



## Original Article

### Epidemiological Profile and Incidence of Hip Fractures in Greece

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#### ABSTRACT

##### Article history

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**Introduction:** This study was designed to determine the epidemiological profile of hip fractures among Greek population with special importance to the cause of fracture, their characteristics, the treatment instituted and to assess the incidence.

**Methods:** The current study conducted in a single hospital in the northern part of Greece, in the regional unit of Grevena, during the 2016 calendar year. Patients themselves, or a relative member or a caregiver, were interviewed by a questionnaire regarding to the past medical history, time and place of the fracture occurrences.

**Results:** The 73 patients included in the study presented a mean age of 83.5 years, with a male-to-female ratio of 1:2.17. Falling from the same level was the cause of 97.6% of the fractures. Transtrochanteric fractures accounted for 52.1% of the fractures, femoral neck fractures, 38.4% and subtrochanteric fractures, 9.6%. More fractures are seen during the summer months (32.9%), inside the house (61.6%) and during the morning (49.3%). The overall annual incidence rate was 672.2 per 100,000 inhabitants (442.6 and 882.9 per 100,000 male and female, respectively). Length of waiting time to surgery was 1.87 days and length of hospital stay was 8.46 days, without statistical significance according to the type of surgery, the age group and the associated comorbidities. Hypertension (87.7%) was the most common comorbidity, followed by heart disease (50.7%) and depression (31.5%).

**Conclusion:** The patients attended at this hospital presented an epidemiological profile similar to the worldwide literature. Hip fracture rates in the region of Grevena are higher than other regions in Greece, such as Athens and Crete.

**Keywords:** Hip fractures, Epidemiology, Incidence, Seasonal variations, Greece

#### Introduction

Hip fractures are probably the most important types of fragility fractures as most patients require immediately hospitalization and treatment (1, 2). Worldwide, the total number of hip fractures was 1.66 million in 1990 and is expected to surpass 6 million by the year 2050 (3). The growth in this difference is mainly due to the rapid increase in the life expectancy and therefore in the proportion of elderly population. Studies over the last few decades have demonstrated geographical variations in the incidence of hip fractures and according to age and gender (1). Few reports have studied the epidemiology of hip

fractures in the Mediterranean region, which are characterized by similar meteorological conditions, socio-economic profile and dietary habits (1, 4, 5).

In Greece, the proportion of elderly patients in the general population is expected to increase over the next two decades. Elderly population has weaker bone and is more likely to fall due to poor balance, as result is at high risk for hip fractures. According to the level of the fracture, these fractures can be divided into three types-femoral neck, transtrochanteric and sub trochanteric fractures (6). Treatment should be surgical, as

surgery is the ideal option to help these patients regain their autonomy and minimizes the length of time a patient is confined to bed rest. Proponents of early surgical treatment argue that this approach reduces the risk for associated complications, such as pressure sores, deep vein thrombosis and urinary tract infection (2).

The main objective of this prospective study was to determine the epidemiological profile of fractures of the proximal third of the femur among elderly people who were treated in the orthopedic department of General Hospital of Grevena, a district hospital in the northern part of Greece. Thus, the study aimed to analyze the causes of the fractures, their characteristics, the treatment instituted and to assess the incidence.

## Methods

### *Geographical location*

Prefecture of Grevena is located in northern Greece, at longitude 21°25'38 and latitude 40°5'4 with a total area of 2,291 km<sup>2</sup>. The terrain of the prefecture, as a whole, is mountainous and semi mountainous (approximately 85%). It has a Mediterranean climate with the mean temperature is 9.3°C and 27°C during winter and summer season, respectively. The population in 2016 was 31,251. Approximately 61% of the population lives in rural areas, while 39% of the population lives in urban areas.

There is one hospital that has an orthopedic department and emergency admission facilities. The study included elderly patients with fracture of the proximal third of the femur who were attended consecutively between January 2016 and December 2016. Patients who met the diagnostic criteria according to the International Classification of Diseases 10th revision, clinical modification (ICD-10: S72.0, S72.1 and S72.2) (7) and were older than 60 years at the time of the fracture were recruited. The exclusion criteria were: i) non-residents of prefecture of Grevena, ii) fractures of pathologic bone (e.g. metastasis) and iii) patients who were treated non-operatively.

