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Trends in the incidence of hip fracture in Gran Canaria, Canary Islands, Spain: 2007–2011 versus 1989–1993

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Abstract

Summary—Hip fracture incidence in the Canaries was studied in two 5-year periods (1989–1993 and 2008–2011). The incidence in 2007–2011 was 24 % higher than in 1989, but did not differ between 2007–2011 and 1993. These findings suggest a trend to stabilize the incidence of hip fracture.

Introduction—A dramatic increase in hip fractures between 1988 and 2002 was reported in Northern Spain. We performed the present study in Gran Canaria, the Canary Islands, to compare changes in the incidence of hip fracture between 1989–1993 and 2007–2011.

Methods—We recorded every osteoporotic hip fracture admitted to any hospital in Gran Canaria in the population 50 years of age or older.

Results—In 1989–1993, we collected 1175 hip fractures (72 % women; mean age 78.2±9.9 years), and the total incidence rate was 152.1 cases/100,000 population/year. In 2007–2011, we collected 2222 hip fracture cases (71 % women; mean age 79±9.8 years). The total incidence was

180.9/100,000/year. A Poisson model showed that the incidence of fractures increased by 7.1 % (95 % CI=3.1 %; 11.8 %) each year in 1989–1993, while there was no statistically significant variation ($p=0.515$) during the period 2007–2011. The incidence in 2007–2011 was 24 % higher than in 1989 (first year in the first period) but did not differ between 2007–2011 and 1993 (the last year of the first period). Incidence rates were 76.7 % (95 % CI=63.9 %; 90.5 %) higher in women than in men, but the female/male ratio remained unchanged. The age-adjusted incidence of hip fractures increased by 7.3 % each year from 1989 to 1993. The proportions of trochanter and cervical fractures were similar in the two time periods, but the mean hospital stay was reduced from 11 days in 1989–1993 to 7 days in 2007–2011.

Conclusions—These findings suggest a trend to stabilize the incidence of hip fracture in the Canary Islands due to a decrease in men, while in women, the incidence increased.

Keywords

Canary Islands; Hip fracture; Incidence; Osteoporosis; Spain; Trend

Introduction

Hip fracture is the most serious clinical complication of osteoporosis due to the related mortality, morbidity, and enormous care expenditures [1]. For over 30 years, campaigns have been created to prevent the onset of osteoporosis, and a number of drugs have been developed to reduce the risk of fragility fractures [2, 3]. This could account for the decline in hip fracture incidence in some countries [4, 5], although growth of the elderly population in most Western countries can still result in dramatic increases in the actual numbers of hip fractures observed. Incidence trends have varied widely around the world, but most recent data reveal relatively stable or slightly declining hip fracture rates in most areas [6, 7]. However, the situation in Spain is not completely clear. Hernández and colleagues emphasized a 54 % increase in the number of hip fractures observed in the Cantabria region of Northern Spain between 1988 and 2002, but the age- and sex-adjusted incidence rates did not differ [8]. However, that observation was based on two single years of data when hip fracture incidence can vary widely from year to year in a small population. Moreover, there is substantial geographic variability in hip fracture incidence, and rates in the Canary Islands were among the lowest observed for any region in Spain in 2000–2002 [9]. Although the overall incidence of hip fractures in Spain appears to have risen somewhat in men and declined slightly in women between 1997–2000 and 2007–2010 [10], it is unclear what may have happened more recently in the Canary Islands. This is relevant because the decline in hip fracture incidence is most evident in high-risk regions of the world [7], whereas many formerly low-risk populations have experienced a recent increase in hip fracture incidence [11–14]. We previously published a first study on the incidence of hip fracture on the island of Gran Canaria for a period of 5 years (1989–1993) [15], and we have now repeated the study 20 years later (in 2007–2011) in order to compare possible changes in the incidence of this fracture over time in a low-risk area of Spain.

Material and methods

For the present study, we consulted the Admission Services, Emergency Services, Orthopaedic Surgery Services, and Codification Areas of all hospitals of Gran Canaria, Canary Islands, incorporating both the public and private sectors. We included all hip fracture cases recorded on the island of Gran Canaria from January 1, 2007 to December 31, 2011, according to the criteria of the International Classification of Diseases published by the Ministry of Health and Consumption [16]. We subsequently excluded cases among nonresidents who were on the island temporarily, as well as any fractures produced by major trauma (car accident, fall on stairs, etc.) or coexisting neoplastic pathology.

To estimate fracture incidence, we obtained data for the population age ≥ 50 years stratified by age and sex from census data published by the Canarian Institute of Statistics [17]. Finally, we compared the data from the period, 2007–2011, with those previously obtained by our working group during the period, 1989–1993, carried out with identical methodology.

