Osteoporosis in the European Union: a compendium of country-specific reports

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Abstract
Summary This report describes epidemiology, burden, and treatment of osteoporosis in each of the 27 countries of the European Union (EU27).

Introduction In 2010, 22 million women and 5.5 million men were estimated to have osteoporosis in the EU; and 3.5 million new fragility fractures were sustained, comprising 620,000 hip fractures, 520,000 vertebral fractures, 560,000 forearm fractures and 1,800,000 other fractures. The economic burden of incident and prior fragility fractures was estimated at €37 billion. Previous and incident fractures also accounted for 1,180,000 quality-adjusted life years lost during 2010. The costs are expected to increase by 25% in 2025. The majority of individuals who have sustained an osteoporosis-related fracture or who are at high risk of fracture are untreated and the number of patients on treatment is declining. The aim of this report was to characterize the burden of osteoporosis in each of the EU27 countries in 2010 and beyond.

Methods The data on fracture incidence and costs of fractures in the EU27 were taken from a concurrent publication in this journal (Osteoporosis in the European Union: EU review panel of the IOF).
Medical Management, Epidemiology and Economic Burden) and country specific information extracted.

Results The clinical and economic burden of osteoporotic fractures in 2010 is given for each of the 27 countries of the EU. The costs are expected to increase on average by 25% in 2025. The majority of individuals who have sustained an osteoporosis-related fracture or who are at high risk of fracture are untreated and the number of patients on treatment is declining.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis has decreased in recent years, suggesting that a change in healthcare policy concerning the disease is warranted.

Keywords Epidemiology · Fracture · Economic burden · European Union · Treatment · Health Technology Assessment

List of abbreviations

| Abbreviation | Description |
|--------------|-------------|
| DDD          | Defined daily dosage |
| DXA          | Dual-energy X-ray absorptiometry |
| EU27         | Refers to the 27 countries of the European Union |
| FRAX®        | WHO fracture risk assessment tool |
| GDP          | Gross domestic product |
| QALY         | Quality-adjusted life year |
| SD           | Standard deviation |
| T-score      | number of SDs by which BMD in an individual differs from the mean value expected in young healthy women |

Introduction

Osteoporosis, literally “porous bone”, is a disease characterized by weak bone. It is a major public health problem, affecting hundreds of millions of people worldwide, predominantly postmenopausal women. The main clinical consequence of the disease is bone fractures. It is estimated that one in three women and one in five men over the age of fifty worldwide will sustain an osteoporotic fracture. Hip and spine fractures are the two most serious fracture types, associated with substantial pain and suffering, disability, and even death. As a result, osteoporosis imposes a significant burden on both the individual and society. During the past two decades, a range of medications has become available for the treatment and prevention of osteoporosis. The primary aim of pharmacological therapy is to reduce the risk of osteoporotic fractures.

A recent report ‘Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden’ published concurrently with this report described the current burden of osteoporosis in the EU in 2010. Twenty two million women and 5.5 million men were estimated to have osteoporosis; and 3.5 million new fragility fractures were sustained, comprising 620,000 hip fractures, 520,000 vertebral fractures, 560,000 forearm fractures and 1,800,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures). The economic burden of incident and prior fragility fractures was estimated at €37 billion. Incident fractures represented 66% of this cost, long-term fracture care 29% and pharmacological prevention 5%. Previous and incident fractures also accounted for 1,180,000 quality-adjusted life years lost during 2010. The costs are expected to increase by 25% in 2025. The majority of individuals who have sustained an osteoporosis-related fracture or who are at high risk of fracture are untreated and the number of patients on treatment is declining.

The objective of this report is to review and describe the current burden of osteoporosis in each of the EU member states. Epidemiological and health economic
aspects of osteoporosis and osteoporotic fractures are summarised for 2010 with projections of the future prevalence of osteoporosis, the number of incident fractures, the direct and total cost of the disease including the value of QALYs lost. The report may serve as a basis for the formulation of healthcare policy concerning osteoporosis in general and the treatment and prevention of osteoporosis in particular. It may also provide guidance regarding the overall healthcare priority of the disease in each member state.
Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Austria.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Austria, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Austria was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 87,000 new fragility fractures were sustained in Austria, comprising 16,000 hip fractures, 13,000 vertebral fractures, 13,000 forearm fractures and 44,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €799 million for the same year. Incident fractures represented 68 % of this cost, long-term fracture care 29 % and pharmacological prevention 4 %. Previous and incident fractures also accounted for 27,900 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 116,000 in 2025, representing an increase of 30,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 5,700, 4,400, 3,700 and 15,900, respectively. The burden of fractures in Austria in 2025 was estimated to increase by 28 % to €1,025 million.

Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. The majority of women at high fracture risk did not receive active treatment.
Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Austria in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Austria was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Austria

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 1,381,000 and 1,660,000 respectively in Austria in 2010 (Table 1).

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–59      | 556,000 | 545,000 | 1,101,000 |
| 60–69      | 477,000 | 435,000 | 912,000 |
| 70–79      | 351,000 | 275,000 | 626,000 |
| 80–89      | 238,000 | 116,000 | 354,000 |
| 90+        | 38,000  | 10,000  | 48,000  |
| 50+        | 1,660,000 | 1,381,000 | 3,041,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 460,000 (Table 2). There were 28.7 DXA scan machines per million inhabitants [2] and guidelines for the assessment and treatment of osteoporosis are available [3, 4]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Austria [6]. Given that country specific incidences of vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 322.9 and 757.2 respectively.

The number of incident fractures in 2010 was estimated at 87,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 16,000, 13,000, 13,000 and 44,000 respectively. 66 % of fractures occurred in women. These estimates are in close agreement with recently published data for 2008 [7].

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals who had suffered a fracture prior to 2010 were estimated at 2.44 % for hip and 2.75 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 74,000 and 84,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 19,026 | 7,525 |
| 55–59      | 24,384 | 8,540 |
| 60–64      | 34,320 | 12,992 |
| 65–69      | 47,874 | 15,614 |
| 70–74      | 54,684 | 12,636 |
| 75–79      | 58,125 | 11,639 |
| 80+        | 130,272 | 20,916 |
| 50+        | 368,685 | 89,862 |
The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 1,018 (Table 8). Hip, vertebral and “other” fractures accounted for 505, 317 and 195 deaths respectively. Overall, approximately 55% of deaths occurred in women.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 1,018 (Table 8). Hip, vertebral and “other” fractures accounted for 505, 317 and 195 deaths respectively. Overall, approximately 55% of deaths occurred in women.

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Austria by age

| Age (years) | hip | vertebral | forearm | other | 
|-------------|-----|-----------|---------|-------|
| **Women**   |     |           |         |       |
| 50–54       | 34  | 88        | 217     | 224   |
| 55–59       | 69  | 191       | 528     | 605   |
| 60–64       | 115 | 203       | 433     | 442   |
| 65–69       | 203 | 296       | 493     | 694   |
| 70–74       | 411 | 579       | 738     | 1,165 |
| 75–79       | 845 | 821       | 824     | 1,777 |
| 80–84       | 1,773| 1,114   | 1,099   | 3,014 |
| 85+         | 3,312| 1,473   | 1,337   | 5,262 |
| **Men**     |     |           |         |       |
| 50–54       | 57  | 146       | 52      | 253   |
| 55–59       | 79  | 138       | 121     | 741   |
| 60–64       | 109 | 260       | 205     | 1,069 |
| 65–69       | 162 | 255       | 243     | 1,044 |
| 70–74       | 262 | 399       | 168     | 1,345 |
| 75–79       | 470 | 542       | 133     | 1,255 |
| 80–84       | 924 | 642       | 179     | 2,457 |
| 85+         | 1,652| 1,110   | 303     | 4,785 |

Table 4 Estimated number of incident fractures in Austria, 2010

| Age (years) | hip | vertebral | forearm | other |
|-------------|-----|-----------|---------|-------|
| **Women**   |     |           |         |       |
| 50–74       | 2,159| 3,328 | 6,166  | 8,204 |
| 75+         | 9,675| 4,952 | 4,883  | 17,824 |
| Total       | 11,835| 8,280 | 11,049 | 26,029 |
| **Men**     |     |           |         |       |
| 50–74       | 1,603| 2,819 | 1,820  | 10,509 |
| 75+         | 2,650| 2,004 | 554    | 7,385 |
| Total       | 4,254| 4,822 | 2,373  | 17,894 |
| **Men and Women** | | | | |
| 50–74       | 3,763| 6,146 | 7,986  | 18,713 |
| 75+         | 12,326| 6,956 | 5,437  | 25,209 |
| Total       | 16,088| 13,102| 13,422 | 43,923 |

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Austria, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| **Women**   |             |                   |
| 50–54       | 0.1          | 0.2               |
| 55–59       | 0.3          | 0.8               |
| 60–64       | 0.6          | 1.5               |
| 65–69       | 1.2          | 2.3               |
| 70–74       | 2.3          | 3.7               |
| 75–79       | 4.4          | 5.8               |
| 80–84       | 8.4          | 8.4               |
| 85+         | 17.6         | 13.4              |
| **Men**     |             |                   |
| 50–54       | 0.1          | 0.2               |
| 55–59       | 0.4          | 0.8               |
| 60–64       | 0.8          | 1.4               |
| 65–69       | 1.3          | 2.0               |
| 70–74       | 2.0          | 2.6               |
| 75–79       | 3.1          | 3.5               |
| 80–84       | 5.3          | 4.5               |
| 85+         | 10.4         | 7.9               |

Cost of osteoporosis in Austria including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs

Table 6 Number of men and women in Austria with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| **Women**   |             |                   |
| 50–74       | 9,860        | 18,815            |
| 75+         | 42,758       | 39,129            |
| Total       | 52,617       | 57,944            |
| **Men**     |             |                   |
| 50–74       | 9,005        | 14,331            |
| 75+         | 12,648       | 11,348            |
| Total       | 21,653       | 25,679            |
| **Men and Women** | | | |
| 50–74       | 18,865       | 33,146            |
| 75+         | 55,405       | 50,476            |
| Total       | 74,270       | 83,623            |
Table 7 Incidence (per 100,000) of causally related deaths in Austria within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
| Women       |     |                    |                  |
| 50–54       | 573 | 744                | 15               |
| 55–59       | 609 | 749                | 18               |
| 60–64       | 990 | 1,150              | 31               |
| 65–69       | 1,314| 1,441              | 49               |
| 70–74       | 1,510| 1,558              | 69               |
| 75–79       | 2,100| 2,029              | 132              |
| 80–84       | 2,513| 2,224              | 280              |
| 85–89       | 3,111| 2,418              | 545              |
| 90+         | 2,936| 1,655              | 1,021            |
| Men         |     |                    |                  |
| 50–54       | 1,549| 1,857              | 24               |
| 55–59       | 1,852| 2,105              | 38               |
| 60–64       | 2,577| 2,772              | 70               |
| 65–69       | 2,731| 2,770              | 98               |
| 70–74       | 3,110| 2,961              | 140              |
| 75–79       | 3,979| 3,529              | 236              |
| 80–84       | 5,017| 4,074              | 421              |
| 85–89       | 6,643| 4,856              | 718              |
| 90+         | 10,106| 6,577             | 1,264            |

in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

Table 8 The number of deaths in men and women in Austria in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Fracture at the vertebra | “other” |
|-------------|-----|--------------------------|--------|
| Women       |     |                          |        |
| 50–74       | 31  | 48                       | 4      |
| 75+         | 257 | 97                       | 124    |
| Total       | 288 | 145                      | 128    |
| Men         |     |                          |        |
| 50–74       | 46  | 80                       | 10     |
| 75+         | 171 | 93                       | 57     |
| Total       | 217 | 172                      | 67     |
| Men and Women | 77  | 128                      | 55     |
| 75+         | 428 | 189                      | 181    |
| Total       | 505 | 317                      | 195    |

Table 9 One year costs for relevant pharmaceuticals in Austria, 2010 [11]

| Annual drug cost (€) |
|----------------------|
| Alendronate          | 174 |
| Risedronate          | 173 |
| Etidronate           | 337 |
| Ibandronate          | 266 |
| Zoledronic acid      | 368 |
| Raloxifene           | 463 |
| Strontium ranelate   | 602 |
| Parathyroid hormone  | 4,881|
| Teriparatide         | 5,033|

For Austria, only inpatient costs the first year after hip fracture had been reported at the cut off date [8]. Total first year costs after fracture were imputed by applying the inpatient cost for Austria to the ratio of inpatient cost to total first year costs observed in Sweden, resulting in an estimated total first year hip fracture cost of € 13,527. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report. A recent publication provides similar estimates [7].

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€ 33,317 [9]) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Cost of pharmacological fracture prevention including its administration were based on treatment uptake reported by IMS Health [10]. Annual drug cost for individual treatments

Table 10 Cost of osteoporosis (€) in Austria by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|---------------------------|--------------------------|------------|
| Women       |                          |                           |                          |            |
| 50–74       | 102,053,686              | 20,498,662                | 16,211,264               | 138,763,611|
| 75+         | 251,821,366              | 139,171,528               | 10,238,872               | 401,231,767|
| All         | 353,875,052              | 159,670,190               | 26,450,136               | 539,995,378|
| Men         |                          |                           |                          |            |
| 50–74       | 100,949,687              | 22,209,312                | 2,580,748                | 125,739,747|
| 75+         | 84,698,294               | 47,262,010                | 1,137,709                | 133,098,012|
| All         | 185,647,981              | 69,471,322                | 3,718,456                | 258,837,759|
| Women and Men |                         |                           |                          |            |
| 50–74       | 203,003,373              | 42,707,973                | 18,792,012               | 264,503,358|
| 75+         | 336,519,660              | 186,433,538               | 11,376,581               | 534,329,779|
| All         | 539,523,033              | 229,141,511               | 30,168,592               | 798,833,136|
is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 30 [11] and a DXA scan costing € 30 every second year to monitor treatment [11].

The cost of osteoporosis in 2010 was estimated at € 799 million (Table 10). These costs are close to recently published estimates for 2008 [7]. First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to € 540 million, € 229 million and € 30 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 3.8 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€ 421 million) followed by “other” (€ 300 million), spine (€ 36

| Age   | Hip     | Spine   | Forearm | Other   | All     |
|-------|---------|---------|---------|---------|---------|
| Women |         |         |         |         |         |
| 50–74 | 48,671,702 | 9,608,786 | 5,096,281 | 59,175,579 | 122,552,347 |
| 75+   | 254,284,487 | 13,377,107 | 4,036,070 | 119,295,231 | 390,992,895 |
| All   | 302,956,189 | 22,985,893 | 9,132,351 | 178,470,809 | 513,545,242 |

| Men   |         |         |         |         |         |
|-------|---------|---------|---------|---------|---------|
| 50–74 | 42,389,664 | 7,862,829 | 1,504,074 | 71,402,432 | 123,158,999 |
| 75+   | 75,870,194 | 5,017,929 | 457,487 | 50,614,693 | 131,960,303 |
| All   | 118,259,858 | 12,880,758 | 1,961,561 | 122,017,126 | 255,119,302 |

| Women and Men |         |         |         |         |         |
|---------------|---------|---------|---------|---------|---------|
| 50–74         | 91,061,365 | 17,471,615 | 6,600,355 | 130,578,011 | 245,711,346 |
| 75+           | 330,154,681 | 18,395,036 | 4,493,557 | 169,909,924 | 522,953,198 |
| All           | 421,216,047 | 35,866,651 | 11,093,912 | 300,487,935 | 768,664,544 |

| Age         | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 518 | 2,013 | 2,531 |
| Incident vertebral fractures | 1,099 | 1,411 | 2,510 |
| Incident forearm fractures | 217 | 147 | 365 |
| Incident other fractures | 982 | 1,841 | 2,824 |
| Prior hip fractures | 1,545 | 5,741 | 7,286 |
| Prior vertebral fractures | 1,052 | 1,889 | 2,940 |
| Total        | 5,413 | 13,043 | 18,456 |

| Men          |       |     |     |
|--------------|-------|-----|-----|
| Incident hip fractures | 391 | 633 | 1,025 |
| Incident vertebral fractures | 938 | 638 | 1,575 |
| Incident forearm fractures | 63 | 18 | 81 |
| Incident other fractures | 1,246 | 839 | 2,085 |
| Prior hip fractures | 1,407 | 1,873 | 3,280 |
| Prior vertebral fractures | 796 | 598 | 1,395 |
| Total        | 4,842 | 4,599 | 9,441 |

| Men and Women |       |     |     |
|---------------|-------|-----|-----|
| Incident hip fractures | 910 | 2,646 | 3,556 |
| Incident vertebral fractures | 2,037 | 2,049 | 4,086 |
| Incident forearm fractures | 281 | 165 | 446 |
| Incident other fractures | 2,229 | 2,680 | 4,909 |
| Prior hip fractures | 2,952 | 7,614 | 10,565 |
| Prior vertebral fractures | 1,848 | 2,487 | 4,335 |
| Total        | 10,255 | 17,642 | 27,897 |
million) and forearm fractures (€ 11 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites. The results are generally consistent with a recent cost of illness study undertaken for the year 2008 [7].

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 27,900 (Table 12). 66 % of the total QALY loss was incurred in women. Prior fractures accounted for 53 % of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at € 1.90 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 2.70 billion in Austria in 2010.

Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 20 %, 8 %, 1 %, 70 % respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 3.0 million in 2010 to 3.8 million in 2025, corresponding to an increase of 26 % (Table 14).

