Factors associated with prolonged hospital stay in an acute geriatric unit

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Abstract

Objective: to analyze the factors associated with prolonged hospital stay in the Acute Geriatric Unit of a general hospital.

Materials and methods: the study included 2,014 patients ≥60 years old who were hospitalized between January 2012 and September 2015. The dependent variable was prolonged hospital stay (>10 days vs ≤10 days). The independent variables included sociodemographic, laboratory, comorbidity, and functional and mental status variables. The *Chi*^{2} test for categorical variables and the non-parametric two-sample Wilcoxon test for quantitative variables were employed for bivariate analysis. A multivariate logistic regression model was run.

Results: 51.1% of the study subjects were women and the average age was 82.3 ± 7.2 years. The average length of stay was 14.7 ± 14 days, and the median was 10.6 days. Altogether, 50.6% had a prolonged stay. Those with prolonged hospital stay were characterized by having functional dependence, anemia, comorbidity (Charlson Index ≥4), hypoalbuminemia, high levels of acute phase reactants (CRP), and pressure sores. Women had fewer inpatient days. Prolonged length of stay was not related to the social variables.

Conclusion: the main independent factors increasing hospital stay are pressure sores, functional dependence, hypoalbuminemia, comorbidity and elevated CRP levels. (Acta Med Colomb 2021; 46. DOI: https://doi.org/10.36104/amc.2021.1844).

Key words: *acute geriatric unit, prolonged hospital stay, older adult*.

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Introduction

Population aging is a growing global phenomenon which varies from one region to another, with Europe being the most long-lived continent and Africa the youngest (1). Similarly, a population census in Colombia showed an increase in the population over the age of 60, from 9% in 2005 to 13.4% in 2018 (2).

Aging brings important morphological and physiological changes, which, together with frailty and a high burden of morbidity, increase the risk that older adults (OAs), when faced with acute illness or exacerbations of chronic illness, will have a greater probability of adverse health outcomes such as prolonged hospitalizations, infectious processes, functional decline, institutionalization and death (3).

Hospitals have defined prolonged stay as a period greater than 10 days (4). Interventions aimed at decreasing the length of hospitalization must identify the institutional, clinical, functional, social and familial factors that affect hospital stay (3).

Acute geriatric units (AGUs) seek to prevent functional decline, complications of acute illness, and hospitalization (5).

These units differ from conventional units in that care is based on the biopsychosocial model and the comprehensive geriatric assessment (CGA) conducted by an interdisciplinary team (6). A meta-analysis published in 2012 reported that care in AGUs showed a reduction compared with conventional units in: falls, pressure sores (PSs), onset of delirium, functional decline, length of hospital stay and healthcare costs (5). Given the progressive aging of the Colombian population (2, 3), and the availability of information on hospital stay in AGUs from other countries but not our own (4-6), it is important to determine the factors that may affect hospital stay in geriatric patients. The objective of this study was to analyze the factors associated with prolonged hospital stay in frail elderly patients admitted with acute medical illnesses and hospitalized in an AGU at a general hospital.

Materials and methods

Study design and data collection

This was a cross-sectional analytical observational study which included 2,014 patients admitted to an AGU between January 2012 and September 2015. The study was approved by the institution's Ethics Committee.

Patients were admitted to the AGU if they were 60 years old or older and had at least one of the following criteria: taking five or more medications, a cerebrovascular accident in a

sub-acute phase, prior severe or total dependence, frequent hospital readmissions (two or more per month), prior mental conditions (delirium on admission or baseline dementia), the presence of multiple geriatric syndromes (frailty, pressure sores, falls), a body mass index <20 kg/m^2, an inadequate social support network, residence in a geriatric institution, or 80 years old or older with an acute medical illness.

After obtaining informed consent (from the patient or a proxy), the questionnaire was completed on admission by the interdisciplinary team (geriatrician, physical therapist, psychologist, social worker and nurse), trained to collect data from CGA scales. Data during hospitalization was obtained through interviews (with the patient or proxy).

