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ORIGINAL ARTICLE

Prognostic factors for discharge to home and residing at home 12 months after hip fracture: an Anoia hip study

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Abstract

Objectives Hip fracture is often associated with loss of physical function and institutionalization. The aim of this study is to describe the prognostic factors for discharge to home and residing there 12 months after a hip fracture.

Methods A prospective study that includes patients aged ≥ 69 years that live at home before the fracture, admitted from June 1st, 2010, to May 31st, 2013. We registered the demographic data, presurgical function and cognitive assessment, surgical waiting time, type of fracture and complications during hospitalization.

Results We included 273 patients (mean age 84.8 ± 6.1 years; 80% women), 130 (47.6%) were discharged directly to their own home. The predictors of discharge to home were a lower Geriatrics Dementia Scale score (OR 1.42; 95% CI 1.17–1.71; $p < 0.001$), a higher Barthel Index score at discharge (OR 1.07; 95% CI 1.05–1.10; $p < 0.001$) and a longer hospital stay (OR 1.14; 95% CI 1.02–1.27; $p = 0.019$). At 12 months, 169 (63.5%) were still residing at home. Predictors of residing at home 12 months after the hip fracture were age (OR 1.07; 95% CI 1.02–1.12; $p = 0.010$), the discharge Barthel Index score (OR 0.96; 95% CI 0.94–0.98; $p < 0.001$), the Geriatrics Dementia Scale score (OR 1.27; 95% CI 1.05–1.52; $p = 0.013$), the surgical waiting time (OR 3.42; 95% CI 1.077–10.89; $p = 0.037$) and Charlson comorbidity index (OR 1.27; 95% CI 1.05–1.55; $p = 0.016$).

Conclusion Prognostic factors for discharging to home and remaining there 12 months after a hip fracture are those that reflect a better health condition prior to the fracture and better functionality at the hospital discharge for hip fracture.

Keywords Hip fracture · Elderly · Prognostic factors · Community-dwelling life

Introduction

Among osteoporotic fractures, hip fractures have the greatest impact on older adult patients and are one of the most significant public health problems in Western countries [1, 2]. Hip fractures have a hospital mortality between 4 and 8% [3, 4]. At 1 year, the mortality rate can reach 25% and can even increase to 40% in the subsequent 2 years [5–8]. Hip fractures are also a determinant of functional impairment, which often precipitates institutionalization; many patients are unable to regain their pre-fracture status of mobility and daily activities, it is estimated that between 15 and 30% of patients will be institutionalized after hip fracture [5, 9–11] and entails high health costs [6, 7].

In the elderly who suffer a hip fracture, the objective is to achieve recovery of the functional state prior to the fracture, since this is one of the factors that prevent institutionalization [12, 13]. One of the major objectives for those who

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work in geriatric medicine should be to enable their patients to stay in their environment, preserving the maximum degree of physical and mental autonomy for as long as possible. The aim of this study is to describe the prognostic factors that enable a return home after discharge from an acute geriatric unit (AGU) and to still be residing at home 12 months after a hip fracture.

Methods

Study population and design

This is an observational prospective study. The study was conducted in the Hospital of Igualada, which covers 118,467 habitants belonging to the Anoia region (Barcelona, Spain). We included prospective patients older than 69 years, who were living in their home before the fracture. We included patients admitted with hip fracture to the acute geriatric unit of Igualada Hospital between June 1st, 2010, and May 31st, 2013.

The patients in the sample underwent a healthcare intervention in which the management for the entire process was the responsibility of the interdisciplinary geriatric team. This intervention is encompassed within the therapeutic guidelines for hip fractures of the Hospital of Igualada. The key points of the intervention are listed in Table 1, and the complete intervention is described elsewhere [14]. It is important to mention that in the AGU, patients follow a program of functional recovery based on the concept of "Rapid Recovery" at 24 h post-intervention, based on physiotherapy and intensive occupational therapy of the basic mobility of daily life such as getting in and out of bed, sitting and standing from a chair, (mobility on the stairs) and walking with the appropriate support material [15]. At discharge from hospital, either at home or in the geriatric rehabilitation unit, the patient continues the intensive recovery program focused on this phase to reeducate the balance, obtain an efficient and safe ambulation and improve muscle strength to prevent other fractures and maintain the maximum level of physical activity, since a low level of physical activity is associated with an increased risk of hip fracture.

