Predictors of Prolonged Hospitalization and In-Hospital Mortality After Hip Fracture: A Retrospective Study on Discharge Registry

P. Di Giovanni[1], G. Di Martino[2,3], I.A.L. Zecca[4], I. Porfilio[3], F. Romano[5], T. Staniscia[2]

Abstract

Background. *Hip fracture injury is one of the principal health problems affecting the elderly. Patients reporting hip fractures often show relevant comorbidities leading to prolonged hospital stay, significant complications and higher mortality rates. This study aims to assess the risk factors associated with prolonged hospitalization after hip fracture, in-hospital mortality and transfers to other facilities.*
Study design. *Retrospective cross-sectional study.*
Methods. *The study considered all admissions performed between 2006 and 2015 in Abruzzo region, Italy. Logistic regression analyses were performed to evaluate odds ratios for each risk factor as predictor of in-hospital mortality, length of stay, and transfer to other facilities.*
Results. *Age over 85 (OR=5.38) and cancer (OR=3.62) were identified as the strongest risk predictors for in hospital mortality; diabetes (OR=2.24) and heart failure (OR=1.57) were identified as predictors of prolonged length of stay and age over 85 (OR=1.38) and atrial fibrillation (OR=1.69) were identified as predictors of transfer to other facilities.*
Conclusions. *With the rising incidence of hip fractures, identification of modifiable factors may help to reduce morbidity and mortality.*

[1] Department of Pharmacy, "G. d'Annunzio" University of Chieti-Pescara, Chieti, Italy

[2] Department of Medicine and Aging Sciences, "G. d'Annunzio" University of Chieti-Pescara, Chieti, Italy

[3] Unit of Hygiene, Epidemiology and Public Health, Local Health Authority of Pescara, Pescara, Italy

[4] Unit of Hygiene, Epidemiology and Public Health, Local Health Authority of Ferrara, Ferrara, Italy

[5] Department of Public Health and Infectious Diseases, "La Sapienza" University of Rome, Piazzale Aldo Moro 5, 00185 Rome, Italy

Introduction

Hip fracture injury is one of the most serious health care problems affecting the elderly (1). Increased life expectancy in old age has led to an increased incidence of fractures at the proximal end of the femur in aging people (1, 2). Patients reporting hip fractures often suffer from pre-existing impaired mobility and show relevant comorbidities leading to prolonged hospital stays, significant complications, and higher mortality rates (2). Particularly old age, male gender and more than two comorbidities are known risk factors for in-hospital mortality (3, 4).

Furthermore, 30% of hip fractured patients are estimated to become permanently disabled, while 80% are unable to perform independently activities of daily living after the fracture has occurred (5).

Italy shows one of the highest life expectancies in the world and outcomes after hip fracture in the Italian population are similar to those of other industrialized countries (6). Despite a decrease in the incidence of hip fracture (from 22.9 to 20.1 per 10,000 inhabitants between 2007 and 2014) (7), Italian healthcare finances have faced several challenges, such as the declining birthrate, population aging, and the increasing of healthcare costs (8).

In response, the Italian government has developed policies aiming at the reduction of healthcare costs, specifically linked to the excessive length of stay (LOS) in acute care hospitals. The reduction of LOS was recently obtained for fractured patients with the fast discharge from acute care to long-term care and rehabilitation (9). The objective of reducing healthcare cost and improving care of elderly patients with hip fracture, needs a deeper understanding of the phenomenon and its associated risk factors.

The aim of this study was to assess the risk factors associated with prolonged hospitalization, in-hospital mortality and need of transfer to long term facilities among patients with hip fracture.