Dependent variable

The dependent variable was prolonged hospital stay (more than 10 days after admission vs. 10 or fewer days) (4).

Covariables

On hospital admission, sociodemographic, biological, mental and functional variables which could affect the outcome were evaluated.

We used the Charlson Comorbidity Index (CCI) (7); it is scored from 0-13 and a score of 4 or more is considered to be a high burden of morbidity.

Polypharmacy (the use of five or more medications) on admission (8). Biomarkers measured on admission: hemoglobin and the presence of anemia defined according to the World Health Organization (WHO) criteria of < 13g/dL for men and <12 g/dL for women (9), leukocytes, creatinine with an estimated glomerular filtration rate (eGFR) using the MDRD equation (mL/min/1.73 m^2), albumin, cholesterol, blood sugar, sodium and C-reactive protein (CRP, according to the median >36.4 vs. ≤ 36.4).

Cognitive status on admission was classified according to the mini-mental (MMSE) score as follows: normal 24-30, mild impairment 19-23, moderate impairment 14-18, and severe impairment <14 (10). Depression was assessed using the Yesavage scale (Geriatric Depression Scale [GDS]): positive for depression if ≥6 points on a scale from 1-15 points (11). During the AGU stay, the onset of delirium was assessed using the Confusion Assessment Method (CAM), which evaluates four characteristics: acute onset and fluctuating course, inattention, disorganized thinking and altered level of consciousness, with the presence of characteristics 1 and 2, and 3 or 4, or all four being considered positive for delirium (12).

Activities of daily living were assessed on admission using the Barthel Index (BI) for basic activities: ≤60 (severe dependence) and >60 (moderate dependence or independence) (13), and the Lawton-Brody scale (LBS) for instrumental activities: 0 (totally dependent) and 8 (independent) (14).

The social situation on admission was assessed using Gijón's abbreviated scale: good situation (≤7 points), at-risk situation (8-9 points) and severe social deterioration (≥10 points) (15). Also, during hospitalization, the development of pressure sores (PSs) and need for intensive care unit (ICU) or intermediate care unit (IMCU) care was assessed.

Statistical analysis

An exploratory and descriptive analysis was performed. Proportions (%) were estimated for categorical variables and continuous variables are expressed in averages ±SD (standard deviation), medians (IQR=interquartile ranges Q1 and Q3). For the bivariate analysis between the independent variables and the binary dependent variable (length of stay ≤ 10 days vs. >10 days), the Chi^2 test (categorical variables) and two-sample Wilcoxon nonparametric test (quantitative variables) were used. A multivariate logistic regression model was run to determine the association between hospital stay (code 1 is >10 days and code 0 is ≤ 10 days) and the significant variables from the bivariate analysis, using backward elimination. This yielded the odds ratios (ORs) with their respective 95% confidence intervals (95%CI). All the analyses were run on the SAS version 9.4 statistical program for Windows (SAS Institute, Inc., Cary, NC); the statistical significance level selected was p <0.05 for the two-tailed test.

Results

A total of 2,014 patients admitted to the AGU from January 2012 to September 2015 were recruited. The average age was 82.3 years (SD ±7.2 years), 51.1% were women and 50.6% had a prolonged stay. The average length of hospital stay was 14.7 ±14 days (median 10.5; Q1 to Q3 interquartile range= 6.0 to 18.0). Those with prolonged hospital stay were characterized by having social deterioration (Table 1); a higher CCI; lower levels of cholesterol, albumin, hemoglobin and lymphocytes; higher levels of C-reactive protein (CRP); more admissions to the ICU or IMCU and the development of PSs during hospitalization (Table 2).

Patients with prolonged stay had a greater frequency of severe cognitive impairment and a greater percentage of delirium during hospitalization. Prolonged hospitalization was associated with greater physical disability, with lower BI and LBS scores (Table 3).