We collected the following variables: demographic (sex, age, marital status, and discharge destination), ability in the activities of daily living and ambulation performance prior to admission and at discharge (Barthel index [16], Lawton and Brody index [17], functional ambulation classification, FAC [18]), cognitive status (Geriatric Dementia Scale, GDS [19]), fracture type, Charlson comorbidity index [20], biochemical markers (renal function, thyroid-stimulating hormone, calcium, proteins, albumin), surgical waiting time, anesthetic risk (American Society of Anesthesiologists, ASA classification) [21], hospital length of stay, presence of delirium or other complications during the hospitalization (infections, electrolyte disturbances, cardiovascular decompensation, anemia that requires transfusion), sensory disorders and drugs associated with falls. We conducted a telephone follow-up 12 months after baseline assessment, which includes all patients discharged home directly from AGU and those who returned home after discharge from rehabilitation units. The purpose of the call was to determine those patients who did not reside in their homes and were institutionalized in long-term care facilities.

Verbal consent was obtained from all participants prior to their inclusion in the study (in the case of dementia, the consent of the responsible family member and/or guardian). The study was approved by the Ethics Committee of the Hospital of Bellvitge, Barcelona (PR197/13).

Statistical analysis

To study the relationship between the numerical and categorical variables, we employed the Mann–Whitney *U* test. To study the relationship between categorical variables, we employed the Chi-squared test with the Fisher's test correction. The variables that showed a statistically significant relationship in the bivariate analysis were included in a multivariate analysis model of binary logistic regression. The variables that were not statistically significant were discarded (provided there were no confounding factors) to obtain an optimal prediction model for the study variables.

Table 1 Intervention activities in the orthogeriatric model

Accident and Emergency length of stay less than or equal to 3 h
Direct admission from the Accident and Emergency department to AGU, with protocolized treatment
Care by the interdisciplinary Geriatrics team
Daily visit, jointly by Traumatology and Geriatrics, from Monday to Friday at 8:30 a.m. Surgical waiting time less than 48 h if clinical stability allows
Prevention of complications related to hospitalization such as immobility syndrome and delirium
Performing sitting exercises within 24 h after the surgery
Start of physiotherapy and occupational therapy within 48 h after the surgery
Start of the discharge planning, with the objective of returning patients to their regular place of residence
Assessment and indication of specific treatment for secondary prevention of fracture

The model's discriminatory power was evaluated with the area under the curve and the calibration of the model with the Hosmer–Lemeshow test. Throughout the analysis, p values ≤ 0.05 were considered statistically significant. For the statistical analysis, we used the statistical program SPSS version 19.0 (IBM Corporation, Chicago, IL).

Table 2 Basal characteristics of the population

	Total ($n=371$)
Years	
Male	84.7 ± 6.1
Female	85.2 ± 6.4
Sex	
Male	74 (19.9%)
Female	297 (80.1%)
Marital status	
Widowed	135 (60.0%)
Married	66 (29.3%)
Single/Separated/Divorced	24 (10.6%)
Functional status	
Baseline Lawton and Brody Index	3.5 ± 3.31
Baseline Barthel Index	73.0 ± 28.9
Baseline Functional Ambulation Classification	4.2 ± 1.2
Baseline Cognitive Function (Reisberg GDS degrees)	3.1 ± 2.2
Charlson comorbidity index	2.3 ± 1.7
Sensory organs	
Reduced visual acuity	122 (54.2%)
Reduced auditory acuity	118 (52.4%)

Results

During the study period, 371 patients were admitted, mean age 84.9 ± 6.1 years; (80.1% women). The basal characteristics of the population are summarized in Table 2. The distribution of patients through the study is available in Fig. 1.

The final sample was 273 patients that resided at home prior to the hip fracture.