### *Measure*

Patients themselves, or a relative member or a caregiver who might be living with patient, were interviewed (use of a questionnaire designed by the authors) by the present authors to collect information in regards to the past medical history, time and place of the fracture occurrences. In this questionnaire, in addition to basic sociodemographic information such as gender and age, the trauma mechanism, the place and the time where the event occurred and day/season when it occurred were evaluated. The patients were also asked about comorbidities, including osteoporosis. The other data gathered in the present study comprised the type of fracture, type of surgery and anesthesia, total

duration of hospital stay and length of waiting time until surgery and treatment instituted.

### *Ethical considerations*

This research has been conducted in conformity with the Declaration of Helsinki (2000) and was approved by the Institutional Ethical and Scientific Committee (Scientific Council 2016; code number 01/03-02-2016).

### *Data Analysis*

Collected data were analyzed with the use of SPSS (Version 16.0). Continuous variables (age, LWTS, LHS) are expressed as mean, standard deviation (SD) and categorical variables (gender, type of fracture, season, place, type of surgery) as percentages. The Kolmogorov-Smirnov test was utilized for normality analysis. Student t-test and Mann-Whitney test were utilized for the comparison of the quantities-continuous variables in our independent samples, for normal or not distribution, respectively. Pearson-x2 (cross tabulation) was utilized for the comparison of the categorical variables. The level of significance is determined at  $p < 0.05$ .

## Results

The estimated population of the prefecture of Grevena was 31,251 in 2016. The population aged over 60 years was 10,860 (34, 8%). In the one-year period, there were 73 hip fractures (23 males, 31.5% and 50 females, 68.5%), with a male-to-female ratio of 1:2.17; 28 femoral neck fractures (38.4%), 38 transtrochanteric fractures (52.1%) and 7 sub trochanteric (9.6%). The mean age of the patients was 83.5 years (84.1 in males, range 64 to 92 years; 83.3 females, range 64 to 93 years). Most of the fractures occurred in the age group of 80 to 89 years (41 patients, 56.2%). The fractures occurred in 20 (27.4%), 13 (17.8%), 24 (32.9) and 16 (21.9%) patients during winter, spring, summer and autumn, respectively. Approximately one-fourth (19 patients, 26.1%) of the fractures occurred during the weekend and the half of them (36 patients, 49.3%) occurred during the morning. Falls were reported by 72 patients, while one had suffered from a pedestrian accident. The mechanism of injury was a slip down in 71 fractures, 97.2%. Among the falls, forty-five (61.7%) had occurred in the patient's own home, while 16 (21.9%) in their home outdoor and 10 (13.7%) were in the streets (Table 1).

The crude one-year incidence of hip fractures in the total population over 60 years of age was 672.2/100,000. The gender-specific incidence was 442.6/100,000 in males and 882.9/100,000 in females (Figure 1). The age-specific incidence for the 10-year age groups was 113.7/100,000 for those 60 to 69 years of age, 267.6/100,000 for those 70 to 79 years of age, 1607.2/100,000 for those 80 to 89 years of age and 5228.8/100,000 for those over-90 years of age (Table 2).

Table 1. The patient's Demographic data

Characteristics		Distribution
Number of patients		73
Gender (male: female-ratio)		23:50-1:2.17
Age, mean (range) years	Male	84.1 (64 - 92)
	Female	83.3 (64 - 93)
	Total	83.5 (64 - 93)
Age group	60-69 years	4 (5.5)
	70-79 years	12 (16.4)
	80-89 years	41 (56.2)
	≥ 90 years	16 (21.9)
Anatomic location	Femoral neck	28 (38.4)
	Transtrochanteric	38 (52.1)
	Sub trochanteric	7 (9.6)
Mechanism of injury	Fall from same level (slip down)	71 (97.2)
	Home indoor	45 (61.6)
	Home outdoor (garden)	16 (21.9)
	Street	10 (13.7)
Season of fracture	Fall from height	1 (1.4)
	High-energy contact injury	1 (1.4)
	Winter	20 (27.4)
	Spring	13 (17.8)
Day of fracture	Summer	24 (32.9)
	Autumn	16 (21.9)
	Monday	7 (9.6)
	Tuesday	11 (15.1)
Time of fracture	Wednesday	12 (16.4)
	Thursday	10 (13.7)
	Friday	14 (19.2)
	Saturday	8 (11)
	Sunday	11 (15.1)
	06:00-12:00	36 (49.3)
	12:00-18:00	17 (23.3)
	18:00-00:00	20 (27.4)

Values are presented as number (%) unless otherwise indicated.