In the multivariate logistic regression model, the variables which were independently associated with prolonged hospital stay were: greater morbidity (CCI ≥4; p=0.0016), functional dependence (BI ≤60; p<0.0001), hypoalbuminemia (p<0.0001), anemia (p=0.0142), admission to the ICU or IMCU (p=0.0185), pressure sores (p<0.0001) and elevated acute phase reactants (CRP) (p<0.0001). Finally, being a woman was associated with fewer inpatient days (p=0.0155) (Figure 1).

Figure 2 includes descriptive statistics of inpatient days with regard to the variables found to be significant in the multivariate analysis (medians and Q1 and Q3 interquartile ranges). The longer hospital stay medians belonged to pres-

sure sores (15.0 days), high CRP (14.0 days), functional dependence (Barthel ≤60; 13.0 days), low albumin (13.0), and having been in the IMCU (13.0).

Discussion

In OAs, prolonged stay is a factor associated with an increased rate of complications, functional deterioration, hospital readmission and mortality, both inpatient and one year after admission (16). There is no consensus on the quantitative definition of prolonged stay, ranging from 9.4 ±3.3 days to 14.1 ±7.2 days, according to the study reviewed, with a mean length of 11.5 ± 6.4 days (17).

In our study, prolonged stay was defined as more than 10 days of hospitalization (4), which was found in 50.6% of the patients. This high rate could be a result of the sum of the independent factors we found to be associated with hospital stay, some of which have a higher median stay; for example, pressure sores, high CRP, functional dependence, low albumin and having been in the IMCU (Figure 2).

Age was not related to prolonged stay in our study. The average age was similar to that of other studies (4,7,16). In a study in 2014, Bernabei et al. (4) classified AGU patients according to whether they were admitted from the emergency room or electively. They found that, in those admitted from the emergency room, the greatest predictor of prolonged stay was excessive polypharmacy (≥10 medications) and an elevated erythrocyte sedimentation rate, while being female had an inverse relationship (OR 0.58, CI 0.37-0.90) (4). These findings are similar to those in our study, where being female was associated with a shorter length of stay; and elevated CRP, as an acute phase reactant similar to erythrocyte sedimentation rate, was associated with a longer hospital stay (4). In our study, we found no relationship between polypharmacy and prolonged stay.

Pressure sores are considered to have a negative impact on OAs from their onset and may become chronic lesions which cause greater morbidity and mortality (18). Theisen et al.'s study found that hospitalized OA patients who developed PSs increased their hospital stay an average of nine days compared with those who did not have them (19). These findings concur with those of our study, in which PSs led to a longer median hospital stay of 15 days (Figure 2), thus constituting a significant factor in prolonging the total hospital stay of the study population. This can be explained by specific skin care lapses by healthcare workers and family members or caregivers. Thus, it is important to insist on an effective prevention strategy involving the interdisciplinary healthcare team as well as the family.

From a biopyschosocial model and the experience with this perspective in our AGU, we hypothesized that the social situation of an OA who is hospitalized, for whatever cause, has an impact on his/her recovery (20). However, no statistically significant association was found in the multivariate analysis. The studies reviewed do not allow for a relationship between low social support and increased hospital stay (4, 21). Studies prior to the year 2000 showed an association between "living alone" and prolonged hospital stay (17, 22, 23). We believe it is important to always include a social evaluation of the OA on hospital admission in order to design a management plan consistent with the psychosocial and familial situation, to reduce adverse health outcomes. There is a knowledge gap regarding the impact of social-familial variables on length of OA hospitalization, and other negative outcomes that may be evaluated in future studies.

High comorbidity was associated with a 1.3 times greater chance of having a prolonged stay. This finding is compatible with the literature regardless of the instrument used for measuring (4). This is based on biological plausibility, given that the burden of disease affects the functional

Table 1. *Sociodemographic variables by hospital stay category*.