Methods

The study considered all hospital admissions performed between January 1, 2006 and December 31, 2015 in Abruzzo, a region of central Italy counting over 1.3 million inhabitants. Twenty-nine hospitals (18 public hospitals and 11 private clinics) are located in the region. Data were collected from all hospital discharge records (HDRs) using the hospital information system that includes information about the demographic characteristics of patients, a Diagnosis Related Group code (DRG, grouped in 25 Major Diagnostic Categories - MDC) used to classify the admission, and a maximum of 6 diagnoses (one principal diagnosis and up to 5 secondary diagnosis) and 6 procedures (one principal procedure and up to 5 secondary procedures) performed during the hospitalization, coded as per the International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM). Hospital records containing the codes 820.0-820.9 (hip fracture) as the principal diagnosis or secondary diagnosis was considered for the analysis. Patients with polytrauma were excluded from the analysis.

The following variables were also collected: age, LOS, gender, mode of admission and mode of discharge. Additionally, the most frequent patients' comorbidities, with a prevalence of 1.5% at least, were identified using the ICD-9-CM codes: malignant cancer (140-208, V10.46), prior myocardial infarction (412), atrial fibrillation (427.31), dementia (290, 331), COPD (491.20-22), diabetes (250), kidney disease (582-3, 585–6, 588, V42.0, V45.1, V56.x), hepatic disease (571-2), congestive heart failure (402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.93 425, 428, 429.3).

Ethical Approval

This research has been approved by the IRB of the authors' affiliated institutions. The study was conducted in conformity with the regulations on data management of our Region and the Law on privacy. Data were encrypted prior to the analysis at the regional statistical office, where each patient was assigned a unique identifier. This identifier eliminates the possibility to trace the patient's identity.

Statistical Analysis

Continuous variables were summarized as median and interquartile range (IQR). Categorical variables were summarized as frequencies and percentages. Univariate and multivariate logistic regression analyses were performed to evaluate crude and adjusted odds ratios (ORs) with 95% confidence intervals (95% CI) for each comorbidity as predictor of in-hospital mortality, of LOS, and of transfer to other facilities. Prolonged LOS was identified as LOS of 14 days or more, corresponding to the upper quartile of the distribution. Multivariate models were adjusted for all comorbidities. Patients who died during hospitalization (187 patients, 21.3%) were excluded from prolonged LOS analysis. Age and gender were also included into account as covariate. For all analyses, a $p<0.05$ was considered as statistically significant. Statistical analysis was performed using IBM SPSS Statistics v20.0 software (SPSS Inc. Chicago, Illinois, USA).

Results

Characteristics of Hospital Admissions for Hip Fracture

Over the study period, 23,075 patients were admitted and received surgery for hip fracture. Their age (median and IQR) was 80.5 (69.8-89.8) and 16,749 were female (72.6%). Most of the admissions were

Table 1 - Patients' Characteristics

n=23,075	N (%)
Age	
<65	1840 (8.0)
65-85	11721 (50.8)
>85	9501 (41.2)
Gender	
Male	6326 (27.4)
Female	16749 (72.6)
Admission	
Emergency Room	21484 (93.1)
Planned	1543 (6.7)
Other	48 (0.2)
Discharge	
At Home	15439 (66.9)
Rehabilitation Facilities/Long term care facilities	3740 (16.3)
Transferred to Different Ward	1813 (7.9)
Death	878 (3.8)
Other	1205 (5.1)
Lenght of Stay *Median (IQR)*	11 (8-14)

performed under emergency conditions (21,484 cases, 93.1%) and occurred in public hospitals (20,986 cases, 90.9%). The median length of stay was 11 days (IQR 8-14). During the hospital stay, 878 patients (3.8%) died. After the first hospitalization, 3,740 patients (16.3%) were transferred to other institutions for long-term care/rehabilitation. 1,782 fractured patients (7.7%) did not received any surgery.

All the characteristics of hospital admissions for hip fracture are reported in Table 1. Diabetes was the most frequent comorbidity (8.2%), followed by dementia (2.7%), and atrial fibrillation (2.3%).

