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Which items of the modified Barthel Index can predict functional independence at discharge from inpatient rehabilitation? A secondary analysis retrospective cohort study

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The modified Barthel Index (mBI) is a well-established patient-centered outcome measure commonly administrated in rehabilitation settings to evaluate the functional status of patients at admission and discharge. This study aimed to detect which mBI items collected on admission can predict the total mBI at discharge from first inpatient rehabilitation in large cohorts of orthopedic (n = 1864) and neurological (n = 1684) patients. Demographic and clinical data (time since the acute event 11.8 ± 17.2 days) at patients' admission and mBI at discharge were collected. Univariate and multiple binary logistic regressions were performed to study the associations between independent and dependent variables for each cohort separately. In neurological patients, the shorter time between the acute event and rehabilitation admission, shorter length of stay, and being independent with feeding, personal hygiene, bladder, and transfers were independently associated with higher total mBI at discharge ($R^2 = 0.636$). In orthopedic patients, age, the shorter time between the acute event and rehabilitation admission, shorter length of stay, and being independent with personal hygiene, dressing, and bladder were independently associated with higher total mBI at discharge ($R^2 = 0.622$). Our results showed that different activities in neurological (i.e. feeding, personal hygiene, bladder, and transfer) and orthopedic sample (i.e. personal hygiene, dressing, and bladder) are positively associated with better function (measured by mBI) at the discharge. Clinicians have to take into account these predictors of functionality when they plan an appropriate rehabilitation treatment. *International Journal of Rehabilitation Research* 46: 230–237 Copyright © 2023 The Author(s). Published by Wolters Kluwer Health, Inc.

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Introduction

According to the WHO statement, 'Rehabilitation addresses the impact of a health condition on a person's everyday life, by optimizing their functioning and reducing their experience of disability', regardless of the reason for its need, and 'is a priority health strategy for the 21st century that uniquely contributes to optimizing the functioning of the population' [1–4]. Many studies investigated the possibility of predicting the results of the rehabilitation of disability secondary to different pathologies [5–9], rarely facing the recovery of autonomy activities of daily life (ADLs) [10–13]. Among different assessment tools, the Barthel Index (BI) is a well-established patient-centered outcome measure and one of the most administrated instruments in rehabilitation settings to evaluate the functional status of patients at admission and discharge. The inter and intra-observer reliability of BI has been verified in different rehabilitation areas while it proved to be of functional prognostic value in stroke rehabilitation in several stroke outcome studies [12,14]. The modified BI (mBI) contains the same items as the original BI for assessing independence in different ADLs but the original three-point rating system is modified to a five-point system to improve the sensitivity. In some settings, the total BI score is used for determining the eligibility for admission to rehabilitation centers [15].

Although the suitability of overall indexes of ADL independence has been clearly demonstrated, there has also been ongoing interest in the possibility of identifying more specific variables that could be equally effective or

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more so in predicting functional outcomes [16]. Dewit *et al.* investigated if the long-term (5 years) independence represented by the total BI score can be predicted by single BI items at the end of the rehabilitation, considering the total score >95 points (score ranging from 0 to 100 points) as the best outcome at long-term follow-up in stroke survivors. The findings showed (in)dependence on dressing and bathing at discharge from a rehabilitation center are significant factors in the prediction of (in) dependence in personal ADL 5 years after stroke [17].

In a recently published retrospective study of 3548 patients with orthopedic and neurological conditions [18], Pellicciari *et al.* investigated which demographic, clinical, and functional variables collected on admission could predict the total mBI at discharge. They reported that the total mBI score, age, time from the acute event to admission, etiology, and the presence of different impairments and complications were significantly associated with the total mBI score at discharge [18].

However, the predictive value of the early (in)dependence level of patients in performing each personal ADL at admission for rehabilitation outcomes at discharge is understudied, and the previous studies were mostly performed on specific pathologies, especially in stroke rehabilitation [19].