Variable	Total n=2,014	Stay ≤10 days, n=993	Stay >10 days, n=1,021	P value
	n (%), or average ±SD and median [IQR]	n (%), or average ±SD and median [IQR]	n (%), or average ±SD and median [IQR]	
Age (years)	82.3±7.2	82.2±7.3	82.4 ±7.2	0.2568
80+	1333 (66.2)	647 (65.2)	686 (67.2)	0.3350
Female	1030 (51.1)	539 (54.3)	491 (48.1)	0.0055
Hospital stay (days)	14.7±14.0; 10.7 [6.0-18.0]	6.1 ± 2.4; 6.0 [4.0-8.0]	23.1 ±15.5; 18.0 [13.5-26.0]	
Social				
Guijón Scale				
Good	1253 (62.2)	661 (66.6)	592 (58.0)	<.0001
At risk	575 (28.6)	261 (26.3)	314 (30.7)	
Severe social deterioration	186 (9.2)	71 (7.1)	115 (11.3)	

SD= standard deviation. IQR= interquartile ranges Q1-Q3. P values obtained from Chi^2 or Wilcoxon two-sample non-parametric tests.

Table 2. *Biological variables according to hospital stay category.*

Variable	Total N=2,014	Stay ≤ 10 days. N=993	Stay >10 days. N=1,021	P value
	N (%) or average ±SD and median [IQR]	N (%) or average ±SD and median [IQR]	N (%) or average ±SD and median [IQR]	
Charlson Comorbidity Index (CCI, 0-13)	3.3 ± 2.1; 3.0 (2.0-4.0)	3.0 ± 2.0; 3.0 (2.0-4.0)	3.5 ± 2.1; 3.0 (2.0-5.0)	<0.0001
CCI ≥ 4	782 (38.8)	335 (33.7)	447 (43.8)	<0.0001
Total cholesterol (mg/dL)	134.0 ± 38.5; 129.5 [107.5-155.8]	139.5 ± 38.5; 136.0 [112.0-162.0]	128.2 ± 37.7; 121.5 [103.0-149.0]	<0.0001
Low (<130)	403 (20.0)	184 (18.5)	219 (21.5)	0.1015
Albumin (g/dL)	3.1 ± 0.6; 3.2 [2.7-3.6]	3.3 ± 0.6; 3.3 [3.0-3.7]	3.0 ± 0.6; 3.1 [2.6-3.4]	<0.0001
Low (<3.5)	852 (42.3)	328 (33.0)	524 (51.3)	<0.0001
Hemoglobin (g/dL)	11.5 ± 2.4; 11.7 [10.0-13.1]	11.7 ± 2.3; 11.9 [10.5-13.2]	11.2 ± 2.5; 11.2 [9.8-12.8]	<0.0001
Anemia (<13g/dL men/<12 g/dL women)	1,284 (63.7)	579 (58.3)	705 (69.0)	<0.0001
Lymphocytes -number cel/mm^3	3.4 ± 38.4; 1.5 [1.0-2.2]	4.8 ± 54.7; 1.6 [1.1-2.3]	2.1 ± 3.1; 1.5 [1.0-2.1]	0.0073
≤1,500 cel/mm^3	1,003 (49.8)	467 (47.0)	536 (52.5)	0.0141
Blood sugar (mg/dL)	139.1 ± 73.1; 119.0 [97.0-153.0]	136.9 ± 73.9; 116.0 [95.0-152.5]	141.0 ± 72.3; 122.0 [98.0-155.0]	0.0969
Sodium (mmol/L)	138.9 ± 7.1; 139.3 [136.0-142.0]	138.5 ± 6.4; 139.1 [136.4-141.5]	139.2 ± 7.6; 139.5 [135.8-142.3]	0.1192
CRP (C-reactive protein) (mg/dL)	68.3 ± 81.2; 36.4 [7.6-90.5]	52.0 ± 72.9; 36.4 [4.0-57.7]	81.9 ± 85.2; 46.2 [15.7-119.7]	<0.0001
Kidney function				
eGFR, (ml/min/1.73 m^2) –MDRD-4 equation	67.6 ± 37.9; 63.7 [42.0-85.9]	65.9 ± 34.9; 62.0 [43.9-81.9]	69.4 ± 40.5; 65.2 [39.2-89.6]	0.2232
Nº. of medications on admission	4.6 ± 2.9; 4.0 [2.0-6.0]	4.6 ± 2.8; 4.0 [2.0-6.0]	4.6 ± 3.0; 4.0 [2.0-6.0]	0.9216
Polypharmacy (≥ 5)	883 (43.8)	430 (43.3)	453 (44.4)	0.6301
Pressure sores	194 (9.6)	53 (5.3)	141 (13.8)	<0.0001
Has been in the ICU or IMCU	215 (10.7)	85 (8.6)	130 (12.7)	0.0024

