

Review Article

Epidemiology of hip fractures in Europe: Geographic variability

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Hip fracture constitutes a significant health concern especially for older adults. The incidence of hip fractures varies among countries, but it is estimated that globally, around 18% of women and 6% of men will be affected. Despite a gradual decrease in age-standardized incidence in several countries, the overall increase in the ageing population will lead to an expected rise in the number of hip fractures. This review provides an overview of hip fractures in European countries focuses on the most recent epidemiological data on hip fracture.

Keywords: Epidemiology, Hip fracture, Osteoporosis**Introduction**

Osteoporosis is the most common metabolic bone disease and the primary cause of fracture in people over the age of 50 years. Hip fractures constitute a major public health issue worldwide, particularly among the elderly population, and can cause substantial pain, disability, and even death¹. Despite representing only 20% of all osteoporotic fractures, hip fractures are the most serious and costly consequence of osteoporosis and are typically identified because they require hospitalization and medical attention². Hip fractures are a growing concern, with estimates indicating that over six million hip fractures occur on a global scale every year. This number is projected to rise significantly in the coming years, particularly in developing countries, due to the aging of the population and changes in lifestyle factors³. Hip fractures are associated with significant mortality and morbidity rates. For instance, up to 20% of patients with hip fractures die within one year of the injury, while another 50% experience a significant decline in their overall health and quality of life⁴. Additionally, hip fractures are a major cause of healthcare costs, particularly due to the need for prolonged hospital stays, surgery, and postoperative rehabilitation.

International Osteoporosis Foundation (IOF) report projects that the population of individuals over 50 years old in the Europe will increase by 11.4% between 2019 and 2034, and the annual number of osteoporotic fractures will rise by 25%⁵. Although the population of Western

countries is not expected to increase significantly, the proportion of the elderly population in Europe is projected to rise by 33% in the next thirty years. By 2050, it is estimated that approximately 6.26 million hip fractures will occur³. Consequently, the clinical and care implications of hip fractures pose one of the most significant obstacles that healthcare authorities will need to address in the years ahead.

Numerous studies have reported significant geographic variations in hip fracture rates across the globe, varying by at least 10-fold⁶⁻⁸. The broad range reported can be attributed, at least in part, to differences in the time frame during which fractures were documented for each country, the population of interest, and whether the regions covered were urban or rural. While hip fracture rates were stabilizing or declining in western countries, they continued to increase in densely populated regions^{2,9}. The demographic explosion is having a

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greater impact on developing countries than developed ones, and there is a lack of reliable data on hip fracture rates in some countries. Understanding the incidence of hip fractures is crucial to developing effective strategies for prevention and treatment of this condition.

In this review, we provide an overview of hip fractures in European countries focuses on the most recent studies regarding epidemiological data on hip fracture. However, comparing hip fracture incidence is challenging due to differences in study periods that cannot be perfectly aligned and for many countries it was not possible to identify published national data. This paper was conducted using the PubMed database. Keywords that were employed included hip fracture, incidence rate, geographic variation, osteoporosis, and epidemiology. The articles were selected based on three criteria: (1) studies that examined geographic variation in hip fracture with a focus on Europe (2) articles in English; (3) studies were included if they reported the incidence of hip fractures in adults aged 50 years or older.

Europe

The risk of fracture varies considerably across countries⁷, with Northern European countries having the highest observed rates worldwide. In Europe, hip fractures account for 17% of all fragility fractures, but contribute to 54% of direct costs and 49% of deaths caused by fractures¹⁰. In 2010, approximately 600,000 hip fractures occurred in Europe¹¹, with the highest incidence rates being reported in Northern Europe and the lowest in Switzerland and France¹². While most developed countries have witnessed a decline in the incidence of hip fractures over the last few years, developing countries have reported a rising trend⁹.

Northern Europe

The countries of Scandinavia [Sweden¹³, Denmark¹⁴, Norway¹⁵ and Finland¹⁶] show the highest hip fracture rates in Europe for both genders. The Scandinavian countries have reported a decrease in hip fracture incidence rates in recent years. The implementation of successful prevention and treatment programs, such as the Fracture Liaison Service (FLS) have contributed to these positive trends¹⁷.

According to a recent nationwide study conducted in Sweden between 1998 and 2017, the incidence as well as the total number of hip fractures declined, despite the fact that the population was aging. The study revealed that the incidence of hip fractures decreased significantly in women from 79.2 to 46.7 per 10,000 population and in men from 35.7 to 26.5 per 10,000 population. This decline was observed in all age groups, but the absolute risk reduction was more significant in older age groups. The study also showed a decrease in the total number of hip fractures in both genders specifically in women from 13,340 to 9,266 cases, and 5,194 to 4,922 fractures in men¹⁸. For the years 2007–2016, 151,554 individuals in the Swedish population had a total of 165,233 hip fractures, most of which occurred in

women (68.1%). The hip fracture incidence rate was 29.4 for women and 14.0 for men. From 2007 to 2016, there was a gradual decrease in the rate among women, while the rate remained steady among men¹⁷.