Therefore, the aim of this secondary analysis observational study was to determine which individual mBI items collected within 72 h of admission to inpatient rehabilitation are associated with functional outcomes at discharge in two large cohorts of patients admitted to rehabilitation following an orthopedic or neurologic acute event. We hypothesized that being independent in some ADLs on admission (first three ordinal scores for each mBI item) will predict a better functional outcome at discharge (total mBI ≥ 75 points) above and beyond other identified predictors [18].

Methods

Study design

This secondary analysis retrospective observational cohort study was performed at the Institute for Scientific Research and Health Care (in Italian Istituto di Ricovero e Cura a Carattere Scientifico – IRCCS) San Raffaele (Rome, Italy). This inpatient rehabilitation center admits patients with neurological and orthopedic disabilities who have just been discharged from the acute care hospital to undergo intensive rehabilitation treatment. The level of disability of the whole sample at admission was classified as total disability (mBI between 0 and 24 points) or severe disability (mBI between 25 and 49 points) due to the regional regulations for public health that allow admission to intensive rehabilitation only to subacute patients with a specific range of dependence (mBI score <50 points). The reporting of this study followed the STROBE guidelines [20].

Ethical considerations

In March 2012, the Italian Data Protection Authority (Garante per la Protezione dei Dati Personali) declared that the IRCCS can perform retrospective studies without approval from the local ethics committee and only formal communication is needed. This communication was registered by the ethical committee of the IRCCS San Raffaele (Number: 07/18, 18 July 2018).

Participants

The subjects, recruited through a convenience sampling, were included in this study if they met the following inclusion criteria: (1) adults (≥18 years); (2) time from the acute event ≤60 days; (3) length of stay in the rehabilitation center between 14 and 90 days; (4) first ever admission to the rehabilitation center for the considered condition. Subjects were excluded from this study if data on clinical and sociodemographic variables were missing.

Content and intensity of inpatient rehabilitation

Due to the regional (Lazio Region) regulations for public health, patients admitted to Intensive Rehabilitation Centers, known in Italy as 'code 56', undergo at least 3 h of rehabilitation per day. The rehabilitation program conducted is generally tailored to the patient's personal needs and includes physiotherapy, physical therapy, instrumental physical therapy, occupational therapy and speech therapy. Furthermore, every aspect of the integrated rehabilitation process is optimized, and each stage is personalized with the aim of accompanying the patient toward discharge with the best possible degree of autonomy.

Procedures

The electronic medical records of patients consecutively admitted to the study rehabilitation center between January 2015 and December 2018 were screened for meeting the eligibility criteria. The following demographic and clinical variables were extracted: age (years); sex (male or female); marital status (single or married); time since the acute event (days); length of stay (days); mBI item raw scores at the admission; mBI total score at discharge. These data were collected by a physiatrist during the recovery of each patient as a routine clinical assessment.

The primary outcome was the total mBI, used to measure the functional outcome. The mBI is composed of the following 10 items investigating 10 functional ADLs: feeding, personal hygiene, bathing, dressing, chair-bed transfer, toileting, bladder continence, bowel continence, ambulation or wheelchair use, and stair climbing. The score for each item is attributed by the clinician who observes the patient while performing the functional task and evaluates the amount of assistance the patient requires using a 5-point Likert scale. The mBI was proven to be valid and reliable [21–25].

Statistical analysis

Descriptive statistics were computed in order to describe the collected clinical and demographic characteristics of the sample; particularly, mean and SD and frequency with their relative percentage were calculated for continuous and categorical variables, respectively.

An absolute correlation coefficient (R) greater than 0.7 among the predictors indicates the presence of multicollinearity. The correlation coefficients in our data were <0.6, suggesting that multicollinearity among mBI items was acceptable. Moreover, a Variance Inflation Factor (VIF) above 4 indicates that multicollinearity might exist, and further investigation is required. Our findings reported a (VFI) equal to 1.56 ($VIF = 1/(1–R^2) = 1/(1–0.36) = 1.56$).

The primary outcome was the total mBI at discharge dichotomized using the cutoff of 75 points. A score of >75 points represents a mild disability that can be considered a favorable and reasonable outcome after a month of intensive rehabilitation [26]. This cutoff was used in previously published studies [27,28], and also represents the mean value among patients who require minimal assistance and/or supervision [15]. Each item was classified as dependent or independent according to its content; particularly, the first three item scores were considered dependent, while the last two item scores were considered independent.