The total number of fractures was estimated to rise from 87,000 in 2010 to 116,000 in 2025 (Table 15), corresponding to an increase of 34 %. Hip, clinical spine, forearm and other fractures increased by 5,700, 4,400, 3,700 and 15,900 respectively. The increase in the number of fractures ranged from 28 % to 36 %, depending on fracture site. The increase was estimated to be particularly marked in men (49 %) compared to women (27 %). Note that the calculations assume no change in the age- and sex-specific incidence of fracture. In the case of hip fracture, there is evidence that age specific rates have been decreasing in recent years [13].

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from € 799 million in 2010 to € 1,025 million in 2025, corresponding to an increase of 28 % (Table 16). Costs incurred in women and men increased by 21 % and 43 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 27,900 in 2010 to 34,600 in 2025, corresponding to an increase of 24 % (Table 17). The increase was estimated to be particularly marked in men (38 %) compared to women (17 %). Incident and prior fractures accounted for 67 % and 33 % of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately € 2.7 billion in 2010 to € 3.4 billion in 2025. The increase was estimated to be particularly marked in men (+39 %) compared to women (+18 %) (Table 18).

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to
derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 3.06 % in 2001 to 6.1 % in 2006 but subsequently decreased to 5.17 % in 2011.

### Table 15  Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Austria

|            | 2010  | 2025  | 2010  | 2025  | 2010  | 2025  | 2010  |
|------------|-------|-------|-------|-------|-------|-------|-------|
|            | Hip   | Spine | Forearm | Other |
| **Women**  |       |       |       |       |       |       |       |
| 50–74      | 2,159 | 2,645 | 3,328 | 4,083 | 6,166 | 7,606 | 8,204 |
| 75+        | 9,675 | 12,528| 4,952 | 6,362 | 4,883 | 6,185 | 17,824|
| All        | 11,835| 15,173| 8,280 | 10,445| 11,049| 13,791| 26,029|
| **Men**    |       |       |       |       |       |       |       |
| 50–74      | 1,603 | 2,041 | 2,819 | 3,608 | 1,820 | 2,382 | 10,509|
| 75+        | 2,650 | 4,616 | 2,004 | 3,492 | 554   | 961   | 7,385 |
| All        | 4,254 | 6,657 | 4,822 | 7,100 | 2,373 | 3,343 | 17,894|
| **Women and Men** |       |       |       |       |       |       |       |
| 50–74      | 3,763 | 4,686 | 6,146 | 7,692 | 7,986 | 9,989 | 18,713|
| 75+        | 12,326| 17,144| 6,956 | 9,853 | 543   | 7,145 | 25,209|
| All        | 16,088| 21,830| 13,102| 17,545| 13,422| 17,134| 43,923|

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Austria were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were

### Table 16  Current and future cost (€ 000,000) of osteoporosis (excluding values of QALY’s lost) by age and calendar year in men and women in Austria

|            | 2010  | 2015  | 2020  | 2025  | 2010  | 2025  | 2010  |
|------------|-------|-------|-------|-------|-------|-------|-------|
|            |       |       |       |       |       |       |       |
| **Women**  |       |       |       |       |       |       |       |
| 50–74      | 139   | 150   | 156   | 166   |
| 75+        | 401   | 425   | 454   | 488   |
| All        | 540   | 575   | 610   | 654   |
| **Men**    |       |       |       |       |       |       |       |
| 50–74      | 126   | 136   | 146   | 159   |
| 75+        | 133   | 153   | 181   | 212   |
| All        | 259   | 290   | 327   | 370   |
| **Women and Men** |       |       |       |       |       |       |       |
| 50–74      | 265   | 286   | 302   | 325   |
| 75+        | 534   | 578   | 635   | 700   |
| All        | 799   | 864   | 937   | 1,025 |

### Table 17  Projected QALY’s lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Austria

|            | 2010  | 2015  | 2020  | 2025  | 2010  | 2025  | 2010  |
|------------|-------|-------|-------|-------|-------|-------|-------|
|            |       |       |       |       |       |       |       |
| **Women**  |       |       |       |       |       |       |       |
| 50–74      | 2,817 | 3,457 | 2,596 | 2,800 | 5,413 | 6,257 |
| 75+        | 5,413 | 6,952 | 7,630 | 8,386 | 13,043| 15,338|
| All        | 8,230 | 10,409| 10,226| 11,187| 18,456| 21,595|
| **Men**    |       |       |       |       |       |       |       |
| 50–74      | 2,638 | 3,393 | 2,203 | 2,552 | 4,842 | 5,944 |
| 75+        | 2,128 | 3,716 | 2,471 | 3,373 | 4,599 | 7,089 |
| All        | 4,767 | 7,109 | 4,674 | 5,924 | 9,441 | 13,033|
| **Women and Men** |       |       |       |       |       |       |       |
| 50–74      | 5,456 | 6,850 | 4,800 | 5,352 | 10,255| 12,202|
| 75+        | 7,541 | 10,668| 10,101| 11,759| 17,642| 22,427|
| All        | 12,997| 17,518| 14,900| 17,111| 27,897| 34,628|
estimated at 52% and 51% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

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Table 18 Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Austria assuming the uptake of treatment remains unchanged

|          | 2010       | 2015       | 2020       | 2025       |
|----------|------------|------------|------------|------------|
| Women    |            |            |            |            |
| 50–74    | 508        | 539        | 561        | 593        |
| 75+      | 1,291      | 1,364      | 1,441      | 1,534      |
| All      | 1,799      | 1,903      | 2,002      | 2,127      |
| Men      |            |            |            |            |
| 50–74    | 456        | 486        | 520        | 564        |
| 75+      | 447        | 501        | 585        | 695        |
| All      | 903        | 987        | 1,105      | 1,259      |
| Women and Men |       |            |            |            |
| 50–74    | 964        | 1,026      | 1,081      | 1,157      |
| 75+      | 1,737      | 1,864      | 2,026      | 2,229      |
| All      | 2,701      | 2,890      | 3,107      | 3,386      |

Fig. 2 Treatment uptake in Austria (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|          | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|----------|----------------------------------|--------------------------------------|---------------------|-------------------|
| Men      | 21                               | 43                                   | 22                  | 52                |
| Women    | 139                              | 282                                  | 143                 | 51                |
Epidemiology and Economic Burden of Osteoporosis in Belgium

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Belgium.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Belgium, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Belgium were reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.
Results  It was estimated that approximately 80,000 new fragility fractures were sustained in Belgium, comprising 15,000 hip fractures, 12,000 vertebral fractures, 12,000 forearm fractures and 41,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at € 606 million for the same year. Incident fractures represented 69% of this cost, long-term fracture care 26% and pharmacological prevention 5%. Previous and incident fractures also accounted for 26,800 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 99,000 in 2025, representing an increase of 19,000 fractures. Hip, clinical spine, forearm and other fractures was estimated to increase by 3,900, 2,900, 2,300 and 10,300, respectively. The burden of fractures in Belgium in 2025 was estimated to increase by 21% to € 733 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. A substantial proportion of women at high fracture risk did not receive active treatment.

Conclusions  In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Belgium in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Belgium was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

| Table 1 Population at risk: men and women over the age of 50 in Belgium, 2010 [1] |
|-------------------------------|-----------|-----------|-----------|
| Age (years) | Women | Men | All |
| 50–59 | 727,000 | 728,000 | 1,455,000 |
| 60–69 | 568,000 | 540,000 | 1,108,000 |
| 70–79 | 480,000 | 379,000 | 859,000 |
| 80–89 | 308,000 | 168,000 | 476,000 |
| 90+ | 47,000 | 14,000 | 61,000 |
| 50+ | 2,130,000 | 1,829,000 | 3,959,000 |

Epidemiology of osteoporosis in Belgium

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 1,829,000 and 2,130,000 respectively in Belgium in 2010 (Table 1). The number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 600,000 (Table 2), similar to an earlier estimate in 2008 [2]. There are 53 DXA scan machines per million inhabitants [3], and guidelines for the assessment and treatment of osteoporosis are available [4–8]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Belgium and we used a mean estimate for 2005–7 [10]. The incidence of hip fractures was determined using the national hospital database, which fully covers the annual hospital stays in Belgium (source: INAMI-RIZIV [Institut National d’Assurance Maladie Invalidité–Rijksinstituut voor Ziekte en Invaliditeitsverzekering] and SPF Public Health). Given that country specific incidence of vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 228.5 and 538.7 respectively.

| Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤-2.5 SD) in Belgium by age using female-derived reference ranges at the femoral neck, 2010 [9] |
|-------------------------------|-----------|-----------|
| Age (years) | Women | Men |
| 50–54 | 23,940 | 9,550 |
| 55–59 | 33,312 | 12,110 |
| 60–64 | 46,189 | 18,212 |
| 65–69 | 49,490 | 16,724 |
| 70–74 | 68,634 | 16,068 |
| 75–79 | 87,750 | 17,819 |
| 80+ | 167,560 | 30,212 |
| 50+ | 476,875 | 120,695 |
The number of incident fractures in 2010 was estimated at 80,000 (Table 4). Incident hip, clinical vertebral, forearm and “other” fractures were estimated at 15,000, 12,000, 12,000 and 41,000 respectively. 66% of fractures occurred in women. A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals who had suffered a fracture prior to 2010 were estimated at 1.88% for hip and 2.04% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was

| Table 3 | Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Belgium by age |
|---------|--------------------------------------------------|
| Age (years) | Fracture at the | hip | vertebra | forearm | other |
|-----------|-----------------|-----|----------|---------|-------|
| 50–54     | Women           | 27  | 70       | 173     | 179   |
| 55–59     |                 | 53  | 148      | 410     | 469   |
| 60–64     |                 | 84  | 149      | 317     | 324   |
| 65–69     |                 | 140 | 203      | 339     | 477   |
| 70–74     |                 | 271 | 382      | 486     | 768   |
| 75–79     |                 | 606 | 589      | 591     | 1,274 |
| 80–84     |                 | 1,263 | 794    | 791       | 2,148 |
| 85+       |                 | 2,371 | 1,115 | 1,012     | 3,983 |
| 50–54     | Men             | 34  | 88       | 32      | 152   |
| 55–59     |                 | 49  | 85       | 74      | 455   |
| 60–64     |                 | 73  | 174      | 137     | 716   |
| 65–69     |                 | 104 | 164      | 157     | 673   |
| 70–74     |                 | 159 | 243      | 102     | 819   |
| 75–79     |                 | 313 | 361      | 89      | 836   |
| 80–84     |                 | 669 | 464      | 130     | 1,778 |
| 85+       |                 | 1,371 | 921   | 251      | 3,971 |

The number of incident fractures in 2010 was estimated at 80,000 (Table 4). Incident hip, clinical vertebral, forearm and “other” fractures were estimated at 15,000, 12,000, 12,000 and 41,000 respectively. 66% of fractures occurred in women. A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals who had suffered a fracture prior to 2010 were estimated at 1.88% for hip and 2.04% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was

| Table 4 | Estimated number of incident fractures in Belgium, 2010 |
|---------|--------------------------------------------------|
| Age (years) | Fracture at the | hip | vertebra | forearm | other |
|-----------|-----------------|-----|----------|---------|-------|
| 50–74     | Women           | 1,829 | 2,890  | 5,562   | 7,230  | 17,511 |
| 75+       |                 | 8,932 | 4,676  | 4,701   | 16,579 | 34,888 |
| Total     |                 | 10,761 | 7,566  | 10,263  | 23,809 | 52,399 |
| 50–74     | Men             | 1,280 | 2,293  | 1,490   | 8,571  | 13,634 |
| 75+       |                 | 2,919 | 2,187  | 605     | 8,148  | 13,860 |
| Total     |                 | 4,199 | 4,480  | 2,095   | 16,720 | 27,493 |
| 50–74     | Men and Women   | 3,109 | 5,182  | 7,052   | 15,802 | 31,144 |
| 75+       |                 | 11,851 | 6,863  | 5,306   | 24,727 | 48,748 |
| Total     |                 | 14,960 | 12,046 | 12,358  | 40,529 | 79,892 |

| Table 5 | Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Belgium, 2010 |
|---------|--------------------------------------------------|
| Age (years) | Hip fracture | Vertebral fracture |
|-----------|--------------|-------------------|
| Women     |              |                   |
| 50–54     | 0.0          | 0.1               |
| 55–59     | 0.2          | 0.7               |
| 60–64     | 0.5          | 1.3               |
| 65–69     | 0.9          | 1.7               |
| 70–74     | 1.7          | 2.7               |
| 75–79     | 3.4          | 4.3               |
| 80–84     | 6.5          | 6.2               |
| 85+       | 14.6         | 10.3              |
| Men       |              |                   |
| 50–54     | 0.1          | 0.1               |
| 55–59     | 0.3          | 0.4               |
| 60–64     | 0.5          | 0.9               |
| 65–69     | 0.8          | 1.3               |
| 70–74     | 1.3          | 1.7               |
| 75–79     | 2.1          | 2.4               |
| 80–84     | 3.7          | 3.3               |
| 85+       | 8.3          | 6.1               |

| Table 6 | Number of men and women in Belgium with a prior hip or clinical vertebral fracture after the age of 50 years, 2010 |
|---------|--------------------------------------------------|
| Age (years) | Hip fracture | Vertebral fracture |
|-----------|--------------|-------------------|
| Women     |              |                   |
| 50–74     | 9,095        | 18,168            |
| 75+       | 44,641       | 38,957            |
| Total     | 53,737       | 57,124            |
| Men       |              |                   |
| 50–74     | 7,297        | 11,396            |
| 75+       | 13,451       | 12,186            |
| Total     | 20,749       | 23,582            |
| Men and Women |            |                   |
| 50–74     | 16,393        | 29,563            |
| 75+       | 58,093       | 51,143            |
| Total     | 74,485       | 80,706            |
The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. These comprise approximately 30% of deaths associated with fracture [11]. The number of causally related deaths in 2010 was estimated at 979 (Table 8). Hip, vertebral and “other” fractures accounted for 492, 310 and 177 deaths respectively. Overall, approximately 51% of deaths occurred in women.

Table 7: Incidence (per 100,000) of causally related deaths in Belgium within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|-----------------|
| Women       |     |                    |                 |
| 50–54       | 601 | 781                | 16              |
| 55–59       | 852 | 1,048              | 25              |
| 60–64       | 1,165| 1,352              | 37              |
| 65–69       | 1,603| 1,757              | 60              |
| 70–74       | 1,807| 1,865              | 82              |
| 75–79       | 2,174| 2,100              | 136             |
| 80–84       | 2,451| 2,169              | 273             |
| 85–89       | 3,038| 2,362              | 532             |
| 90+         | 2,528| 1,425              | 879             |
| Men         |     |                    |                 |
| 50–54       | 1,906| 2,286              | 30              |
| 55–59       | 2,135| 2,427              | 44              |
| 60–64       | 2,502| 2,691              | 68              |
| 65–69       | 2,854| 2,895              | 102             |
| 70–74       | 3,378| 3,216              | 152             |
| 75–79       | 4,157| 3,687              | 247             |
| 80–84       | 5,017| 4,074              | 421             |
| 85–89       | 7,048| 5,152              | 761             |
| 90+         | 9,359| 6,090              | 1,171           |

Table 8: The number of deaths in men and women in Belgium in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Fracture at the vertebra | “Other” |
|-------------|-----|--------------------------|---------|
| Women       |     |                          |         |
| 50–74       | 29  | 46                       | 4       |
| 75+         | 230 | 91                       | 102     |
| Total       | 259 | 137                      | 106     |
| Men         |     |                          |         |
| 50–74       | 39  | 68                       | 8       |
| 75+         | 195 | 105                      | 63      |
| Total       | 233 | 173                      | 71      |
| Men and Women|   |                          |         |
| 50–74       | 67  | 114                      | 13      |
| 75+         | 425 | 196                      | 165     |
| Total       | 492 | 310                      | 177     |

Table 9: One year costs for relevant pharmaceuticals in Belgium, 2010 [15]

| Annual drug cost (€) |
|----------------------|
| Alendronate          | 123 |
| Risedronate          | 19  |
| Etidronate           | 93  |
| Ibandronate          | 160 |
| Zoledronic acid      | 324 |
| Raloxifene           | 395 |
| Strontium ranelate   | 464 |
| Parathyroid hormone -Teriparatide | 3,656 |

Table 10: Cost of osteoporosis (€) in Belgium by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention costs | Total cost |
|-------------|--------------------------|---------------------------|--------------------------|------------|
| Women       |                          |                           |                          |            |
| 50–74       | 73,267,761               | 12,842,111                | 15,118,387               | 101,228,259|
| 75+         | 199,531,556              | 97,521,075                | 10,688,414               | 307,741,045|
| All         | 272,799,317              | 110,363,186               | 25,806,802               | 408,969,304|
| Men         |                          |                           |                          |            |
| 50–74       | 67,907,494               | 11,998,486                | 2,395,596                | 82,301,576 |
| 75+         | 78,540,769               | 35,072,065                | 1,229,492                | 114,842,326|
| All         | 146,448,264              | 47,070,551                | 3,625,088                | 197,143,903|
| Women and Men|                      |                           |                          |            |
| 50–74       | 141,175,255              | 24,840,597                | 17,513,983               | 183,529,836|
| 75+         | 278,072,325              | 132,593,139               | 11,917,906               | 422,583,371|
| All         | 419,247,581              | 37,433,737                | 29,431,890               | 606,113,207|
The cost of a hip fracture has been estimated at €11,426 in Belgium [12] comparable to a more recent estimate [13]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€22,608 [14]) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €19 and a DXA scan at €34 every second year to monitor treatment [15].

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Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €19 and a DXA scan at €34 every second year to monitor treatment [15].