To avoid the inclusion of patients who had suffered a traumatic fracture or had a pathologic fracture (e.g., cancer), we performed a careful review of all the codes assigned to hip fracture patients, according to the International Classification of Diseases, Clinical Modification, used to classify morbidity data from the inpatient and outpatient records, physician offices, and most National Center for Health Statistics (NCHS) surveys. We also cross-checked the social security cards of the inpatients to exclude any tourists who suffered a fracture during their holidays in Gran Canaria.

Statistical analysis

The incidence of hip fracture was expressed as number of cases per 100,000 person-years. In order to evaluate secular trends, we denote by $N_{\text{period}, t, \text{age}, \text{sex}}$ the size of the Gran Canaria population ≥ 50 years of age according the period (1989–1993; 2007–2011), year t within each period (see Table 2 for codes), age (see Table 3 for codes), sex (male and female), and by $fx_{\text{period}, t, \text{age}, \text{sex}}$ the number of fractures in that cohort. We consider that $fx_{\text{period}, t, \text{age}, \text{sex}}$ follows a Poisson distribution with parameter $\mu_{\text{period}, t, \text{age}, \text{sex}}$, being (see Fig. 1):

$$\log(\mu_{\text{period}, t, \text{age}, \text{sex}}) = \log(N_{\text{period}, t, \text{age}, \text{sex}}) + \theta + \alpha_{\text{period}} + \beta_{\text{period}} \cdot t + \gamma \cdot \text{age} + \delta_{\text{sex}}$$

where $\alpha_{1989-1992}=0$ and $\delta_{\text{male}}=0$. The model was estimated using the maximum likelihood method. Comparisons between incidence rates were carried out by means of the relative risks deduced from the model. Statistical significance was set at $p<0.05$. Data were analyzed using the R package, version 3.1.0 (R Development Core Team, 2014).

Results

During the period, 2007–2011, 2222 hip fractures were recorded compared to 1175 in 1989–1993 (Table 1). The incidence (expressed as cases/100,000 population/year aged more than 49 years) rose from 152.1 in 1989–1993 to 180.9 in 2007–2011. The female/male ratio was a similar 2.6 in 1989–1993 and 2.5 in 2007–2011. The age mean at hip fracture increased among women from 79.3 ± 9.1 to 80.2 ± 9.1 years between 1989–1993 and 2007–2011, but no

statistically significant difference was observed in men. The proportion of fractures that was trochanteric or cervical remained constant, involving the trochanteric in about 2/3 of the fractures. On the other hand, the average hospital stay was significantly reduced in the period 2007–2011, shrinking approximately by half in both men and women compared to 1989–1993.

Table 2 shows the observed incidence of hip fractures grouped by age and gender. The rates increased dramatically with age in both genders, rising from 18.4/100,000/year in people aged 50–59 years old to 963.3 cases/100,000/year in people over 80 years old.

Table 3 shows the observed incidence rates in the total population, males and females, grouped by the studied years. Comparing every year of the second period studied, 2007–2011, to every year of the first period, 1989–2003, the rates are higher throughout the period 2007–2011 with the exception of the last year: In 2011, the incidence rate of 164.3 was lower to the one found in 1993 at 170.6 cases/100,000 population over 49 years old.

Table 4 documents the estimation of the Poisson model. Overdispersion was not statistically significant ($p=0.074$). The model showed that fracture incidence was increased by 7.3 % (95 % CI=3.1 %, 11.8 %) annually during the 1989–1993 period. However, during the 2007–2011 period, no significant trend ($p=0.515$) was detected. Thus, the incidence in 1989 (first year of the first period) was statistically significantly lower compared to the period 2007–2011 (RR=1.241; 95 % CI=1.093; 1.41). Nevertheless, the incidence in 1993 (the last year of the first period) was not significantly different from that of the second period (RR= 0.934; 95 % CI=0.829, 1.053). Globally, the adjusted incidence showed no statistical differences between 1993 and the whole period 2007–2011, which reflects a trend to stabilization in the incidence of hip fractures in Gran Canaria.

The Poisson model was based on the graphic in Fig. 1. While the incidence of hip fracture showed a trend to increase in the first period, from 1989–1993, a trend to decrease was observed in the second period, mainly in women. Finally, the adjusted incidence of fractures in women was 76.7 % (95 % CI=63.9 %; 90.5 %) higher than in men.