Subsequently, univariate analyses were conducted, assessing associations between independent (i.e. item raw score at admission) and dependent (i.e. mBI total score at discharge) variables. Finally, all variables significant in the univariate analyses were entered in a multiple binary logistic regression with a stepwise approach to determine their independent contributions to the prediction of the primary outcome.

All statistical analyses were run with SPSS Version 27 for Windows, and the p-value was set at 0.05 for all analyses.

Results

Of 4054 potentially eligible recorded subjects, 3548 satisfy the inclusion criteria and were included in this study. Demographic and clinical characteristics are reported in Table 1.

Neurological sample

The variables that emerged as significant in univariate analysis were the following: age, time since the acute event, length of stay, feeding, personal hygiene, dressing, bowels, bladder, toilet use, transfer, and wheelchair ($P < 0.05$) (Table 2).

The findings of the multivariate analysis showed that sex, time since the acute event, length of stay, feeding, personal hygiene, bladder, and transfers were independently associated with the mBI at discharge and explained 63.6% of the total variance (Table 3). Table 3 reports the logistic regression model of predicted odds ratios (ORs) of mBI for neurologic patients. The model shows that sex is a significant predictor of mBI such that being a man is positively associated with a better mBI score. Specifically, the odds of achieving a total mBI ≥ 75 points at discharge are increased by 34% in the males compared to the females (OR = 1.34, $P = 0.041$). Times since the acute event and length of stay are negatively associated to have a better mBI score: for each day increment of these predictors the likelihood of achieving mBI ≥ 75 points decreases by 2% (OR = 0.98, $P < 0.001$) and 3% (OR = 0.97, $P < 0.001$). The feeding, personal hygiene, bladder, and transfer items are negatively associated with a better mBI score: being dependent, rather than independent, in these ADLs on admission increases the odds of achieving an mBI > 75 points: being independent with feeding was 1.6 times (OR = 1.6, $P = 0.004$) more likely to achieve an mBI > 75 points than being dependent; being independent with personal hygiene was 84 times (OR = 84.2, $P < 0.001$) more likely to achieve an mBI > 75 points than being dependent; being independent with bladder was 2.1 times (OR = 2.1, $P < 0.001$ more likely to achieve an mBI > 75 points than being dependent; being independent with transfer was 3.7 times (OR = 3.7, $P = 0.045$) more likely to achieve an mBI > 75 points than being dependent.

Orthopedic sample

The variables that resulted as significant in univariate analysis were the following: age, time since the acute event, length of stay, feeding, personal hygiene, dressing, bowels, bladder, and wheelchair (Table 2).

The findings of the multivariate analysis showed that age, time since the acute event, length of stay, personal hygiene, dressing, and bladder were significantly associated with the mBI at discharge and explained 62.2% of the total variance (Table 4). Table 4 reports the logistic

Table 1 Demographic and clinical characteristics of the sample (N = 3548)

Variables	Mean ± SD	Frequency (%)
Age, years	71.2 ± 12.5	
Sex		
Male		1.535 (43.3%)
Female		2.013 (56.7%)
Marital status		
Single		1.551 (43.7%)
Married		1.997 (56.3%)
Time since the acute event, days	11.8 ± 17.2	
Length of stay, days	37.4 ± 13.7	
mBI at admission	34.2 ± 12.2	
mBI at discharge	75.2 ± 22.7	

mBI, modified Barthel Index.