Table 11 Total cost (€) in 2010 by fracture site in men and women in Belgium. Note that costs for fracture prevention therapy and monitoring are not included

| Age | Hip | Vertebral | Forearm | Other | All |
|-----|-----|-----------|---------|-------|-----|
| Women |
| 50–74 | 32,930,499 | 7,022,947 | 3,883,014 | 42,273,412 | 86,109,872 |
| 75+ | 188,200,459 | 10,747,124 | 3,281,739 | 94,823,308 | 297,052,631 |
| All | 221,130,958 | 17,770,070 | 7,164,754 | 137,096,720 | 383,162,503 |
| Men |
| 50–74 | 25,561,846 | 5,384,963 | 1,039,942 | 47,919,230 | 79,905,981 |
| 75+ | 61,536,698 | 4,607,182 | 422,622 | 47,046,332 | 113,612,834 |
| All | 87,098,543 | 9,992,145 | 1,462,564 | 94,965,562 | 193,518,815 |

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Belgium according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-----------|-------|-----|-----|
| Women |
| Incident hip fractures | 441 | 1,868 | 2,308 |
| Incident vertebral fractures | 959 | 1,341 | 2,299 |
| Incident forearm fractures | 197 | 143 | 339 |
| Incident other fractures | 869 | 1,719 | 2,588 |
| Prior hip fractures | 1,426 | 6,006 | 7,432 |
| Prior vertebral fractures | 1,018 | 1,887 | 2,905 |
| Total | 4,909 | 12,963 | 17,872 |
| Men |
| Incident hip fractures | 313 | 699 | 1,012 |
| Incident vertebral fractures | 764 | 697 | 1,461 |
| Incident forearm fractures | 52 | 20 | 71 |
| Incident other fractures | 1,017 | 926 | 1,943 |
| Prior hip fractures | 1,140 | 1,989 | 3,129 |
| Prior vertebral fractures | 633 | 642 | 1,275 |
| Total | 3,918 | 4,974 | 8,892 |
| Men and Women |
| Incident hip fractures | 753 | 2,567 | 3,321 |
| Incident vertebral fractures | 1,722 | 2,038 | 3,760 |
| Incident forearm fractures | 249 | 162 | 411 |
| Incident other fractures | 1,885 | 2,645 | 4,531 |
| Prior hip fractures | 2,566 | 7,995 | 10,561 |
| Prior vertebral fractures | 1,651 | 2,529 | 4,180 |
| Total | 8,827 | 17,937 | 26,763 |

Table 13 Value of lost QALYs (€) in men and women in Belgium in 2010

| | 1 × GDP/ capita | 2 × GDP/ capita | 3 × GDP/ capita |
|---|----------------|----------------|----------------|
| Incident hip fractures | 107,584,970 | 215,169,940 | 322,754,911 |
| Incident vertebral fractures | 121,830,873 | 243,661,747 | 365,492,620 |
| Incident forearm fractures | 13,312,751 | 26,625,503 | 39,938,254 |
| Incident other fractures | 146,788,449 | 293,576,898 | 440,365,347 |
| Prior hip fractures | 342,179,611 | 684,359,221 | 1,026,538,832 |
| Prior vertebral fractures | 135,438,142 | 270,876,285 | 406,314,427 |
| Total | 867,134,797 | 1,734,269,594 | 2,601,404,391 |
amounted to €419 million, €157 million and €29 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 4.8% of the total cost. This cost is very likely overinflated since reimbursement for DXA only came into effect in August of 2010 and repeat DXA is only reimbursed at 5 years.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€308 million) followed by “other” (€232 million), spine (€28 million) and forearm fractures (€9 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 26,800 (Table 12). 67% of the total QALY loss was incurred in women. Prior fractures accounted for 55%...
of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €1.73 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €2.34 billion in Belgium in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 18 %, 7 %, 1 %, 74 % respectively.

Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Belgium

| Fracture Type          | Age Group | 2010 | 2025 |
|------------------------|-----------|------|------|
| Incident fractures     | 50–74     | 2,465| 3,001|
|                        | 75+       | 5,070| 6,040|
|                        | All       | 7,535| 9,041|
| Prior fractures        | 50–74     | 2,444| 2,663|
|                        | 75+       | 7,893| 8,458|
|                        | All       | 10,337|11,121|
| All fractures          | 50–74     | 4,909| 5,664|
|                        | 75+       | 12,963|14,499|
|                        | All       | 17,872|20,163|

Table 18 Present and future cost (€000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Belgium assuming the uptake of treatment remains unchanged

| Fracture Type          | Age Group | 2010 | 2015 | 2020 | 2025 |
|------------------------|-----------|------|------|------|------|
| All fractures          | Women     |      |      |      |      |
| 50–74                  | 419       | 438  | 471  | 491  |
| 75+                    | 1,148     | 1,209| 1,239| 1,295|
| All                    | 1,567     | 1,647| 1,711| 1,786|
| All fractures          | Men       |      |      |      |      |
| 50–74                  | 336       | 354  | 384  | 407  |
| 75+                    | 437       | 469  | 503  | 569  |
| All                    | 773       | 823  | 888  | 976  |
| All fractures          | Women and Men |      |      |      |      |
| 50–74                  | 756       | 792  | 856  | 898  |
| 75+                    | 1,585     | 1,678| 1,743| 1,864|
| All                    | 2,340     | 2,471| 2,599| 2,762|

Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 4.0 million in 2010 to 4.6 million in 2025, corresponding to an increase of 17 % (Table 14). The total number of fractures was estimated to rise from 80,000 in 2010 to 99,000 in 2025 (Table 15), corresponding to an increase of 24 %. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 18 %, 7 %, 1 %, 74 % respectively.

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

| Age Group | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|-----------|-------------------------------------|----------------------------------------|---------------------|-------------------|
| Men       | 32                                  | 58                                     | 26                  | 45                |
| Women     | 214                                 | 402                                    | 188                 | 47                |
to be particularly marked in men (+26 %) compared to women (+14 %) (Table 18).

Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 2 % in 2001 to 6.3 % in 2011 and thereafter decreased.

Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Belgium were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture defined as individuals with a 10-year fracture probability. The proportion of persons over the age of 50 years who were treated increased from 2 % in 2001 to 6.3 % in 2011 and thereafter decreased.

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Epidemiology and Economic Burden of Osteoporosis in Bulgaria

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract
Summary This report describes epidemiology, burden, and treatment of osteoporosis in Bulgaria.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Bulgaria, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Bulgaria was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 38,000 new fragility fractures were sustained in Bulgaria, comprising

Bulgaria, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Bulgaria was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 38,000 new fragility fractures were sustained in Bulgaria, comprising
5,900 hip fractures, 6,400 vertebral fractures, 6,500 forearm fractures and 19,400 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at € 42 million for the same year. Incident fractures represented 71 % of this cost, long-term fracture care 25 % and pharmacological prevention 3 %. Previous and incident fractures also accounted for 12,300 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 40,000 in 2025, representing an increase of 1,400 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 400, 200, 100 and 600, respectively. The burden of fractures in Bulgaria in 2025 was estimated to increase by 5 % to € 45 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Bulgaria in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Bulgaria was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

### Table 1 Population at risk: men and women over the age of 50 in Bulgaria, 2010 [2]

| Age (years) | Women    | Men     | All      |
|------------|----------|---------|----------|
| 50–59      | 545,000  | 503,000 | 1,048,000|
| 60–69      | 503,000  | 407,000 | 910,000  |
| 70–79      | 376,000  | 257,000 | 633,000  |
| 80–89      | 170,000  | 97,000  | 267,000  |
| 90+        | 12,000   | 6,000   | 18,000   |
| 50+        | 1,606,000| 1,270,000| 2,876,000|

Epidemiology of osteoporosis in Bulgaria

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 1,270,000 and 1,606,000 respectively in Bulgaria in 2010 (Table 1). A more recent census in 2011 indicates a small decrease in the population aged 50 years or more from 2.88 million to 2.84 million [2].

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 420,000 (Table 2). Allowing for differences in the calculation of T-scores the estimate for women is similar to previously published data [3]. There are 1.2 DXA scan machines per million inhabitants [4], and guidelines for the assessment and treatment of osteoporosis are available [5]. A country specific FRAX model for the assessment of fracture risk is not available for Bulgaria.

Incidence data were not available for Bulgaria; therefore data for hip fractures was imputed from Romanian age-standardized incidence rates [7]. Fracture incidence is presented in Table 3. Standardized to the EU27 population, this hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 170.3 and 282.3 respectively.

### Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Bulgaria by age using female-derived reference ranges at the femoral neck, 2010 [6]

| Age (years) | Women    | Men     |
|------------|----------|---------|
| 50–54      | 16,947   | 6,375   |
| 55–59      | 26,496   | 8,680   |
| 60–64      | 40,040   | 13,630  |
| 65–69      | 45,046   | 12,728  |
| 70–74      | 55,242   | 10,920  |
| 75–79      | 66,750   | 12,051  |
| 80+        | 85,904   | 17,098  |
| 50+        | 336,425  | 81,482  |
The number of incident fractures in 2010 was estimated at 38,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 6,000, 6,000, 6,000 and 19,000 respectively. 56% of fractures occurred in women. The number of hip fractures is consistent with Government sources when accounting for multiple admissions [8].

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals who had suffered a fracture prior to 2010 were estimated at 1.09% for hip and 1.14% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age, presented in Table 5, are consistent with an earlier report of a survey in Bulgarian women [9].

In the population over 50 years of age, the number of individuals with hip and clinical vertebral fractures that occurred before 2010 was estimated at 31,000 and 33,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 647 (Table 8). Hip, vertebral and “other” fractures accounted for 294, 283 and 71 deaths respectively. Overall, approximately 47% of deaths occurred in women.

Cost of osteoporosis in Bulgaria including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to

Table 4  Estimated number of incident fractures in Bulgaria, 2010

| Age (years) | Fracture at the | All fractures |
|-------------|----------------|--------------|
|             | hip | vertebra | forearm | other |            |
| Women       |     |         |         |       |           |
| 50–54       | 17  | 44      | 108     | 108   | 112        |
| 55–59       | 34  | 94      | 260     | 298   |            |
| 60–64       | 60  | 105     | 225     | 230   |            |
| 65–69       | 115 | 168     | 280     | 394   |            |
| 70–74       | 228 | 321     | 409     | 646   |            |
| 75–79       | 407 | 396     | 397     | 856   |            |
| 80–84       | 667 | 419     | 417     | 1,133 |            |
| 85+         | 1,048| 493   | 447     | 1,761 |            |
| Men         |     |         |         |       |            |
| 50–54       | 50  | 129     | 46      | 223   |            |
| 55–59       | 70  | 121     | 106     | 648   |            |
| 60–64       | 94  | 225     | 177     | 924   |            |
| 65–69       | 124 | 194     | 186     | 797   |            |
| 70–74       | 186 | 283     | 119     | 954   |            |
| 75–79       | 274 | 316     | 78      | 732   |            |
| 80–84       | 410 | 285     | 80      | 1,091 |            |
| 85+         | 587 | 394     | 108     | 1,701 |            |
| Total       | 3,857| 3,558 | 4,914 | 9,147 | 21,476 |

Table 5  Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Bulgaria, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.1          | 0.5                |
| 60–64       | 0.4          | 0.8                |
| 65–69       | 0.7          | 1.2                |
| 70–74       | 1.4          | 1.8                |
| 75–79       | 2.4          | 2.5                |
| 80–84       | 4.1          | 3.2                |
| 85+         | 7.6          | 4.5                |
| Men         |              |                    |
| 50–54       | 0.1          | 0.2                |
| 55–59       | 0.3          | 0.6                |
| 60–64       | 0.5          | 0.9                |
| 65–69       | 0.9          | 1.1                |
| 70–74       | 1.3          | 1.3                |
| 75–79       | 1.9          | 1.5                |
| 80–84       | 2.6          | 1.9                |
| 85+         | 5.0          | 3.0                |
Table 6 Number of men and women in Bulgaria with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 5,946        | 9,836              |
| 75+         | 14,075       | 11,087             |
| Total       | 20,021       | 20,924             |

| Men          |              |                    |
| 50–74        | 5,590        | 7,722              |
| 75+          | 5,759        | 4,135              |
| Total        | 11,349       | 11,856             |

| Men and Women|              |                    |
| 50–74        | 11,535       | 17,558             |
| 75+          | 19,835       | 15,222             |
| Total        | 31,370       | 32,780             |

consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of a hip fracture has been estimated at €1,826 in Bulgaria based on hip fracture costs in Slovenia [10]. The costs are consistent with the information available from the Romanian National Health Insurance Fund [11]. No other fracture costs were available. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€4,044 [12]) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €2 [13] and a DXA scan costing €59 [14] every second year to monitor treatment.

Table 7 Incidence (per 100,000) of causally related deaths in Bulgaria within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|-----------------|
| Women       |     |                    |                 |
| 50–54       | 941 | 1,222              | 24              |
| 55–59       | 1,314| 1,616              | 39              |
| 60–64       | 1,709| 1,984              | 54              |
| 65–69       | 2,127| 2,332              | 80              |
| 70–74       | 3,224| 3,327              | 147             |
| 75–79       | 4,257| 4,113              | 267             |
| 80–84       | 4,372| 3,868              | 487             |
| 85–89       | 5,207| 4,047              | 912             |
| 90+         | 3,560| 2,007              | 1,238           |

| Men          |     |                    |                 |
| 50–54        | 3,892| 4,669              | 61              |
| 55–59        | 4,446| 5,055              | 91              |
| 60–64        | 5,306| 5,706              | 144             |
| 65–69        | 5,591| 5,671              | 201             |
| 70–74        | 6,207| 5,910              | 280             |
| 75–79        | 7,407| 6,569              | 439             |
| 80–84        | 7,920| 6,432              | 665             |
| 85–89        | 9,521| 6,959              | 1,029           |
| 90+          | 11,042| 7,185             | 1,381           |

Table 8 The number of deaths in men and women in Bulgaria in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Vertebral | “Other” |
|-------------|-----|-----------|---------|
| Women       |     |           |         |
| 50–74       | 36  | 55        | 5       |
| 75+         | 115 | 60        | 31      |
| Total       | 151 | 114       | 36      |

| Men          |     |           |         |
| 50–74        | 66  | 121       | 14      |
| 75+          | 77  | 47        | 20      |
| Total        | 143 | 168       | 34      |

| Men and Women|     |           |         |
| 50–74        | 102 | 176       | 19      |
| 75+          | 192 | 107       | 51      |
| Total        | 294 | 283       | 71      |

Table 9 One year costs for relevant pharmaceuticals in Bulgaria, 2010

| Annual drug cost (€) |          |
|----------------------|----------|
| Alendronate           | 80       |
| Risedronate           | 147      |
| Etdronate             | -        |
| Ibandronate           | 142      |
| Zoledronic acid       | 309      |
| Raloxifene            | 279      |
| Strontium ranelate    | 389      |
| Parathyroid hormone   | -        |
| Teriparatide          | 3,198    |
The cost of osteoporosis in 2010 was estimated at €42 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €30 million, €11 million and €1 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 3.1% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€20 million) followed by “other” (€18 million), spine (€2 million) and forearm fractures (€1 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

| Table 10 | Cost of osteoporosis (€) in Bulgaria by age in men and women, 2010 |
|----------|-------------------------------------------------------------------|
| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
| Women | | | | |
| 50–74 | 7,842,874 | 1,504,059 | 731,354 | 10,078,286 |
| 75+ | 9,024,313 | 5,039,264 | 405,975 | 14,469,553 |
| All | 16,867,187 | 6,543,323 | 1,137,328 | 24,547,839 |
| Men | | | | |
| 50–74 | 9,471,297 | 1,653,408 | 110,324 | 11,235,029 |
| 75+ | 3,891,789 | 2,577,775 | 49,708 | 6,519,272 |
| All | 13,363,086 | 4,231,183 | 160,032 | 17,754,301 |

The cost of osteoporosis in 2010 was estimated at €42 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €30 million, €11 million and €1 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 3.1% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€20 million) followed by “other” (€18 million), spine (€2 million) and forearm fractures (€1 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

Table 11 | Total cost (€) in 2010 by fracture site in men and women in Bulgaria. Note that costs for fracture prevention therapy and monitoring are not included |
| Age (years) | Hip | Spine | Forearm | Other | All |
|----------|------|------|--------|------|-----|
| Women | | | | | |
| 50–74 | 3,709,882 | 751,964 | 381,844 | 4,503,243 | 9,346,933 |
| 75+ | 8,971,729 | 545,012 | 166,283 | 4,380,554 | 14,063,578 |
| All | 12,681,611 | 1,296,976 | 548,128 | 8,883,796 | 23,410,510 |
| Men | | | | | |
| 50–74 | 3,446,288 | 722,591 | 153,970 | 6,801,854 | 11,124,704 |
| 75+ | 3,846,808 | 234,747 | 22,141 | 2,365,868 | 6,469,564 |
| All | 7,293,096 | 957,338 | 176,112 | 9,167,723 | 17,594,269 |

The share (%) of fracture cost by fracture site in Bulgaria is shown in Fig. 1. Note that costs for fracture prevention therapy and monitoring are not included.

