



## Original Article

# Functional status and mortality at month and year in nonagenarians hospitalized due to acute medical illness



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## ABSTRACT

**Objectives:** To analyze risk factors associated with short and long-term mortality in nonagenarians hospitalized due to acute medical conditions.

**Design, Setting, and Participants:** Prospective study of all patients aged 90 years or older admitted in a geriatric unit during 2009 due to medical acute illness. Baseline variables were collected at admission (sex, cause of admission, Charlson index, serum albumin, functional, and mental status), functional loss at admission (as the difference between Barthel index (BI) 2 weeks before admission and BI at admission), and functional loss at discharge (as the difference between BI 2 weeks before admission and BI at discharge). The association of these variables with mortality at 1 month and 1 year after admission was analyzed by multivariate Cox regression analysis.

**Results:** Out of all patients admitted, 434 (33%) were 90 years old or older and 76.3% were female. Mortality at 1 month and 1 year after admission was 19% and 57%, respectively. In the month mortality multivariate analysis, being older (HR, 1.11; 95% CI = 1.02 to 1.20), a previous Barthel index less than 40 points (HR, 5.87; 95% CI = 1.16 to 29.67), and functional loss at admission (HR; 1.13; 95% CI = 1.03 to 1.25) were independent risk factors. When patients that died 1 month after admission were excluded, the presence of hypoalbuminemia <3 g/dl (HR, 2.70; 95% CI = 1.69 to 4.32) and functional loss at discharge (HR-1.08, 95% CI = 1.03 to 1.14) were the factors associated with 1 year mortality.

**Conclusions:** In nonagenarians, functional impairment is the most important risk factor associated with short and long-term mortality after hospitalization due to acute medical illness.

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## 1. Introduction

The progressive increase of life expectancy in developed countries leads to an increase in very elderly patients admitted to hospital. In the case of nonagenarians in Spain, it becomes 6% of the total of admissions in the area of Internal Medicine. Knowledge of this group of patients' characteristics is important and can lead to establish future care strategies [1,2].

Hospitalization is an inherently serious event in nonagenarians, as the risk of complications associated with it increases exponentially with age, which in the case of risk of functional decline affects more than 60% of patients hospitalized in this age-group [3–5], and can lead to death up to 20% [1,2].

Few studies have evaluated the prognostic factors for mortality in hospitalized nonagenarians. In this group of age, traditional variables that influence mortality in other groups of younger patients as toxic habits or cause of admission could not be valid. Prognosis in nonagenarians may be more influenced by other variables included in the

Comprehensive Geriatric Assessment, such as functional and mental status [2,6].

The aim of this study is to analyze the main risk factors associated with short-term (a month after) and long-term (a year after) mortality in nonagenarians patients admitted due to acute medical conditions.

## 2. Materials and methods

### 2.1. Population studied

This is a study of all patients aged 90 years and over admitted to the Geriatric Acute Unit (UGA) of the Hospital Central de la Cruz Roja, Madrid, in 2009.

### 2.2. Variables studied

The following baseline variables were collected from hospital medical records discharge summary and coding service: sociodemographic variables (age, sex, prior institutionalization), clinical variables (cause of admission encoded by the admission service, comorbidity measured by the Charlson Index [7], serum albumin categorized as normal, mild (3–3.5 g/l) and severe (less than 3 g/l) hypoalbuminemia [8], and

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functional variables (Barthel index, BI) 2 weeks prior to admission, at admission, and on discharge [9]. The previous functional status was categorized into four groups: severe (BI  $\leq$  40), moderate (BI = 41–60), mild functional impairment (BI = 61–90), and independent patients (BI > 90 points) [9,10]. Cognitive situation was assessed using the Mental Scale of the Red Cross (CRM), which evaluates mental status from 0 (normal) up to 5 (very severe impairment), and in which CRM  $\geq$  2 score indicates a positive association with the presence of cognitive impairment [11].

Functional loss at admission was measured as the difference between BI 2 weeks before admission and BI in the first 48 hours after admission, and discharge functional loss by subtracting the previous BI from BI at discharge. Functional decline clinically relevant at admission and discharge was defined as impairment in BI of at least 5 points [12,13]. Also, we evaluate functional impairment at admission and discharge in relative terms, at admission as percentage of functional decline from preadmission to admission  $([(2 \text{ weeks preadmission BI} - \text{BI on admission}) / \text{preadmission BI}] \times 100)$ , and at discharge as a percentage of functional decline from preadmission to discharge  $([(2 \text{ weeks preadmission BI} - \text{BI on discharge}) / \text{preadmission BI}] \times 100)$  [13]. The main outcome variable was mortality a month after admission, in order to include those deaths that may occur early after discharge and that could be related to the illness that led to the hospitalization, and 1 year after admission. The date of death was extracted from the official record available from the National Death Index from the Spanish Ministry of Health, Equality and Consume ([http://msssi.gob.es/estadEstudios/estadisticas/etministerio/IND\\_tipodifusion.html](http://msssi.gob.es/estadEstudios/estadisticas/etministerio/IND_tipodifusion.html)).

