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# Basal functional status predicts one-year mortality after a heart failure hospitalization in elderly patients — The RICA prospective study

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ABSTRACT

*Background:* Dependence for basic activities of the daily living (ADL) relates to adverse outcomes in elderly acute heart failure (AHF) patients.
*Methods:* We evaluated patients ≥75 years admitted because of AHF, divided according to preadmission Barthel Index (BI) category: severe (BI 0–60), moderate (BI 61–90) and slight dependence or independence for basic ADL (BI 91–100). We compared their baseline characteristics and used logistic regression models to determine whether a BI ≤ 60 confers higher one-year mortality risk.
*Results:* We included 2195 patients, mean age 83 years; 57% women, Charlson Index 3, 65% with preserved left ventricular ejection fraction. Their median preadmission BI was 90 (65–100); 21.7% had BI ≤ 60. Patients with BI ≤ 60 were older, more often females, with higher comorbid and cognitive burden and more likely to be institutionalized. 560 patients (26%) died within the follow-up period. A preadmission BI ≤ 60 was significantly associated with higher risk of 12-month mortality (HR 1.42, 95% CI 1.14–1.77) together with male sex (1.27, 1.04–1.54), valve disease (1.49, 1.20–1.83), worse preadmission NYHA class (1.44, 1.20–1.73), stage IV chronic kidney disease (1.70, 1.35–2.15), pulmonary edema (1.33, 1.01–1.76), no family support (1.47, 1.06–2.06), and higher Charlson Comorbidity Index (1.09, CI 1.05–1.13) and Pfeiffer cognitive screening questionnaire scores (1.10, 1.05–1.14).
*Conclusion:* Among elderly AHF patients, the presence of severe (BI ≤ 60) preadmission dependence for basic ADL confers a significant and independent risk of one-year post-discharge mortality.


## 1. Introduction

Despite continuous advances in its diagnosis and therapy, HF remains a worldwide epidemic, with growing prevalence especially among the very elderly (people 75 years of age or older) due to both the increasing numbers of aged subjects and the improved survival of HF patients [1]. The episodes of decompensation, presenting as acute HF (AHF), are nowadays the most common discharge diagnosis for elderly patients in Spain [2]. Elderly patients who experience an AHF-related hospitalization are more likely to develop future adverse outcomes, including mortality, than those who remain stable [3]. Mortality risks after an AHF episode relate to many factors: the patients' age and sex, the characteristics of the underlying HF, the presence of concomitant diseases, the admission clinical presentation, the in-hospital management or the discharge therapies prescribed [4].

In the last two decades, and in concordance with the aging of the AHF population, a lot of data has accumulated on the role that the "geriatric components" (frailty, cognition, nutrition or overall functional status) play in the prognosis of the elderly patient [5–9]. A subject's independent basic functional status can be defined as its ability to perform without help from others the everyday behaviors known as the basic activities of the daily life (ADL) [10]. HF sustains a bidirectional relationship with remaining independent for ADL: HF symptoms may

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render a patient unable to perform some basic ADL [11] and AHF episodes may impair a patient's ability to keep performing at least some of them [12,13], but on the other hand a poor functional status (dependence for basic ADL or even for the more advanced instrumental ADL) has been identified as a risk factor for developing adverse outcomes both in chronic HF [14–16] and AHF [17–21].

Our group has previously identified that elderly AHF patients with severe preadmission dependence for basic ADL present a significantly higher 3-month all-cause mortality risk after hospital discharge, irrespective of other variables classically influencing short-term survival [22]. However, data on this prognostic role of basic ADL dependence in the mid-term after an episode of AHF are scarce [23–26]. We undertook the present study as a continuation of the previous one to investigate whether a low preadmission BI still remains a predictor for higher mortality risk one year after an admission for AHF in elderly HF patients.