A study based on the Danish Multidisciplinary Hip Fracture Registry¹⁹ documented 86,438 patients who had experienced hip fractures between 2006 and 2018. The study reported that the incidence rate decreased by 2.2% per year in women and by 1.7% per year in men. The number of patients remained fairly constant during the study period, with an average of around 6,800 cases. The incidence of hip fractures in Denmark in 2018 was 5.65 per 1,000 inhabitants.

A study conducted using data from the Norwegian Patient Registry²⁰ between 2002 and 2013 revealed that Norway experienced an annual average of 9,182 hip fractures, with a higher prevalence among women than men. This gender disparity was more pronounced among younger age groups, where the incidence stood at 84 per 10,000 person-years for women in Oslo, as opposed to 41 for men. Notably, the gender gap lessened among individuals aged 80 and above. The incidence rates of hip fractures, adjusted for age, exhibited variations across different counties, ranging from 69 to 84 per 10,000 person-years in women and 34 to 41 per 10,000 person-years in men. Notably, Oslo registered the highest mean age-standardized hip fracture rates for both genders. In contrast, the county with the lowest incidence rate was Sogn and Fjordane, showing a 17% lower rate among women compared to Oslo. Similarly, in men, Oslo and Nord-Trøndelag, the county with the lowest rate, showed a 15% difference.

A study published in 2018 used data from the Finnish National Hospital Discharge Register²¹ to examine hip fracture incidence rates from 1970 to 2016. The study reported that the incidence rate increased from 1970 to 1997 and then decreased. Hip fracture incidence in Finland increased rapidly until the late 1990s, with the number of fractures rising from 1,857 in 1970 to 7,122 in 1997. Since then, the rate of increase has slowed down, with 7,716 hip fractures reported in 2016. After peaking in 1997, the age-adjusted incidence of hip fractures declined, particularly among women, with a rate of 537.9 per 100,000 persons in 1997 compared to 344.1 in 2016. For men, the corresponding rates were 256.5 and 194.7, respectively. However, due to the sharp growth of the population at risk, hip fractures are still projected to increase by 44% by 2030, unless there is a further decline in incidence rates from 2016 to 2030.

Western Europe

A nationwide study conducted in Austria²² examined hip fracture epidemiology. The research revealed that from 2009 to 2018, the total number of hip fracture cases initially rose from 13,984 to 14,640 but then decreased to 14,457, even with a consistent increase in cases among

men. The age-standardized incidences reached a peak of 476 per 100,000 in 2010, followed by a decline to 408 per 100,000 in 2018. The reduction in overall incidence was primarily driven by a decrease in the female population. The study's incidence rate ratios demonstrated a statistically significant annual decrease in age-standardized incidences for both women and men. Although there was a slight decrease in the absolute number of hip fractures in women over the last decade, there was an increase in men. However, the age-standardized incidence decreased in both genders, indicating a positive trend. Nevertheless, the rapidly aging population may threaten this trend in the coming decades.

In France the incidence of hip fracture between 2002 and 2013 increased from 49,287 to 51,661 in women (4.8%) and from 12,716 to 15,482 in men (21.8%) aged over 59 years. Over the same period, the population of individuals aged 59 years and older in France increased by 21.3% among women and 28.7% among men. As a result, there was a decline in the incidence rates of hip fracture, with a decrease of 13.6% among women and 5.4% among men. However, after standardization on the 2013 population of reference, this decrease was larger at 25.6% in women and 19.2% in men, due to differences in the age-structure of the population²³. The number of hip fractures increased from 74,844 (18,697 men vs 56,147 women) in 2015 to 79,340 in 2019 (20,235 men vs 59,105 women).

While many studies from Europe have reported a decrease in hip fracture incidence in recent years, Germany has observed an increase in hip fracture incidence until 2003²⁴. A study that utilized the national hospital discharge register in Germany revealed that from 1995 to 2004, there was a 0.5% annual increase in hip fracture incidence in women and a 0.7% increase in men. Among women aged 40 years and older, the incidence of hip fracture tended to decrease up to the age of 74, but then increased notably in those over 75 years. Notably, a more pronounced rise in hip fracture incidence was evident in Eastern Germany as opposed to Western Germany, especially among older age groups. These results imply that the dissimilarities in hip fracture rates between the Eastern and Western regions might have decreased over time²⁴. Although there was no significant trend in the total population of Germany between 1995 and 2010, varying trends were observed in different subgroups. Rates decreased in women from Western Germany, while rates increased in men from both Western and Eastern Germany. The convergence of lifestyles in both parts of the country could have contributed to the convergence of hip fracture incidence rates in the Eastern and Western Germany^{25,26}.

Between 1995 and 2010, the total count of hospitalizations for hip fracture surged from 99,146 to 128,240. Yet, upon adjusting for age, sex, and region, no notable trend was discernible over this duration. However, upon delving into specific subcategories, a noteworthy decline emerged in individuals under 40 years of age across

both sexes and regions. Additionally, among women aged 60 years and above in Western Germany, the incidence of hip fractures diminished, while Eastern Germany saw stability. In contrast, among men aged 40-59 and 60 years and older, both regions witnessed an increase in hip fracture rates. While overall incidence rates continued to be markedly higher in Western Germany and its subgroups, a semblance of convergence over time was apparent²⁶.

