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## Review of the incidence of hip fracture in Spain

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### Summary

The aging of the world population is an indicator of improving health worldwide. In developed countries, increased longevity has been accompanied by a so-called "compression of morbidity", that is, although people live longer, they do not spend more years suffering a poor health status. However, hip fracture itself may reduce life expectancy in almost two years and one in five patients will require permanent health care.

Epidemiological studies reporting the incidence of hip fracture in Spain are numerous. In most cases, they are retrospective and short-term studies, and their results have shown variations across regions. The overall incidence of hip fracture in our country, in subjects older than 65 years, have varied between 301 and 897/10<sup>5</sup> inhabitants, lower figures than reported in other European countries or in the USA.

In this paper, we critically review the main published studies in Spain on the incidence of hip fracture.

**Key words:** *epidemiology, hip fracture, incidence, secular trend, osteoporosis.*

## Introduction

The development of osteoporosis has been closely linked to the aging process. In this respect, the number of people aged 60 or more years worldwide has doubled since 1980, and is expected to reach 2,000 million by 2050<sup>1</sup>. The involution process associated with age implies a decrease in neuromuscular co-ordination, vision, hearing and autonomous warning systems. The co-existence of co-morbidities and diminished cognitive function decrease the responsiveness of the organism and imply a more fragile situation. Similarly, the increased consumption of drugs in the elderly, especially psychotropic medications further alters these capabilities, thus leading to falls with possible fracture. Due to its high mortality and morbidity, hip fracture is the most serious complication of osteoporosis. Indeed, hip fracture alone is capable of reducing life expectancy by almost two years and one in five patients who suffer this require permanent health care assistance<sup>2</sup>.

Based on these data, the management of osteoporosis and hip fracture will be an issue of great importance in terms of care, hospital management and economic and social spending in the coming decades. Forecasting the evolution of this fracture is a crucial matter and that goes beyond the field of health care. Therefore. In order to interpret the incidence rates of hip fracture at present, we need to ascertain precisely the previous situation. In this paper, we review the most relevant articles published on the incidence of hip fracture in Spain over the past four decades.

## Geographical variations in the incidence of hip fracture in Spain

There are many epidemiological studies describing the incidence of hip fracture in this country. In most cases, they are retrospective studies, local, covering short periods of time. Results have varied between different provinces. Thus, the overall incidence of hip fracture in Spain in people older than 65 years has been between 301 and 897/10<sup>5</sup> inhabitants<sup>3</sup>, values below those of other countries in Europe or the US.

As in other geographical locations, Spain also presents a north-south gradient in hip fracture incidence rates. The highest numbers are reported in the north, in places such as Barcelona, and lesser in the southern regions, such as the Canary Islands.

Table 1 shows a summary of epidemiological studies on hip fracture incidence in our country.

### Catalonia

Díez et al.<sup>4</sup> studied the incidence of hip fractures in Barcelona in 1984, using records of patients over 45 years admitted to acute care hospitals. A total of 1,163 patients, of whom 863 were women, were analyzed. The crude incidence of hip fractures in women was 252.2/10<sup>5</sup> and 115.6 inhabitants in men. The risk of fracture was 50% higher in women in any age group. In 1989, in the same city, Cucurull et al.<sup>5</sup> found the incidence was increased significantly in women, but was stable in men, in statistical terms.

### Asturias

Altadill et al.<sup>6</sup> analyzed the epidemiology of hip fracture in Asturias. They reviewed the medical records of all patients over 45 years of age admitted during 1992 and residing in two health areas of Asturias, a representative group encompassing rural and urban areas. Pathological fractures were excluded. The authors identified 283 osteoporotic hip fractures, 225 of them women. The annual incidence was 219.6/10<sup>5</sup> inhabitants in individuals over 50 years. The incidence in women over 45 years was three times higher than that of men of the same age (271 vs 88/10<sup>5</sup>, respectively). They also observed an exponential increase in incidence with age, finding that it doubled every five years from 75 years of age and in both sexes. The overall incidence of fractures was similar in both health areas: 76.5 and 83.5/10<sup>5</sup> inhabitants per year. The incidence of hip fractures in the rural habitat was 167.4/10<sup>5</sup>-year residents over 45 years and 218.9/10<sup>5</sup> year in an urban setting, for the same age group. The incidence in individuals over 50 years was also higher in urban areas (266 cases/10<sup>5</sup> inhabitants/year) than in rural (185.7/10<sup>5</sup> inhabitants/year). No difference in the proportion of women and men from both population areas.