Prognostic factors for discharge to home from the AGU

A total of 130 (47.6%) patients (85.1 ± 6.6 years; 47.7% women) were discharged to home from the acute geriatric unit, while 143 (52.3%) patients (84.6 ± 6.2 years; 52.3% women) were discharged to geriatric rehabilitation unit with the objective to get functional recovery. The differences between the two groups are presented in Table 3.

Prognostic factors related to the discharge to home were higher discharge Barthel index and FAC (for both $p<0.001$), intracapsular fracture ($p=0.013$) and a longer length of hospital stay ($p<0.001$) (Table 3).

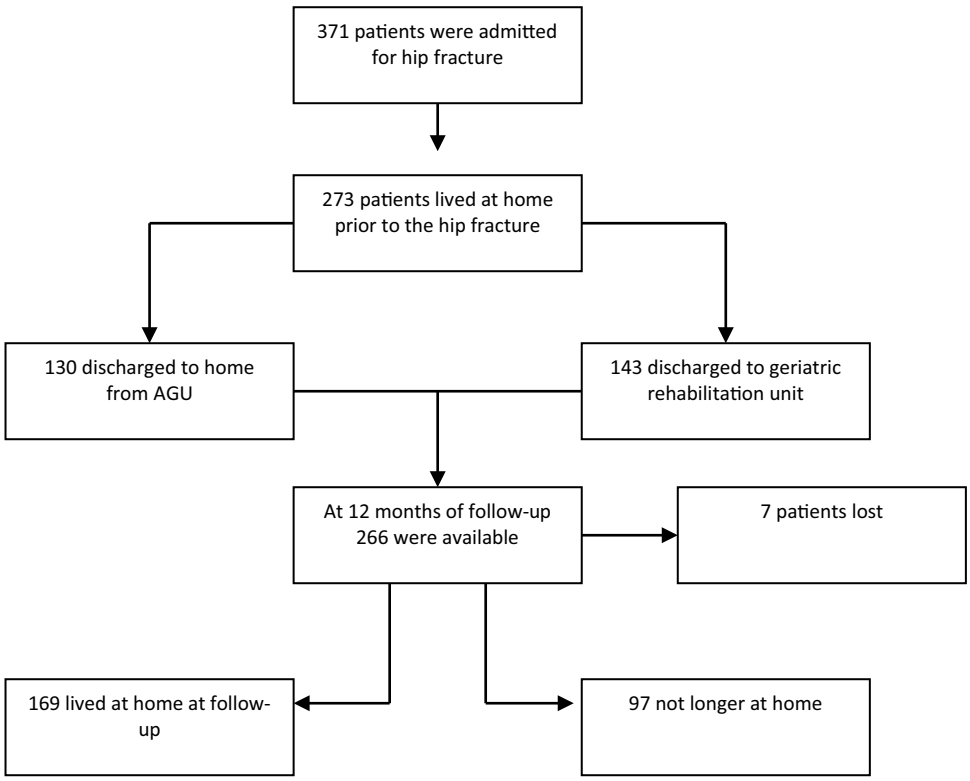

Fig. 1 Flow diagram of participants through the study

Table 3 Factors related to the return home after discharge from the AGU (bivariate analysis)