Discussion

Although there was some variation in the rates observed for single years of the study, we found that overall hip fracture incidence increased by 7.3 % annually during the 1989–1993 period, while the increase was not statistically significant in 2007–2011. In fact, the total hip fracture incidence in 2007–2011, 180.9/100,000 population aged more than 49 years old, was similar to the incidence rate obtained in 1993 ($p=0.515$). The incidence of fractures in the period 1989–1993 was based on 1175 hip fracture patients, whereas the period 2007–2011 included 2222 patients, but this increase is partly attributable to the strong increase of the population at risk (772,578 in the first period against 1,228,112 in the second).

These data are similar from those of the Cantabria region of Northern Spain, where no change in age- and sex-adjusted hip fracture incidence was seen between 1988 and 2002 [8]. They differ, however, from secular trends in hip fracture incidence for Spain generally

between 1997–2000 and 2007–2010, where age-adjusted incidence rates increased by 0.4 %/year in men but declined by 0.2 %/year in women [10].

More generally, hip fracture incidence rates in the Canary Islands were among the lowest observed for any region in Spain in 2000–2002 [9]. Although the Canary Islands are located geographically in Africa, its population, culture, lifestyles, and health services are European. Moreover, incidence rates in the other Mediterranean regions of Spain (i.e., Catalonia, Valencia, Murcia, and Balearic Islands) are higher than those seen in Cantabria [9].

Although the incidence rates themselves changed relatively little over time, there was a dramatic increase in the actual number of hip fractures observed from 1175 in 1989–1993 to 2222 in 2007–2011. Similar results were seen by Hernandez et al. [8], who identified 490 new hip fracture cases in 2002 compared to only 318 in 1988 through review of clinical records from emergency units and orthopedic surgical services of all hospitals in the Cantabria region. The increase was greatest among the women, and the male/female sex ratio increased from 3.4:1 in 1988 to 4.7:1 in 2002. This compares to a ratio of about 2.5:1 in both time periods of the present investigation.

Our data do not coincide with those recently published by Azagra et al. [1] for the population of the whole Spain because they obtained a 2.3-fold increase in the incidence of hip fracture in males and 1.4 in women, while we have observed a reduction in the incidence of hip fracture in men. These discrepancies may be due to the different methodology used. Thus, with respect to age, we collected all fractures among those aged more than 49 years, while only elderly individuals were included in the study of Azagra et al. On the other hand, records of hip fracture in Gran Canaria were obtained directly from the databases of hospitals and private clinics, being later contrasted with population data from the Canaries Institute of Statistics, while Azagra et al. obtained data from the National Institute of Statistics. We compared 1989–1993 with 2007–2011, while Azagra et al. compared 1997–2000 with 2007–2010. In our study, we have adjusted the incidence with the data of the population of Gran Canaria between the years 1989–1993 and 2007–2011, while Azagra et al. included the total population between 1997 and 2010. Finally, in our study, we have included other ICD-9 codes besides the 820.0–820.9, given the possibility of underestimation of hip fracture cases that we have previously suggested [18].

We observed no differences in some other clinical findings. Thus, the proportion of trochanteric and cervical fractures, around 60 % in favor of the trochanteric, did not vary between the two time periods. However, the median days of stay declined significantly from 11 days in the period 1989–1993 to 7 days in 2007–2011.

Outside Spain, other trends are observed according to the period studied. In general, studies showed an increase in hip fracture incidence in 1996–1997 [19–22], which agrees with our findings for the period 1989–1993. A more or less significant fall in both sexes was observed in 2000 to 2007 [19–25], but we have not studied the period from 1994 to 2006. Nevertheless, studies using data at the beginning of the last decade (2010) show changes in trend similar to the ones we observed. Thus, in a study conducted in Estonia [26], the authors saw a more or less stable incidence of hip fractures during the second half of the

decade 2000–2010, although in more recent years (2009–2012), the incidence decreased significantly in women, but not in men (who even show a slight increase until 2011), contrary to what we found. A study in Germany [27] describes an increase in incidence in men over 40 years old, while the incidence in women over age 60 decreased slightly. However, in the Polish population, there was an increased incidence of hip fracture in 2010 compared to 2002, which was greater among men (57.6 %) than women (20.7 %), as observed also in our data for men [28]. These most recent findings can be related (as so many authors suggest) with the increase in the population of 80 year olds in European countries, the age at which the incidence of hip fracture increases significantly. A recent study by Rosengren and Karlsson predicts that by 2050 the incidence of hip fractures in Sweden will double, which is explained by the growing increase in life expectancy of this population [29].

