



# Relationships between nutritional screening and functional impairment in institutionalized Spanish older people



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## ABSTRACT

**Objectives:** An association between functional status and nutritional status has previously been demonstrated and the value of the Mini Nutritional Assessment (MNA) as an indicator of functional status has been investigated. However, experience in nursing homes is still limited. The objectives of this survey were to study the relationships between functional impairment as measured by the Barthel Index (BI) and broad nutritional assessment categories as measured by the MNA.

**Study design:** Cross-sectional study developed with data collected from 895 residents in 34 nursing homes all over the province of Albacete (Spain).

**Main outcome measures:** Nutritional and functional statuses were assessed using the MNA and the BI, respectively. Correlations between MNA and BI were evaluated. Analyses of BI against the MNA were utilized to obtain cut-off points for three broad categories of the MNA, “well”, “at risk” and “malnourished”. Multiple logistic regression analyses were used to assess the association of the MNA items with the BI.

**Results:** MNA and BI were significantly correlated. The BI cut-off point that best determined malnourished versus well or at risk was 40.5. The BI cut-off point that best determined well versus malnourished or at risk was 85.5. The BI was positively associated with the following MNA items: mobility, mode of feeding, self view of health status and mid-arm circumference.

**Conclusions:** Both tests, MNA and BI, are positively associated. The scores of BI can help determine who may be at risk of poor nutrition.

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## 1. Introduction

Nursing staff members assist older people in the community and traditionally they have been responsible for the care of nutrition and disability [1,2]. Malnutrition and disability show a high prevalence in nursing homes due to the fact that residents spend their last stage of life in the institution [3]. Moreover, physical functional ability and nutritional status are indicators for predicting the risk of mortality in older adults [4,5]. Therefore, the assessment of them is essential in order to establish adequate interventions [6,7].

The relationship of the functional status with the nutritional status has been investigated in some studies [8–10].

The Mini Nutritional Assessment (MNA) is a screening tool that classifies older people according to their nutritional status. On the other hand, the Barthel Index (BI) classifies individuals according to different levels of functional dependence. Some authors recommend that the MNA and the BI scoring systems should be routinely applied by nursing staff [11,12]. Implementing early interventions in individuals at risk of malnutrition will improve the residents' quality of life and decrease the need of care from nursing staff [13].

Cereda et al. [14] and Lee and Tsai [15] suggested that the MNA was able to predict functional decline of older people. Mirarefin et al. [16] obtained a BI cut-off point which established a two-classification scoring system for the functional status by the BI based on the categorized MNA  $\leq 23.5$  versus  $>23.5$ . However, to the best of our knowledge, none study has obtained a second cut-off point to establish a three-classification scoring system for the BI according to the three MNA categories.

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The objectives of this survey were to study the relationships between functional impairment as measured by the BI and broad nutritional assessment categories as measured by the MNA.

## 2. Methods

### 2.1. Subject recruitment and data collection

The present survey is a cross-sectional study performed with data collected from residents living in nursing homes all over the province of Albacete (Spain). The inclusion criteria were: subjects, aged 65 or older, living in nursing homes, whose management teams accepted to participate in the study. The exclusion criteria were: (1) staying temporarily or living in the institution <3 months, (2) receiving supplements or tube feeding, (3) suffering from acute disease at the beginning of the survey, (4) being in a terminal condition of health, (5) suffering from cognitive impairment, and (6) not accepting to take part in the survey. Data were collected in 34 out of the 37 institutions located in the province. This study was approved by the University of Castilla-La Mancha (Spain) and by the authorities for the Social Welfare of the province of Albacete.

### 2.2. Functional ability

The Barthel Index (BI) is an easy tool widely used to evaluate the functional ability by the measurement of the individual's performance on 10 activities of daily living (ADL) functions (personal hygiene, bathing self, feeding, toilet use, stairs climbing, dressing, bowel control, bladder control, ambulation and chair/bed transfers). The BI total score ranges from 0 to 100 and it classifies the individuals' level of dependence as follows: 0–20 total, 21–60 severe, 61–90 moderate and 91–99 slight. A score of 100 indicates independence. The original BI was first published in 1965 [17] and modified versions of the BI have been proposed afterwards. In this study the modified version developed by Shah et al. [18] was used. In this version, the sensitivity of the test is improved and no difficulties are added when it is applied.