Variable	Discharged to home $n=130$	Discharged to rehabilitation unit $n=143$	p value
Age, years	85.1 ± 6.6	84.6 ± 6.2	0.699
Sex, female *n* (%)	105 (47.7%)	115 (52.3%)	0.942
Marital status			
Widowed*	44 (46.8%)	50 (53.2%)	0.805
Married	29 (50.9%)	28 (49.1%)	
Single/Separated/Divorced	5 (41.7%)	7 (58.3%)	
Functional status			
Baseline Lawton and Brody Index	3.7 ± 3.3	3.5 ± 3.4	0.713
Baseline Barthel Index	83.1 ± 21.9	81.1 ± 24.4	0.617
Barthel Index at admission	19.2 ± 10.6	18.4 ± 12.2	0.472
Barthel Index at discharge	39.1 ± 16.6	26.7 ± 16.5	< 0.001
Baseline FAC	4.5 ± 0.8	4.4 ± 0.9	0.401
FAC at discharge	2.3 ± 1.4	1.5 ± 1.6	< 0.001
Cognitive function (Reisberg scale)	2.4 ± 1.8	2.5 ± 1.9	0.852
Charlson comorbidity index	2.2 ± 1.5	2.3 ± 1.9	0.839
Polypharmacy before hip fracture			
≥ 4 drugs	92 (46.2%)	107 (53.8%)	0.515
< 4 drugs	37 (50.7%)	36 (49.3%)	
Sensory organs			
Reduced visual acuity	48 (55.8%)	38 (44.2%)	0.127
Reduced auditory acuity	43 (50.0%)	43 (50.0%)	0.947
Vision loss and/or hearing loss	84 (49.7%)	85 (50.3%)	0.372
Architectural barriers	42 (46.2%)	49 (53.8%)	0.625
Fracture type			
Intracapsular	52 (58.4%)	37 (41.6%)	0.013
Extracapsular	78 (42.4%)	106 (57.6%)	
Anesthetic risk			
ASA ≤ II	71 (49.3%)	73 (50.7%)	0.639
ASA ≥ III	59 (46.5%)	68 (53.5%)	
Surgical waiting time, days	1.71 ± 1.089	1.99 ± 1.272	0.084
Surgical waiting time, days			
< 2 days*	65 (53.7%)	56 (46.3%)	0.195
2 days*	35 (42.2%)	48 (57.8%)	
≥ 3 days*	30 (45.4%)	36 (54.6%)	
Cognitive impairment	32 (47.8%)	35 (52.2%)	0.995
Biochemical parameters			
Glomerular filtration rate < 60 (MDRD)	59 (46.5%)	68 (53.5%)	0.723
Calcidiol < 20 ng/ml	98 (49.5%)	100 (50.5%)	0.761
Albumin < 3.5 g/dl	89 (44.7%)	110 (55.3%)	0.128
Hb < 13 g/L M and < 12 g/L W*	53 (47.7%)	58 (52.3%)	0.990
Intrahospital complications			
Anemia that requires transfusion	53 (45.3%)	64 (54.7%)	0.656
Cardiorespiratory	15 (41.7%)	21 (58.3%)	0.505
Hydroelectrolytic	49 (51.0%)	47 (49.0%)	0.428
Infections	6 (50.0%)	6 (50.0%)	0.820
Delirium	56 (42.7%)	75 (57.3%)	0.122
Hospital length of stay, days	6.78 ± 1.961	5.87 ± 3.054	< 0.001

ASA American Society of Anesthesiologists, *FAC* functional ambulation classification, *GDS* Geriatric Dementia Scale, *Hb* hemoglobin, *MDRD* modification of diet in renal disease, *TSH* thyroid-stimulating hormone, *M* men, *W* women

*At the time of admission to AGU

In the multivariate analysis, the predicting factors for returning home after discharge from the acute geriatric unit were a lower GDS score (OR 1.42; 95% CI 1.17–1.71; $p < 0.001$), a higher discharge Barthel index (OR 1.074; 95% CI 1.050–1.098; $p < 0.001$) and a longer length of hospital stay (OR 1.138; 95% CI 1.021–1.269; $p = 0.019$), with a discriminatory power for this AUC model of 0.758 (95% CI 0.702–0.815) (Table 4).

Residing at home 12 months after the hip fracture

At the 12-month follow-up, 7 patients were lost (it was not possible to contact the patient or relatives), resulting in a sample of 266 patients. Of the 266 patients followed up, 169 (63.5%) patients (83.7 ± 6.4 years, 62.6% women) were residing at home at 12 months, while 97 (36.5%) patients (86.6 ± 6.1 years, 37.4% women) were no longer at home. The differences between the two groups are presented in Table 5.

Prognostic factors related to residing at home at 12 months were: higher baseline Lawton, FAC, Lawton and Brody index and discharge Barthel index (all $p < 0.001$), lower Charlson comorbidity index ($p < 0.001$), intracapsular fracture ($p = 0.011$). Moreover, lesser surgical waiting time ($p < 0.001$), anesthetic risk (ASA) ($p = 0.004$), and ratio of patients who experienced delirium during the hospitalization ($p < 0.001$) were associated with residing at home 12 months after discharge (Table 5).