As in our study, some authors have observed a decrease in hospital stay for hip fracture after 2007 [30] while others observed no change [31] or even an increase [32]. The hospital stay for hip fracture depends on several variables, such as the policies of the hospital or the volume of admitted patients. In this regard, Kristensen et al. [33] found that patients admitted to high-volume hip fracture units had a longer hospital stay. Lau et al. [34] observed that the total lengths of stay were shortened by over 5 days after the implementation of a geriatric hip fracture clinical pathway in their acute care hospital. In the Hospital University Insular, a Bone Metabolic Unit was established in 1989 for follow-up of hip fracture patients from admission to discharge, which promoted the shortening of hospital stay. In the other university hospital, Hospital University Dr. Negrin, a Geriatric Unit was created more recently with the same objective.

One strength of our study is that in both 1989–1993 and 2007–2011, the methodology was identical and basically consisted of recording all cases of hip fracture among the residents of Gran Canaria attended at any hospital, either public or private. The need for admission of such patients, together with the phenomenon of insularity, contributes to the fact that all cases are attended on the island and encourages us to believe that we have identified all the relevant hip fracture cases. In addition, we studied two 5-year periods in order to provide more robust estimates of hip fracture incidence. Nevertheless, further work is now ongoing.

In conclusion, the incidence of hip fracture in the Canary Islands after 20 years shows a tendency to stabilization.

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Fig. 1.
Observed adjusted incidence of hip fracture by year and gender

Table 1

Comparison of hip fracture patients in Gran Canaria between 1989–1993 and 2007–2011

	1989–1993	2007–2011	<i>p</i> value
Cases (<i>n</i>)	1175	2222	
Crude incidence ^a	152.1	180.9	
Sex distribution			0.799
Females, <i>n</i> (%)	848 (72.2)	1593 (71.7)	
Males, <i>n</i> (%)	327 (27.8)	629 (28.3)	
Ratio female/male	2.6	2.5	
Mean age (years)			
Total	78.2±9.9	79.0±9.8	0.017
Females	79.3±9.1	80.2±9.1	0.118
Males	75.4±11.3	76.2±10.9	0.274
Hip fracture site, <i>n</i> (%)			0.145
Trochanteric	735 (62.6)	1333 (60.0)	
Cervical	440 (37.4)	889 (40.0)	
Hospital stay (days)			
Total	11 (6; 21)	7 (5; 10)	<0.001
Females	11 (5; 22)	7 (5; 10)	<0.001
Males	12 (6; 21)	8 (5; 11)	<0.001

^aNumber of cases/100,000 population/year

Table 2
Hip fracture incidence, by time period, gender, and age group among residents of Gran Canaria

Age, years	1989–1993			2007–2011		
	Total	Male	Female	Total	Male	Female
50–59 (0) ^a	18.4	23.4	13.6	20.3	25.9	18.7
60–69 (1) ^a	66.1	45.0	85.0	66.5	55.5	77.0
70–79 (2) ^a	258.4	173.5	321.1	264.1	161.0	348.4
80 (3) ^a	963.3	604.0	1168.1	1012.6	658.3	1214.0
Total	152.1	91.4	204.5	180.9	108.1	246.4

Data are number of cases per 100,000 population/year

^aCodes for the Poisson model

Table 3

Hip fracture incidence among Gran Canaria residents by year and gender

1989-1993				2007-2011			
Year	Total	Male	Female	Year	Total	Male	Female
1989 (0) ^a	127.5	76.6	172.1	2007 (0) ^a	174.9	109.4	233.8
1990 (1) ^a	131.8	71.8	184.2	2008 (1) ^a	177.2	106.2	249.5
1991 (2) ^a	176.0	109.7	233.0	2009 (2) ^a	185.2	114.3	249.0
1992 (3) ^a	156.0	90.0	211.5	2010 (3) ^a	198.8	112.4	276.7
1993 (4) ^a	170.6	110.0	223.0	2011 (4) ^a	164.3	98.9	222.9

Data are number of cases per 100,000 population/year

^aCodes for the Poisson model

Table 4

Estimation of Poisson model

Parameter	Estimation (SE)	<i>p</i>
θ (intercept)	−9.067 (0.073)	<.001
$\alpha_{2007-2011}$ (Second period)	0.216 (0.065)	.001
$\beta_{1989-1993}$ (Slope 1989–1993)	0.071 (0.021)	<.001
$\beta_{2007-2011}$ (Slope 2007–2011)	−0.010 (0.15)	.515 (NS)
γ (Age group) ^a	1.293 (0.020)	<.001
δ_{female} (Sex female)	0.569 (0.038)	<.001

^aTable 2 shows the codes for the ages