### Castilla-Leon

Fernandez et al.<sup>7</sup> studied the incidence of hip fracture in Salamanca, in subjects over 50, from 1977 to 1988. They obtained an annual incidence of 195 cases/10<sup>5</sup> in women and 73/10<sup>5</sup> in men. During the 12 years analyzed, an increase in crude incidence of fracture of 143% was observed. Later, White et al.<sup>8</sup> conducted a retrospective study to determine the incidence of hip fracture in 1994-2002. They collected data on hospital discharges University Hospital of Salamanca patients over 65 diagnosed with hip fracture. A total of 2,726 cases were registered and was observed relative increase in hip fracture of 81% for women and 98% for males. The crude incidence fractures increased from 315 in 1994 to 496/10<sup>5</sup> inhabitants in 2002. This increase was not explained population aging, as during the study period, the number of subjects over 65 years increased 17% while the relative increase in hip fracture incidence was 57%.

### The Canary Islands

In the Canary Islands, Sosa and colleagues analyzed the epidemiological and demographic characteristics of hip fracture over two defined periods. In the first<sup>9</sup>, they studied the incidence of hip fractures from January 1, 1989 to December 31, 1993, in people age over 49 years in Gran Canaria, using records culled from the island's public and private hospitals. The total number of fractures was 1,175, of which 848 were in women. The adjusted incidence showed an increase in fractures from 127.8/10<sup>5</sup> in 1989 to 170.1 in 1993, an increase that, although observed in both sexes, was more pronounced in men. A higher incidence was recorded in autumn and winter.

Table 1. Epidemiological studies on the incidence of hip fracture age of 10<sup>5</sup> persons/year in females (F) and males (V) in Spain

Author (year)	Period	Location	Population study	Cup of incidence (10 <sup>5</sup> /year) (F/V)
Ferrández L (1992)	1977-1988	Salamanca	>50 years	195/73
Díez A (1989)	1984	Barcelona	>45 years	252/115
Olmos JM (1992)	1988	Cantabria	>49 years	277/100
Sosa M (1993)	1989-1993	Canary Islands	>49 years	221/170
Altadill A (1995)	1992	Asturias	>45 years	271/88
Arboleya LR (1997)	1994-1995	Palencia	>49 years	337/121
Serra L (2002)	1996-1999	Spain	>65 years	695/270
Herrera A (2006)	2002	Spain	>60 years	913/417
Blanco J (2006)	1994-2002	Salamanca	>65 years	699/225
Hernández JL (2006)	1988-2002	Cantabria	>50 years	389/101
Álvarez-Nebreda ML (2007)	2000-2002	Spain	>65 years	678/262
Sosa M (2013)	2007-2011	Canary Islands	>50 años	205/89
Azagra R (2014)	1997-2010	Spain	>65 years	766/325
Sosa M (2015)	1989-1993	Canary Islands	>49 years	204.5/91.4
	2007-2011			246/108.1
Etxebarria-Foronda I (2015)	200-2012	Spain	>65 years	153.24

In the second study, carried out during 2007 and 2011<sup>10</sup>, a total of 2,222 cases were collected of hip fractures in patients over 50, of whom 1,593 (71.7%) were women. The number of fractures increased with age until the early 90s. The female/male ratio was 2.53. The overall annual incidence was 150 cases/10<sup>5</sup> inhabitants, and 205.4 in women and 89.1 in men. During the study period, the incidence of hip fracture in Gran Canaria remained broadly stable, with the highest overall incidence in 2010 and the lowest in 2007, with a difference between both of 34.1 cases/10<sup>5</sup> inhabitants/year. 29.7% of all fractures occurred in winter.

The most recent work of this group, published in early 2015<sup>11</sup>, has aimed to compare changes in the incidence of hip fracture between the two periods mentioned. The age-adjusted incidence of hip fracture increased by 7.3% annually between 1989 and 1993. These findings suggest a trend towards stabilization of the incidence of hip fractures in the Canary Islands, mainly benefiting men. In women, however, the incidence has continued to increase.