Table 12 | Number of QALYs lost due to fractures during 2010 in men and women in Bulgaria according to age |
| Age (years) | Incident hip fractures | Incident vertebral fractures | Incident forearm fractures | Incident other fractures | Prior hip fractures | Prior vertebral fractures | Total |
|----------|------------------------|----------------------------|---------------------------|-------------------------|-------------------|------------------------|------|
| Women | | | | | | | |
| 50–74 | 316 | 667 | 121 | 550 | 930 | 551 | 3,135 |
| 75+ | 563 | 469 | 46 | 487 | 1,946 | 550 | 4,206 |
| All | 879 | 1,136 | 167 | 1,037 | 2,876 | 1,101 | 7,197 |
| Men | | | | | | | |
| 50–74 | 288 | 712 | 48 | 932 | 874 | 430 | 3,284 |
| 75+ | 227 | 239 | 7 | 282 | 857 | 219 | 1,831 |
| All | 515 | 951 | 54 | 1,214 | 1,732 | 649 | 5,115 |
| Men and Women | | | | | | | |
| 50–74 | 604 | 1,379 | 168 | 1,482 | 1,805 | 981 | 6,419 |
| 75+ | 790 | 708 | 53 | 769 | 769 | 5,893 | 12,312 |
| All | 1,394 | 2,087 | 221 | 2,251 | 4,608 | 1,751 | 21,838 |

Fig. 1 | Share (%) of fracture cost by fracture site in Bulgaria. Note that costs for fracture prevention therapy and monitoring are not included |
The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 12,300 (Table 12). 58% of the total QALY loss was incurred in women. Prior fractures accounted for 52% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €118 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €160 million in Bulgaria in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 19%, 7%, 1%, and 74%, respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to be approximately constant at 2.9 million between 2010 and 2025 (Table 14). The total number of fractures was estimated to rise from 38,000 in 2010 to 40,000 in 2025 (Table 15), corresponding to an increase of 4%. Hip, clinical spine, forearm and other fractures increased by 400, 200, 100 and 600 respectively. The increase in the number of fractures ranged from 2% to 8%, depending on fracture site. The increase in women was estimated at 7% while a decrease is expected in men. The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from €42 million in 2010 to €45 million in 2025, corresponding to an increase of 5%.

### Table 13 Value of lost QALYs (€) in men and women in Bulgaria in 2010

|                | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|----------------|----------------|----------------|----------------|
| Incident hip fractures | 6,692,022      | 13,384,044     | 20,076,066     |
| Incident vertebral fractures | 10,017,949  | 20,035,897     | 30,053,846     |
| Incident forearm fractures | 1,062,140     | 2,124,279      | 3,186,419      |
| Incident other fractures | 10,804,803    | 21,609,606     | 32,414,408     |
| Prior hip fractures | 22,118,181    | 44,236,361     | 66,354,542     |
| Prior vertebral fractures | 8,402,614       | 16,805,229     | 25,207,843     |
| Total           | 59,097,708     | 118,195,416    | 177,293,124    |

### Table 14 Population projections in Bulgaria by age and sex [16]

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Women    |        |        |        |        |
| 50–59    | 545,000| 516,000| 496,000| 504,000|
| 60–69    | 503,000| 528,000| 502,000| 477,000|
| 70–79    | 376,000| 359,000| 399,000| 422,000|
| 80–89    | 170,000| 179,000| 174,000| 175,000|
| 90+      | 12,000 | 20,000 | 25,000 | 29,000 |

|          |        |        |        |        |
|----------|--------|--------|--------|--------|
| Men      |        |        |        |        |
| 50–59    | 503,000| 480,155| 472,000| 487,000|
| 60–69    | 407,000| 425,000| 408,000| 396,000|
| 70–79    | 257,000| 238,000| 264,000| 278,000|
| 80–89    | 97,000 | 99,000 | 90,000 | 88,000 |
| 90+      | 6,000  | 9,000  | 10,000 | 10,000 |

### Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Bulgaria

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Hip      |        |        |        |        |
| Women    |        |        |        |        |
| 50–74    | 1,298  | 1,355  | 1,997  | 2,043  |
| 75+      | 2,559  | 2,933  | 1,562  | 1,753  |
| All      | 3,857  | 4,288  | 3,558  | 3,795  |

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Spine    |        |        |        |        |
| Women    |        |        |        |        |
| 50–74    | 1,139  | 1,159  | 2,075  | 2,072  |
| 75+      | 922    | 918    | 730    | 733    |
| All      | 2,061  | 2,078  | 2,805  | 2,806  |

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Forearm  |        |        |        |        |
| Women    |        |        |        |        |
| 50–74    | 3,481  | 3,852  | 2,291  | 2,486  |
| 75+      | 3,481  | 3,852  | 2,291  | 2,486  |
| All      | 5,918  | 6,365  | 6,363  | 6,601  |

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Other    |        |        |        |        |
| Women    |        |        |        |        |
| 50–74    | 2,437  | 2,514  | 4,072  | 4,115  |
| 75+      | 3,481  | 3,852  | 2,291  | 2,486  |
| All      | 5,918  | 6,365  | 6,363  | 6,601  |

|          |        |        |        |        |
|----------|--------|--------|--------|--------|
| Men      |        |        |        |        |
| 50–74    | 1,139  | 1,159  | 2,075  | 2,072  |
| 75+      | 922    | 918    | 730    | 733    |
| All      | 2,061  | 2,078  | 2,805  | 2,806  |

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Women    |        |        |        |        |
| 50–74    | 1,139  | 1,159  | 2,075  | 2,072  |
| 75+      | 922    | 918    | 730    | 733    |
| All      | 2,061  | 2,078  | 2,805  | 2,806  |

|          |        |        |        |        |
|----------|--------|--------|--------|--------|
| Men      |        |        |        |        |
| 50–74    | 1,139  | 1,159  | 2,075  | 2,072  |
| 75+      | 922    | 918    | 730    | 733    |
| All      | 2,061  | 2,078  | 2,805  | 2,806  |

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Women and Men |        |        |        |        |
| 50–74    | 2,437  | 2,514  | 4,072  | 4,115  |
| 75+      | 3,481  | 3,852  | 2,291  | 2,486  |
| All      | 5,918  | 6,365  | 6,363  | 6,601  |
(Table 16). Costs incurred in women and men increased by 9% and 1% respectively.

The total number of QALYs lost due to fracture was estimated to rise only from 12,300 in 2010 to 12,800 in 2025, corresponding to an increase of 4% (Table 17). The increase in men was estimated to be 1% and the increase in women was estimated at 6%. Incident and prior fractures accounted for 46% and 54% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €160 million in 2010 to €168 million in 2025. The increase was estimated to be 1% in men and 7% in women (Table 18).

**Table 17** Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Bulgaria

|                | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
|----------------|------|------|------|------|------|------|
| **Women**      |      |      |      |      |      |      |
| 50–74          | 1,654| 1,684| 1,481| 1,528| 3,135| 3,213|
| 75+            | 1,566| 1,771| 2,496| 2,674| 4,062| 4,445|
| All            | 3,219| 3,456| 3,978| 4,202| 7,197| 7,658|
| **Men**        |      |      |      |      |      |      |
| 50–74          | 1,980| 1,973| 1,304| 1,330| 3,284| 3,303|
| 75+            | 755  | 753  | 1,076| 1,094| 1,831| 1,848|
| All            | 2,734| 2,726| 2,381| 2,424| 5,115| 5,151|
| **Women and Men** |      |      |      |      |      |      |
| 50–74          | 3,633| 3,657| 2,786| 2,858| 6,419| 6,515|
| 75+            | 2,320| 2,525| 3,573| 3,768| 5,893| 6,293|
| All            | 5,954| 6,182| 6,358| 6,626|12,312|12,808|

**Table 18** Present and future cost (€1,000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women from Bulgaria assuming the uptake of treatment remains unchanged

|                | 2010 | 2015 | 2020 | 2025 |
|----------------|------|------|------|------|
| **Women**      |      |      |      |      |
| 50–74          | 40   | 41   | 42   | 41   |
| 75+            | 53   | 55   | 56   | 59   |
| All            | 94   | 95   | 98   | 100  |
| **Men**        |      |      |      |      |
| 50–74          | 43   | 42   | 42   | 43   |
| 75+            | 24   | 23   | 24   | 24   |
| All            | 67   | 66   | 66   | 67   |
| **Women and Men** |      |      |      |      |
| 50–74          | 83   | 83   | 84   | 84   |
| 75+            | 78   | 79   | 83   | 83   |
| All            | 160  | 164  | 164  | 168  |

**Treatment uptake**

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.01% in 2001 to 0.53% in 2011.
In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Bulgaria were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 98% and 95% respectively (Table 19).

Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Bulgaria were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 98% and 95% respectively (Table 19).

Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

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### Table 19

| Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|-----------------------------------|---------------------------------------|---------------------|------------------|
| Men                               | 2                                     | 92                  | 90               | 98               |
| Women                             | 13                                    | 240                 | 227              | 95               |
Epidemiology and Economic Burden of Osteoporosis in Cyprus

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Cyprus.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Cyprus, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Cyprus was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 5,000 new fragility fractures were sustained in Cyprus, comprising 800 hip fractures, 800 vertebral fractures, 1,000 forearm fractures and 2,600 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €52 million for the same year. Incident fractures represented 65% of this cost, long-term fracture care 13% and pharmacological prevention 22%. Previous and incident fractures also accounted for 1,800 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 7,700 in 2025, representing an increase of 2,600 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 440, 390, 420 and 1,300, respectively. The burden of fractures in Cyprus in 2025 was estimated to increase with 47% to €76 million.

Conclusions There is a high cost of osteoporosis with a substantial projected increase of the economic burden driven by an aging population, suggesting that a change in healthcare policy concerning the disease is warranted.
Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Cyprus in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Cyprus was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Cyprus

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 150,000 and 161,000 respectively in Cyprus in 2010 (Table 1). In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 40,000 (Table 2). There are 23.9 DXA scan machines per million (m) inhabitants [2], and there are no guidelines for osteoporosis treatment [3]. A country specific FRAX model for the assessment of fracture risk is not available for Cyprus.

Incidence data was not available for Cyprus, therefore data for hip fractures was imputed from Greek age-standardized incidence rates [5]. Fracture incidence is presented in Table 3. Standardized to the EU27 population, this hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 212.7 and 494.0 respectively. The incidence of vertebral, forearm and “other” fractures was imputed using the methods described in Chapter 3 of the main report.

The number of incident fractures in 2010 was estimated at approximately 5,000 (Table 4). Incident hip, clinical spine, forearm fractures were estimated at approximately 1,000 each and “other” fractures were estimated at 3,000. 61% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals

Table 1 Population at risk: men and women over the age of 50 in Cyprus, 2010 [1]

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–59      | 65,000| 66,000| 131,000|
| 60–69      | 49,000| 45,000| 94,000|
| 70–79      | 30,000| 27,000| 57,000|
| 80–89      | 15,000| 11,000| 26,000|
| 90+        | 2,000 | 1,000 | 3,000 |
| 50+        | 161,000| 150,000| 311,000|

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Cyprus by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 2,205 | 875 |
| 55–59      | 2,880 | 1,085|
| 60–64      | 3,861 | 1,450|
| 65–69      | 4,444 | 1,480|
| 70–74      | 4,743 | 1,248|
| 75–79      | 4,875 | 1,133|
| 80+        | 8,024 | 1,992|
| 50+        | 31,032| 9,263|

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Cyprus by age

| Age (years) | hip | vertebra | forearm | other |
|------------|-----|----------|---------|-------|
| Women      |     |          |         |       |
| 50–54      | 2   | 5        | 12      | 12    |
| 55–59      | 61  | 170      | 469     | 537   |
| 60–64      | 120 | 213      | 455     | 464   |
| 65–69      | 198 | 288      | 480     | 675   |
| 70–74      | 436 | 614      | 783     | 1,235 |
| 75–79      | 707 | 688      | 690     | 1,488 |
| 80–84      | 1,281| 805      | 802     | 2,178 |
| 85+        | 1,855| 872      | 792     | 3,116 |

| Men        |     |          |         |       |
|------------|-----|----------|---------|-------|
| 50–54      | 21  | 55       | 20      | 94    |
| 55–59      | 45  | 79       | 69      | 420   |
| 60–64      | 69  | 165      | 130     | 678   |
| 65–69      | 102 | 161      | 154     | 660   |
| 70–74      | 220 | 336      | 141     | 1,132 |
| 75–79      | 363 | 418      | 103     | 968   |
| 80–84      | 725 | 503      | 141     | 1,927 |
| 85+        | 1,087| 730      | 199     | 3,148 |
who had suffered a fracture prior to 2010 were estimated at 1.58% for hip and 1.98% for vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 5,000 and 6,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Cyprus, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
|              | Women        |                    |
| 50–74        | 0.0          | 0.0                |
| 75+          | 0.2          | 0.6                |
| Total        | 0.2          | 0.6                |
|              | Men          |                    |
| 50–74        | 0.2          | 0.7                |
| 75+          | 1.4          | 4.3                |
| Total        | 1.6          | 5.0                |
|              | Men and Women|                    |
| 50–74        | 0.4          | 1.0                |
| 75+          | 7.8          | 10.2               |
| Total        | 8.2          | 11.2               |

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 53 (Table 8). Hip, vertebral and “other” fractures accounted for 27, 19 and 8 deaths respectively. Overall, approximately 46% of deaths occurred in women.

Table 6 Number of men and women in Cyprus with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
|              | Women        |                    |
| 50–74        | 1,027        | 1,888              |
| 75+          | 2,360        | 2,331              |
| Total        | 3,387        | 4,219              |
|              | Men          |                    |
| 50–74        | 589          | 1,039              |
| 75+          | 946          | 892                |
| Total        | 1,535        | 1,931              |
|              | Men and Women|                    |
| 50–74        | 1,616        | 2,927              |
| 75+          | 3,305        | 3,223              |
| Total        | 4,921        | 6,150              |

Table 7 Incidence (per 100,000) of causally related deaths in Cyprus within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|-----------------|
|              | Women|                    |                 |
| 50–54        | 641  | 833                | 17              |
| 55–59        | 463  | 569                | 14              |
| 60–64        | 683  | 793                | 22              |
| 65–69        | 1,007| 1,104              | 38              |
| 70–74        | 1,698| 1,753              | 77              |
| 75–79        | 2,642| 2,552              | 166             |
| 80–84        | 3,468| 3,069              | 386             |
| 85–89        | 3,096| 2,407              | 542             |
| 90+          | 4,436| 2,501              | 1,542           |
|              | Men  |                    |                 |
| 50–54        | 1,496| 1,794              | 23              |
| 55–59        | 1,999| 2,273              | 41              |
| 60–64        | 1,768| 1,901              | 48              |
| 65–69        | 2,904| 2,945              | 104             |
| 70–74        | 3,040| 2,895              | 137             |
| 75–79        | 4,005| 3,552              | 238             |
| 80–84        | 5,830| 4,734              | 490             |
| 85–89        | 8,267| 6,042              | 893             |
| 90+          | 13,245| 8,619        | 1,657           |
Table 8  The number of deaths in men and women in Cyprus in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Fracture at the | Women | | Men | | Men and Women |
|-------------|----------------|-------|---|----|---|-----------|
|             | hip | vertebra | “other” | |             | |               |
| 50–74   | 2   | 3       | 0       | | 50–74   | 3   | 5       | 1       | | 50–74   | 5   | 8       | 1       |
| 75+     | 11  | 4       | 4       | | 75+     | 11  | 6       | 3       | | 75+     | 22  | 10      | 7       |
| Total   | 13  | 8       | 4       | | Total   | 14  | 11      | 4       | | Total   | 27  | 19      | 8       |

Cost of osteoporosis in Cyprus including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of a hip fracture has been estimated at € 14,821 in Cyprus based on cost estimates in Italy [6]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€ 15,261 [7,8], approximated by adjusting the Bulgarian cost for health adjusted price levels) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 14 [9] and a DXA scan costing € 75 [10] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at € 52 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to € 34 million, € 7 million and € 12 million, respectively. It is notable that pharmacological fracture prevention costs accounted for only 22.4 % of the total cost.

When stratifying costs of osteoporosis by fracture type, “other” fractures were most costly (€ 20 million) followed by hip (€ 17 million), spine (€ 2 million) and forearm fractures (€ 1 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of QALYs lost due to osteoporosis in 2010 was estimated at 1,800 (Table 12). Prior fractures accounted for 58 % of the total loss and 63 % of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALY’s lost was estimated at € 78 million.

Table 10 Cost of osteoporosis (€) in Cyprus by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|---------------------------|-------------------------|------------|
| Women       |                          |                           |                         |            |
| 50–74       | 9,814,331                | 974,826                   | 7,000,496               | 17,789,653 |
| 75+         | 9,775,132                | 3,225,383                 | 3,174,204               | 16,174,719 |
| All         | 19,589,463               | 4,200,209                 | 10,174,700              | 33,964,372 |
| Men         |                          |                           |                         |            |
| 50–74       | 8,073,051                | 670,806                   | 1,025,858               | 9,769,715  |
| 75+         | 5,946,705                | 1,636,933                 | 405,798                 | 7,989,436  |
| All         | 14,019,756               | 2,307,739                 | 1,431,655               | 17,759,151 |
| Women and Men |                          |                           |                         |            |
| 50–74       | 17,887,382               | 1,645,632                 | 8,026,353               | 27,559,367 |
| 75+         | 15,721,837               | 4,862,316                 | 3,580,002               | 24,164,155 |
| All         | 33,609,219               | 6,507,948                 | 11,606,355              | 51,723,522 |

Table 9 One year costs for relevant pharmaceuticals in Cyprus, 2010 [9]

| Annual drug cost (€) | Alendronate | Risedronate | Etidronate | Ibandronate | Zoledronic acid | Raloxifene | Strontium ranelate | Parathyroid hormone | Teriparatide |
|----------------------|-------------|-------------|------------|-------------|-----------------|------------|-------------------|---------------------|-------------|
|                      | 327         | 508         | -          | 489         | 481             | 1,037      | 655                | -                   | 7,179       |
When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €130 million in Cyprus in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 26%, 5%, 9% and 60%, respectively.