Predictors of In-Hospital Mortality

Overall, the in-patient mortality rate was 3.8%. Logistic regression analysis (Table 2) identified heart failure (OR=7.82, 95% CI 6.66-9.68), age over 85 years (OR=5.38, 95% CI 3.33-8.88), malignant cancer (OR=3.62,

Table 2 - Univariate and Multivariate Logistic Regression Analyses of In-Hospital Mortality

N=23,075	Frequency (%)	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age							
<65	1840 (8.0)	Reference			Reference		
65-85	11721 (50.8)	2.83	(1.73-4.62)	**0.001**	2.40	(1.47-3.91)	**0.001**
>85	9501 (41.2)	6.70	(4.13-10.89)	**<0.001**	5.38	(3.33-8.88)	**<0.001**
Public Hospital	18598 (80.6)	1.38	(0.66-3.98)	0.584	1.23	(0.71-3.01)	0.485
Emergency condition	21484 (93.1)	1.07	(0.80-5.55)	0.485	1.02	(0.86-2.98)	0.321
Female Gender	16749 (72.6)	1.42	(0.72-2.01)	0.639	1.19	(0.80-1.82)	0.517
Malignant Cancer	369 (1.6)	3.32	(2.24-4.92)	**<0.001**	3.62	(2.41-5.55)	**<0.001**
Previous Myocardial Infarction	115 (0.5)	5.32	(3.67-7.70)	**<0.001**	3.11	(2.04-4.69)	**<0.001**
Atrial Fibrillation	854 (3.7)	3.54	(2.69-4.65)	**<0.001**	1.95	(1.45-2.65)	**<0.001**
Dementia	738 (3.2)	0.95	(0.62-1.45)	0.819	0.82	(0.51-1.32)	0.489
COPD	736 (3.2)	2.99	(2.22-4.03)	**<0.001**	1.72	(1.24-2.35)	**0.001**
Kidney Disease	623 (2.7)	4.26	(3.32-5.46)	**<0.001**	2.74	(2.11-3.64)	**<0.001**
Diabetes	2,054 (8.9)	1.18	(0.93-1.48)	0.166	1.10	(0.88-1.37)	0.501
Hepatic Disease	208 (0.9)	2.78	(1.70-4.54)	**<0.001**	2.77	(1.69-4.49)	**<0.001**
Heart Failure	878 (3.8)	11.95	(9.68-14.74)	**<0.001**	7.82	(6.66-9.68)	**<0.001**

Table 3 - Univariate and Multivariate Logistic Regression Analyses of LOS ≥ 14 Days

N=22,888	Frequency (%)	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age							
<65	1840 (8.0)	Reference			Reference		
65-85	11561 (50.5)	1.08	(0.96-1.21)	0.216	1.03	(0.90-1.14)	0.730
>85	9501 (41.5)	0.99	(0.89-1.20)	0.972	0.94	(0.84-1.07)	0.280
Public Hospital	18441 (80.4)	1.27	(0.69-4.22)	0.668	1.11	(0.75-2.99)	0.365
Emergency condition	21484 (93.0)	1.19	(0.92-3.65)	0.111	1.15	(0.95-1.98)	0.098
Female Gender	16648 (72.7)	1.55	(0.78-1.96)	0.435	1.34	(0.80-1.87)	0.344
Malignant Cancer	359 (1.6)	1.42	(1.09-1.86)	**0.010**	1.39	(1.08-1.71)	**0.019**
Previous Myocardial Infarction	110 (0.5)	1.51	(1.12-2.02)	**0.006**	1.25	(0.91-1.74)	0.211
Atrial Fibrillation	799 (3.5)	1.77	(1.47-2.11)	**<0.001**	1.57	(1.28-1.89)	**<0.001**
Dementia	711 (3.1)	1.21	(1.01-1.44)	**0.041**	1.24	(1.09-1.47)	**0.037**
COPD	723 (3.2)	1.39	(1.15-1.69)	**0.001**	1.21	(0.98-1.51)	0.072
Kidney Disease	557 (2.4)	1.64	(1.37-1.96)	**<0.001**	1.46	(1.22-1.75)	**<0.001**
Diabetes	1943 (8.5)	1.38	(1.25-1.53)	**<0.001**	2.24	(1.87-2.67)	**<0.001**
Hepatic Disease	208 (0.9)	1.64	(1.21-2.27)	**0.002**	1.44	(1.10-2.05)	**0.014**
Heart Failure	789 (3.4)	2.49	(2.07-2.98)	**<0.001**	2.23	(1.85-2.70)	**<0.001**