In the multivariable model, predictors of residing at home 12 months after the hip fracture were age, discharge Barthel index (OR 0.962; 95% CI 0.941–0.983; $p < 0.001$), lower GDS score (OR 1.266; 95% CI 1.052–1.524; $p = 0.013$), shorter surgical waiting time (OR 3.425; 95% CI 1.077–10.889; $p = 0.037$) and lower Charlson comorbidity index (OR 1.274; 95% CI 1.046–1.551; $p = 0.016$), with a discriminatory power of the AUC model of 0.813 (95% CI 0.759–0.867) (Table 6).

Table 4 Predictors of returning home after discharge from the AGU (multivariate analysis)

Variable	OR (95% CI)*	*p*
Age		
For each reduction of 1 year	1.04 (0.99–1.09)	0.054
Barthel index at discharge		
For each 1-point increase	1.07 (1.05–1.10)	< 0.001
Baseline cognitive function		
For each reduction of 1° of GDS	1.42 (1.17–1.71)	< 0.001
Hospital stay		
For each 1-day increase	1.14 (1.02–1.27)	0.019

Model's discriminatory power, AUC (±95% CI): 0.758 (0.702–0.815) Model calibration, Hosmer–Lemeshow test: $p = 0.234$

AUC area under the curve, *CI* confidence interval, *GDS* Geriatric Dementia Scale, *OR* odds ratio

*Values > 1 indicate higher probability of returning home

Discussion

In the orthogeriatric model implemented in our hospital's AGU, the prognostic factors (related and predictive) for staying at home after the discharge and 12 months after the hip fracture surgery corresponded to those that determined a good health condition prior to the fracture.

47.6% of our patients returned home after being discharged from the AGU after hip fracture surgery. The ability to discharge almost half of the patients to their homes (who already resided at home before the fracture) could be attributed to the comprehensive geriatric intervention the patients underwent [14, 22, 23]. This geriatric intervention requires interdisciplinary work from the AGU geriatric team to prevent the risks associated with hospitalization, provide early functional rehabilitation during their hospitalization and correctly plan the discharge [22, 24, 25].

We observed that achieving better physical function by the time of the discharge, along with an intracapsular fracture, were related to a greater likelihood of returning home. However, the predictors were once again the same variables that identified better physical function, the length of stay and the presence of better cognitive function, which in turn were related with a better state of health.

Few studies have described the factors related to returning home after a hip fracture in elderly, and most of these studies have not been performed in geriatric settings [26–28]. However, these studies have shown that diverse factors inherent in patients, such as age, prior health condition (such as the absence of cognitive impairment or dementia), are related to returning home after a hip fracture. Better performances of basic activities of daily life and better mobility at the time of discharge are also factors related to the return home following a hip fracture, all of which are similar to those of our study. We can attribute the short hospital stay (6.8 ± 2.0 days), to various aspects: (a) the occupational therapy support within our interdisciplinary team; (b) the option of home rehabilitation and home care services; and (c) undergoing surgery within 48 h, which allows physical therapy to start early and for the speedy planning for the discharge to the place of origin, as observed in previous studies [29–31].

The prognostic and predictive factors related to continuing to reside at home 12 months were younger age, better functional capacity and cognitive status before and after the fracture, factors associated with the intervention model and an intracapsular location for the fracture.

In the presence of predictor factors, our model has a discriminatory power of 81.3%. These results once again

Table 5 Prognostic factors related to residing at home at 12 months of the hip fracture (bivariate analysis)