Table 2. Incidence of hip fracture by age group (per 100,000) in 2016

Age group (years)	Total		Rate <sup>b</sup>	95% CI <sup>c</sup>
	Person/year <sup>a</sup>	NoF		
60-69	3,518	4	113.7	22.9-2,251.2
70-79	4,485	12	267.6	1,163.2-44,188
80-89	2,551	41	1,607.2	11,189-20,955.3
≥ 90	306	16	5,228.8	27,205.6-77,370
Overall	10,860	73	672.2	5,184.9-8,258.9
Age group (years)	Male		Rate <sup>b</sup>	95% CI <sup>c</sup>
	Person/year <sup>a</sup>	NoF		
60-69	1,763	2	113.4	438.4-2,707.3
70-79	2,152	2	92.9	359.1-2,217.8
80-89	1,179	11	933	3,834.2-14,825.7
≥ 90	103	8	7,767	25,104.4-13,023.3
Overall	5,197	23	442.6	2,620.4-6,230.9
Age group (years)	Female		Rate <sup>b</sup>	95% CI <sup>c</sup>
	Person/year <sup>a</sup>	NoF		
60-69	1,755	2	114	440.4-2,719.6
70-79	2,333	10	428.6	1,633.4-6,939.2
80-89	1,372	30	2,186.6	14,117.8-29,613.9
≥ 90	203	8	3,940.9	12,416.1-66,401.7
Overall	5,663	50	882.9	6,392.1-11,266.4

<sup>a</sup> Based on National Database [http://www.edemography.gr/estimations/esti\\_resid\\_jul\\_givenarea\\_pergenderage.cfm](http://www.edemography.gr/estimations/esti_resid_jul_givenarea_pergenderage.cfm), Accessed on Sep 12, 2017. <sup>b</sup> Rate per 100,000 population. <sup>c</sup> 95% CI = 95% confidence interval of the odds ratio. NoF : number of fractures.

**Table 3. Length of waiting time to surgery (LWTS) and length of hospital stay (LHS) compared with gender**

	Total (n = 73)	Male (n = 23)	Female (n = 50)	p-value
<b>LWTS</b>	1.87 ± 1.03	1.67 ± 0.87	1.96 ± 1.09	0.413
<b>LHS</b>	8.46 ± 2.43	8.32 ± 3.39	8.52 ± 1.88	0.795

Values are expressed as the number of days; ± Standard deviation.

**Table 4. Length of hospital stay according gender compared in relation to the type of fracture, type of surgery, number of associated diseases and age group**

	Length of hospital stay (days)		p-value
	Male	Female	
<b>Type of fracture</b>			
Femoral neck	8.8	8.5	0.043
Transtrochanteric	11	10	
Subtrochanteric	7.3	8.1	
<b>Type of surgery</b>			
Fixation	9.2	8.6	0.321
Replacement	7.9	8.3	
<b>Number of associated diseases</b>			
1-2	8.1	8.5	0.683
3-4	8.9	8.7	
≥ 5	8.5	7.5	
<b>Age group</b>			
60- 69	6.5	7.5	0.187
70-79	10	8.6	
80-89	7.3	8.5	
≥ 90	10	8.9	

The mean length of waiting time to surgery (LWTS) was 1.87 days (± 1.03 days) and the mean length of hospital stay (LHS), was 8.46 days (± 2.43 days), for both gender. There was not difference in the LWTS and LHS among the different gender (Table 3). There was not any statistical significant difference in the LHS for both gender according the type of fracture, the type of surgery, the number of associated diseases and the age groups. Only femoral neck fractures had a shorter LHS compared to subtrochanteric fractures (7.3-8.06 vs 10-11,  $p = 0.043$ ) (Table 4). Three patients had denied to undergone any operation, while 69 patients had undergone some type of surgical intervention. Internal fixation ( $n = 45$ ) was the treatment instituted in all the cases of transtrochanteric and subtrochanteric fractures. In relation to femoral neck fractures, all the fractures ( $n = 24$ ) were treated with joint replacement, except one (Garden type I) who had undergone conservative treatment.

The frequencies of preexisting comorbidities are shown in Table 5. Hypertension was the most common comorbid condition affecting 87.7% of the population.