#### Cantabria

In the north central area of Cantabria, two studies have been published so far into the epidemiology of hip fracture. The first, made by Olmos et al.<sup>12</sup>, the incidence of hip fracture in men and women older than 49 years was analyzed during 1988,

stratifying the data by place of residence (rural or urban) and on the time of year when the fracture occurred. The overall annual incidence rate was 198/10<sup>5</sup> inhabitants. For women, the figures were 277/10<sup>5</sup> and, in males, 100 cases/10<sup>5</sup> inhabitants. No significant differences in the incidence of hip fractures in rural and urban areas were found nor any evidence of seasonality.

Later, Hernandez et al.<sup>13</sup> analyzed the incidence of hip fractures in both sexes in 2002. The data obtained were compared with those of 1988, establishing for the first time the long-term trend of hip fracture in Cantabria. On this occasion, the authors observed increased incidence of hip fracture of about 50%, especially among women with respect to the values obtained 14 years earlier. However, adjusting the crude values depending on the age, no significant changes were observed. The recorded increase was attributed to factors related to the aging population. An interesting finding of this study was a greater increase in the number of cervical hip fractures (72.5%) than for trochanteric fractures (41%). As this type of fracture is considered the typical osteoporotic disease, given the aging of the population mentioned previously, it would seem logical to find an increase in the number of trochanteric fractures and not the cervical. The authors related this fact with the possible effect of anti-osteoporotic drugs and with the increase in size and physical exercise, factors that

favor an increase in cervical fractures. A seasonal pattern in the incidence of hip fracture in males in 2002 was also observed, not present in 1988, which consisted of an increased fracture rate in the summer and winter in connection with the spring and autumn. In this case the cause was more likely to be increased based on time out of the home during summer as residents tend to spend more time practicing outdoor sports activities, especially in the case of men. In winter months, with unfavorable weather conditions, there is an increased probability of falls and possible fractures. This work highlighted, from the results commented, that the relationship between the incidence of hip fracture in Spain compared to northern European countries remained constant.

### National studies

Only five studies published to date have analyzed the incidence of hip fracture across Spain. In the first, Serra et al.<sup>3</sup>, analyzed data from the National Register of the Minimum Basic Data Set (MBDS) at the Ministry of Health regarding hip fracture (identified by codes 820.0 to 820.9 of ICD-9) from 1996 to 1999. In this period a total of 130,414 cases of hip fracture in Spain in subjects older than 65 years were recorded. The overall crude incidence was 517 cases/10<sup>5</sup> inhabitants/year (270 cases in men and 695 in women). The results in the various regions showed large differences in incidence rates, the lowest in the Canary Islands and the highest in Catalonia (221 and 658 hip fractures per 10<sup>5</sup> inhabitants/year, respectively). The incidence by age group increased exponentially, from 107 cases/10<sup>5</sup> inhabitants/year in the age group 65 to 69 years, reaching 3,992 cases/10<sup>5</sup> inhabitants/year in individuals over 94 years. The incidence of hip fractures in women was almost double that of men in all age groups up to age 94.

Herrera et al.<sup>14</sup> conducted a multi-center study in 77 Spanish hospitals, recording osteoporotic hip fractures in patients over 60. The retrospective study evaluated fractures which occurred in 2002, and a prospective phase evaluated hip fractures in May 2003. In the retrospective phase 13,195 hip fractures were recorded, 74% of them in women. The overall average incidence was 6.94/10<sup>3</sup> inhabitants, 4.17/10<sup>3</sup> inhabitants/year in the case of men and 9.13/10<sup>3</sup> inhabitant/year in women. Extrapolation of these data allowed the authors to calculate an average of 61,173±3,878 osteoporotic hip fractures in patients older than 60 years in Spain in 2002. In the prospective phase, a total of 1,399 hip fractures were recorded. The annual incidence in males was 0.36/10<sup>3</sup> and 0.80/10<sup>3</sup> women. With these data, the authors estimated a prevalence of osteoporotic hip fractures 7.20 per 10<sup>3</sup> inhabitants/year in 2003 in subjects over 60 years in Spain.

Alvarez-Nebreda et al.<sup>15</sup> conducted a retrospective study of patients over 65, treated for hip fractures in the 19 Spanish Regional Communities from 2000 to 2002, data from the National Registry of the Ministry of Health (MBDS). They reported

107 718 cases, of which 74% were women. The adjusted annual incidence of hip fracture was 503 cases/10<sup>5</sup> inhabitants/year, 262 in men and 678 in women. The authors found differences between different communities, the Canary Islands showing the lowest incidence of hip fracture and the city of Melilla, the highest (312 and 679/10<sup>5</sup> inhabitants, respectively). The annual incidence rates increased exponentially with age (97 cases per 10<sup>5</sup> inhabitants/year among patients 65 to 69 years by 1898 and 10<sup>5</sup> inhabitants/year over 85 years). The incidence rate in women was twice that of men in all age groups up to 85 years.