**Burden of osteoporosis up to 2025**

The population above 50 years of age is expected to increase from 311,000 in 2010 to 430,000 in 2025, corresponding to an increase of 38% (Table 14).

### Table 11 Total cost (€) in 2010 by fracture site in men and women in Cyprus. Note that costs for fracture prevention therapy and monitoring are not included

| Age | Hip  | Spine | Forearm | Other | All   |
|-----|------|-------|---------|-------|-------|
|     | 50–74| 75+   | All     |       |       |
| Women | 3,540,884 | 7,293,878 | 10,834,762 | 13,799,048 | 23,789,672 |
| Men   | 2,272,964 | 3,627,001 | 5,899,965 | 9,316,085 | 16,327,495 |
| All   | 5,813,848 | 1,489,828 | 640,927 | 11,588,411 | 19,533,014 |

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €130 million in Cyprus in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 26%, 5%, 9% and 60%, respectively.

### Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Cyprus according to age

| Age (years) | Women | Men | Total |
|-------------|-------|-----|-------|
| 50–74       |       |     |       |
| Incident hip fractures | 43   | 28  | 71    |
| Incident vertebral fractures | 91  | 66  | 157   |
| Incident forearm fractures | 20  | 4   | 24    |
| Incident other fractures | 90  | 90  | 180   |
| Prior hip fractures | 161 | 58  | 219   |
| Prior vertebral fractures | 105 | 140 | 245   |
| Total       | 511  | 632 | 1,143 |

### Table 13 Value of lost QALYs (€) in men and women in Cyprus in 2010

| Age | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|-----|----------------|----------------|----------------|
| Women | Incident hip fractures | 3,878,655 | 7,757,311 | 11,635,966 |
|       | Incident vertebral fractures | 5,369,465 | 10,738,931 | 16,108,396 |
|       | Incident forearm fractures | 704,293  | 1,408,586 | 2,112,879 |
|       | Incident other fractures | 6,555,346 | 13,110,692 | 19,666,038 |
|       | Prior hip fractures | 15,557,915 | 31,115,830 | 46,673,745 |
|       | Prior vertebral fractures | 7,059,402 | 14,118,803 | 21,178,205 |
| Total | 39,125,076 | 78,250,153 | 117,375,229 |

Fig. 1 Share (%) of fracture cost by fracture site in Cyprus. Note that costs for fracture prevention therapy and monitoring are not included.
The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €52 million in 2010 to €76 million in 2025, corresponding to an increase of 47% (Table 16). Costs incurred in women and men increased by 47% and 48% respectively.

The total number of QALYs lost due to fracture was estimated to increase from 1,800 in 2010 to 2,300 in 2025, corresponding to an increase of 29% (Table 17). The increase was estimated to be particularly marked in men (38%) compared to women (24%). Incident and prior fractures accounted for 73% and 27% of the increase respectively.
The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €130 million in 2010 to €177 million in 2025. The increase was estimated to be particularly marked in men (+42 %) compared to women (+33 %) (Table 18).

**Table 18** Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Cyprus assuming the uptake of treatment remains unchanged

|            | 2010 | 2015 | 2020 | 2025 |
|------------|------|------|------|------|
| **Women**  |      |      |      |      |
| 50–74      | 40   | 45   | 48   | 52   |
| 75+        | 44   | 47   | 54   | 59   |
| All        | 84   | 92   | 102  | 112  |
| **Men**    |      |      |      |      |
| 50–74      | 24   | 27   | 30   | 34   |
| 75+        | 22   | 24   | 26   | 32   |
| All        | 46   | 51   | 57   | 66   |
| **Women and Men** | | |      |      |
| 50–74      | 64   | 72   | 79   | 86   |
| 75+        | 66   | 71   | 81   | 91   |
| All        | 130  | 142  | 169  | 177  |

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €130 million in 2010 to €177 million in 2025. The increase was estimated to be particularly marked in men (+42 %) compared to women (+33 %) (Table 18).

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Abstract

This report describes epidemiology, burden, and treatment of osteoporosis in the Czech Republic.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in the Czech Republic, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods

The literature on fracture incidence and costs of fractures in the Czech Republic was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results

It was estimated that approximately 72,000 new fragility fractures were sustained in the Czech Republic, comprising 12,000 hip fractures, 11,000 vertebral fractures, 12,000 forearm fractures and 37,000 other fractures (i.e. fractures of the pelvis, rib, humerus,ibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €273 million for the same year. Incident fractures represented 60% of this cost, long-term fracture care 20% and pharmacological prevention 19%. Previous and incident fractures also accounted for 22,800 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 94,000 in 2025, representing an increase of 21,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 4,700, 3,400, 2,400 and 11,000, respectively. The burden of fractures in the Czech Republic in 2025 was estimated to increase by 29% to €352 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of
patients aged 50 or above who received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by an aging population, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in the Czech Republic in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in the Czech Republic was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in the Czech Republic

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 1,710,000 and 2,092,000 respectively in the Czech Republic in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 530,000 (Table 2). There are 5.2 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for the Czech Republic [5]. Given that country specific incidence of vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 277.1 and 566.6 respectively.

The number of incident fractures in 2010 was estimated at 72,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 12,000, 11,000, 12,000 and 37,000 respectively. 61 % of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals who had suffered a fracture prior to 2010 were estimated at 1.55 % for hip and 1.69 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 59,000 and 64,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

| Table 1 | Population at risk: men and women over the age of 50 in the Czech Republic, 2010 [1] |
|---|---|---|---|
| Age (years) | Women | Men | All |
| 50–59 | 768,000 | 746,000 | 1,514,000 |
| 60–69 | 662,000 | 573,000 | 1,235,000 |
| 70–79 | 406,000 | 276,000 | 682,000 |
| 80–89 | 235,000 | 109,000 | 344,000 |
| 90+ | 21,000 | 6,000 | 27,000 |
| 50+ | 2,092,000 | 1,710,000 | 3,802,000 |

| Table 2 | Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in the Czech Republic by age using female-derived reference ranges at the femoral neck, 2010 [4] |
|---|---|---|
| Age (years) | Women | Men |
| 50–54 | 23,310 | 9,200 |
| 55–59 | 38,208 | 13,230 |
| 60–64 | 55,484 | 20,068 |
| 65–69 | 55,348 | 16,798 |
| 70–74 | 56,637 | 11,544 |
| 75–79 | 76,125 | 13,184 |
| 80+ | 120,832 | 19,090 |
| 50+ | 425,944 | 103,114 |
The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 1,034 (Table 8). Hip, vertebral and “other” fractures accounted for 501, 380 and 154 deaths respectively. Overall, approximately 50% of deaths occurred in women.

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in the Czech Republic by age

| Age (years) | hip | vertebra | forearm | other |
|-------------|-----|----------|---------|-------|
| Women       |     |          |         |       |
| 50–54       | 23  | 58       | 143     | 148   |
| 55–59       | 45  | 124      | 344     | 394   |
| 60–64       | 80  | 141      | 302     | 308   |
| 65–69       | 144 | 210      | 350     | 493   |
| 70–74       | 301 | 424      | 541     | 853   |
| 75–79       | 679 | 660      | 662     | 1,429 |
| 80–84       | 1,380| 867      | 864     | 2,347 |
| 85+         | 2,462| 1,158    | 1,051   | 4,135 |
| Men         |     |          |         |       |
| 50–54       | 46  | 118      | 42      | 204   |
| 55–59       | 69  | 120      | 105     | 640   |
| 60–64       | 100 | 239      | 188     | 982   |
| 65–69       | 143 | 225      | 215     | 923   |
| 70–74       | 221 | 338      | 142     | 1,138 |
| 75–79       | 409 | 471      | 116     | 1,091 |
| 80–84       | 810 | 562      | 157     | 2,154 |
| 85+         | 1,457| 979      | 267     | 4,221 |

Table 4 Estimated number of incident fractures in the Czech Republic, 2010

| Age (years) | hip | vertebra | forearm | other | fractures |
|-------------|-----|----------|---------|-------|-----------|
| Women       |     |          |         |       |           |
| 50–74       | 1,826| 2,860    | 5,590   | 7,252 | 17,529    |
| 75+         | 6,504| 3,546    | 3,774   | 12,390| 26,213    |
| Total       | 8,330| 6,406    | 9,364   | 19,642| 43,741    |
| Men         |     |          |         |       |           |
| 50–74       | 1,649| 3,017    | 2,102   | 11,698| 18,466    |
| 75+         | 2,111| 1,606    | 448     | 5,821 | 9,987     |
| Total       | 3,761| 4,623    | 2,550   | 17,319| 28,453    |
| Men and Women|  |          |         |       |           |
| 50–74       | 3,476| 5,877    | 7,692   | 18,950| 35,995    |
| 75+         | 8,615| 5,151    | 4,222   | 18,211| 36,199    |
| Total       | 12,091| 11,029   | 11,914  | 37,161| 72,194    |

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in the Czech Republic, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| Women       |              |                   |
| 50–54       | 0.1          | 0.1               |
| 55–59       | 0.2          | 0.6               |
| 60–64       | 0.5          | 1.0               |
| 65–69       | 0.9          | 1.5               |
| 70–74       | 1.8          | 2.6               |
| 75–79       | 3.5          | 4.1               |
| 80–84       | 6.7          | 5.9               |
| 85+         | 13.9         | 9.3               |
| Men         |              |                   |
| 50–54       | 0.1          | 0.2               |
| 55–59       | 0.4          | 0.6               |
| 60–64       | 0.7          | 1.1               |
| 65–69       | 1.0          | 1.5               |
| 70–74       | 1.5          | 1.9               |
| 75–79       | 2.3          | 2.5               |
| 80–84       | 4.0          | 3.3               |
| 85+         | 8.4          | 5.7               |

Cost of osteoporosis in the Czech Republic including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still

Table 6 Number of men and women in the Czech Republic with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| Women       |              |                   |
| 50–74       | 9,186        | 16,090            |
| 75+         | 31,837       | 26,937            |
| Total       | 41,023       | 43,027            |
| Men         |              |                   |
| 50–74       | 8,670        | 13,327            |
| 75+         | 9,286        | 7,986             |
| Total       | 17,956       | 21,313            |
| Men and Women|            |                   |
| 50–74       | 17,856       | 29,417            |
| 75+         | 41,123       | 34,923            |
| Total       | 58,979       | 64,340            |
incurred costs in 2010 ("long-term disability cost"); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs ("pharmacological fracture prevention costs"). See Chapter 4 of the main report for further details.

The cost of a hip fracture has been estimated at € 5,169 in the Czech Republic [6]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€ 10,614 [6]) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 18 (approximated by adjusting Polish cost for health adjusted price levels [7]) and a DXA scan costing € 32 [8] every second year to monitor treatment.

Table 8 The number of deaths in men and women in the Czech Republic in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
| Women       |     |                    |                  |
| 50–54       | 637 | 827                | 16               |
| 55–59       | 841 | 1,034              | 25               |
| 60–64       | 1,283 | 1,490           | 41               |
| 65–69       | 1,941 | 2,127            | 73               |
| 70–74       | 2,411 | 2,488            | 110              |
| 75–79       | 3,240 | 3,130            | 203              |
| 80–84       | 3,382 | 2,992            | 377              |
| 85–89       | 4,112 | 3,196            | 720              |
| 90+         | 3,254 | 1,835            | 1,131            |
| Men         |     |                    |                  |
| 50–54       | 2,197 | 2,635            | 34               |
| 55–59       | 3,144 | 3,575            | 65               |
| 60–64       | 3,643 | 3,918            | 99               |
| 65–69       | 4,501 | 4,566            | 161              |
| 70–74       | 4,815 | 4,584            | 217              |
| 75–79       | 5,758 | 5,106            | 341              |
| 80–84       | 6,681 | 5,425            | 561              |
| 85–89       | 8,607 | 6,291            | 930              |
| 90+         | 10,459 | 6,806           | 1,308            |

Table 9 One year costs for relevant pharmaceuticals in the Czech Republic, 2010 [9]

| Annual drug cost (€) |
|----------------------|
| Alendronate          | 187 |
| Risedronate          | 231 |
| Etidronate           | -   |
| Ibandronate          | 328 |
| Zoledronic acid      | 355 |
| Raloxifene           | 454 |
| Strontium ranelate   | 478 |
| Parathyroid hormone  | 4,485 |
| Teriparatide         | 4,753 |

Table 10 Cost of osteoporosis (€) in the Czech Republic by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|---------------------------|-----------------------------|--------------------------|------------|
| Women       |                           |                             |                          |            |
| 50–74       | 33,155,972                | 6,053,193                   | 29,527,124               | 68,736,288 |
| 75+         | 66,493,086                | 31,809,286                  | 16,565,776               | 114,868,147 |
| All         | 99,649,058                | 37,862,478                  | 46,092,899               | 183,604,306 |
| Men         |                           |                             |                          |            |
| 50–74       | 39,982,017                | 6,564,719                   | 4,719,626                | 51,266,361 |
| 75+         | 25,536,336                | 11,208,040                  | 1,772,569                | 38,516,945 |
| All         | 65,518,352                | 17,772,759                  | 6,492,194                | 89,783,306 |
| Men and Women|                         |                             |                          |            |
| 50–74       | 73,137,988                | 12,617,912                  | 34,246,749               | 120,002,649 |
| 75+         | 92,029,422                | 43,017,326                  | 18,338,344               | 153,385,092 |
| All         | 165,167,410               | 55,635,237                  | 52,585,094               | 273,387,741 |
The cost of osteoporosis in 2010 was estimated at €273 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €165 million, €56 million and €53 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 19.2% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€110 million) followed by “other” (€96 million), spine (€11 million) and forearm fractures (€4 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 22,800 (Table 12). Prior fractures accounted for 52% of the total loss and 63% of the loss occurred in women. The monetary value of

| Table 11 | Total cost (€) in 2010 by fracture site in men and women in the Czech Republic. Note that costs for fracture prevention therapy and monitoring are not included |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Age      | Hip                        | Spine                     | Forearm                   | Other                      | All                                          |
|----------|-----------------------------|---------------------------|---------------------------|---------------------------|------------------------------------------------|
| Women    |                             |                           |                           |                           |                                               |
| 50–74    | 15,018,232                  | 3,110,191                 | 1,765,305                 | 19,315,436                | 39,209,164                                     |
| 75+      | 60,773,117                  | 3,584,788                 | 1,191,836                 | 32,752,631                | 98,302,372                                     |
| All      | 75,791,350                  | 6,694,979                 | 2,957,141                 | 52,068,066                | 137,511,536                                    |
| Men      |                             |                           |                           |                           |                                               |
| 50–74    | 14,221,056                  | 3,101,243                 | 663,766                   | 28,560,671                | 46,546,736                                     |
| 75+      | 19,582,345                  | 1,487,887                 | 141,547                   | 15,532,597                | 36,744,376                                     |
| All      | 33,803,401                  | 4,589,130                 | 805,313                   | 44,093,268                | 83,291,111                                     |
| Women and Men |                      |                           |                           |                           |                                               |
| 50–74    | 29,239,289                  | 6,211,434                 | 2,429,071                 | 47,876,106                | 85,755,900                                     |
| 75+      | 80,355,462                  | 5,072,675                 | 1,333,383                 | 48,285,228                | 135,046,748                                    |
| All      | 109,594,750                 | 11,284,109                | 3,762,454                 | 96,161,334                | 220,802,648                                    |

Fig. 1 Share (%) of fracture cost by fracture site in the Czech Republic. Note that costs for fracture prevention therapy and monitoring are not included.

| Table 12 | Number of QALYs lost due to fractures during 2010 in men and women in the Czech Republic according to age |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Age (years) |                                                                 |                                                                 |                                                                 |                                                                 |                                                                 |
| Women    |                             |                           |                           |                           |                                                                 |
| 50–74    | 443                         | 1,393                     | 1,836                     | 2,176                     | 2,223                                                                 |
| 75+      | 953                         | 1,038                     | 1,991                     | 2,176                     | 5,784                                                                 |
| All      | 1,996                       | 2,431                     | 3,827                     | 4,352                     | 7,007                                                                 |
| Men      |                             |                           |                           |                           |                                                                 |
| 50–74    | 410                         | 519                       | 1,538                     | 2,056                     | 2,232                                                                 |
| 75+      | 1,019                       | 15                        | 88                        | 2,056                     | 1,164                                                                 |
| All      | 1,429                       | 54                       | 32                        | 2,056                     | 3,396                                                                 |

| Table 13 | Value of lost QALYs (€) in men and women in the Czech Republic in 2010 |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $1 \times $GDP/capita | $2 \times $GDP/capita | $3 \times $GDP/capita |
| Incident hip fractures | 38,084,562 | 76,169,123 | 114,253,685 |
| Incident vertebral fractures | 48,705,018 | 97,410,035 | 146,115,053 |
| Incident forearm fractures | 5,531,867 | 11,063,733 | 16,595,600 |
| Incident other fractures | 58,403,810 | 116,807,619 | 175,211,429 |
| Prior hip fractures | 117,570,796 | 235,141,592 | 352,712,388 |
| Prior vertebral fractures | 46,747,054 | 93,494,108 | 140,241,161 |
| Total | 315,043,105 | 630,086,211 | 945,129,316 |
a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €630 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €900 million in Czech Republic in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 18 %, 6 %, 6 %, and 70 %, respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 3.8 million in 2010 to 4.3 million in 2025, corresponding to an increase of 13 % (Table 14).