This study was approved by the Clinical Research Ethics Committee of La Paz University Hospital, Madrid, Spain.

### 2.3. Statistical analysis

To assess baseline variables associated with mortality a month after admission, a Cox regression analysis was used in which age, sex, previous institutionalization, diagnostic at admission, Charlson Index, Barthel index (BI) 2 weeks previous admission and functional impairment at admission (as the difference between BI 2 weeks previous admission and BI in the first 48 hours after admission), cognitive impairment, and albumin were included, calculating the Hazard Ratio with a confidence interval of 95%. A similar analysis was realized to assess variables associated with mortality a year after admission, including similar baseline variables, except functional impairment at admission, that was changed by functional impairment at discharge (as the difference between BI 2 weeks previous admission and BI at discharge).

Also Kaplan–Meier curves for each functional impairment group were performed and compared with log rank. Statistical significance with  $p < 0.05$  was considered. Data were analyzed with SPSS program, version 15.0, SPSS Inc. (Chicago, IL, USA).

### 3. Results

During the study period, 1,321 patients were admitted, of whom 434 (33%) were 90 years old and older. Of these, 89% were admitted from the emergency room and the rest from other geriatric care levels.

The most frequent diagnoses at admission were heart failure and pneumonia. The medium hospital stay was 10.6 (SD 7.22) days. The mortality rate during admission was 13.3%, a month after admission 19% and a year after 56.9%. Clinically relevant functional decline (defined as impairment in BI of at least 5 points) was present in 79% of patients at admission and 49.1% at discharge of total sample. All other features of the sample are shown in Table 1.

In multivariate analysis of mortality 1 month after admission (Table 2), mortality increased by 11% each year from the age of 90 years old. Having a worse functional status (measured as BI score before admission less than 40 points) increased almost 6 times the risk of death after a month after admission. Also, the effects of acute illness on

functional status at admission (functional loss at admission) measured by the Barthel index were the following independent risk factors: 5 points lost in Barthel index score at admission and increased mortality by 13%.

To better assess the parameters associated with mortality 1 year after discharge, we chose the variable functional impairment at discharge rather than at admission because it better reflected the impact of hospitalization. The factors that were associated with 1-year mortality were the presence of worse Barthel index previous admission, hypoalbuminemia at admission, and functional loss at discharge (Table 2).

Fig. 1 shows the survival curves of Kaplan–Meier in nonagenarians according to their previous functional status. A better prior functional status is associated with lower death risk after hospitalization with a year mortality rate increasing from 35.5% on patients with Barthel index previous admission higher than 90 points to 69.2% on those patients with Barthel index previous admission lower than 40 points.

### 4. Discussion

The results of this study suggest that previous functional status, measured by the previous Barthel index and hypoalbuminemia, could be the key factors associated with mortality in nonagenarian patients admitted due to acute medical illness. Also, functional loss at admission is associated with mortality a month after discharge, and functional loss at discharge is also an important mortality risk factor a year after.

There are few studies analyzing the mortality factors in nonagenarian hospitalized patients. In the Conde-Martel et al. study, the year mortality rate of 57% was similar to our study, finding also that functional loss at discharge was associated with a higher mortality [6]. This fact may reflect the prognostic significance of the functional impact due to acute disease as severity index in this group population, as has been shown in other studies with elderly [14].

In absolute terms, mortality per year close to 50% means a reduction in life expectancy of up to a third of the expected if compared with other representatives cohorts of nonagenarians in our environment, with a median survival of 3 years [15,16], which may be due to both worse functional, cognitive, and nutritional situation in this cohort, as the negative impact on long-term survival of hospitalization itself. An incidence of functional impairment at discharge up to 50%, is slightly lower than that found in other studies of hospitalized nonagenarians, whose incidence of functional decline at discharge exceeds 60%, and probably conditions the worst long-term prognosis, such as we find in our study and previous works [6,14,15].

On the other hand, hypoalbuminemia at admission, which may reflect both the state of hypercatabolism or acute disease as a result of malnutrition, was significantly associated with higher mortality a year after hospitalization due to acute illness in nonagenarians, as found in younger population studies [17]. Higher albumin levels were associated with reduced post-discharge mortality in nonagenarians hospitalized in the Internal Medicine Department [18].

By contrast, in relation to the work of Barba et al., neither comorbidity nor diagnostic at admission was a risk factor for mortality [2]. This discrepancy may be related to the inclusion of functional variables in our analysis, which have been previously presented as the most significant risk factors for mortality in older age-groups [19–21].

This study's main findings is to observe that modifiable factors, such as functional impairment at discharge and hypoalbuminemia, are independent risk factors of mortality 1 year after admission, which may lead to strategies to improve functional and nutritional status during hospitalization and specially to try to minimize functional loss during hospitalization.

There are limitations in the present study. The results obtained are from a sample of elderly patients hospitalized due to medical illness, so conclusions cannot be extrapolated to the general population but show that "Comprehensive Geriatric Assessment" can provide data to help establish a suitable care plan and appropriate continuity care,

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