Previous Disability as a Predictor of Outcome in a Geriatric Rehabilitation Unit

Emiliana Valderrama-Gama,1,2 Javier Damián,2 Eliseo Guallar,2 and Leocadio Rodríguez-Manas3

1Geriatric Department, Red Cross Hospital, Madrid, Spain.
2Department of Epidemiology and Biostatistics, National School of Public Health, Instituto de Salud Carlos III, Madrid.
3Geriatric Department, Getafe University Hospital, Madrid.

Background. Functional status at admission has been shown consistently to predict rehabilitation results, but the impact of previous disability has been seldom considered.

Methods. A prospective follow-up study of elderly patients admitted to a geriatric rehabilitation unit in Madrid, Spain, was carried out. The study population comprised 135 subjects aged 65 years or older, who were consecutively admitted during a 7-month period. Outcome variables included the Barthel Index (BI) at discharge, the improvement in BI from admission to discharge, the achieved percentage of potential gain, and the efficiency of gains. Previous BI, admission BI, diagnosis, source (hospital/others), mental status, age, and gender were examined as explanatory variables.

Results. In multiple regression analysis, previous BI was the only significant independent predictor for all the outcome variables. For each 5-point increase in previous BI, the increase in BI at discharge was 1.7 (p = .007). Corresponding values for the achieved percentage of potential gain and for the efficiency of gains were 0.05 (p = .01) and 0.05 (p = .04), respectively. Except for the achieved percentage of potential gain, admission BI and source of referral were also independent significant predictors of outcome.

Conclusions. Previous functional situation of elderly people is important to predict rehabilitation outcome, even after taking into account information on disability at admission. As a consequence, a measure of the achieved percentage of potential gain corrected by the preadmission functional status is proposed, especially in the case of elderly patients.

FUNCTIONAL impairment in old persons is becoming an important health problem in industrialized nations. Functional benefits have been demonstrated in geriatric inpatient units with emphasis on geriatric assessment and rehabilitation (1–3).

With limited resources and significant increment in demand, improvement of efficiency of care is essential. Identification of admission variables associated with better outcome after rehabilitation has been the purpose of several studies (4–15) that have consistently found functional status at admission as the best predictor of outcome. Few studies, however, took into account previous functional status when evaluating the outcome of the intervention (16,17), although many patients, especially if they are old, may be already disabled before the onset of the new disability. The purpose of this study is to evaluate the predictive value of previous disability, measured by the Barthel Index (BI) (18), in the functional status at discharge in a geriatric rehabilitation unit.

METHODS

Unit Description

Our 29-bed Geriatric Rehabilitation Unit is located at the Red Cross Hospital in Madrid, Spain. The unit includes a day room for socialization, meals and other group activities, and an area for therapy services. Staff members comprise a geriatrician, a resident in geriatric medicine, 7 nurses, 14 nurse assistants, an occupational therapist and a part-time social worker. In addition to this unit, the Geriatric Department also includes the 36-bed Geriatric Acute Care Unit, the 20-place Day Hospital, the Geriatric Outpatient Clinic and the Home Treatment Team. The Rehabilitation Medicine Department is separate from the Geriatric Department and it is shared with the rest of the hospital and ambulatory services. Domiciliary rehabilitation is not provided in our work area.

Patients eligible for treatment at the unit are usually 65 years or older, with functional problems considered to be improvable. Patients are ineligible if they refuse, if they are in a terminal stage of a documented medical disorder, or if they require acute medical or surgical services. Although good cognitive status and social support are desirable, selected patients with moderate or severe dementia can be admitted for conditioning techniques that do not require new learning, or for training of the caregiver.

Patients are referred to the unit from several acute care services, from the Geriatric Outpatient Clinic, and from the Home Treatment Team. Admissions from acute care services are accepted after stabilization of the patient’s illness. Almost all patients have received some rehabilitation by acute ward physiotherapists before admission. Regardless
of the source of admission, all patients are evaluated by the geriatrician for unit eligibility. During the first 48 hours after admission, each patient’s functional status is routinely assessed by the occupational therapist using the Barthel Index (18), and the mental status is evaluated by the resident in geriatric medicine using the Red Cross Hospital Mental Scale (Appendix). This scale assesses cognitive situation from 0 (normal mental situation) to 5 (vegetative life). It is extensively used in Spain, and its validity and reliability have been determined (19).