Table 2 Relationship between clinical and sociodemographic characteristics of neurologic and orthopedic patients and independence at discharge (mBI > 75/100) using χ^2 test

	Neurologic smple (N = 1684)			Orthopedic sample (N = 1864)		
	mBI ≥ 75/100 at discharge			mBI ≥ 75/100 at discharge		
Variables	Yes (N = 815)	No (N = 869)	*P*-value	Yes (N = 1285)	No (N = 579)	*P*-value
Age	67.72 ± 13.7	71.2 ± 12.9	**<0.0001**	70.7 ± 10.6	77.3 ± 11.8	**<0.0001**
Sex						
Female	353 (43.3)	433 (49.8)	0.07	836 (65.1)	391 (67.5)	0.298
Male	462 (56.7)	436 (50.2)		449 (34.9)	188 (32.5)	
Time since the acute event	13.3 ± 11.8	17.9 ± 23.5	**<0.0001**	6.8 ± 5.2	12.7 ± 25.1	**<0.0001**
Length of stay	42.5 ± 11.3	47.5 ± 15.6	**<0.0001**	28.6 ± 7.7	34.4 ± 10.1	**<0.0001**
mBI admission						
Total (0–24)	109 (13.3)	531 (61.1)	**<0.0001**	43 (3.3)	188 (32.5)	**<0.0001**
Severe (25–49)	700 (85.9)	337 (38.8)		1238 (96.3)	391 (67.5)	
Moderate (50–74)	6 (0.8)	1 (0.1)		4 (0.4)	0	
Individual mBI item admission						
Feeding						
Dependent	528 (64.8)	753 (86.7)	**<0.0001**	172 (13.4)	202 (34.9)	**<0.0001**
Independent	287 (35.2)	116 (13.3)		1113 (86.6)	377 (65.1)	
Bathing						
Dependent	813 (99.8)	869 (100)	0.234	1285 (100)	579 (100)	N/A
Independent	2 (0.2)	0		-	-	
Personal hygiene						
Dependent	19 (2.3)	613 (70.5)	**<0.0001**	16 (1.2)	356 (61.5)	**<0.0001**
Independent	796 (97.7)	256 (29.5)		1269 (98.8)	223 (38.5)	
Dressing						
Dependent	779 (95.6)	855 (98.4)	**0.001**	1230 (95.7)	574 (99.1)	**<0.0001**
Independent	36 (4.4)	14 (1.6)		55 (4.3)	5 (0.9)	
Bowels						
Incontinent	265 (32.5)	559 (64.3)	**<0.0001**	194 (15.1)	236 (40.8)	**<0.0001**
Continent	550 (67.5)	310 (35.7)		1091 (84.9)	343 (59.2)	
Bladder						
Incontinent	496 (60.9)	758 (87.2)	**<0.0001**	413 (32.1)	419 (72.4)	**<0.0001**
Continent	319 (39.1)	111 (12.8)		872 (67.9)	160 (27.6)	
Toilet use						
Dependent	803 (98.5)	868 (99.9)	**0.001**	1277 (99.4)	579 (100)	0.064
Independent	12 (1.5)	1 (0.1)		8 (0.6)	0	
Transfer						
Dependent	788 (96.7)	865 (99.5)	**<0.0001**	1279 (99.5)	576 (99.5)	1.000
Independent	27 (3.3)	4 (0.5)		6 (0.5)	3 (0.5)	
Ambulation						
Dependent	812 (99.6)	868 (99.9)	0.359	1284 (99.9)	578 (99.8)	0.525
Independent	3 (0.4)	1 (0.1)		1 (0.1)	1 (0.2)	
Stair						
Dependent	815 (100)	869 (100)	N/A	1284 (99.9)	579 (100)	1.000
Independent	-	-		1 (0.1)	0	
Wheelchair[a]						
Dependent	269 (95.4)	675 (99.1)	**<0.0001**	616 (78.2)	491 (93.0)	**<0.0001**
Independent	13 (4.6)	6 (0.9)		172 (21.8)	37 (7.0)	

Data are reported as mean ± SD or frequency (percentage).
Significant *P*-values are reported in bold.
mBI, modified Barthel Index; N/A, not appropriate.
[a]Item wheelchair was not rated for all subjects as it was completed if the patient did not walk (i.e. score item Ambulation = 0).