95% CI 2.41-5.55) and previous myocardial infarction (OR=3.11, 95% CI 2.04-4.69) as main predictors of in-hospital mortality. Atrial fibrillation, COPD, kidney disease, and hepatic disease were also independently associated with in-hospital mortality.

Predictors of Prolonged Length of Stay

Overall, 5,482 patients (23.8%) were hospitalized for at least 14 days. Logistic regression analyses (Table 3) identified diabetes (OR=2.24, 95% CI 1.87-2.67), and heart failure (OR=1.57, 95% CI 1.28-1.89) as the main predictors of prolonged length of stay.

Predictors of Transfer to Other Facilities

Overall, 3,241 patients (14.0%) were transferred to other facilities: most of them were referred to rehabilitation facilities (1928 cases, 8.4%), and the rest to long term care facilities. Logistic regression analysis (Table 4) identified being over 85 years of age (OR=1.38, 95% CI 1.18-1.64), atrial fibrillation (OR=1.69 95% CI 1.35-2.06), and been admitted in a public hospital (OR=2.90, 95% CI 1.99-3.50) as main predictors of the transfer to other facilities. A LOS>14 days was associated with a lower likelihood of being transferred (OR=0.83, 95% CI 0.78-0.93).

Discussion

It is well known that hip fracture mainly affects patients over 65 years of age (1, 2). In our study, most of the patients were over 65 (93.0%), confirming hip fracture as a disease typical of the elderly, affecting subjects belonging to a specific age class (10). Despite in Italy the burden of hip fracture shows a decreasing trend in all the age groups, the number of hospitalizations for hip fractures is still increasing, due to the fractures occurring in people ≥85 years old (7, 11). The high proportion of geriatric patients can explain the great prevalence of multimorbidity, causing substantial costs in terms of in-hospital mortality, of prolonged LOS, and leading to admissions to different kinds of facilities or wards (12). Despite females were more frequently affected from hip fracture (72.6%), it did not resulted as a significant risk-factor for all the study outcomes.

We documented an In-hospital mortality rate of 3.8%, in line with other studies (3, 4, 13). HF, aging over 85, a previous myocardial infarction and malignant cancer were the strongest predictors of in-hospital mortality. These results are in line with the findings of Frost et al (14). The prevalence of HF in the community increased with advancing age (15), and despite the ACC/AHA preoperative cardiac evaluation guidelines classify orthopedic procedures as "intermediate risk" (16), in-hospital mortality after hip fracture remains high (17). Surgical procedures have an important impact on patient cardiovascular balance, so HF needs to be considered as a significant risk factor for in-hospital mortality, despite recent guidelines do not take it in consideration. For this reason ACC preoperative cardiac evaluation guidelines actually may not be applied to the frail population undergoing hip fracture repair (17). In addition a opiè+àìmeta-analysis (18) had previously examined pre-operative indicators for mortality after hip fracture, confirming aging over 85 as a predictor. Besides, Diamantopulos et al. (19) identified cancer as a mortality risk factor as well as kidney disease and atrial fibrillation, confirming the findings of Neuhaun et al. (20) and Pérez-Sáez et al. (21).

In our study, heart failure also resulted to be a risk factor for prolonged LOS, confirming previous findings by Cullen et al. (17). In fact, fracture or surgery may probably aggravate the disease in patients with mild/moderate heart failure, causing immediate readmission or prolonged LOS during the hospitalization for hip fracture.