### 2.3. Nutritional status

The Mini Nutritional Assessment test (MNA), first developed and published in 1994 [19], is a nutrition screening tool that was designed to provide a rapid assessment of nutrition risk in older people ( $\geq 65$  years). It is a very useful instrument for detecting malnutrition and risk of malnutrition in a wide range of settings as part of the geriatric evaluation [20]. The MNA consists of 18 questions with a total score of 30 points. It is structured in four parts: anthropometric assessment (weight loss, BMI, mid-arm circumference and calf circumference), global assessment (mobility, prescription drugs, independent life, psychological stress or acute disease, pressure sores or skin ulcers and neuropsychological problems), dietary assessment (full meals eaten daily, food intake decline, fluid consumption, protein intake, fruit and vegetable intake and mode of feeding) and self assessment (self view nutritional status and self view health status). The MNA classifies individuals as malnourished (<17 points), at risk of malnutrition (17–23.5 points) and normal nutritional status ( $\geq 24$  points).

### 2.4. Statistical analysis

Statistical analysis was performed with IBM SPSS Statistics 19 (SPSS Inc. Chicago IL, USA). P-Values  $p < 0.05$  were considered statistically significant. Means and standard deviations were used as descriptive statistics for quantitative variables. Proportions were used to describe qualitative variables. Mann–Whitney  $U$  test was

used to compare two means. Kruskal–Wallis test was applied to compare three or more means.

The presence of correlations was analyzed by Spearman's model. In order to determine upper and lower BI cut-off points based on the MNA, receiver operating characteristic (ROC) curves to determine sensitivity and specificity were conducted. In each case, the area under the ROC curve (AUC) and the Youden Index (sensitivity + specificity - 1) were obtained as diagnostic measurements. Based on these cut-off points, positive and negative predictive values were calculated. Finally, in age and sex-adjusted multiple logistic regression analyses, the BI (dichotomized by the upper and lower BI cut-off points) was included as dependent variable and the odds ratios for the MNA and MNA components were determined.

## 3. Results

A total of 3088 subjects out of the 3232 available in the nursing homes in Albacete met inclusion criteria. 1628 residents suffered from cognitive impairment, 202 suffered from acute disease and 347 fulfilled one or more of the rest of exclusion criteria. Therefore, 911 individuals were interviewed and, after a careful review and adjustment, 895 residents, who gave their oral consent, were definitely considered in the survey.

Subjects, with mean age 82.3 (SD: 7.1) years old, had a gender distribution of 523 women (58.4%) and 372 men (41.6%). Women's mean age was 82.9 (SD: 6.7) and men's mean age was 81.3 (SD: 7.6). The mean MNA score for the total sample was 23.9 (SD: 3.1). Means for women and men were 23.7 (SD: 3.3) and 24.3 (SD: 2.9), respectively. The MNA classified 2.8% ( $n = 25$ ) residents as malnourished, 37.3% ( $n = 334$ ) as at risk of malnutrition and 59.9% ( $n = 536$ ) as well nourished.

Table 1 shows the general characteristics of the older people participating in the survey according to the functional status by the BI. The BI classified subjects as follows: 5.8% ( $n = 52$ ) totally dependent, 17.9% ( $n = 160$ ) severely dependent, 33.4% ( $n = 299$ ) moderately dependent, 22.7% ( $n = 203$ ) slightly dependent and 20.2% ( $n = 181$ ) independent subjects.

The correlation analysis showed that the MNA and the BI scores were positively associated ( $r = 0.375$ ;  $p < 0.001$ ). The MNA score was significantly related to all the BI items. The strongest correlations existed between the MNA and the following items: chair/bed transfers, dressing and toilet use (Table 2). The BI scores were significantly correlated with the following MNA items: food intake decline, weight loss, mobility, neuropsychological problems, pressure sores or skin ulcers, mode of feeding, self view of nutritional status, self view of health status, mid-arm circumference and calf circumference. The items that showed stronger correlations were: mobility, mode of feeding and self view of health status (Table 2).

In order to determine the BI cut-off point based on the MNA dichotomized categorization "well nourished" versus "at risk of malnutrition–malnourished" (upper BI cut-off point), a ROC curve was plotted, showing an area under the curve of 0.669. The optimal upper BI cut-off point was assessed by optimizing sensitivity among the higher values of the Youden Index. The upper BI cut-off point at a score of 85.5 demonstrated a sensitivity of 0.6156 and a specificity of 0.6399 (Youden Index: 0.2555). Positive and negative predictive values are shown in Table 3. In order to calculate a second BI cut-off point (lower BI cut-off point) the MNA categorization "well nourished–at risk of malnutrition" versus "malnourished" was considered. The area under the corresponding ROC curve was 0.831. The optimal lower BI cut-off point, obtained by optimizing specificity among the higher values of the Youden Index, was found at a BI score of 40.5. This cut-off point showed a sensitivity of 0.6400, a specificity of 0.8793 and a Youden Index of 0.5193. Positive and

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