SD= standard deviation. IQR= Q1-Q3 interquartile ranges. P values obtained from Chi^2 or Wilcoxon two-sample non-parametric tests. eGFR= estimated glomerular filtration rate; MDRD-4= Modification of Diet in Renal Disease Study; ICU=intensive care unit; IMCU= intermediate care unit.

Table 3. *Mental and functional variables according to hospital stay category.*

Variable	Total n=2,014	Stay ≤10 days. n=993	Stay >10 days. n=1,021	P value
	N (%) or average ±SD and median [IQR]	N (%) or average ±SD and median [IQR]	N (%) or average ±SD and median [IQR]	
Mini-mental cognitive evaluation score (0-30)				
Normal 24-30	873 (43.3)	469 (47.2)	404 (39.6)	<0.0001
Mild 19-23	175 (8.7)	97 (9.8)	78 (7.6)	
Moderate 14-18	435 (21.6)	227 (22.9)	208 (20.4)	
Severe <14	531 (26.4)	200 (20.1)	331 (32.4)	
Delirium	405 (20.1)	155 (15.6)	250 (24.5)	<0.0001
Depression (Yesavage ≥ 6)	233 (11.6)	101 (10.2)	132 (12.9)	0.0531
Barthel Index (0-100)	44.5 ± 40.4; 45.0 [0.0-90.0]	57.4 ± 38.4; 65.0 [15.0-95.0]	32.9 ± 38.6; 5.0 [0.0-70.0]	<0.0001
BI ≤ 60	1,179 (58.5)	478 (48.1)	701 (68.7)	<0.0001
Lawton Scale (0-8)	2.2 ± 2.8; 0.0 [0.0-4.0]	2.9 ± 2.9; 2.0 [0.0-5.0]	1.6 ± 2.6; 0.0 [0.0-3.0]	<0.0001

SD= standard deviation. IQR= Q1-Q3 interquartile ranges. P values obtained from Chi^2 or Wilcoxon two-sample non-parametric tests.