Table 4 -. Univariate and Multivariate Logistic Regression Analyses of Transfers to Other Facilities

N=22,288	Frequency (%)	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age							
<65	1840 (8.0)	Reference			Reference		
65-85	11561 (50.5)	1.36	(1.13-1.57)	**<0.001**	1.41	(1.22-1.59)	**<0.001**
>85	9501 (41.5)	1.37	(1.17-1.61)	**<0.001**	1.38	(1.18-1.64)	**<0.001**
Public Hospital	18441 (80.4)	3.79	(3.07-4.73)	**<0.001**	2.90	(1.99-3.50)	**0.002**
Emergency condition	21484 (93.0)	1.27	(0.91-2.96)	0.274	1.15	(0.90-2.82)	0.209
Female Gender	16648 (72.7)	1.38	(0.83-1.68)	0.331	1.20	(0.87-1.46)	0.321
Malignant Cancer	359 (1.6)	1.38	(0.97-1.91)	0.081	1.35	(0.97-1.90)	0.078
Previous Myocardial Infarction	110 (0.5)	1.34	(0.96-2.01)	0.088	1.43	(1.07-2.07)	**0.029**
Atrial Fibrillation	799 (3.5)	1.69	(1.33-2.10)	**<0.001**	1.69	(1.35-2.06)	**<0.001**
Dementia	711 (3.1)	1.27	(1.01-1.56)	**0.041**	1.23	(1.11-1.61)	**0.027**
COPD	723 (3.2)	1.02	(0.71-1.33)	0.988	1.05	(0.77-1.48)	0.732
Kidney Disease	557 (2.4)	0.77	(0.62-1.05)	0.091	0.81	(0.61-1.20)	0.325
Diabetes	1943 (8.5)	1.28	(1.07-1.41)	**0.007**	1.26	(1.05-1.41)	**0.011**
Hepatic Disease	208 (0.9)	1.12	(0.73-1.64)	0.639	1.10	(0.73-1.68)	0.542
Heart Failure	789 (3.4)	1.08	(0.82-1.38)	0.578	1.16	(0.85-1.58)	0.423
LOS>14 Days	5482 (24.6)	0.82	(0.71-0.90)	**<0.001**	0.83	(0.78-0.93)	**<0.001**

Both diabetes and kidney disease resulted to be predictors of prolonged LOS, as documented in the recent literature (22, 23). In fact, hip fracture mainly affects the elderly' mild kidney disease: an acute event such as hip fracture exposes patients to a worsening of the preexisting kidney disease, swelling the risk of mortality up to one year after the fracture (24). In addition, diabetes has an important impact on postoperative care: slower recovery of the surgical wound, higher risk of infection and poor metabolic control - due to surgical procedure or drugs - can lead to prolonged LOS. A focus on tight perioperative glycemic control can better improve postoperative and post-discharge outcomes of surgical patients (25).

The analyses of discharge have revealed that elderly patients affected by diabetes, atrial fibrillation, or dementia were those most frequently transferred to other healthcare facilities. By contrast, a prolonged LOS associated with lower likelihood of being transferred to other facilities: in fact, acute diseases occurring during the admission often needed a prolonged LOS to be resolved. In addition, patients with chronic and not healable diseases, as cardiovascular disease, diabetes or dementia, were rapidly referred to other healthcare structures. As previously described by Vochteloo et al. (26) in a Netherlands sample, Dementia was a strong predictor of discharge in other facilities. The main reason could be the previous source of the patients: often, geriatric patients with dementia are already admitted to healthcare facilities. On the other hand, hip fracture could lead to cognitive decompensation in geriatric patients; this can make homecare problematic, thus leading to the choice of alternative post-discharge options. In addition, after an acute event, chronic diseases require a prolonged treatment in a safe healthcare setting, in order to obtain stabilization.