Over a span of two decades (1998 to 2018) in Switzerland, hip fractures exhibited a notable shift. The instances of hip fractures escalated more significantly in men, soaring from 2,478 to 3,517 (+41.9%), compared to a relatively moderate increase in women, from 7,512 to 8,322 (+10.8%). However, intriguingly, the incidence of hip fractures experienced a decline, diminishing by 15.3% among men and 21.5% among women²⁷. From 1991 to 2000, a cumulative total of 4,115 hip fractures were documented, impacting 2,981 women and 822 men. The incidence of hip fractures displayed a higher occurrence in women, with a rate of 455 per 100,000 person-years, in contrast to 153 per 100,000 person-years in men. Even though the count of hip fractures remained constant at 412, the average age of affected patients escalated annually by 0.13 years among women and 0.04 years among men. Once standardized to the 2000 Geneva population, the age-adjusted hip fracture incidence dwindled considerably by 1.4% annually among women, while maintaining stability among men. Further insights revealed that the ratio of hip fracture incidence between females and males stood at 2.99, yet it saw a significant decline of 0.07 per year²⁸.

Eastern Europe

In Poland, a study conducted by Czerwinski et al. 2009²⁹ using data from National Health Fund registry of treatment service showed that in 2005, the count of diagnosed hip fractures tallied to 17,625. Delving into the demographics, the incidence of hip fractures within the population aged 50 and above was 89 per 100,000 for men and 165 per 100,000 for women. Interestingly, within the 50-65 age group, the occurrence of hip fractures exhibited a higher prevalence among men compared to women²⁹. A more recent study from R. Wilk et al. (2014)³⁰, conducted between 2002 and 2010 in Tarnowskie Góry district and Piekary Śląskie city, analyzed data from 937 patients who had suffered hip osteoporotic fractures and were aged between 50 and 101 years. The majority of the participants were women, totaling 697 subjects (74.4%), with a mean age of 79.1±9.3 years. The male population studied was slightly younger than the female population, with a mean age of 73.2±11.5 years, and this difference was statistically significant³⁰. The incidence of fractures was significantly higher in urban areas compared to rural areas and was observed to be two to three times higher in females than males. Over the study period, there was a systematic increase in the fracture rate, with the last year's rate being 44% higher than the rate in 2002. The

increase was observed to be lower in females (20.7%) than in males (57.6%) and lower in urban (27%) than in rural (67.7%) residents. The study conducted by Czerwinski et al.²⁹ examined hip fracture incidence and risk using validated hospital discharge records from the entire country. The study revealed an incidence of 165 hip fractures per 100,000 inhabitants in women aged over 50 years, compared to 89 fractures in men. However, in the R. Wilk et al. study³⁰ reported different figures, with a higher incidence for women (218) and a lower one for men (69). Additionally, the estimated number of hip fractures for 2005 exceeded the value reported in the Czerwinski et al. study.

In Bulgaria, according to national data on hip fracture incidence, it was estimated that there were 9,322 hip fractures in individuals over the age of 50 in 2015, and this number is projected to increase to 11,398 by 2050. The number of hip fractures in individuals aged 50 years and above in Bulgaria was 9322 in 2015, with 2521 cases in men and 6801 cases in women, resulting in a female/male ratio of 2.7. The rise in hip fracture incidence is more pronounced in women, with a 24% increase compared to an 18% increase in men, owing to the greater age-related susceptibility to hip fractures in women. Among individuals below the age of 65 years, men had a higher prevalence of hip fractures compared to women with a female/male ratio of 0.7. However, among those above the age of 65 years, women had a higher frequency of hip fractures with a female/male ratio of 3.2. Hip fracture incidence increased with age in both genders, but the increase was more pronounced in women³¹.

The incidence of hip fractures in Greece varies by age and sex. In 2019, the incidence of hip fractures in women was more than twice that of men (564.6 vs. 243.3 per 100,000 person-years). The incidence of hip fractures also increased with age, with the highest incidence observed in individuals aged 85 years and older. The total population over 60 years of age had a crude one-year incidence of hip fractures at a rate of 672.2 per 100,000. When broken down by gender, males had an incidence of 442.6 per 100,000 while females had an incidence of 882.9 per 100,000. The age-specific incidence for each 10-year age group showed an incidence of 113.7 per 100,000 for those aged 60 to 69, 267.6 per 100,000 for those aged 70 to 79, 1607.2 per 100,000 for those aged 80 to 89, and 5228.8 per 100,000 for those over 90 years of age³².

Conclusion

While incidence hip rates vary across countries, the burden of hip fractures is projected to increase in the coming years, particularly in countries with an aging population. To address this public health concern, strategies are needed to reduce the incidence of hip fractures, particularly in high-risk populations. These strategies may include lifestyle modifications to promote healthy bone density, improved screening and diagnosis of high-risk patients, and the

development of effective treatments for those who do experience a hip fracture.

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