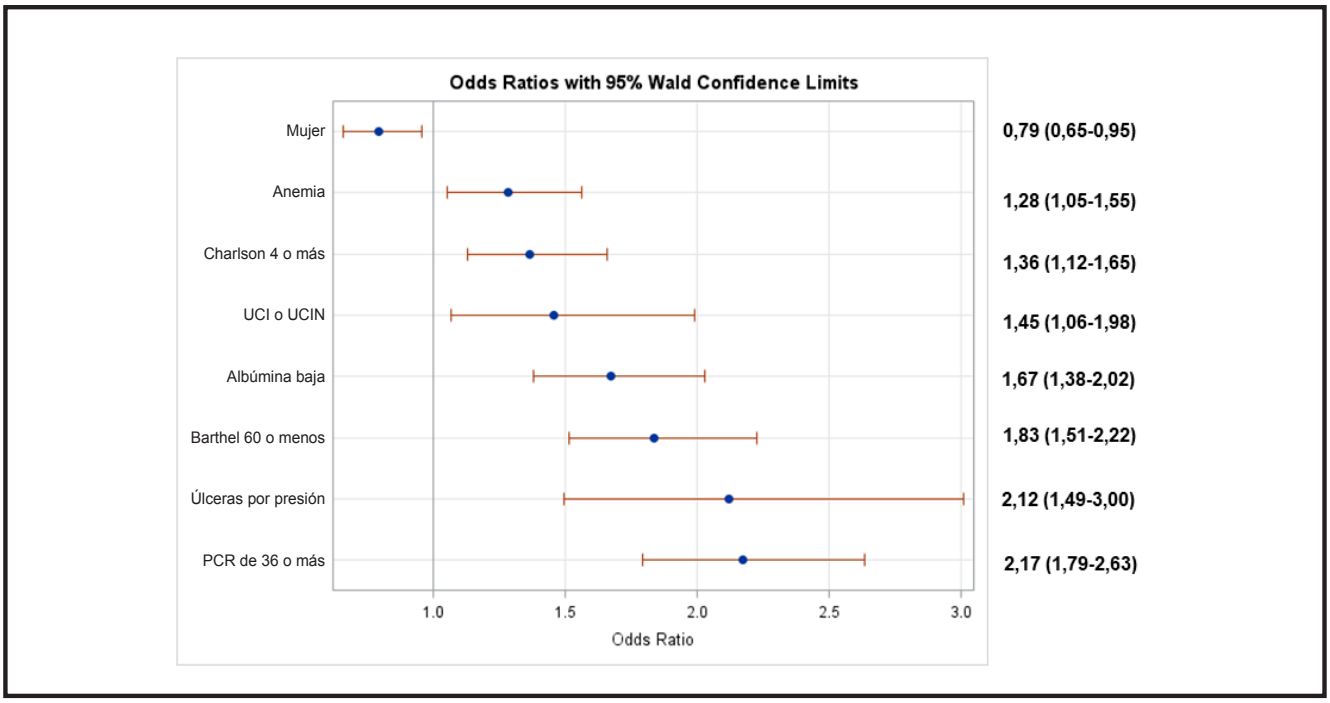

Figure 1. *Multivariate logistic regression, dependent variable hospital stay (>10 days)* ***– * variables selected by backward elimination***