Currently, few prediction scores for discharge location after admission following a hip fracture are available (26-28). The great part of these models are old, based on small patient series and on different population than Italian. When comparing studies from different countries, one must be aware of various possible disturbing factors. First, there are large differences between countries in type of housing and traditions for homes for the elderly. Second, as for the location and timing of discharge from the hospital, large local, national and international differences exist between discharge directly to home or to temporary rehabilitation units (26).

Strengths and limitations

The major strength of our study is represented by the large number of patients evaluated, making the study results very robust. Furthermore, the study sample included all the residents of the Abruzzo region, making the results highly generalizable. Despite these results are in line with prior literature, this is the first study of this kind performed in Italy. The study also has limitations. First, the identification of diagnosis is based on ICD-9-CM codes, that does not take into account the severity of the conditions. Second, the use of administrative data may be limited by the reliability of certain types of information such as drugs therapy, clinical information (such as stability of fracture and mobility before fracture), and prior history of fractures cannot be obtained. Particularly, known morbidity risk factors, as ASA score or operative time, were missing. Third, HDR does not report the time of the admission (hour and minutes) and surgery, so it is not possible to take into account the surgery over 48 hours from the admission as risk factor. Additionally, information on out-of-hospital mortality could not be assessed. Finally, the true prevalence of some comorbid conditions could be underestimated, due to underreporting of their codes in the hospital discharge registry.

Conclusions

Over recent years, risk-adjusted mortality measures have been increasingly used as indicators of quality of care, but no studies were performed in the Italian setting, where the life expectancy is high. In this study, risk factors associated to prolonged LOS and mortality were identified, allowing to identify frail patients that need specific care, and to focus on particular conditions that can be worsened by the fracture event. Highlighting risk factors associated to in-hospital mortality and prolonged LOS in patients with hip fracture, will implement clinical and prevention strategies in order to reduce adverse outcomes rates. The next step will be the development of prognostic tool, based on discharge registry, aiming the benchmarking hospital performances.

Riassunto

Fattori predittivi di ospedalizzazione prolungata e mortalità intraospedaliera dopo frattura d'anca: studio retrospettivo sulle schede di dimissione ospedaliera

Background. La frattura di anca è uno dei principali problemi di salute che colpisce gli anziani. I pazienti che subiscono una frattura di anca spesso hanno rilevanti comorbosità che causano prolungata degenza ospedaliera, significative complicanze e aumentata mortalità. Questo studio si pone l'obiettivo di stimare il rischio associato a degenza prolungata, mortalità intraospedaliera e dimissione presso altre strutture di cura.

Disegno dello studio. Studio cross-sectional retrospettivo.

Metodi. Lo studio ha considerato tutti i ricoveri per frattura d'anca avvenuti in Abruzzo, Italia, tra il 2006 ed il 2015. Una analisi di regressione logistica è stata effettuata per stimare l'odds ratio di ogni fattore di rischio associato a mortalità intraospedaliera, durata della degenza e trasferimento in altre strutture di cura.

Risultati. Età superiore a 85 anni (OR=5.38) e neoplasie (OR=3.62) sono stati identificate come fattori maggiormente associati a mortalità intraospedaliera. Diabete (OR=2.24) e scompenso cardiaco (OR=1.57) sono risultati associati a degenza prolungata, mentre età superiore a 85 anni (OR=1.38) e fibrillazione atriale (OR=1.69) sono risultate associate a trasferimento presso altre strutture.

Conclusioni. Con l'aumento dell'incidenza della frattura di anca, l'identificazione di fattore di rischio può aiutare a ridurre la mortalità e la morbosità dei pazienti.

References

1. Marks R. Hip fracture epidemiological trends, outcomes, and risk factors, 1970-2009. Int J Gen Med. 2010 Apr; **8**(3): 1-17.

2. Aigner R, Meier Fedeler T, Eschbach D, et al. Patient factors associated with increased acute care costs of hip fractures: a detailed analysis of 402 patients. Arch Osteoporos. 2016 Dec; **11**(1): 38. doi: 10.1007/s11657-016-0291-2. Epub 2016 Nov 4.