### Table 14 Population projections in the Czech Republic by age and sex [10]

| Population | 2010   | 2015   | 2020   | 2025   |
|------------|--------|--------|--------|--------|
| Women      |        |        |        |        |
| 50–59      | 768,000| 665,000| 650,000| 721,000|
| 60–69      | 662,000| 757,000| 726,000| 632,000|
| 70–79      | 406,000| 430,000| 568,000| 653,000|
| 80–89      | 235,000| 246,000| 234,000| 265,000|
| 90+        | 21,000 | 40,000 | 51,000 | 58,000 |
| Men        |        |        |        |        |
| 50–59      | 746,000| 659,000| 663,000| 742,000|
| 60–69      | 573,000| 664,000| 652,000| 583,000|
| 70–79      | 276,000| 310,000| 422,000| 494,000|
| 80–89      | 109,000| 123,000| 122,000| 148,000|
| 90+        | 6,000  | 12,000 | 15,000 | 19,000 |
| All        | 1,514,000| 1,324,000| 1,313,000| 1,463,000|

### Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in the Czech Republic

| Hip   | 2010 | 2025 | Spine | 2010 | 2025 | Forearm | 2010 | 2025 | Other | 2010 | 2025 |
|-------|------|------|-------|------|------|---------|------|------|-------|------|------|
| Women |      |      |       |      |      |         |      |      |       |      |      |
| 50–74 | 1,826| 2,310| 2,860 | 3,411| 5,590| 6,202   | 7,252| 8,498|
| 75+   | 6,504| 9,061| 3,546 | 4,917| 3,774| 5,127   | 12,390| 17,287|
| All   | 8,330| 11,371| 6,406 | 8,328| 9,364| 11,329  | 19,642| 25,786|
| Men   |      |      |       |      |      |         |      |      |       |      |      |
| 50–74 | 1,649| 2,038| 3,017 | 3,507| 2,102| 2,240   | 11,698| 13,198|
| 75+   | 2,111| 3,341| 1,606 | 2,584| 448  | 719     | 5,821 | 9,202 |
| All   | 3,761| 5,379| 4,623 | 6,091| 2,550| 2,958   | 17,519| 22,401|

| Women and Men | | | | | | | | | | | |
|---------------|---|---|---|---|---|---|---|---|---|---|
| 50–74 | 3,476| 4,348| 5,877| 6,918| 7,692| 8,442| 18,950| 21,697|
| 75+   | 8,615| 12,402| 5,151| 7,502| 4,222| 5,846| 18,211| 26,490|
| All   | 12,091| 16,750| 11,029| 14,419| 11,914| 14,287| 37,161| 48,187|

### Table 16 Current and future cost (€000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in the Czech Republic

| Women |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|
| 50–74 | 69 | 77 | 84 | 82 |   |   |   |   |
| 75+   | 115| 121| 130| 151|   |   |   |   |
| All   | 184| 197| 214| 233|   |   |   |   |

| Men   |   |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|---|
| 50–74 | 51 | 57 | 62 | 62 |   |   |   |   |
| 75+   | 39 | 42 | 47 | 57 |   |   |   |   |
| All   | 90 | 99 | 108| 119|   |   |   |   |

| Women and Men |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|
| 50–74 | 120| 134| 146| 144|   |   |   |   |
| 75+   | 153| 162| 176| 208|   |   |   |   |
| All   | 273| 297| 322| 352|   |   |   |   |
The total number of fractures was estimated to rise from 72,000 in 2010 to 94,000 in 2025 (Table 15), corresponding to an increase of 31%. Hip, clinical spine, forearm and other fractures increased by 4,700, 3,400, 2,400 and 11,000 respectively. The increase in the number of fractures ranged from 20% to 39%, depending on fracture site. The increase was estimated to be similar in men (29%) and women (30%).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €273 million in 2010 to €352 million in 2025, corresponding to an increase of 29% (Table 16). Costs incurred in women and men increased by 27% and 33% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 22,800 in 2010 to 27,900 in 2025, corresponding to an increase of 22% (Table 17). The increase was estimated to be particularly marked in men (27%) compared to women (19%). Incident and prior fractures accounted for 67% and 33% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €900 million in 2010 to €1.1 billion in 2025. The increase was estimated to be particularly marked in men (+28%) compared to women (+22%) (Table 18).

**Table 17** Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in the Czech Republic

|                | Incident fractures | Prior fractures | All fractures |
|----------------|--------------------|-----------------|---------------|
|                | 2010               | 2025            | 2010          | 2025       | 2010   | 2025   |
| Women          |                    |                 |               |            |        |        |
| 50–74          | 2,465              | 2,917           | 2,347         | 2,485      | 4,812  | 5,402  |
| 75+            | 3,852              | 5,325           | 5,661         | 6,359      | 9,513  | 11,684 |
| All            | 6,317              | 8,242           | 8,008         | 8,844      | 14,324 | 17,086 |
| Men            |                    |                 |               |            |        |        |
| 50–74          | 2,892              | 3,332           | 2,099         | 2,353      | 4,991  | 5,686  |
| 75+            | 1,714              | 2,722           | 1,800         | 2,370      | 3,514  | 5,091  |
| All            | 4,605              | 6,054           | 3,900         | 4,723      | 8,505  | 10,777 |
| Women and Men  |                    |                 |               |            |        |        |
| 50–74          | 5,357              | 6,249           | 4,446         | 4,838      | 9,803  | 11,087 |
| 75+            | 5,565              | 8,047           | 7,461         | 8,729      | 13,026 | 16,775 |
| All            | 10,922             | 14,296          | 11,907        | 13,567     | 22,829 | 27,863 |

The total number of fractures was estimated to rise from 72,000 in 2010 to 94,000 in 2025 (Table 15), corresponding to an increase of 31%. Hip, clinical spine, forearm and other fractures increased by 4,700, 3,400, 2,400 and 11,000 respectively. The increase in the number of fractures ranged from 20% to 39%, depending on fracture site. The increase was estimated to be similar in men (29%) and women (30%).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €273 million in 2010 to €352 million in 2025, corresponding to an increase of 29% (Table 16). Costs incurred in women and men increased by 27% and 33% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 22,800 in 2010 to 27,900 in 2025, corresponding to an increase of 22% (Table 17). The increase was estimated to be particularly marked in men (27%) compared to women (19%). Incident and prior fractures accounted for 67% and 33% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €900 million in 2010 to €1.1 billion in 2025. The increase was estimated to be particularly marked in men (+28%) compared to women (+22%) (Table 18).

**Treatment uptake**

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2). Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.64% in 2001 to 2.29% in 2011.

**Table 18** Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in the Czech Republic assuming the uptake of treatment remains unchanged

|                | 2010 | 2015 | 2020 | 2025 |
|----------------|------|------|------|------|
| Women          |      |      |      |      |
| 50–74          | 202  | 218  | 232  | 231  |
| 75+            | 377  | 396  | 421  | 473  |
| All            | 579  | 614  | 653  | 705  |
| Men            |      |      |      |      |
| 50–74          | 189  | 201  | 213  | 219  |
| 75+            | 135  | 144  | 161  | 198  |
| All            | 325  | 346  | 374  | 417  |
| Women and Men  |      |      |      |      |
| 50–74          | 391  | 419  | 445  | 450  |
| 75+            | 513  | 541  | 582  | 671  |
| All            | 903  | 960  | 1,027| 1,121|

**Table 19** Number of men and women eligible for treatment, treated and treatment gap in 2010

|                | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|----------------|-------------------------------------|----------------------------------------|---------------------|-------------------|
| Men            | 12                                  | 102                                    | 90                  | 88                |
| Women          | 79                                  | 330                                    | 251                 | 76                |
Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in the Czech Republic were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 88 % and 76 % respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

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Epidemiology and Economic Burden of Osteoporosis in Denmark

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Denmark.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Denmark, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Denmark was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 66,000 new fragility fractures were sustained in Denmark, comprising 12,000 hip fractures, 10,000 vertebral fractures, 10,000 forearm fractures and 34,000 other fractures (i.e. fractures of the pelvis, rib, humerus,ibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fractures was estimated at €1,055 million for the same year. Incident fractures represented 68 % of this cost, long-term fracture care 28 % and pharmacological prevention 4 %. Previous and incident fractures also accounted for 20,200 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 86,000 in 2025, representing an increase of 20,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 4,300, 3,200, 2,400 and 10,300, respectively. The burden of fractures in Denmark in 2025 was estimated to increase by 27 % to €1,344 million. Though the uptake of osteoporosis treatments...
increased from 2001, the proportion of patients aged 50 or above who received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions

In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Denmark in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Denmark was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis. Where possible, country-specific data were used (see below).

Epidemiology of osteoporosis in Denmark

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 950,000 and 1,053,000 respectively in Denmark in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated to be 280,000 (Table 2). Note that the numbers do not include patients with vertebral osteoporosis (spine T-score < −2.5) in whom femoral neck BMD lies in the normal or osteopenic range. There are 14.6 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

| Table 1 Population at risk: men and women over the age of 50 in Denmark, 2010 [1] |
|---|---|---|---|
| Age (years) | Women | Men | All |
| 50–59 | 355,000 | 357,000 | 712,000 |
| 60–69 | 346,000 | 337,000 | 683,000 |
| 70–79 | 205,000 | 175,000 | 380,000 |
| 80–89 | 119,000 | 72,000 | 191,000 |
| 90+ | 28,000 | 9,000 | 37,000 |
| 50+ | 1,053,000 | 950,000 | 2,003,000 |

| Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤ −2.5 SD) in Denmark by age using female-derived reference ranges at the femoral neck, 2010 [4] |
|---|---|---|
| Age (years) | Women | Men |
| 50–54 | 11,403 | 4,600 |
| 55–59 | 16,704 | 6,055 |
| 60–64 | 27,170 | 10,904 |
| 65–69 | 31,512 | 11,026 |
| 70–74 | 32,364 | 8,112 |
| 75–79 | 33,375 | 7,313 |
| 80+ | 69,384 | 13,446 |
| 50+ | 221,912 | 61,456 |
which had occurred after the age of 50 years and before 2010. In the population $\geq 50$ years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 2.48 % for hip and 2.92 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 50,000 and 59,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was

### Table 3: Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Denmark by age

| Age (years) | Hip fracture | Vertebral fracture | Forearm | Other | Total |
|-------------|--------------|--------------------|---------|-------|-------|
| Women       |              |                    |         |       |       |
| 50–54       | 1,859        | 2,831              | 5,080   | 6,793 | 16,563|
| 75+         | 6,629        | 3,390              | 3,219   | 12,093| 25,331|
| Total       | 8,488        | 6,221              | 8,299   | 18,886| 41,894|
| Men         |              |                    |         |       |       |
| 50–54       | 1,318        | 2,329              | 1,541   | 8,660 | 13,848|
| 75+         | 2,236        | 1,689              | 464     | 6,229 | 10,617|
| Total       | 3,553        | 4,018              | 2,004   | 14,889| 24,464|
| Men and Women|            |                    |         |       |       |
| 50–54       | 3,177        | 5,161              | 6,620   | 15,453| 30,411|
| 75+         | 8,864        | 5,078              | 3,683   | 18,322| 35,948|
| Total       | 12,041       | 10,239             | 10,303  | 33,775| 66,359|

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 50,000 and 59,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 7,593        | 14,167             |
| 75+         | 26,370       | 24,754             |
| Total       | 33,963       | 38,921             |
| Men         |              |                    |
| 50–54       | 6,489        | 11,028             |
| 75+         | 9,294        | 8,624              |
| Total       | 15,783       | 19,652             |

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Men and Women|            |                    |
| 50–54       | 14,082       | 25,195             |
| 75+         | 35,664       | 33,378             |
| Total       | 49,746       | 58,573             |
estimated at 879 (Table 8). Hip, vertebral and “other” fractures accounted for 427, 293 and 158 deaths respectively. Overall, approximately 52% of deaths occurred in women.

Table 7 Estimated incidence (per 100,000) of causally related deaths [6] in Denmark within the first year after fracture (adjusted for comorbidities), 2010.

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
|             |     |                    |                  |
| Women       |     |                    |                  |
| 50–54       | 596 | 774                | 15               |
| 55–59       | 1,251 | 1,539              | 37               |
| 60–64       | 1,285 | 1,492              | 41               |
| 65–69       | 1,953 | 2,141              | 73               |
| 70–74       | 2,368 | 2,444              | 108              |
| 75–79       | 3,092 | 2,987              | 194              |
| 80–84       | 3,064 | 2,711              | 341              |
| 85–89       | 3,189 | 2,479              | 559              |
| 90+         | 2,868 | 1,617              | 997              |
| Men         |     |                    |                  |
| 50–54       | 1,704 | 2,044              | 27               |
| 55–59       | 2,559 | 2,909              | 53               |
| 60–64       | 2,658 | 2,858              | 72               |
| 65–69       | 3,009 | 3,052              | 108              |
| 70–74       | 3,821 | 3,638              | 172              |
| 75–79       | 4,982 | 4,418              | 295              |
| 80–84       | 5,634 | 4,575              | 473              |
| 85–89       | 7,051 | 5,153              | 762              |
| 90+         | 10,259 | 6,676              | 1,283            |

Table 8 The number of deaths in men and women in Denmark in the first year after fracture attributable to the fracture event (causally related), 2010.

| Age (years) | Hip | Fracture at the vertebral | “Other” |
|-------------|-----|----------------------------|---------|
|             |     |                            |         |
| Women       |     |                            |         |
| 50–74       | 39  | 59                         | 5       |
| 75+         | 185 | 73                         | 92      |
| Total       | 224 | 133                        | 97      |
| Men         |     |                            |         |
| 50–74       | 43  | 74                         | 9       |
| 75+         | 160 | 87                         | 52      |
| Total       | 203 | 161                        | 61      |
| Men and Women |   |                            |         |
| 50–74       | 82  | 133                        | 15      |
| 75+         | 345 | 160                        | 144     |
| Total       | 427 | 293                        | 158     |

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of a hip fracture has been estimated at € 25,117 in Denmark [7, 8]. No other fracture costs were available. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Table 9 One year costs for relevant pharmaceuticals in Denmark, 2010 [11].

| Annual drug cost (€) |    |
|----------------------|----|
| Alendronate           | 126|
| Risedronate           | 50 |
| Etidronate            | 103|
| Ibandronate           | 400|
| Zoledronic acid       | 468|
| Raloxifene            | 430|
| Strontium ranelate    | 721|
| Parathyroid hormone   | 6,874|
| Teriparatide          | 6,902|

Table 10 Cost of osteoporosis (€) in Denmark by age in men and women, 2010.

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| Women       |                          |                            |                          |            |
| 50–74       | 145,724,301              | 30,667,586                 | 21,325,556               | 197,717,442|
| 75+         | 302,207,187              | 168,994,988                | 10,992,998               | 482,195,174|
| All         | 447,931,489              | 199,662,573                | 32,318,554               | 679,912,616|
| Men         |                          |                            |                          |            |
| 50–74       | 145,200,658              | 31,166,101                 | 3,257,310                | 179,624,069|
| 75+         | 124,862,866              | 69,543,398                 | 1,290,043                | 195,696,307|
| All         | 270,063,525              | 100,709,498                | 4,547,353                | 375,320,376|
| Women and Men |                      |                            |                          |            |
| 50–74       | 290,924,960              | 61,833,688                 | 24,582,865               | 377,341,511|
| 75+         | 427,070,054              | 238,538,386                | 12,283,041               | 677,891,481|
| All         | 717,995,013              | 300,372,072                | 36,865,907               | 1,055,232,992|

Cost of osteoporosis in Denmark including and excluding values of QALYs lost

The cost of a hip fracture has been estimated at € 25,117 in Denmark [7, 8]. No other fracture costs were available. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.
Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€ 64,831 [9]) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 160 [10] and a DXA scan costing € 187 [10] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at € 1,055 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to € 718 million, € 300 million and € 37 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 3.5 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€ 564 million) followed by “other” (€ 431 million), spine (€ 12 million) and forearm fractures (€ 12 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 20,200 (Table 12). Prior fractures accounted for 50 % of the total loss and 63 % of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at € 1.7 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 2.76 billion in Denmark in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 26 %, 11 %, 1 %, 62 % respectively.

## Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 2.0 million in 2010 to 2.4 million in 2025, corresponding to an increase of 18 % (Table 14).