regression model of predicted ORs of mBI for orthopedic patients. The model shows that age is a significant determinant of the responder' mBI: for each year increment the achieving mBI ≥ 75 points is reduced by 2% (OR = 0.98, $P = 0.017$). Times since the acute event and length of stay are negatively associated to have better mBI score: for each day increment of these predictors the likelihood of achieving mBI ≥ 75 points decrease by 3% (OR = 0.97, $P < 0.001$) and 7% (OR = 0.93, $P < 0.001$). The items personal hygiene, dressing, and bladder are negatively associated with the better mBI score: being independent, rather than dependent, in these ADLs on admission increases the odds of achieving a mBI > 75 points: being independent with personal hygiene was about 98 times (OR = 97.91, $P < 0.001$) more likely to achieve an mBI > 75 points than being dependent; being independent with dressing was 4.3 times (OR = 4.3, $P = 0.022$ more likely to achieve an mBI > 75 points than being dependent; being independent with bladder was 2.0 times (OR = 2.0, $P < 0.001$) more likely to achieve an mBI > 75 points than being dependent.

Discussion

This study identified early predictors of a successful rehabilitation outcome assessed by mBI (primary outcome) in a cohort of patients (secondary analysis) with disabilities secondary to neurological and orthopedic diseases. In the neurological sample, times since the acute event and length of stay were found negatively associated with a better mBI score; the male sex and feeding,

personal hygiene, bladder, and transfer items were positively associated with a better mBI score. In the orthopedics sample, age, time since the acute event, and length of stay were negatively associated whereas personal hygiene, dressing, and bladder items were positively associated with a better mBI score. It should be noted that as regards early and targeted reeducation (shorter time between the acute event and hospitalization in rehabilitation) and a short length of hospitalization, these two data could be linked to the readiness/preparation of the patient (medical, physicist, cognitive-behavioral) to engage in rehabilitation and patients' ability to achieve desired outcomes within a shorter time beyond independence from the identified mBI elements.

Neurological disability

Our results are partially in agreement with those of De Wit *et al*. [17]. These authors examined the prognostic value of single items of the mBI at discharge from rehabilitation for predicting independence in ADLs (mBI score ≥95/100 points) 5 years after stroke in 132 patients from four rehabilitation centers. Although each mBI item was significantly associated with independence in personal ADLs in univariate analysis, only dressing and bathing items were retained in the multivariate model and accounted for 34% of the variance [17]. Specifically, those who were independent in dressing and bathing at the rehabilitation discharge had a 74% versus 6% chance of reaching independence in self-care and mobility 5 years after stroke compared to those who were not independent on these two mBI items [17]. Our results agree with those reported by Rexrode *et al*. (2022) who showed reduced functional recovery and a lower quality of life for women than men after stroke [29]. The authors also pointed out that women experience worse outcomes after stroke than men in terms of mortality, quality of life, post-stroke depression and activity limits. It could be correlated with other factors such as age disease, pre-stroke function, comorbidities, social support, and an increased likelihood of being widowed. Among all, depression could have a relevant impact considering that it affects up to one-third

Table 3 Logistic regression model of predictor of mBI ≥ 75/100 at discharge for neurologic sample (N = 1684)

Variables	β	SE	Wald χ^2	*P*-value	OR	95% CI OR
Sex						
Female	Ref					
Male	0.292	0.143	4.161	**0.041**	1.339	1.012–1.773
Time since the acute event	-0.020	0.006	13.557	**<0.001**	0.980	0.969–0.991
Length of stay	-0.032	0.006	25.393	**<0.001**	0.969	0.957–0.981
Feeding						
Dependent	Ref					
Independent	0.471	0.165	8.090	**0.004**	1.601	1.158–2.960
Personal hygiene						
Dependent	Ref					
Independent	4.573	0.373	150.291	**<0.001**	84.21	51.58–137.51
Bladder						
Dependent	Ref					
Independent	0.754	0.169	19.977	**<0.001**	2.126	1.527–2.960
Transfer						
Dependent	Ref					
Independent	1.310	0.652	4.032	**0.045**	3.705	1.032–13.306
$R^2 = 0.636$; $\chi^2_{(7)} = 1090.042$; $P = <0.001$						

Significant *P*-values are reported in bold.
CI, confidence interval; OR, odds ratio; SE, standard error; β, beta coefficient.