Azagra et al.<sup>16</sup> analyzed the incidence rates of hip fracture in Spain in subjects older than 65 during two time periods: 1997-2000 and 2007-2010. As the MBDS source from the Ministry of Health and the codes used were analyzed from 820.0 to 820.9 of ICD-9. A total of 119,857 hip fractures in men and 415,421 women were counted. Incidence rates by sex were 259.24/10<sup>5</sup> inhabitants/year in men and 664.79/10<sup>5</sup> inhabitants/year in women in 1997 and 325.30/10<sup>5</sup> inhabitants/year and 766.37/10<sup>5</sup> inhabitants/year 2010, respectively.

In this work, a downward trend was observed in the incidence of hip fracture in women 65 to 80 years old accompanied by a significant increase after 85 years in both sexes. The authors pointed out that changes in population structure in Spain could be responsible for increased hip fracture rates in the population aged 85 or more. Furthermore, the widespread prescription of anti-resorptive drugs, especially bisphosphonates, in women and men under 70 could be responsible for the decline in the crude rate of hip fracture found in the youngest of the sample population.

Finally, Etxebarria-Foronda et al.<sup>17</sup>, based on data collected in the same national MBDS analyzed the trend in the incidence of hip fracture by age, among women of different Spanish autonomous regions, from 2000 to 2012. In 2000, the incidence of hip fracture in women was 131.26/10<sup>5</sup> inhabitants/year, which in 2012 amounted to 153.24/10<sup>5</sup> inhabitants/year. In this study, a continuous increase in absolute numbers was noted in the rate of hip fracture. However, after adjusting these rates by age, a decreasing trend was observed in certain sectors of the population. Accordingly, the authors demonstrated the presence of statistically significant changes in the trend of incidence rates in all age groups in women over 65 years. In the group of women between 65 and 74 years, the annual reduction was 2.2% and was slightly lower in the group of 75-84 years. The incidence rate in women over 85 increased by 0.58% on a yearly basis. The authors suggested that given the absence of major changes in the population structure, drugs for osteoporosis could be the main factor involved in the observed changes.

### Discussion

As we have seen, most of the studies in Spain are cross-sectional, ie. quantify the incidence of hip fracture in a specific city or region over a given

time period of time. Often the analyzed population varies between the studies and others, as well as the duration of the time period studied. Furthermore, the design of the work, the analysis methods used, results and conclusions are not quite reach homogeneous.

Studies published since the second half of the 90s, and especially those made during the first decade of the century, have begun to enhance the analysis of the incidence of this type of fracture, carrying out comparisons between the rates found in different geographical areas examined and considered in the interpretation of the results, the possible influence of factors such as climate, habitat and the effect of lifestyle changes and drug treatment for osteoporosis.

This situation should make us reflect as to what extent the international agencies responsible for planning strategies for the prevention and treatment of osteoporosis and hip fracture are based on data that properly reflect developments in the incidence of hip fracture in Spain. In 2011, Cooper et al.<sup>18</sup>, published an extensive report made from the analysis of 40 studies on the incidence of hip fractures in 40 countries from 4 of the 5 continents (Africa was not included). In this report, the question of the evolution of the incidence of hip fracture from the point of view of analyzing long-term trends identified, through the use of models of age-period-cohort, the age-specific rates of hip fracture in the final decades of the twentieth century. In this report, Spain was represented only by the study by Hernandez et al. in 2006, cited previously.

A year later, another report by Kanis et al. was published, by the Working Group for Epidemiology and Quality of Life of the International Osteoporosis Foundation (IOF)<sup>19</sup> based on the analysis of 72 studies from 63 countries. Unlike the previous study, this did not refer to secular trends in the populations studied, but noted that there are geographic differences in the incidence of hip fracture, approximately 10 times, depending on the area considered. It also found a decreasing north-south and urban-rural gradient. The precise reasons for these variations were not well defined, but related to genetic, environmental and demographic factors. In this report, Spain was represented using data from four studies, some of which collected data over more than three decades<sup>4,9,20,21</sup>. However, the methodological quality was deemed "good" or "appropriate."