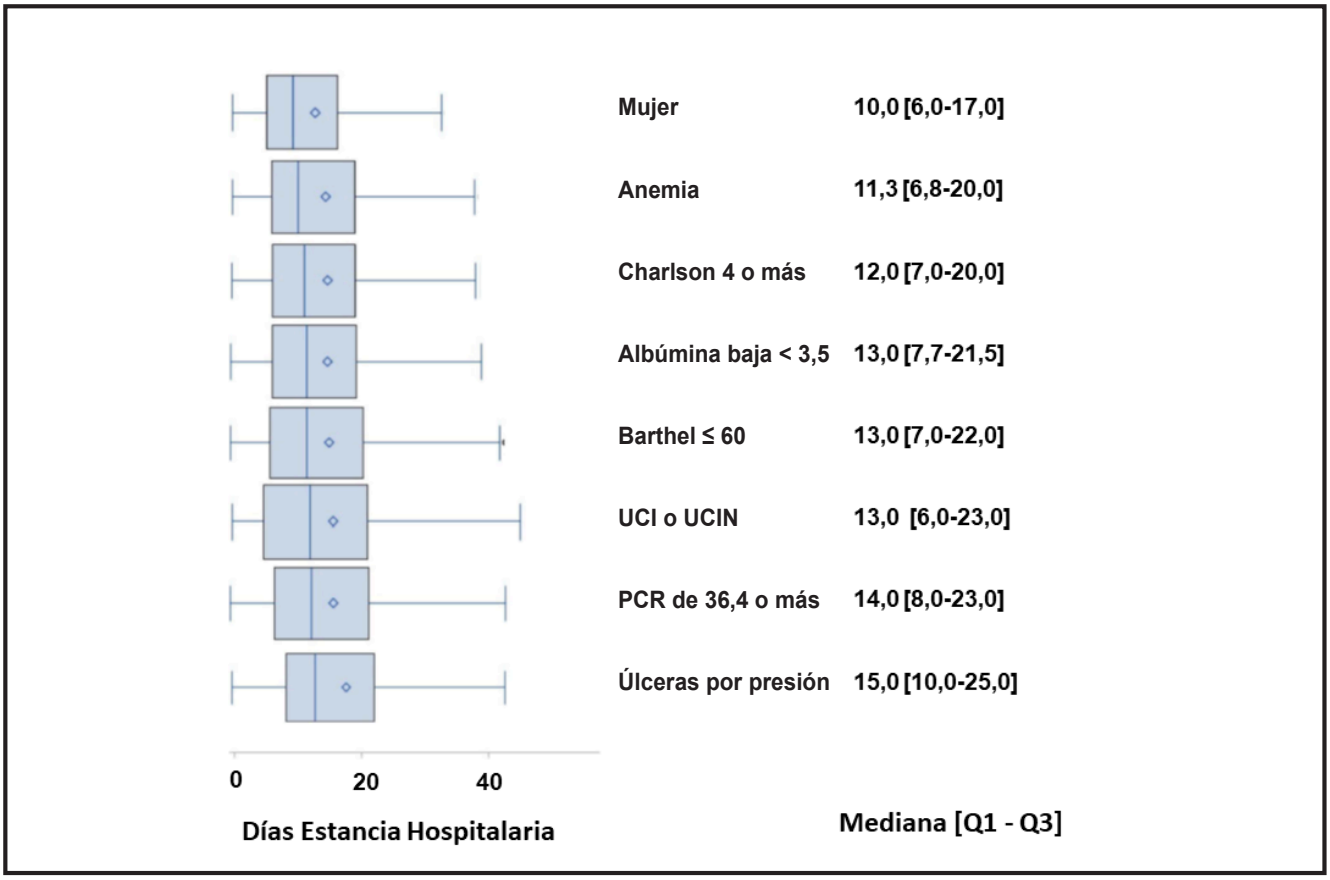

Figure 2. *Descriptive statistics of hospital stay with regard to significant variables in the multivariate analysis.*

reserve, creating a greater probability of decompensation of the underlying diseases and/or appearance of new acute conditions, in addition to exposure to the hospital environment, which leads to prolonged stay.

In this study, being admitted to the hospital while severely dependent (BI≤60 points) was related to prolonged hospitalization. Another study showed a bidirectional relationship, where the greater the number of hospital days the greater the dependence and functional loss and decreased functional gain both in the hospital as well as after discharge (18).

The presence of anemia in hospitalized patients has been reported in other studies as a factor in prolonged stay (4, 24). We found similar results in our study. In another vein, admission to the ICU causes vulnerability in patients, who then require additional care. We found that patients who required ICU or IMCU care had a median of 13 days of hospitalization, which agrees with other studies. A study by Moitra et al. found that 88.9% of the patients had an ICU-only stay of 1-6 days, and 1.3% up to 21 days (25). Atoui et al. showed in their study that 27.2% had an average ICU stay of 4.25 days, extending their hospitalization on the floors with an average of 12.73 days; in addition, 30.5% of the patients had a prolonged hospital stay on the floors, with an average of 15.3 days (26).

The strength of this study includes the number of patients assessed by a multidisciplinary team who provided daily follow up based on the CGA. We analyzed the social situation on admission, although the association between this and hospital stay was not found on multivariate analysis, a point which needs to be assessed in future studies.

This study also has limitations. The cross-sectional design limits the possibility of finding risk factors or causal variables, and no comparison was made of different care models in a single institution (AGU vs. conventional unit). In addition, administrative factors (such as authorizations for home care or referrals to functional recovery units) which may have delayed the discharge of OAs, and consequently lengthened hospital stay, were not assessed.

In conclusion, the main independent factors lengthening hospital stay were pressure ulcers, functional dependence, hypoalbuminemia and elevated CRP levels.

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