Table 4 Logistic regression model of predictor of mBI ≥ 75/100 at discharge for orthopedic sample (N = 1864)

Variables	β	SE	Wald χ^2	*P*-value	OR	95% CI OR
Age	−0.018	0.007	5.656	**0.017**	0.983	0.968–0.997
Time since the acute event	−0.033	0.009	12.419	**<0.001**	0.968	0.950–0.986
LOS	−0.068	0.009	55.755	**<0.001**	0.935	0.918–0.951
Personal hygiene						
Dependent	Ref					
Independent	4.584	0.280	267.161	**<0.001**	97.91	56.51–169.65
Dressing						
Dependent	Ref					
Independent	1.454	0.635	5.244	**0.022**	4.278	1.233–14.844
Bladder						
Dependent	Ref					
Independent	0.700	0.158	19.618	**<0.001**	2.013	1.477–2.744
$R^2 = 0.622$; $\chi^2_{(6)} = 1085.996$; $P = <0.001$						

Significant *P*-values are reported in bold.
CI, confidence interval; OR, odds ratio; SE, standard error; β, beta coefficient.

of stroke survivors and is almost twice as common in women than men in the early stages of the post-stroke [30,31].

Considering the times since the acute event, nowadays it is commonly accepted and abundantly highlighted in the literature how early rehabilitation represents an effective and efficient approach in the post-stroke rehabilitation process [32,33]. This early global reeducation in fact exploits an important therapeutic window with important neuroplastic properties, which guarantee effective recovery in impairment and ADL. Thus, earlier admission likely reflects earlier readiness (i.e. physical, mental) to participate in therapy, hence better functional outcome. Furthermore, a comprehensive approach that includes early mobilization and support of the hemiplegic side, allows the avoidance of pressure injuries, muscle-tendon retractions, and joint blocks, which would further delay the rehabilitation process [6,34].

As regards the length of stay, nowadays, particular attention is paid to the right timing after an acute event, especially in post-stroke patients. This attention is motivated by various factors such as identifying the right setting, which satisfies the different/ evolving clinical and rehabilitative needs of patients in the days following the acute event, as well as adequate use of material and personnel resources [35,36]. The difference that must be recognized between the efficiency and effectiveness of the therapeutic and rehabilitative intervention, which must be adequately balanced to achieve an optimal 'restitutio ad integrum', is therefore discussed [16]. Therefore, the current trend is to avoid a prolonged length of stay (both from the acute care and rehabilitation ward) for the purpose of early rehabilitative intervention and domestic and social reintegration [37]. Obviously, a global approach to rehabilitation intervention aimed at the disabilities and residual capacities of the patient remains of fundamental importance [38]. Moreover, in this context with the introduction of new technologies, the home environment is no longer separated from the therapeutic environment but represents an important therapeutic element where, through the supervision of the rehabilitation team (both online and offline), it is possible to carry out telerehabilitation sessions [39–41].

The feeding, personal hygiene, bladder and transfer items are positively associated with a higher mBI score. These results, which represent and describe the most severe disabilities and the greatest difficulties of effective reintegration in ADL of post-stroke patients, indirectly demonstrate the reliability and specificity of mBI in post-stroke patients. This fact, which in the past was only theoretically identified, finds in this result, obtained from a large number of patients, an important demonstration of evidence [15–19]. The major correlation appears to be with personal hygiene. This datum must certainly be correlated to the sense of non-self-definition that affects patients with this disability which unequivocally affects possible depressive disorders.

Orthopedics disability

Greater age represents a negative prognostic factor, not only for the severity of the underlying pathology but also for the more frequent presence of comorbidities [42]. Very similar is the possibility of post-traumatic prosthetic replacement for fracture of the femoral head, very frequent in women with osteoporosis. In this regard, it is important to underline that not only the underlying pathology must always be considered, but also the risk of bed rest as well as the surgical intervention, which in the orthopedic field is traumatic. In fact, due to their nature, these surgical interventions must be adequately considered as they can be particularly difficult for elderly subjects [43,44].