Variable	Residing at home ($n=169$; 63.5%)	Did not reside at home ($n=97$; 36.5%)	p
Age, years	83.7 ± 6.3	86.6 ± 6.0	< 0.001
Sex, female *n* (%)	134 (62.6%)	80 (37.4%)	0.528
Marital status			
Widowed*	57 (62.6%)	34 (37.4%)	0.107
Married	43 (76.8%)	13 (23.2%)	
Single/Separated/Divorced	10 (83.3%)	2 (16.7%)	
Functional status			
Baseline Lawton and Brody Index	4.9 ± 3.0	1.3 ± 2.4	< 0.001
Baseline Barthel Index	88.5 ± 18.1	70.9 ± 26.7	< 0.001
Barthel Index at admission to AGU	21.8 ± 10.4	13.4 ± 11.3	< 0.001
Barthel Index at discharge from AGU	38.8 ± 16.1	22.2 ± 15.3	< 0.001
Baseline FAC	4.7 ± 0.6	4.1 ± 1.1	< 0.001
FAC at discharge from AGU	2.3 ± 1.5	1.3 ± 1.5	< 0.001
Cognitive Function (Reisberg scale)	1.9 ± 1.4	3.4 ± 2.1	< 0.001
Charlson comorbidity index	1.9 ± 1.3	2.9 ± 2.2	< 0.001
Polypharmacy before hip fracture			
≥ 4 drugs	123 (62.8%)	73 (37.2%)	0.715
< 4 drugs	45 (65.2%)	24 (34.8%)	
Sensory organs			
Reduced visual acuity	55 (66.3%)	28 (33.7%)	0.520
Reduced auditory acuity	58 (69.0%)	26 (31.0%)	0.921
Vision loss, hearing loss or combined loss	105 (63.3%)	61 (36.7%)	0.866
Location of the fracture			
Intracapsular	64 (74.4%)	22 (25.6%)	0.011
Extracapsular	105 (58.3%)	75 (41.7%)	
Anesthetic risk			
ASA ≤ II	100 (72.5%)	38 (27.5%)	0.001
ASA ≥ III	67 (53.2%)	59 (46.8%)	
Surgical waiting times, days	1.6 ± 0.9	2.2 ± 1.4	0.001
Surgical waiting times (days)			
< 2 days*	86 (73.5%)	31 (26.5%)	0.004
2 days	53 (63.9%)	30 (36.1%)	
3 days	22 (52.4%)	20 (47.6%)	
≥ 4 days	8 (38.1%)	13 (61.9%)	
Cognitive impairment *n* (%)	25 (38.5%)	40 (61.5%)	< 0.001
Biochemical parameters			
Glomerular filtration rate < 60 (MDRD)	71 (56.8%)	54 (43.2%)	0.029
Calcidiol < 20 ng/ml	125 (64.4%)	69 (35.6%)	0.170
Albumin < 3.5 g/dL	121 (62.4%)	73 (37.6%)	0.081
Hb < 13 g/L M and < 12 g/L W	65 (59.6%)	44 (40.4%)	0.241
Intrahospital complications			
Anemia that requires transfusion*	68 (59.6%)	46 (40.4%)	0.332
Cardiorespiratory	22 (61.1%)	14 (38.9%)	0.814
Hydroelectrolytic	54 (57.4%)	40 (42.6%)	0.112
Infectious	9 (75.0%)	3 (25.0%)	0.372
Delirium	62 (48.8%)	65 (51.2%)	< 0.001

ASA American Society of Anesthesiologists, *FAC* functional ambulation classification, *GDS* Geriatric Dementia Scale, *Hb* hemoglobin, *MDRD* modification of diet in renal disease, *TSH* thyroid-stimulating hormone

Table 6 Prognostic factors as predictors of residing at home (multivariate analysis)

Variable	OR (95% CI)*	*p*
Age		
For each 1-year decrease	1.069 (1.016–1.125)	0.010
Barthel index at discharge from the AGU		
For each 1-point decrease	0.962 (0.941–0.983)	< 0.001
Baseline cognitive function (Reisberg GDS degrees)		
For each drop of 1°	1.266 (1.052–1.524)	0.013
Charlson comorbidity index		
For each 1-point decrease	1.274 (1.046–1.551)	0.016
Surgical waiting times		
≥ 4 days	1	
3 days	1.302 (0.642–2.639)	0.464
2 days	1.816 (0.770–4.287)	0.173
< 2 days	3.425 (1.077–10.889)	0.037

Model's discriminatory power, AUC (± 95% CI): 0.813 (0.759–0.867) Model calibration, Hosmer–Lemeshow test: $p = 0.309$

ASA American Society of Anesthesiologists, *AUC* area under the curve, *CI* confidence interval, *GDS* Geriatric Dementia Scale, *OR* odds ratio

*> 1 indicates a higher probability of returning home. < 1 indicates a lower probability

show that a better state of physical and cognitive health is instrumental, in this case, for patients to continue residing in the community 12 months after hip fracture. We should emphasize that a potent predictor for remaining at home 12 months after the hip fracture in our model is having a good cognitive state, which is consistent with the study by Schaller et al. [32] who found that patients with medium to moderate cognitive impairment have an increased risk of institutionalization.