All assessment findings are discussed at a weekly team meeting, and a treatment plan is designed for each patient. Treatment objectives vary widely, because minor changes in ability may significantly improve quality of life. Thus, in some cases, standing may be the only goal, whereas complete independent ambulation may be the aim for other patients. Discharge planning begins early in the patient’s stay, although original plans may be adjusted according to the achievement of therapeutic goals. Discharge is determined when the team considers that the patient has attained the maximum benefit, or when the patient and his or her family are ready for living at home. At discharge, patients can be eligible for continuity of care in the Day Hospital, the Geriatric Outpatient Clinic, or the Home Treatment Team, according to the reached level of autonomy.

**Data Collection**

Prospective data collection was performed during a 7-month period (April–November 1995). Independent variables gathered on admission included age, gender, Barthel Index prior to the onset of the new disability (PBI), Barthel Index on admission (ABI), medical diagnosis leading to disability, mental score, and source of admission (hospital or usual place of residence). Regarding admission diagnoses, we defined immobilism as a state of loss of the usual level of performance in activities of daily living, generally due to non-neurologic or nonorthopedic reasons. It refers to both short-term and prolonged situations, including cases of deconditioning. Prior to discharge, all data were abstracted from medical charts by a geriatrician. PBI could not be assessed by direct inspection, so we interviewed the patient and the relatives to assess PBI. When discrepancies were found, we further probed the family and the patients and asked them to resolve the discrepancies and to arrive at a conclusion. Data on discharge included BI, destination after discharge, and length of stay. Indicators of functional improvement were the discharge BI (DBI), the change in BI from admission to discharge (DBI–ABI or improvement), the achieved percentage of potential gain (5) \((\text{DBI} - \text{ABI})/\left[100 - \text{ABI}\right] \times 100\), and efficiency of gains, computed as improvement in BI divided by the length of stay (LOS) \((\text{DBI} - \text{ABI})/\text{LOS}\), or number of BI points gained per day (5). When evaluating efficiency, we excluded 3 patients with stays less than 8 days, since improvement cannot be attributed to the unit for patients with such short stays.

**Statistical Methods**

Pearson’s correlation coefficients, t tests, and one-way ANOVA were used to evaluate relationships between PBI and the rest of variables. The independent effect of baseline variables on outcome measurements was assessed with multiple linear regression. All p values are two-tailed. Statistical significance was considered when \(p < .05\).

**RESULTS**

A total of 151 patients were initially included in the study. We excluded 3 patients who died and 13 who were transferred to acute care, resulting in a sample size of 135. Table 1 shows the admission and discharge data of the patients. Overall, patients had a mean age of 78.5 years and were mostly female (61.5%). Most patients lived at home prior to hospitalization (89.6%), and only 10.4% were living in nursing homes. The three most frequent diagnoses on admission were stroke (40.7%), hip fracture (28.2%), and immobilism (16.3%). The majority of patients were referred by acute care services (80.7%): Orthopedics (31.1%), Neurology (19.3%), the Geriatric Acute Care Unit (17.8%), and others (12.5%). Only 19.3% of patients came from their usual place of residence, referred either by the Home Treatment Team, the Geriatric or the Rehabilitation Outpatient Clinic.