The total number of fractures was estimated to rise from 66,000 in 2010 to 86,000 in 2025 (Table 15), corresponding to an increase of 30 %, assuming that age-specific fracture rates remain unchanged over time. At present, hip fracture rates are falling in Denmark [13], so that if this trend

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### Table 11  Total cost (€) in 2010 by fracture site in men and women in Denmark. Note that costs for fracture prevention therapy and monitoring are not included

| Age   | Hip       | Spine     | Forearm  | Other    | All       |
|-------|-----------|-----------|----------|----------|-----------|
|       | Women     | Men       | Women    | Men      | All       |
| 50–74 | 74,946,690| 3,521,946 | 5,783,113| 92,140,138| 176,391,887|
| 75+   | 314,015,870| 3,968,783 | 3,664,919| 149,552,603| 471,202,175|
| All   | 388,962,559| 7,490,730 | 9,448,032| 241,692,741| 647,594,062|

| Age   | Hip       | Spine     | Forearm  | Other    | All       |
|-------|-----------|-----------|----------|----------|-----------|
|       | Women     | Men       | Women    | Men      | All       |
| 50–74 | 61,657,164| 2,820,970 | 1,753,853| 110,134,772| 176,366,759|
| 75+   | 113,204,015| 1,816,408 | 527,960  | 78,857,882| 194,406,264|
| All   | 174,861,179| 4,637,378 | 2,281,812| 188,992,654| 370,773,023|

| Age   | Hip       | Spine     | Forearm  | Other    | All       |
|-------|-----------|-----------|----------|----------|-----------|
|       | Women and Men |          |          |          |           |
| 50–74 | 136,603,854| 6,342,917 | 7,536,966| 202,274,910| 352,758,646|
| 75+   | 427,219,884| 5,785,191 | 4,192,879| 228,410,485| 665,608,439|
| All   | 563,823,738| 12,128,108| 11,729,845| 430,685,395| 1,018,367,085|
continues, the present analysis may be an overestimate. Hip, spine, forearm and other fractures increased by 4,300, 3,200, 2,400 and 10,300, respectively. The increase in the number of fractures ranged from 23 % to 35 %, depending on fracture site. The increase was estimated to be particularly marked in men (35 %) compared to women (28 %).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €1,055 million in 2010 to €1,344 million in 2025, corresponding to an increase of 27 % (Table 16). Costs incurred in women and men increased by 23 % and 34 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 20,200 in 2010 to 24,900 in 2025, corresponding to an increase of 23 % (Table 17). The increase was estimated to be particularly marked in men (30 %) compared to women (19 %). Incident and prior fractures accounted for 67 % and 33 % of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €2.8 billion in 2010 to €3.4 billion in 2025. The increase was estimated to be particularly marked in men (+32 %) compared to women (+21 %) (Table 18).

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).
Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.79% in 2001 to 5.71% in 2011. This is near the European average but high by North European standards.

**Treatment gap**

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in each country were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 50% and 54% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

| Table 15 | Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Denmark |
|----------|------------------------------------------------------------------------------------------------------------------|
|          | Hip | 2010 | 2025 | Spine | 2010 | 2025 | Forearm | 2010 | 2025 | Other | 2010 | 2025 |
| Women    |     |      |      |       |      |      |         |      |      |        |      |      |
| 50–74    | 1,859 | 2,150 | 2,831 | 3,237 | 5,080 | 5,708 | 6,793 | 7,728 |
| 75+      | 6,629 | 8,949 | 3,390 | 4,725 | 3,219 | 4,545 | 12,093 | 16,412 |
| All      | 8,488 | 11,099 | 6,221 | 7,962 | 8,299 | 10,253 | 18,886 | 24,140 |
| Men      |     |      |      |       |      |      |         |      |      |        |      |      |
| 50–74    | 1,318 | 1,505 | 2,329 | 2,611 | 1,541 | 1,671 | 8,660 | 9,670 |
| 75+      | 2,236 | 3,703 | 1,689 | 2,824 | 464 | 775 | 6,229 | 10,275 |
| All      | 3,553 | 5,208 | 4,018 | 5,435 | 2,004 | 2,446 | 14,889 | 19,945 |
| Women and Men | | | | | | | | |
| 50–74    | 3,177 | 3,655 | 5,161 | 5,848 | 6,620 | 7,379 | 15,453 | 17,399 |
| 75+      | 8,864 | 12,652 | 5,078 | 7,549 | 3,683 | 5,320 | 18,322 | 26,687 |
| All      | 12,041 | 16,306 | 10,239 | 13,397 | 10,303 | 12,700 | 33,775 | 44,085 |

| Table 16 | Current and future cost of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Denmark |
|----------|-------------------------------------------------------------------------------------------------------------|
|          | 2010 | 2015 | 2020 | 2025 |
| Women    |     |      |      |      |
| 50–74    | 198 | 219 | 229 | 224 |
| 75+      | 482 | 499 | 541 | 615 |
| All      | 680 | 718 | 770 | 839 |
| Men      |     |      |      |      |
| 50–74    | 180 | 196 | 203 | 202 |
| 75+      | 196 | 213 | 249 | 302 |
| All      | 375 | 410 | 452 | 504 |
| Women and Men | | | | |
| 50–74    | 377 | 415 | 431 | 426 |
| 75+      | 678 | 712 | 790 | 917 |
| All      | 1,055 | 1,127 | 1,222 | 1,344 |

| Table 17 | Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Denmark |
|----------|------------------------------------------------------------------------------------------------------------------|
|          | Incident fractures | Prior fractures | All fractures |
|          | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women    |     |      |      |      |      |      |
| 50–74    | 2,381 | 2,715 | 1,983 | 2,079 | 4,364 | 4,793 |
| 75+      | 3,679 | 5,052 | 4,716 | 5,386 | 8,395 | 10,438 |
| All      | 6,060 | 7,767 | 6,699 | 7,465 | 12,758 | 15,232 |
| Men      |     |      |      |      |      |      |
| 50–74    | 2,177 | 2,439 | 1,626 | 1,751 | 3,803 | 4,190 |
| 75+      | 1,801 | 2,988 | 1,826 | 2,495 | 3,627 | 5,483 |
| All      | 3,978 | 5,427 | 3,452 | 4,246 | 7,430 | 9,673 |
| Women and Men | | | | | | |
| 50–74    | 4,558 | 5,154 | 3,609 | 3,830 | 8,166 | 8,984 |
| 75+      | 5,480 | 8,040 | 6,542 | 7,882 | 12,022 | 15,921 |
| All      | 10,038 | 13,194 | 10,150 | 11,711 | 20,188 | 24,905 |
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Table 18 Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Denmark assuming the uptake of treatment remains unchanged

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
|          | Women  |        |        |        |
| 50–74    | 566    | 610    | 620    | 629    |
| 75+      | 1,191  | 1,237  | 1,457  | 1,496  |
| All      | 1,757  | 1,846  | 2,078  | 2,125  |
|          | Men    |        |        |        |
| 50–74    | 501    | 531    | 504    | 556    |
| 75+      | 502    | 539    | 532    | 765    |
| All      | 1,002  | 1,070  | 1,036  | 1,321  |
|          | Women and Men |        |        |        |
| 50–74    | 1,067  | 1,141  | 1,124  | 1,184  |
| 75+      | 1,693  | 1,776  | 1,989  | 2,261  |
| All      | 2,759  | 2,916  | 3,113  | 3,446  |

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|          | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|----------|----------------------------------|----------------------------------------|---------------------|-------------------|
| Men      | 13                               | 26                                     | 13                  | 50                |
| Women    | 87                               | 190                                    | 103                 | 54                |

Fig. 2 Treatment uptake in Denmark (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)
Epidemiology and Economic Burden of Osteoporosis in Estonia

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Estonia.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Estonia, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Estonia was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 9,000 new fragility fractures were sustained in Estonia, comprising 1,600 hip fractures, 1,400 vertebral fractures, 1,400 forearm fractures and 4,300 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €30 million for the same year. Incident fractures represented 73 % of this cost, long-term fracture care 23 % and pharmacological prevention 3 %. Previous and incident fractures also accounted for 2,800 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 10,000 in 2025, representing an increase of 1,500 fractures. Hip, clinical spine (vertebral), forearm and other fractures were estimated to increase by 400, 200, 100 and 800, respectively. The burden of fractures in Estonia in 2025 was estimated to increase by 18 % to €35 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients...
aged 50 or above whom received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

**Conclusions** In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

**Introduction**

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Estonia in 2010 and beyond.

**Methods**

The literature on fracture incidence and costs of fractures in Estonia was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

**Epidemiology of osteoporosis in Estonia**

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 188,000 and 297,000 respectively in Estonia in 2010 (Table 1).

| Age (years) | Women | Men | All |
|-------------|-------|-----|-----|
| 50–59       | 99,000| 81,000| 180,000 |
| 60–69       | 81,000| 55,000| 136,000 |
| 70–79       | 74,000| 38,000| 112,000 |
| 80–89       | 38,000| 13,000| 51,000 |
| 90+         | 5,000 | 1,000 | 6,000 |
| 50+         | 297,000| 188,000| 485,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 80,000 (Table 2). There are 8.9 DXA scan machines per million (m) inhabitants, and guidelines for the assessment and treatment of osteoporosis are available [2]. A country specific FRAX model for the assessment of fracture risk is not available for Estonia. Based on the likelihood that the fracture rate and mortality in Lithuania was equal to Estonia, the FRAX model for Lithuania was used as a surrogate.

There are limited data on fracture rates in Estonia and no specific information on hip fracture incidence [4] Data for hip fractures were imputed from Finnish age-standardized incidence rates [5]. Fracture incidence is presented in Table 3. Standardized to the EU27 population, this hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 238 and 440 respectively.

The number of incident fractures in 2010 was estimated at 8,700 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 1,600, 1,400, 1,400 and 4,300 respectively. 69 % of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.52 % for hip and 1.54 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of both men and women with hip or vertebral fractures that occurred before 2010 was estimated at 7,000 (Table 6). Note that fractures sustained in 2010 were not included in the estimate. The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 134 (Table 8). Hip, vertebral and “other” fractures accounted for 65, 50 and 19 deaths respectively. Overall, approximately 54 % of deaths occurred in women.

| Age (years) | Women | Men |
|-------------|-------|-----|
| 50–54       | 3,150 | 1,075 |
| 55–59       | 4,704 | 1,330 |
| 60–64       | 6,149 | 1,798 |
| 65–69       | 7,676 | 1,776 |
| 70–74       | 11,439| 1,794 |
| 75–79       | 12,375| 1,545 |
| 80+         | 20,296| 2,324 |
| 50+         | 65,789| 11,642 |
The cost of osteoporosis in Estonia including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

In Estonia, the cost of a hip fracture has been estimated at €5,580 using the fracture cost in Finland [6].

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Estonia by age

| Age (years) | Hip | Vertebra | Forearm | Other |
|-------------|-----|----------|---------|-------|
| Women       |     |          |         |       |
| 50–54       | 21  | 53       | 132     | 136   |
| 55–59       | 38  | 105      | 292     | 334   |
| 60–64       | 63  | 111      | 237     | 242   |
| 65–69       | 116 | 169      | 282     | 396   |
| 70–74       | 248 | 350      | 446     | 704   |
| 75–79       | 541 | 526      | 527     | 1,137 |
| 80–84       | 1,068 | 671     | 669     | 1,816 |
| 85+         | 1,825 | 858     | 779     | 3,066 |
| Men         |     |          |         |       |
| 50–54       | 35  | 89       | 32      | 154   |
| 55–59       | 54  | 94       | 82      | 503   |
| 60–64       | 77  | 183      | 144     | 753   |
| 65–69       | 116 | 183      | 175     | 750   |
| 70–74       | 197 | 301      | 126     | 1,012 |
| 75–79       | 377 | 435      | 107     | 1,008 |
| 80–84       | 708 | 492      | 137     | 1,882 |
| 85+         | 1,254 | 842     | 230     | 3,632 |

Table 4 Estimated number of incident fractures in Estonia, 2010

| Age (years) | Hip Fracture | Vertebra Fracture |
|-------------|--------------|------------------|
| Women       |              |                  |
| 50–54       | 263          | 401              |
| 55–59       | 966          | 542              |
| 60–64       | 1,229        | 942              |
| 65–69       | 160          | 279              |
| 70–74       | 224          | 172              |
| 75–79       | 384          | 451              |
| 80–84       | 423          | 680              |
| 85+         | 1,190        | 713              |

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Estonia, 2010

| Age (years) | Hip Fracture | Vertebral Fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.2          | 0.5                |
| 60–64       | 0.4          | 0.9                |
| 65–69       | 0.8          | 1.4                |
| 70–74       | 1.4          | 2.2                |
| 75–79       | 2.9          | 3.4                |
| 80–84       | 5.7          | 4.7                |
| 85+         | 12.1         | 7.7                |

Table 6 Number of men and women in Estonia with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip Fracture | Vertebral Fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 1,165        | 2,101              |
| 75+         | 4,559        | 3,677              |
| Total       | 5,725        | 5,779              |

| Men         |              |                    |
| 50–54       | 703          | 930                |
| 75+         | 922          | 777                |
| Total       | 1,625        | 1,707              |

| Men and Women |              |                    |
| 50–54         | 1,869        | 3,032              |
| 75+           | 5,481        | 4,454              |
| Total         | 7,350        | 7,486              |
Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€ 10,483 [7,8], based on Finnish cost of nursing home that was PPP adjusted) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 12 [9] and a DXA scan costing € 187 [9] every second year to monitor treatment. The cost is conservative in that monitoring is usually conducted annually.

The cost of osteoporosis in 2010 was estimated at € 30 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to € 22 million, € 7 million and € 1 million respectively.

Table 7 Incidence (per 100,000) of causally related deaths in Estonia within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|-----------------|
|             |     |                    |                 |
| Women       |     |                    |                 |
| 50–54       | 831 | 1,080              | 21              |
| 55–59       | 1,008 | 1,240              | 30              |
| 60–64       | 1,327 | 1,541              | 42              |
| 65–69       | 1,971 | 2,160              | 74              |
| 70–74       | 2,456 | 2,535              | 112             |
| 75–79       | 3,052 | 2,948              | 191             |
| 80–84       | 3,247 | 2,873              | 362             |
| 85–89       | 3,717 | 2,889              | 651             |
| 90+         | 3,187 | 1,797              | 1,108           |
| Men         |     |                    |                 |
| 50–54       | 4,696 | 5,633              | 74              |
| 55–59       | 5,076 | 5,771              | 104             |
| 60–64       | 6,210 | 6,679              | 168             |
| 65–69       | 5,997 | 6,084              | 215             |
| 70–74       | 7,114 | 6,774              | 321             |
| 75–79       | 6,591 | 5,845              | 391             |
| 80–84       | 7,241 | 5,880              | 608             |
| 85–89       | 8,501 | 6,213              | 918             |
| 90+         | 10,571 | 6,879              | 1,322           |

Table 8 The number of deaths in men and women in Estonia in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Fracture at the vertebra | “other” |
|-------------|-----|--------------------------|--------|
|             |     |                          |        |
| Women       |     |                          |        |
| 50–74       | 6   | 9                        | 1      |
| 75+         | 31  | 14                       | 11     |
| Total       | 37  | 23                       | 12     |
| Men         |     |                          |        |
| 50–74       | 10  | 17                       | 2      |
| 75+         | 18  | 10                       | 5      |
| Total       | 27  | 27                       | 7      |
| Men and Women |     |                          |        |
| 50–74       | 15  | 26                       | 3      |
| 75+         | 49  | 25                       | 16     |
| Total       | 65  | 50                       | 19     |

Table 9 One year costs for relevant pharmaceuticals in Estonia, 2010 [10]

| Annual drug cost (€) | Alendronate | Risedronate | Etidronate | Ibandronate | Zoledronic acid | Raloxifene | Strontium ranelate | Parathyroid hormone | Teriparatide |
|----------------------|-------------|-------------|------------|-------------|-----------------|------------|-------------------|---------------------|-------------|
|                      | 171         | 143         | -          | 283         | 202             | -          | 446               | -                   | -           |

Table 10 Cost of osteoporosis (€) in Estonia by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| Women       |                          |                            |                          |            |
| 50–74       | 4,887,070                | 765,480                    | 465,897                  | 6,118,447  |
| 75+         | 10,337,649               | 4,543,605                  | 289,565                  | 15,170,818 |
| All         | 15,224,719               | 5,309,085                  | 755,461                  | 21,289,265 |
| Men         |                          |                            |                          |            |
| 50–54       | 4,015,343                | 554,793                    | 76,494                   | 4,646,630  |
| 75+         | 2,906,657                | 1,106,876                  | 29,882                   | 4,043,415  |
| All         | 6,922,000                | 1,661,670                  | 106,376                  | 8,690,045  |
| Women and Men |                      |                            |                          |            |
| 50–74       | 8,902,413                | 1,320,273                  | 542,391                  | 10,765,077 |
| 75+         | 13,244,306               | 5,650,481                  | 319,446                  | 19,214,234 |
| All         | 22,146,719               | 6,970,754                  | 861,837                  | 29,979,310 |
respectively. It is notable that pharmacological fracture prevention costs amounted to only 3.3% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€15 million) followed by “other” (€12 million), spine (€1.5 million) and forearm fractures (€0.5 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 2,800 (Table 12). 72% of the total QALY loss was incurred in women. Prior fractures accounted for 52% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €60 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €90 million in Estonia in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 25%, 8%, 1%, 66% respectively.

**Burden of osteoporosis up to 2025**

The population above 50 years of age is expected to increase from 485,000 in 2010 to 511,000 in 2025, corresponding to an increase of 5% (Table 14).

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**Table 11** Total cost (€) in 2010 by fracture site in men and women from Estonia. Note that costs for fracture prevention therapy and monitoring are not included

| Age   | Hip     | Spine   | Forearm | Other     | All     |
|-------|---------|---------|---------|-----------|---------|
|       | Women   |         |         |           |         |
| 50–74 | 2,154,893 | 468,140 | 230,565 | 2,798,952 | 5,652,550 |
| 75+   | 9,241,445 | 597,087 | 173,937 | 4,868,785 | 14,881,254 |
| All   | 11,396,338 | 1,065,227 | 404,502 | 7,667,737 | 20,533,804 |
|       | Men     |         |         |           |         |
| 50–74 | 1,314,861 | 295,118 | 59,693  | 2,900,464 | 4,570,136 |
| 75+   | 2,062,812 | 170,580 | 16,014  | 1,764,128 | 4,013,533 |
| All   | 3,377,673 | 465,698 | 75,707  | 4,664,592 | 8,583,669 |
|       | Women and Men |         |         |           |         |
| 50–74 | 3,469,754  | 763,257 | 290,258 | 5,699,416 | 10,222,686 |
| 75+   | 11,304,256 | 767,667 | 189,950 | 6,632,913 | 18,894,787 |
| All   | 14,774,011 | 1,530,925 | 480,209 | 12,332,329 | 29,117,473 |

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**Table 12** Number of QALYs lost due to fractures during 2010 in men and women in Estonia according to age

| Age (years) | Women | Men | Total |
|-------------|-------|-----|-------|
| 50–74       |       |     |       |
| Incident hip fractures | 64    | 40  | 104   |
| Incident vertebral fractures | 133   | 96  | 229   |
| Incident forearm fractures | 24    | 6   | 30    |
| Incident other fractures | 110   | 110 | 220   |
| Prior hip fractures | 182   | 124 | 306   |
| Prior vertebral fractures | 117   | 52  | 169   |
| Total       | 630   | 428 | 1,058 |

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**Fig. 1** Share (%) of fracture cost by fracture site in Estonia. Note that costs for fracture prevention therapy and monitoring are not included.