**Table 5. Comorbidity profile of the patients admitted to the hospital**

Comorbidity parameter	Values (%)
Total number in cohort	73 (100)
Comorbidities (at least 1)	72 (98.6)
<b>Number of comorbidities</b>	<b>Values (%)</b>
0	1 (1.4)
1-2	27 (37.0)
3-4	39 (53.4)
≥ 5	6 (8.2)
<b>Specific condition</b>	<b>Values (%)</b>
Hypertension	64 (87.7)
Heart disease	37 (50.7)
Depression	23 (31.5)
Dislipidemia	17 (23.3)
Diabetes mellitus	13 (17.8)
Hypothyroidism	10 (13.7)
Gouty arthritis	10 (13.7)
Cancer	6 (8.2)
Parkinson disease	4 (5.5)
Osteoporosis	4 (5.5)
Alzheimer disease	3 (4.1)
COPD	3 (4.1)

COPD: chronic obstructive pulmonary disease

## Discussion

The epidemiological profile of the individuals in the present study did not differ much from what was found in previous studies conducted in Greece and worldwide. Women predominated over men in the proportion of 2.17:1. This more than twice proportion of women has been explained by the higher incidence of osteoporosis among women by aging. The mean age of the patients was 83.5 years. In a previous study, Lyritis et al. (2) found predominance of women in the proportion of 2.34:1 and a mean age of over 80 years. Dretakis et al. (8) found a proportion of 1.95:1 and a mean age between 72 and 74 years.

The results indicate that 97.2% of the fractures were associated with a fall from standing. This was a higher proportion than in a study conducted to Brasil, where Daniachi et al. (6) correlated 92.9% of the fractures with falls. Another study from the United States found that more than 95% of the fractures are associated with falls (9). The majority of falls related hip fractures occurred inside their homes. The present research found a proportion of 61.7%. This is not surprising considering elderly people tend to spend most of their time inside their homes. It is obvious that due to the elderly sample of the present study, a low mechanism of injury, such as slip down, can lead to a hip fracture. Osteoporosis is the predominant risk factor. The present study indicates that only four patients (5.5%) had been diagnosed with osteoporosis and treated with bisphosphonates prior to admission.

The results indicate that trochanteric fractures (transtrochanteric, 52.1%; subtrochanteric, 9.6%) were more common than femoral neck fractures (38.4%) at all ages in both genders. One study from Crete found that the proportion of trochanteric fractures (67%) was much higher than that of femoral neck fractures (33%)(8). A study from Spain (5) also found that trochanteric fractures (transtrochanteric, 44.1%; subtrochanteric, 8.3%) were more common than femoral neck fractures (47.6%). In contrast, a study from South Korea (10) found slight predominance in femoral neck fractures (50.5%) than trochanteric fractures (49.5%), as well as, a Singapore study (3) that found a higher proportion in femoral neck fractures (53.2%) than trochanteric fractures (46.8%). The reasons for these differences in type of fracture are not clear. Although, the reason for these differences in type of fracture may in part be related to genetic factors (12).

The seasonality of hip fractures in the elderly has been documented in several geographic locations (4, 10, 12-14). Several studies have found winter peaks of hip fracture rates (10, 12-14). The present study found a higher incidence of hip fracture was seen in summer and winter compared with other seasons. It has been proposed that the higher incidence in the summer might be due to increased outdoor activities (4). In contrast, winter predominance might be explained by a variety of factors, such as wetter ground, decreased hours of daylight and sun exposure, as well as, the drop-in temperature connected with blood pressure and hemodynamic changes (14). With regard to the day of the week, the

incidence of hip fractures was equally distributed, with a small peak on Friday. The homogeneous week distribution of hip fractures is in agreement with a study conducted in Israel (14) and may be attributed to no drastic difference in activities of daily living in population aged 65 years and older. Hip fractures may also be influenced by the time of the day. The present research showed that hip fractures were most common during the morning and this may be correlated with the fact that elderly people do most of their routine duties in the early morning hours.