The mean (SD) length of stay was 25.5 (10.0) days

<table>
<thead>
<tr>
<th>Table 1. Descriptive Data of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Admission data</strong></td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>PBI</td>
</tr>
<tr>
<td>ABI</td>
</tr>
<tr>
<td><strong>Percentage</strong></td>
</tr>
<tr>
<td>Gender (% female)</td>
</tr>
<tr>
<td>Diagnosis</td>
</tr>
<tr>
<td>Stroke</td>
</tr>
<tr>
<td>Hip fracture</td>
</tr>
<tr>
<td>Immobilism</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td><strong>Source</strong></td>
</tr>
<tr>
<td>Hospital</td>
</tr>
<tr>
<td>Usual place of residence</td>
</tr>
<tr>
<td><strong>Mental scale</strong></td>
</tr>
<tr>
<td>0–2</td>
</tr>
<tr>
<td>3–5</td>
</tr>
<tr>
<td><strong>Discharge data</strong></td>
</tr>
<tr>
<td>Length of stay</td>
</tr>
<tr>
<td>DBI</td>
</tr>
<tr>
<td>DBI–ABI</td>
</tr>
<tr>
<td>%APG</td>
</tr>
<tr>
<td>Efficiency of gains</td>
</tr>
<tr>
<td><strong>Location at discharge</strong></td>
</tr>
<tr>
<td>Original place of residence</td>
</tr>
<tr>
<td>Home</td>
</tr>
<tr>
<td>Previous nursing home</td>
</tr>
<tr>
<td>Nonprevious nursing home</td>
</tr>
</tbody>
</table>

*Note.* PBI, previous Barthel Index; ABI, admission Barthel Index; DBI, discharge Barthel Index; DBI–ABI, improvement in BI points from admission to discharge; %APG, achieved percentage of potential gain. We excluded 3 patients in computing length of stay and efficiency of gains due to stays of less than 8 days.
The majority of patients returned to their original place of residence (87.4%): home (77.8%) and previous nursing home (9.6%). Only 12.6% went to a nonprevious nursing facility. The continuity of care for those patients who returned home was provided by the general practitioner (60%), the Day Hospital (24.8%), the Geriatric Clinic (11.4%), and the Home Treatment Team (3.8%).

After suffering the event precipitating the admission, patients moved from a mean PBI of 85.8 (17.8) points to a mean ABI of 37.2 (23.7), and during their stay at the unit they reached a DBI of 63.9 (29.3), gaining a mean of 25.5 (20.5) BI points from admission. The achieved percentage of potential gain (%APG) was 46.3 (35.4).

Table 2 shows the relationship between PBI and other baseline variables. On average, younger patients tended to have higher PBI. Pearson’s correlation coefficient for the association between age and PBI was –0.25 (p < .01). PBI was also associated with ABI (r = .37; p < .001). Mentally impaired patients were in the worst previous functional situation. Patients with stroke were in better previous functional situation than those with immobilism.

In univariate analysis (Table 3), age, PBI, ABI, and mental score were related to DBI and the %APG, but not to the improvement (DBI–ABI) or efficiency of gains. The presence of an acute hospitalization directly preceding rehabilitation was associated with better recovery as measured by all the indicators of functional outcome, except for efficiency of gains. Gender and the diagnosis were not associated with outcome. In multivariate analysis (Table 4), PBI
was the only significant independent factor associated to all the dependent variables. Except for %APG, ABI and coming from a hospital were also significantly associated to all of the dependent variables. Age showed no independent association with DBI and %APG.

**Discussion**

In this study we show the importance of previous functional status as a predictor of functional outcome in a geriatric rehabilitation unit. Two of the most commonly used measures to evaluate functional outcome after geriatric and rehabilitation interventions are the BI at discharge and the achieved percentage of potential gain. Many studies (5–7, 14), including our own, find that older people obtain worse results in terms of DBI and %APG, and that the higher the BI on admission, the better the DBI and the %APG. Thus, from a clinical standpoint, the use of DBI and %APG as outcome measures would encourage the rehabilitation provider to admit younger and higher-functioning patients, avoiding the admission of old and previously disabled people (9). Nevertheless, when the relevant variables were controlled for, ABI showed no effect on %APG and the association of age with both variables (DBI and %APG) disappears. PBI (in a positive relationship) remains the only significant predictor of %APG. This is easily understood since the formula to calculate %APG considers a maximum PBI of 100 at the denominator of the quotient, which is not always the real preadmission value of BI in many elderly patients (in our patients PBI = 85.8). They may have arthritis or cardiovascular disease before suffering the new disability (for example a stroke) to rehabilitate. We are then measuring %APG as if they could potentially improve 100–ABI points in BI whereas, in fact, most cases can maximally improve PBI–ABI points (although we cannot rule out the possibility that some patients may recover to a better situation than the PBI). Thus, the better the PBI (and the closer to 100), the higher the %APG.