Regarding these findings, we observed that those classical variables that reflect a good elderly health status (functional capacity and cognitive state) could be favorable conditions for continuing to reside in the community after a hip fracture. These variables, inherent in the patient, are a common denominator in the results of the study.

Previous studies show results similar to our findings. Prior functional status, especially mobility, was a powerful predictor for determining which patients will reside at home 1 year after a hip fracture [33]. The study also showed that age, type of fracture and cognitive state are factors for remaining at home 1 year after a hip fracture. Although the studies by Uriz-Otano et al. [5, 12] were conducted in a rehabilitation unit, these results show that age, mobility and cognitive state are associated with a greater risk of institutionalization, results that are similar to those of our study.

We also observed that a shorter surgical waiting time (undergoing surgery within the first 24–48 h) and reduced in-hospital complications (e.g., electrolyte disturbances, delirium and perisurgical anemia with the requirement for transfusion) could be related to the orthogeriatric model adopted by our hospital. A model with considerable involvement by the multidisciplinary team, which comprises specialists (geriatricians, trauma surgeons, anesthesiologists, geriatric nurses, occupational therapist, physical rehabilitation specialist, social workers), all working towards the same objective: patients returning to the community to recover and maintain good functionality for as long as possible. In our case, the absence of delirium (a geriatric syndrome that carries a poor prognosis) was a factor of considerable relevance for continuing to reside in the community 12 months after a hip fracture.

The present study supports the current recommendations for the care of elderly patients with hip fractures and shows how the preoperative and postoperative management of these patients in orthogeriatric units improves their healthcare results in the short and medium term [22, 29, 34–38].

The main limitation of our study was its observational single-center design. Another limitation could be that we do not have the variables at 12 months of follow-up, nor do we have how long the rehabilitation in the functional recovery units lasts. The strengths of our study are the following: (1) the study was performed in an acute geriatric care setting, and (2) the high mean age of the sample is representative of the geriatric patients.

Conclusions

Our results show that a good functional (cognitive and physical) status prior to the hip fracture, which reflects a good state of health, is a prognostic factor for the patient returning to the community and remaining there 1 year after

hip fracture. The other prognostic factors, such as a shorter surgical waiting time and absence of delirium during hospitalization, could be related to the orthogeriatric care model implemented in our center.

We consider our results to be of special relevance, given that they helped us identify those patients with a potential risk of ceasing to reside in the community after a hip fracture and thereby help us intervene in those factors that could be modifiable.

The implementation of a randomized, multicenter clinical trial could help validate the results of this study and those of other studies, supporting the results from orthogeriatric units, as a validated model for the comprehensive care of elderly patients with hip fractures due to bone frailty.

Authors' contributions AG-A and ED: Study concept and design, acquisition of data, analysis and interpretation of data, drafting of the manuscript. All authors': Acquisition of data. AG-A, ED, VM, FF: Analysis and interpretation of data. AG-A, ED, VM: Drafting of the manuscript. ED, VM: Critical revision of the manuscript for important intellectual content.

Compliance with ethical standards

Conflict of interest Vincenzo Malafarina has received lecture fees and honoraria from Rovi, Lacer, Novartis, Nestle Healthcare, Abbott nutrition, Nutricia, Grünenthal, Ferrer; research grants from Nutricia. The others authors declare that they do not have any conflict of interest.

Statement of human and animal rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (Ethics Committee of the Hospital of Bellvitge, Barcelona (PR197/13)) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the author.

Informed consent Verbal consent was obtained from all participants prior to their inclusion in the study (in the case of dementia, the consent of the responsible family member and/or guardian).

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