Hip fractures are a significant socioeconomic burden worldwide. It has been shown that there are variations in the incidence rate of hip fracture in the different regions of the world (1, 4, 5, 10, 12, 13). Present study showed that the hip fracture incidence rate was 672.2 per 100,000 (inhabitants/year). This finding is significantly higher than reported from Athens (2), the capital of Greece, and among with a study conducted in Crete (8), the largest Greek island in the South of Greece. The present incidence rates are similar to previously reported European incidence rates (5, 13). However, the values are greater than those reported to other parts of the world, such as Mediterranean countries (1, 4), the Asian countries (10, 12, 15), or Latin American countries (16) (Table 6). These geographical variations in the distribution of hip fracture demonstrate that genetic and environmental factors play a crucial role in the etiology of hip fracture.

**Table 6. Geographical variation of the hip fracture incidence (per 100,000)**

Geographic location (Ref.)	Years of study	Incidence
Greece, Grevena *	2016	672.2
Greece, Athens (2)	2007	343.9
Greece, Crete (8)	1986	100
Spain (5)	2002	694
Norway (13)	2004 - 05	346 - 758
Lebanon (1)	2007	147
Morocco (4)	2002	48
South Korea (10)	2002 - 06	126.9
Iran (12)	2007	206 - 214
Malaysia (15)	1996 - 97	90
Equador (16)	2005	49.5

\* Our study conducted in Grevena, a regional unit in the Northern part of Greece.

Ref. = Reference number.

Time from admission to surgery and length of hospital stay has been identified as important medical and economic factors for patients with hip fracture. The present study indicates that the mean LWTS was 1.87 days and the mean LHS was 8.46 days. Also, this study showed that the type of surgery, the comorbidity burden and the age of the patients did not affect their LHS. Only the type of fracture presents a different LHS, with the femoral neck fractures had a shorter LHS with the femoral neck fractures had a shorter LHS compared to subtrochanteric fractures. These results are differed much from those in the central region of the city of



Sao Paulo. Daniachi et al. (6) found a mean LWTS of 7 days and a mean LHS of 13.5 days. Similar observations were reported by the registry data from the New York Statewide Planning and Research Cooperative System with a mean LWTS of 1.8 days and a mean LHS of 8.1 days (17). However, Menzies et al. (18) found a mean LWTS of 21.35 hours and a mean LHS of 4.19 days, much shorter than that reported by the present registry. Differences in LWTS and LHS are probably because of the overall health care system structure and hip fracture therapeutic practices in the various countries. Operative delay beyond 48 hours after admission and prolonged LHS is correlated with increased mortality rate within one year for elderly patients with a hip fracture (19).

Patients included in the present study had multiple comorbid conditions; 98.6% had at least 1 comorbid condition and conditions such as hypertension, heart disease and depression were the leading comorbidities in patients with hip fracture at admission. The prevalence of selected comorbid conditions increased the risk of both short- and long-term mortality following hip fracture. In addition, patients with multiple chronic comorbidities have on average a poorer physical functioning and quality of life, a greater like hood persistent depression, lower levels of social wellbeing, and a higher level of mortality (20).

## Conclusion

This research gives an epidemiological profile of fractures of the proximal third of the femur among elderly people in a rural region of Greece, the regional unit of Grevena. The most observed victim pattern was females, aged between 80 and 89 years, with more than 95% of hip fractures are caused by falling, usually by falling from the same level in theirs' own home and with the half of them happened during the morning. Transtrochanteric is the most common anatomic location of the fractures. Hip fractures in the elderly population are on a rising trend especially among the Greek population due to a number of factors. The overall effect of all changes in the Greek environment during the last 30 years may also play an important role. The incidence rates of hip fractures in the present study are higher than those of other Mediterranean countries and similar with other European countries

## Study limitations

Limitations of this study include the absence of the number of death, which would have provided insight mortality rates in this population. The second limitation of this study is the limited sample size which affected the statistical significance of few variables.

Grevena is a rural municipality and is located in northern Greece. Rural medical practice in Grevena represents a unique set of challenges. Challenges included those resulting from inadequate roads, extremes in weather particularly in winter, poor

public transportation in the isolated villages of the municipality and the lack of an adequate public health infrastructure. An understanding of rural health determinants is vital if health promotion policies and strategies are to result in significant improvements in health status. Currently, policies and strategies for improving rural health must be focused on increasing the workforce and improving access to healthcare services in remote and small rural communities.

## Conflict of interest

The authors declare that they have no conflict of interest.

## Authors' contributions

Study design: AVV

Data collection: AVV, DG

Statistical analysis: AVV, GC

Manuscript preparation: AVV, DG

All the authors have read the manuscript and approved the final version

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