An additional indicator of functional outcome is the change in BI from admission to discharge (DBI–ABI) (20–22). This measure represents the patients’ improvement at the unit. When multiple regression is performed, the lower the ABI, the higher the improvement from admission to discharge. This could contribute to accept elderly and deteriorated people on admission, avoiding the mentioned problems of DBI and %APG. A related issue that should be pointed out is that improvement in patients with high functional status on admission cannot be easily detected due to an intrinsic responsiveness limitation of the BI known as the “ceiling effect” (23). Nevertheless it is possible that these patients could benefit better from the Day Hospital, keeping the unit for more deteriorated patients. PBI is also an independent predictor for DBI–ABI. The higher the PBI, the higher the measured improvement, probably indicating that patients with high PBI have better homeostatic maintenance and potential of recovery.

Previous studies have reported %APG from 55 to 68% (5,7,14), higher than ours (46.0%). Patients in those studies (5,7) were younger, or were not previously living in a nursing facility (14), suggesting that they had a better basal functional condition than ours (PBI = 85.6), and consequently, better %APG. This would confirm the importance of PBI as a predictor of %APG.

Some considerations must be borne in mind to interpret our results. First, we did not collect psychologic or social data with potential impact on outcome, as other studies did (2,4,6,9,14). Even so, we believe that the set of relevant covariates included in the models is sufficient to minimize the probability of residual confounding due to unmeasured variables. Second, BI obtained through self-report or family report of current functional status has consistently shown to be valid and reliable (24,25), but, to our knowledge, analogous studies taking into account past performance levels, have not been carried out. However, in the present study the time span between admission (when PBI was recorded) and the previous situation was usually short. As an approximate indicator of the magnitude of this time interval, patients coming from a hospital (accounting for the 80.7% of the total sample) had an average stay in acute care of 12 days. Third, in some patients, assessment of PBI was difficult, since the onset of the disability was not always clear-cut in diseases of slow onset. However, special care was taken to assess PBI attributed to the moment before the disability started or changed to a higher level.

To conclude, in the present study PBI is an important independent predictor for all the indicators of functional outcome. Full functional recovery should not be a realistic goal for already disabled patients, although high degrees of improvement are possible and desirable. Reasonable recovery for them might be a return to their previous status (11). This could be evaluated with the %APG corrected by the previous functional situation, considering PBI at the denominator of the quotient ((DBI–ABI)/[PBI–ABI] X 100) instead of 100. In fact the differences between %APG in our study (46%) and others (55 to 68%) disappear when we use the corrected %APG (62.8%). Further research is needed to confirm the importance of previous disability in predicting outcome and to elucidate the utility of incorporating PBI as a correction in measures of %APG.

**Acknowledgments**

The authors thank M. D. Martínez Pérez MD, PhD, and D. Quiñones Tapia, MD, for their collaboration in the process of accurate translation of the Red Cross Hospital Mental Scale.

Address correspondence to Javier Damían, Departamento de Epidemiología y Bioestadística, Escuela Nacional de Sanidad, Instituto de Salud Carlos III, c/ Sinesio Delgado 8, Madrid 28029, Spain. E-mail: jdamian@icsii.es

**References**

5. Heinemann AW, Roth EJ, Cicchowski K, Betts HB. Multivariate anal-
ysis of improvement and outcome following stroke rehabilitation. 

Arch Neurol. 1987;44:1167–1172.


Received September 12, 1997
Accepted March 9, 1998

Appendix

Red Cross Hospital Mental Scale*

0. Completely normal.

1. Minor temporal disorientation. Minor changes in personality (awkwardness). Conversation is coherent.


5. Severe dementia, unable to recognize people. Vegetative state with or without aggressiveness. Complete incontinence.

*Three independent English translations were made by the first author of this article and by two bilingual doctors. A meeting among them yielded the final English version.