In this scenario, it is not unreasonable to posit that most of the data used as reference for the incidence of hip fracture in Spain, are not entirely faithful nor do they reflect the situation current of the same in our country. Along with this lack of precision, we must consider the projections made on aging in Spain. The National Statistics Institute (INE) indicated that in our country, the number of people over 65 has doubled over the past 30 years. This process has been exacerbated by the low birth rate that has been recorded for several decades. Current data show that the Spanish population over 65 years represents about 17% of

the total population, with more than 7 million people, of which approximately 25% are octogenarians. The same organization states that, in 2050, people over 65 will constitute more than 30% of the population, ie. almost 13 million people, of which octogenarians will number more than 4 million. Similarly, a United Nations report<sup>22</sup> predicts Spain will be the oldest country in the world in 2050, the year when 40% of our population will be over 60 years.

In addition to this bleak panorama, we would highlight the limited follow-up control in these patients after hip fractures occur. In this sense, it would be desirable to carry out a multidisciplinary treatment of these patients in different units, a fact that would result in better control in the acute phase, especially when complications develop during the postoperative period and the exacerbation of pre-existing conditions. This situation is particularly important in the case of older patients, usually presenting poly-pharmacy and a high frequency of co-morbidities, which makes them an especially complex group. In addition, it is worth noting that, despite improvements in anesthesia and control of infections after surgery, the mortality rate for this type of fracture has barely changed in recent decades<sup>24,25</sup>. Furthermore, the use of anti-osteoporotic drugs after hip fracture remains low and may even be decreasing<sup>23</sup>.

In the past decade, advances in the understanding of the patho-physiology of osteoporosis and the development of anti-resorptive and osteoforming drugs make it essential that these patients be evaluated and monitored by teams of specialists with specific training in this field, which has been designated in recent studies<sup>26</sup> cost-effectiveness.

In conclusion, further work to update data on the incidence of hip fracture in Spain, especially its secular trend, and to unify criteria, both in the design and methods of analysis of the results should be obtained. This update may be of particular interest in defining the intervention thresholds based on absolute fracture risk, implemented at national and international level. Specific training should be provided to health professionals involved in health care after hip fracture, prevent the occurrence of new fractures and to treat chronic age-related diseases that worsen the prognosis and quality of life after the fracture. The development of multidisciplinary fracture units could provide a valuable option to improve the care of these patients and the social and health management of osteoporotic fracture.

## Bibliography

1. Abellán García A, Vilches Fuentes J, Pujol Rodríguez R (2014). "Un perfil de las personas mayores en España, 2014. Indicadores estadísticos básicos". Madrid, Informes Envejecimiento en red nº 6. Fecha de publicación: 14/02/2014. <http://envejecimiento.csic.es/documentos/documentos/enredindicadoresbasicos14.pdf>.
2. Norton R, Butler M, Robinson E, Lee-Joe T, Campbell AJ. Declines in physical functioning attributable to hip fracture.

