such as stroke patients, than others, such as hip fracture patients, the results of this study indicated that there is no difference in effect in a general rehabilitation setting (1).

The participants in this study are not representative of all older people with recent onset of disability who are hospitalized. All patients were assessed prior to admission by a rehabilitation physician with experience and training in assessment and management of patients with a variety of impairments and levels of disability. This process may explain why there were no patients with severe cognitive impairment included in this study. Patients in this study were selected to be likely to benefit from rehabilitation.

In conclusion, assessing functional status at admission has strong predictive value for functional status at discharge, after 6 months, and length of hospital stay, for older people being admitted to a rehabilitation facility. Cognitive impairment may have a small adverse effect on rehabilitation outcome, mainly during the first period of rehabilitation when patients are still in hospital and should therefore also be assessed during admission. The type of impairment has limited predictive value for rehabilitation outcome.

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