## 2. Patients and methods

Patient data were collected from the Spanish National Registry on HF – *Registro Nacional de Insuficiencia Cardiaca* (RICA) – supported by the Working Group on HF of the Spanish Society of Internal Medicine. RICA is a multi-center, prospective cohort registry of HF patients experiencing admissions to Internal Medicine (IM) services of 52 hospitals across Spain [17,22,27]. The ethics committee of the University Hospital "Reina Sofia", Córdoba, Spain, approved on behalf of the others the overall protocol, which conforms to the ethical guidelines of the 1975 Declaration of Helsinki, and all patients signed an informed consent prior to inclusion in the registry.

All patients aged 50 years or older presenting with symptoms and signs fulfilling the European Society of Cardiology [28] criteria for the diagnosis of AHF – *de novo* (new onset) cases or decompensations of a previously known HF – and subsequently admitted to IM are included in the registry. However, data of those patients who die for any cause during the index admission are deleted from the database. Patients are followed after the index admission *via* outpatient clinic controls at 3 and 12 months, and phone contacts at 1 and 6 months; patients failing to show up, or their relatives when they cannot be reached, are contacted to ascertain the causes. For the purpose of the current study, focused on elderly subjects, only patients 75 years of age or older were included in the analysis.

All RICA patients are thoroughly evaluated during the index admission and their data recorded through a password-protected web site —https://www.registrorica.org/—containing the main database. This database comprises sociodemographic data, data on past medical HF story, co-morbidities, functional and cognitive status, the AHF episode clinical data, complications during admission and drug prescription and general advice at discharge. HF symptom severity is characterized using the New York Heart Association (NYHA) scale. Left ventricular ejection fraction (LVEF) is measured using 2-D echocardiography; patients were categorized as presenting with preserved or reduced LVEF according to a LVEF value of ≥50 or <50% respectively. A chest X-ray to evaluate cardiomegaly and signs of congestion and an electrocardiogram are always obtained. Blood tests include a complete blood cell count and a broad biochemistry panel with electrolytes, kidney function parameters, lipid and glucose profiles, uric acid, troponin and brain natriuretic peptides, among other measurements.

To determine the preadmission (*i.e.* before onset of acute HF symptoms) ability of our patients to perform basic ADL we used the Barthel Index (BI), a widely used 10-item scale that measures a subject ability to perform independently ten basic ADL related to self-care, continence and mobility [29]. Its final score ranges from 0 (full dependence) to 100 (full independence), in 5-point intervals. Our patients' BI scores were obtained using the validated Spanish version of the questionnaire [30], through standardized interviews with either patients or relatives or caregivers for those unable to cooperate. For the main purpose of the study, patients were distributed into the widely used functional category groups pre-defined by the BI score as suggested by the research work on stroke patients by Shah et al. [31]: total or severe disability (BI 0–60), moderate disability (61–90) and slight to no disability (BI 91–100). Patients with total or severe disability (BI ≤ 60) are at particular risk of adverse outcomes compared to those in the intermediate category of moderate dependence (BI 61–90) and therefore, as was the case for our previous paper [22], we chose a BI value of 60 as the cutoff for estimating mortality risks.

Cognitive function was estimated with the Short Portable Mental Status questionnaire (SPMSQ), also known as Pfeiffer questionnaire [32] — this questionnaire provides an estimate of a patient's cognitive status according to the number of wrong answers to ten basic questions, with values ranking from 0–1 (no impairment) to 9–10 (most severe impairment). The Charlson Comorbidity Index (CCI) [33], an aggregate of a patients' comorbidity burden built by adding the weighed values assigned to the presence of certain diseases, was used to measure comorbidity. HF is one of the components of the CCI but since all patients had HF as main diagnosis its assigned value was not incorporated in the CCI calculation.

### 2.1. Outcome events: mortality

During the follow-up contacts we evaluated the vital status of our patients, categorizing them either as alive or dead. The date of death was ascertained using discharge reports, medical records, interviewing relatives or consulting administrative data. Survival time in days was calculated by subtracting either the date of the 12-month follow-up completion or the date of death from the index admission date.