- re among older people: a follow-up study of case-control participants. *Disabil Rehabil* 2000;22:345-51.
3. Serra JA, Garrido G, Vidan M, Maranon E, Branas F, Ortiz J. Epidemiology of hip fractures in the elderly in Spain. *An Med Interna* 2002;19:389-95.
  4. Díez A, Puig J, Martínez MT, Díez JL, Aubia J, Vivancos J. Epidemiology of fractures of the proximal femur associated with osteoporosis in Barcelona, Spain. *Calcif Tissue Int* 1989;44:382-6.
  5. Cucurull J, Puig J, Nogués X, Martínez MT, Galofré N, Tuyet J, et al. Fractura femoral osteoporótica en Barcelona. Cambios de incidencia. *Rev Esp Enf Metab Oseas* 1992;1(supl A):36-7.
  6. Altadill Arregui A, Gómez Alonso C, Virgós Soriano MJ, Díaz López B, Cannata Andía JB. Epidemiología de la fractura de cadera en Asturias. *Med Clin (Barc)* 1995;105:281-6.
  7. Ferrandez L, Hernandez J, Gonzalez-Orus A, Devesa F, Ceinos M. Hip fracture in the elderly in Spain. Incidence 1977-88 in the province of Salamanca. *Acta Orthop Scand* 1992;63:386-8.
  8. Blanco JF, Díaz-Alvarez A, De Pedro JA, Borrego D, del Pino J, Cortés J. Incidence of hip fractures in Salamanca, Spain. Period: 1994-2002. *Arch Osteoporos* 2006;1:7-12.
  9. Sosa M, Segarra MC, Hernandez D, Gonzalez A, Liminana JM, Betancor P. Epidemiology of proximal femoral fracture in Gran Canaria (Canary Islands). *Age Ageing* 1993;22:285-8.
  10. Vega Rodríguez N, Limiñana Cañal JM, Arbelo Rodríguez A, Medina Henríquez JA, Cabrera Domínguez D, Blázquez Gómez C, et al. Epidemiología de la fractura de cadera en Gran Canaria durante el quinquenio 2007-2011. *Rev Osteoporos Metab Miner* 2013;5:30-5.
  11. Sosa M, Saavedra P, de Tejada MJ, Navarro M, Cabrera D, Melton IJ, III. Trends in the incidence of hip fracture in Gran Canaria, Canary Islands, Spain: 2007-2011 versus 1989-1993. *Osteoporos Int* 2015;26:1361-6.
  12. Olmos JM, Martínez J, García J, Matorras P, Moreno JJ, Gonzalez-Macias J. Incidence of hip fractures in Cantabria. *Med Clin (Barc)* 1992;99:729-31.
  13. Hernandez JL, Olmos JM, Alonso MA, Gonzalez-Fernandez CR, Martínez J, Pajaron M, et al. Trend in hip fracture epidemiology over a 14-year period in a Spanish population. *Osteoporos Int* 2006;17:464-70.
  14. Herrera A, Martínez AA, Ferrandez L, Gil E, Moreno A. Epidemiology of osteoporotic hip fractures in Spain. *Int Orthop* 2006;30:11-4.
  15. Alvarez-Nebreda ML, Jimenez AB, Rodriguez P, Serra JA. Epidemiology of hip fracture in the elderly in Spain. *Bone* 2008;42:278-85.
  16. Azagra R, Lopez-Exposito F, Martin-Sanchez JC, Aguye A, Moreno N, Cooper C, et al. Changing trends in the epidemiology of hip fracture in Spain. *Osteoporos Int* 2014;25:1267-74.
  17. Etxebarria-Foronda I, Arrospe A, Soto-Gordoa M, Caeiro JR, Abecia LC, Mar J. Regional variability in changes in the incidence of hip fracture in the Spanish population (2000-2012). *Osteoporos Int* 2015;26:1491-7.
  18. Cooper C, Cole ZA, Holroyd CR, Earl SC, Harvey NC, Dennison EM, et al. IOF CSA Working Group on Fracture Epidemiology. Secular trends in the incidence of hip and other osteoporotic fractures. *Osteoporos Int* 2011;22:1277-88.
  19. Kanis JA, Odén A, McCloskey EV, Johansson H, Wahl DA, Cooper C; IOF Working Group on Epidemiology and Quality of Life. A systematic review of hip fracture incidence and probability of fracture worldwide. *Osteoporos Int* 2012;23:2239-56.
  20. Elffors I, Allander E, Kanis JA, Gullberg B, Johnell O, Dequeker J, et al. The variable incidence of hip fracture in southern Europe: the MEDOS Study. *Osteoporos Int* 1994;4:253-63.
  21. Izquierdo Sánchez M, Ochoa Sangrador C, Sánchez Blanco I, Hidalgo Prieto MC, Lozano del Valle F, Martín González T. Epidemiology of osteoporotic hip fractures in the province of Zamora (1993). *Rev Esp Salud Pública* 1997;71:357-67.
  22. Population Ageing and Development 2009: [www.unpopulation.org](http://www.unpopulation.org).
  23. Solomon DH, Johnston SS, Boytsov NN, McMorrow D, Lane JM, Krohn KD. Osteoporosis medication use after hip fracture in U.S. patients between 2002 and 2011. *J Bone Miner Res* 2014;29:1929-37.
  24. Giverson IM. Time trends of mortality after first hip fractures. *Osteoporos Int* 2007;18:721-32.
  25. Brauer CA, Coca-Perrillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. *JAMA* 2009;302:1573-9.
  26. Solomon DH, Patrick AR, Schousboe J, Losina E. The potential economic benefits of improved postfracture care: a cost-effectiveness analysis of a fracture liaison service in the US health-care system. *Bone Miner Res* 2014;29:1667-74.