The time since the acute event is now a widely accepted factor in the literature. Especially early mobilization and strengthening of joint stabilizing muscles as well as, in the case of hip arthroplasty, training for anti-dislocation regulations. This is why it does not seem surprising how a major time since the acute event would represent a negative prognostic factor [45].

As regards the length of stay, our data agree with those of Guerra *et al.* (2015). In fact, the authors, in their randomized controlled trials (622 patients with hip and knee arthroplasties) highlighted how an early mobilization post joint replacement surgery, achieved within 24 h of surgery, can result in a reduced length of stay of about 1.8 days. Furthermore, the authors concluded that the included trials did not show an increase in negative outcomes [46].

The items of personal hygiene, dressing, and bladder are positively associated with a better mBI score. This result also appears to be highly correlated with everyday clinical/rehabilitative practice. Also, in this case, the inability to be able to independently carry out actions aimed at own personal hygiene has an important negative correlation. This data, if included in the rehabilitation process of the patient with orthopedic pathology, reflects a clinical picture of poor rehabilitation compliance and therefore a difficult social reintegration.

Strengths and limitations

The number and the different characteristics of the patients included in our analysis certainly represent the main strength. Our article is not free from limitations. The fact that discharge dates are in some cases also determined by socio-economic, cultural, and health system problems certainly represents a limitation, as the nature of rehabilitation services varies according to international health contexts. Some patients may also have a quick discharge and continue to improve their mBI scores, while others may have a prolonged hospital stay.

General considerations

We highlighted how personal hygiene and bladder impairments are common in patients with disabilities secondary to both orthopedic and neurological pathologies. This suggests that the etiopathogenesis underlying the two disabilities (i.e. neurological and orthopedic) may not be as important as the disability itself at the time of rehabilitation admission. This point must nowadays be taken into consideration for the purpose of a complete rehabilitation framework that considers the patient as a whole, taking into consideration, but not exclusively, the pathology of interest.

Items feeding and transfer are negatively associated with improved mBI only in patients with neurological disabilities. These aspects could be closely correlated with the patient's inability to use the upper limbs for example in the case of hemiplegia. This kind of disability, obviously, is not present in the sample of patients with orthopedic disabilities, mostly hip prostheses [18], and in this sense, it certainly represents a factor of considerable importance that makes autonomy in ADL difficult.

The dressing is an item negatively associated with a better mBI exclusively in patients with disabilities secondary to orthopedic pathologies. In our opinion, this factor could be linked to a state of difficulty in dressing for various causes such as the frequent state of fragility and comorbidity that characterizes a good percentage of this type of patient.

Implications for clinical practice arising from these findings should be discussed. Considering that feeding, personal hygiene, bladder and transfers for the neurological patients, while personal hygiene, bladder and dressing for the orthopedic patients positively influence functionality at the end of an intensive rehabilitation recovery, the rehabilitation treatment should be focused on improving these functions (if impaired on admission) to obtain the best possible functional outcome.

In light of the results highlighted in this article, both for orthopedic and neurological patients, some considerations are necessary. In fact, we have to consider not only the 'ideal' recovery times and the possible differences in patients with different characteristics/ comorbidities that could complicate the rehabilitation process but also by virtue of the health policy which limits, for some types of rehabilitation hospitalizations, an excessive length of stay. In fact, it is necessary to consider the possibility that patients with a slower-than-average functional recovery or who do not reach certain recovery goals within the set times cannot benefit from additional days. Therefore, a longer hospital stay may simply indicate a shallower recovery trajectory where patients are held longer in hopes of further gains. Upon discharge, therefore, it becomes obvious that further recovery is unlikely or that the allowed recovery days have expired.

Conclusions

Our results showed that different activities in neurological (i.e. feeding, personal hygiene, bladder, and transfer) and orthopedic sample (i.e. personal hygiene, dressing, and bladder) are positively associated with better function (measured by mBI) at the discharge. Clinicians have to take into account these predictors of functionality when they plan an appropriate rehabilitation treatment.

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Conflicts of interest

There are no conflicts of interest.

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