### 2.2. Data analysis

Results are shown as mean/median (standard deviation/interquartile range) or number (%). The relationship between BI and potential confounders was examined using Chi-square or Fisher exact tests for categorical variables. The Kolmogorov–Smirnov test was used to determine whether quantitative variables were normally distributed.

To compare baseline characteristics across the three BI pre-specified categories we used ANOVA tests for normally distributed variables or Wilcoxon rank sum tests for those non-normally distributed. Logistic regression analysis determined, at the multivariable level, which baseline factors associate with lower BI values, expressed as unadjusted and adjusted odds ratio (OR) with 95% confidence intervals (95% CI). Variables used in this analysis were those identified in the univariable analysis, with a p value <0.10 and <25% of missing data. The final adjusted model was obtained using the backward stepwise method using a p value of 0.05 as the threshold for elimination of variables from the full model.

Kaplan–Meier survival curves and the log-rank test were calculated from baseline to time of censoring as a function of patients' preadmission BI categories. We used a Cox Regression model to evaluate hazard ratios (HR) with 95% CI between BI (≤60 *vs* >60) and all-cause mortality over time — the Schoenfeld residuals test performed prior to this analysis confirmed the presence of proportional hazards. Covariates used for adjustment of baseline variables were also evaluated in a stepwise multivariable regression analysis using the aforementioned entry criteria.

These analyses were completed with the version 21.0 of the Statistical Package for Social Sciences (IBM® SPSS® Statistics) program. Tests were 2-sided and p values <0.05 were regarded as significant.

## 3. Results

At the time of performing this analysis (April 2016) a total of 2966 patients with fully validated data were included in the RICA registry. Of them 2195 (74.0%) were 75 years of age or older at the time of inclusion and were selected for this study. Their median age was 83 (79–86) years; 57% were women, with a moderate comorbid burden (CCI 3) and a predominance of preserved LVEF (65%). Their median basal preadmission BI value was 90 (65–100); 936 patients (42.6%) were fully independent or slightly dependent for the performance of BADL, whereas the remaining 57.4% showed BI scores ≤90. The baseline characteristics of these patients, distributed according to the three predefined categories of preadmission BI are summarized in Table 1: patients in the lower BI subgroup were older, more often of female sex, with a higher comorbid burden and in particular more likely to suffer from diabetes, chronic kidney disease (CKD), cerebrovascular disease, cognitive impairment and to live in nursing or chronic care facilities; the characteristics of their HF and the clinical data of the episode of AHF were similar to those of patients with BI > 60, but with a higher prevalence of admission abnormal lab results (anemia, impaired kidney function, electrolyte abnormalities) and higher natriuretic peptide values.

Multivariable analysis showed an independent association between a preadmission BI ≤ 60 and the following baseline data: advanced age (OR 1.06, 95% CI 1.03–1.09), female sex (for male sex OR 0.48, 95% CI 0.36–0.63), prior diagnosis of diabetes (OR 1.38, 95% CI 1.05–1.81) and dementia (OR 1.71, 95% CI 1.07–2.71), institutionalization (OR 1.88, 95% CI 1.28–1.56), worse preadmission NYHA class (for NYHA III–IV OR 1.69, 95% CI 1.32–2.18), lower admission sodium values (OR 0.97, 95% CI 0.95–0.99) and higher CCI (OR 1.10, 95% CI 1.04–1.16) and SPMSQ (OR 1.46, 95% CI 1.37–1.56) scores.

### 3.1. Clinical features associated with HF-related mortality

560 patients (26%) died within the 12 months of follow-up. The baseline characteristics of the patients, distributed according to one-year survival status, are summarized in Table 2. Patients who died during the follow-up period were more often of older age and male sex, with a higher prevalence of HF related to valve disease, reduced LVEF and worse preadmission NYHA class, a higher comorbid burden, higher prevalence of pulmonary edema, rhythm disorders and lab abnormalities upon admission (including higher levels of natriuretic