3. Traven SA, Reeves R, Althoff AD, Slone HS, Walton ZJ. New 5-Factor Modified Frailty Index Predicts Morbidity and Mortality in Geriatric Hip Fractures. J Orthop Trauma. 2019 Jul; **33**(7): 319-23. doi: 10.1097/BOT.0000000000001455.

4. Sanz-Reig J, Salvador Marín J, Pérez Alba JM, Ferrández Martínez J, Orozco Beltrán D, Martínez López JF. Risk factors for in-hospital mortality following hip fracture. Rev Esp Cir Ortop Traumatol. 2017 Jul-Aug; **61**(4): 209-15. English, Spanish. doi: 10.1016/j.recot.2017.03.003. Epub 2017 Apr 24.

5. Cooper C. The crippling consequences of fractures and their impact on quality of life. . Am J Med. Aug 18; **103**(2A): 12S-17S; discussion 17S-19S. doi: 10.1016/s0002-9343-(97)90022-x.

6. Piscitelli P, Feola M, Rao C, et al. Ten years of hip fractures in Italy: For the first time a decreasing trend in elderly women. World J Orthop. 2014 Jul 18; **5**(3): 386-91. doi: 10.5312/wjo.v5.i3.386.

7. Tarantino U, Piscitelli P, Feola M et al. Decreasing trend of hip fractures incidence in Italy between 2007 and 2014: epidemiological changes due to population aging. Arch Osteoporos. 2018 Mar 9; **13**(1): 23. doi: 10.1007/s11657018-0423-y.

8. Rombolà G. [Health care: the possible cost reduction and improvement of care]. G Ital Nefrol 2013 Mar-Apr; **30**(2). gin/30.2.1. Italian.

9. Corbi G, Gambassi G, Pagano G, et al. Impact of an Innovative Educational Strategy on Medication Appropriate Use and Length of Stay in Elderly Patients. Medicine (Baltimore). 2013 Jun; **94**(24): e918.

10. Piscitelli P, Iolacson G, Argentiero A, et al. Incidence and costs of hip fractures vs strokes and acute myocardial infarction in Italy: comparative analysis based on national hospitalization records. Clin Interv Aging. **2012**(7): 575-83. doi: 10.2147/CIA.S36828. Epub 2012 Dec 17.

11. Di Giovanni P, Di Martino G, Zecca IA, Porfilio I, Romano F, Staniscia T. Incidence of hip fracture and 30-day hospital readmissions in a region of central Italy from 2006 to 2015. Geriatr Gerontol Int. 2019 Jun; **19**(6): 483-6. doi: 10.1111/ggi.13645. Epub 2019 Mar 13.

12. Athar M, O'Loughlin P, Mitra A, Harty J. Characterization of comorbid factors in hip fracture related in-hospital mortality. Ir Med J. 2014 Oct; **107**(9): 284-7.

13. Di Giovanni P, Di Martino G, Zecca IAL. Outcomes comparison between hip fracture surgery and elective hip replacement: a propensity score-matched analysis on administrative data. Eur Geriatr Med. 2019; **10**: 61-6. https://doi.org/10.1007/s41999-018-0146-z. Epub 2018 Dec 5.

14. Frost SA, Nguyen N, Black DA, Eisman JA, Nguyen TV. Risk factors for in-hospital post-hip fracture mortality. Bone. 2011 Sep; **49**(3): 553-8. doi: 10.1016/j.bone.2011.06.002. Epub 2011 Jun 13.

15. Lam CS, Donal E, Kraigher-Krainer E, Vasan RS. Epidemiology and clinical course of heart failure with preserved ejection fraction. Eur J Heart Fail. 2011 Jan; **13**(1): 18-28. doi: 10.1093/eurjhf/hfq121. Epub 2010 Aug 3.

16. ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery. J Am Coll Cardiol. 2007 Oct 23; **50**(17): 1707-32. doi: 10.1016/j.jacc.2007.09.001.

17. Cullen MW, Gullerud R, Larson DR, Melton LJ 3rd, Huddleston JM. Impact of heart failure on hip fracture outcomes: a population-based study. J Hosp Med. 2011 Nov; **6**(9): 507-12. doi: 10.1002/jhm.918. Epub 2011 Oct 31.

18. Smith T, Pelpola K, Ball M, Ong A, Myint PK. Pre-operative indicators for mortality following hip fracture surgery: a systematic review and meta-analysis. Age Ageing. 2014 Jul; **43**(4): 464-71. doi: 10.1093/ageing/afu065. Epub 2014 Jun 3.

19. Diamantopoulos AP, Hoff M, Hochberg M, Haugeberg G. Predictors of Short- and Long-Term Mortality in Males and Females with Hip Fracture - A Prospective Observational Cohort Study. PLoS One. 2013 Oct 29; **8**(10): e78169. doi: 10.1371/journal.pone.0078169.

20. Neuhaus V, King J, Hageman MG, Ring DC. Charlson comorbidity indices and in-hospital deaths in patients with hip fractures. Clin Orthop Relat Res. 2013 May; **471**(5): 1712-9. doi: 10.1007/s11999-012-2705-9. Epub 2012 Nov 21.

21. Pérez-Sáez MJ, Prieto-Alhambra D, Barrios C, et al. Increased hip fracture and mortality in chronic kidney disease individuals: the importance of competing risks. Bone. 2015 Apr; **73**: 154-9. doi: 10.1016/j.bone.2014.12.020. Epub 2014 Dec 27.

22. Golinvaux NS, Bol DD, Basques BA, Baumgaertner MR, Grauer JN. Diabetes confers little to no increased risk of postoperative complications after hip fracture surgery in geriatric patients. Clin Orthop Relat Res. 2015 Mar; **473**(3): 1043-51. doi: 10.1007/s11999-014-3945-7. Epub 2014 Sep 20.

23. Brown CA Olson S, Zura R. Predictors of length of hospital stay in elderly hip fracture patients. J Surg Orthop Adv. 2013 Summer; **22**(2): 160-3. doi: 10.3113/jsoa.2013.0160.

24. Pedersen AB, Christiansen C, Gammelager H, Kahlert J, Sørensen HT. Risk of acute renal failure and mortality after surgery for a fracture of the hip: a population-based cohort study. Bone Joint J. 2016 Aug; **98-B**(8): 1112-8. doi: 10.1302/0301-620X.98B8.37497.

25. Oyetunji TA, Turner PL, Onguti SK, et al. Predictors of postdischarge complications: role of in-hospital length of stay. Am J Surg. 2013 Jan; **205**(1): 71-6. doi: 10.1016/j.amjsurg.2012.04.006. Epub 2012 Jul 7.

26. Vochteloo AJ, Tuinebreijer WE, Maier AB, Nelissen RG, Bloem RM, Pilot P. Predicting

discharge location of hip fracture patients; the new discharge of hip fracture patients score. Int Orthop. 2012 Aug; **36**(8): 1709-14. doi: 10.1007/s00264-012-1526-5. Epub 2012 Mar 23.

27. Keene J, Anderson CA. Hip fractures in the elderly. Discharge predictions with a functio-nal rating scale. JAMA. 1982 Aug 6; **248**(5): 564-7.

28. Thorngren KG, Cedet L, Svensson K. Predicting results of rehabilitation after hip fracture. A ten-year follow-up study. Clin Orthop Relat Res. 1993 Feb; **287**: 76-81.

Corresponding Author: Giuseppe Di Martino, MD, Department of Medicine and Aging Sciences,
"G. d'Annunzio" University of Chieti-Pescara, Via dei Vestini 31, 66100 Chieti (CH), Italy
e-mail: giuseppe.dimartino@unich.it