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The total number of fractures was estimated to rise from 9,000 in 2010 to 10,000 in 2025 (Table 15), corresponding to an increase of 11%. Hip, clinical spine, forearm and other fractures increased by 400, 200, 100 and 800 respectively. The increase in the number of fractures ranged from 9% to 23%, depending on fracture site. The increase was estimated to be 19% in men and 17% in women.

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €30 million in 2010 to €35 million in 2025, corresponding to an increase of 18% (Table 16). Costs incurred in both women and men increased by 18%.

The total number of QALYs lost due to fracture was estimated to rise from 2,800 in 2010 to 3,200 in 2025, corresponding to an increase of 15%. The increase was estimated to be particularly marked in men (17%) compared to women (15%). Incident and prior fractures accounted for 53% and 47% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €89,000,000,000 in 2010 to €115,000,000,000 in 2025, corresponding to an increase of 18% (Table 16). Costs incurred in both women and men increased by 18%.

The total number of fractures was estimated to rise from 9,000 in 2010 to 10,000 in 2025 (Table 15), corresponding to an increase of 11%. Hip, clinical spine, forearm and other fractures increased by 400, 200, 100 and 800 respectively. The increase in the number of fractures ranged from 9% to 23%, depending on fracture site. The increase was estimated to be 19% in men and 17% in women.

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €30 million in 2010 to €35 million in 2025, corresponding to an increase of 18% (Table 16). Costs incurred in both women and men increased by 18%.

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The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €89,000,000,000 in 2010 to €115,000,000,000 in 2025, corresponding to an increase of 18% (Table 16). Costs incurred in both women and men increased by 18%.

The total number of fractures was estimated to rise from 9,000 in 2010 to 10,000 in 2025 (Table 15), corresponding to an increase of 11%. Hip, clinical spine, forearm and other fractures increased by 400, 200, 100 and 800 respectively. The increase in the number of fractures ranged from 9% to 23%, depending on fracture site. The increase was estimated to be 19% in men and 17% in women.

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €30 million in 2010 to €35 million in 2025, corresponding to an increase of 18% (Table 16). Costs incurred in both women and men increased by 18%.

The total number of QALYs lost due to fracture was estimated to rise from 2,800 in 2010 to 3,200 in 2025, corresponding to an increase of 15% (Table 17). The increase was estimated to be particularly marked in men (17%) compared to women (15%). Incident and prior fractures accounted for 53% and 47% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €89,000,000,000 in 2010 to €115,000,000,000 in 2025, corresponding to an increase of 18% (Table 16). Costs incurred in both women and men increased by 18%.
The increase was estimated to be 17% in men and 16% in women (Table 18).

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.13% in 2001 to 1.66% in 2011.

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Estonia were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 93% and 86% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.
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Epidemiology and Economic Burden of Osteoporosis in Finland

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract
Summary This report describes epidemiology, burden, and treatment of osteoporosis in Finland.
Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Finland, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Finland was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 36,000 new fragility fractures were sustained in Finland, comprising 7,000 hip fractures, 6,000 vertebral fractures, 6,000 forearm fractures and 19,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €383 million for the same year. Incident fractures represented 70% of this cost, long-term fracture care 27% and...
pharmacological prevention 3 %. Previous and incident fractures also accounted for 12,300 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 49,000 in 2025, representing an increase of 13,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 2,900, 2,000, 1,200 and 6,600, respectively. The burden of fractures in Finland in 2025 was estimated to increase by 34 % to € 514 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Finland in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Finland was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Finland

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 960,000 and 1,130,000 respectively in Finland in 2010 (Table 1).

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–59      | 383,000 | 379,000 | 762,000 |
| 60–69      | 348,000 | 327,000 | 675,000 |
| 70–79      | 227,000 | 175,000 | 402,000 |
| 80–89      | 147,000 | 72,000 | 219,000 |
| 90+        | 25,000 | 7,000 | 32,000 |
| 50+        | 1,130,000 | 960,000 | 2,090,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 300,000 (Table 2). There are 16.8 DXA scan machines per million (m) inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on the incidence of hip fractures are available for Finland [5–7] and that used to build the FRAX model was chosen for this study [7]. Given that country specific incidence of the vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Empirical data are expected in the near future [8]. Fracture incidence is presented in Table 3. Standardized to the EU27 population for 2010, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 238.0 and 440.0 respectively.

The number of incident fractures in 2010 was estimated at 36,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 7,000, 6,000, 6,000 and 19,000 respectively. 60 % of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had
occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.64 % for hip and 1.78 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 34,000 and 37,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7.

### Table 4: Estimated number of incident fractures in Finland, 2010

| Age (years) | Hip | Vertebral | Forearm | Other | Total |
|-------------|-----|-----------|---------|-------|-------|
| (Women)     |     |           |         |       |       |
| 50–54       | 869 | 1,350     | 2,469   | 3,253 | 7,940 |
| 55–59       | 3,615| 1,920     | 1,866   | 6,566 | 13,966|
| 60–64       | 4,484| 3,269     | 4,334   | 9,818 | 21,907|
| 75+         | 796 | 1,421     | 937     | 5,355 | 8,509 |
| Total       | 2,064| 2,385     | 1,202   | 8,849 | 14,500|
| (Men)       |     |           |         |       |       |
| 50–54       | 1,665| 2,770     | 3,406   | 8,608 | 16,449|
| 55–59       | 4,883| 2,884     | 2,131   | 10,060| 19,958|
| 60–64       | 5,648| 5,654     | 5,537   | 18,667| 36,407|
| 75+         |     |           |         |       |       |
| Total       |     |           |         |       |       |

### Table 5: Estimated proportion of men and women (in %) with a prior hip or clinical fracture in Finland, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| (Women)     |              |                   |
| 50–54       | 0.0          | 1.1               |
| 55–59       | 0.2          | 1.3               |
| 60–64       | 0.4          | 1.5               |
| 65–69       | 0.7          | 1.7               |
| 70–74       | 1.5          | 2.0               |
| 75–79       | 3.1          | 4.0               |
| 80–84       | 5.9          | 7.8               |
| 85+         | 13.2         | 9.0               |
| (Men)       |              |                   |
| 50–54       | 0.1          | 1.1               |
| 55–59       | 0.3          | 1.3               |
| 60–64       | 0.6          | 1.8               |
| 65–69       | 0.9          | 2.0               |
| 70–74       | 1.4          | 3.2               |
| 75–79       | 2.4          | 4.7               |
| 80–84       | 4.2          | 7.1               |
| 85+         | 8.9          | 6.3               |

### Table 6: Estimated number of men and women in Finland with a prior hip or clinical fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| (Women)     |              |                   |
| 50–54       | 3,984        | 7,981             |
| 75+         | 19,376       | 16,690            |
| Total       | 23,360       | 24,671            |
| (Men)       |              |                   |
| 50–54       | 4,384        | 6,757             |
| 75+         | 6,438        | 5,764             |
| Total       | 10,821       | 12,521            |

### Table 7: Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Finland by age

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| (Women)     |              |                   |
| 50–54       | 0.0          | 1.1               |
| 55–59       | 0.2          | 1.3               |
| 60–64       | 0.4          | 1.5               |
| 65–69       | 0.7          | 1.7               |
| 70–74       | 1.5          | 2.0               |
| 75–79       | 3.1          | 4.0               |
| 80–84       | 5.9          | 7.8               |
| 85+         | 13.2         | 9.0               |
| (Men)       |              |                   |
| 50–54       | 0.1          | 1.1               |
| 55–59       | 0.3          | 1.3               |
| 60–64       | 0.6          | 1.8               |
| 65–69       | 0.9          | 2.0               |
| 70–74       | 1.4          | 3.2               |
| 75–79       | 2.4          | 4.7               |
| 80–84       | 4.2          | 7.1               |
| 85+         | 8.9          | 6.3               |
The number of causally related deaths in 2010 was estimated at 425 (Table 8). Hip, vertebral and "other" fractures accounted for 209, 144 and 72 deaths respectively. Overall, approximately 47% of deaths occurred in women.

### Table 7 Incidence (per 100,000) of causally related deaths [9] in Finland within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip   | Clinical vertebral | "Other" fracture |
|-------------|-------|--------------------|------------------|
| Women       |       |                    |                  |
| 50–54       | 562   | 731                | 15               |
| 55–59       | 870   | 1,070              | 26               |
| 60–64       | 1,011 | 1,174              | 32               |
| 65–69       | 1,353 | 1,483              | 51               |
| 70–74       | 1,642 | 1,694              | 75               |
| 75–79       | 1,944 | 1,878              | 122              |
| 80–84       | 2,402 | 2,125              | 268              |
| 85–89       | 2,974 | 2,312              | 521              |
| 90+         | 2,691 | 1,517              | 936              |
| Men         |       |                    |                  |
| 50–54       | 2,154 | 2,584              | 34               |
| 55–59       | 2,472 | 2,811              | 51               |
| 60–64       | 2,643 | 2,843              | 72               |
| 65–69       | 3,298 | 3,345              | 118              |
| 70–74       | 3,533 | 3,364              | 159              |
| 75–79       | 4,166 | 3,695              | 247              |
| 80–84       | 5,310 | 4,312              | 446              |
| 85–89       | 6,761 | 4,942              | 730              |
| 90+         | 9,357 | 6,089              | 1,171            |

The number of causally related deaths in 2010 was estimated at 425 (Table 8). Hip, vertebral and “other” fractures accounted for 209, 144 and 72 deaths respectively. Overall, approximately 47% of deaths occurred in women.

### Table 8 The number of deaths in men and women in Finland in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip   | Fracture at the vertebral | “other” |
|-------------|-------|----------------------------|---------|
| Women       |       |                            |         |
| 50–74       | 12    | 19                         | 2       |
| 75+         | 90    | 36                         | 39      |
| Total       | 103   | 55                         | 41      |
| Men         |       |                            |         |
| 50–74       | 25    | 45                         | 6       |
| 75+         | 81    | 45                         | 25      |
| Total       | 106   | 89                         | 31      |
| Men and Women |   |                            |         |
| 50–74       | 38    | 64                         | 7       |
| 75+         | 171   | 80                         | 65      |
| Total       | 209   | 144                        | 72      |

### Table 9 One year costs for relevant pharmaceuticals in Finland, 2010 [12]

| Annual drug cost (€) | Alendronate | Risedronate | Etidronate | Ibandronate | Zoledronic acid | Raloxifene | Strontium ranelate | Teriparatide |
|----------------------|-------------|-------------|------------|-------------|----------------|------------|--------------------|-------------|
| Cost                  | 40           | 40           | 1,072      | 456         | 394           | 488        | 527                | 5,933       |

Cost of osteoporosis in Finland including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

In Finland, the cost of a hip fracture has been estimated at €16,066 [10]. No other fracture costs were available. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€32,930 [11]) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €17 [12] and a DXA scan costing €146 [12] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €383 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €269 million, €104 million and €10 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 2.6% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€198 million) followed by “other” (€151 million), spine (€18 million) and forearm fractures (€5 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.
The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 12,300 (Table 12). 62% of the total QALY loss was incurred in women. Prior fractures accounted for 55% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €830 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €1.21 billion in Finland in 2010.

Table 10 Cost of osteoporosis (€) in Finland by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| Women       |                          |                            |                          |            |
| 50–74       | 47,945,497               | 8,216,283                  | 5,430,231                | 61,592,010 |
| 75+         | 112,803,259              | 61,500,023                 | 3,263,327                | 177,566,609|
| All         | 160,748,755              | 69,716,306                 | 8,693,558                | 239,158,620|
| Men         |                          |                            |                          |            |
| 50–74       | 59,783,210               | 10,378,371                 | 868,629                  | 71,030,210 |
| 75+         | 48,235,280               | 24,093,333                 | 354,605                  | 72,683,217 |
| All         | 108,018,490              | 34,471,703                 | 1,223,234                | 143,713,427|

Table 11 Total cost (€) in 2010 by fracture site in men and women in Finland. Note that costs for fracture prevention therapy and monitoring are not included

| Age (years) | Hip | Spine | Forearm | Other | All |
|-------------|-----|-------|---------|-------|-----|
| Women       |     |       |         |       |     |
| 50–74       | 21,692,339 | 4,630,376 | 2,423,491 | 27,415,574 | 56,161,780 |
| 75+         | 113,303,694 | 6,230,587 | 1,831,365 | 52,937,636 | 174,303,282 |
| All         | 134,996,033 | 10,860,963 | 4,254,856 | 80,353,210 | 230,465,062 |

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Finland according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 209  | 756 | 965 |
| Incident vertebral fractures | 446  | 551 | 997 |
| Incident forearm fractures | 87   | 57  | 144 |
| Incident other fractures | 390  | 681 | 1,071 |
| Prior hip fractures | 625  | 2,305 | 3,230 |
| Prior vertebral fractures | 447  | 809 | 1,256 |
| Total       | 2,203 | 5,459 | 7,661 |

Men

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Incident hip fractures | 195  | 303 | 498 |
| Incident vertebral fractures | 473  | 308 | 781 |
| Incident forearm fractures | 32   | 9   | 41  |
| Incident other fractures | 634  | 397 | 1,032 |
| Prior hip fractures | 685  | 953 | 1,638 |
| Prior vertebral fractures | 375  | 304 | 679 |
| Total       | 2,396 | 2,273 | 4,669 |

Men and Women

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Incident hip fractures | 403  | 1,059 | 1,463 |
| Incident vertebral fractures | 919  | 858 | 1,777 |
| Incident forearm fractures | 120  | 65  | 185 |
| Incident other fractures | 1,024 | 1,078 | 2,102 |
| Prior hip fractures | 1,310 | 3,558 | 4,868 |
| Prior vertebral fractures | 822  | 1,113 | 1,935 |
| Total       | 4,598 | 7,732 | 12,330 |
Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 22 %, 9 %, 1 %, 68 % respectively.

Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 2.1 million in 2010 to 2.3 million in 2025, corresponding to an increase of 12 % (Table 14).

### Table 14 Population projections in Finland by age and sex [13]

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Women    |        |        |        |        |
| 50–59    | 383,000| 372,000| 357,000| 324,000|
| 60–69    | 348,000| 390,000| 367,000| 358,000|
| 70–79    | 227,000| 246,000| 313,000| 352,000|
| 80–89    | 147,000| 150,000| 155,000| 170,000|
| 90+      | 25,000 | 34,000 | 42,000 | 46,000 |
| All      | 2,080,000| 2,439,000|         |        |

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Men      |        |        |        |        |
| 50–59    | 379,000| 369,866| 357,000| 327,000|
| 60–69    | 327,000| 367,000| 344,000| 339,000|
| 70–79    | 175,000| 199,000| 265,000| 298,000|
| 80–89    | 72,000 | 85,000 | 97,000 | 115,000|
| 90+      | 7,000  | 10,000 | 15,000 | 20,000 |
| All      | 2,080,000| 2,439,000|         |        |

The total number of fractures was estimated to rise from 36,000 in 2010 to 49,000 in 2025 (Table 15), corresponding to an increase of 36 %. Hip, clinical spine, forearm and other fractures increased by 2,900, 2,000, 1,200 and 6,600 respectively. The increase in the number of fractures ranged from 21 % to 44 %, depending on fracture site. The increase was estimated to be particularly marked in men (42 %) compared to women (30 %).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from € 383 million in 2010 to € 514 million in 2025, corresponding to an increase of 34 % (Table 16).
16). Costs incurred in women and men increased by 28 % and 44 % respectively.
The total number of QALYs lost due to fracture was estimated to rise from 12,300 in 2010 to 15,800 in 2025, corresponding to an increase of 28 % (Table 17). The increase was estimated to be particularly marked in men (38 %) compared to women (22 %). Incident and prior fractures accounted for 59 % and 41 % of the increase respectively.

Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Finland

| Incident fractures | Prior fractures | All fractures |
|--------------------|----------------|--------------|
|                    | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women              |      |      |      |      |      |      |
| 50–74              | 1,131| 1,290| 1,071| 1,158| 2,203| 2,448|
| 75+                | 2,045| 2,854| 3,414| 4,038| 5,459| 6,892|
| All                | 3,176| 4,144| 4,486| 5,196| 7,661| 9,340|
| Men                |      |      |      |      |      |      |
| 50–74              | 1,335| 1,479| 1,061| 1,166| 2,396| 2,645|
| 75+                | 1,017| 1,912| 1,257| 1,863| 2,273| 3,775|
| All                | 2,352| 3,392| 2,317| 3,029| 4,669| 6,421|

Table 18 Present and future cost (£ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Finland assuming the uptake of treatment remains unchanged

|                | 2010 | 2015 | 2020 | 2025 |
|----------------|------|------|------|------|
| Women          |      |      |      |      |
| 50–74          | 210  | 225  | 242  | 237  |
| 75+            | 544  | 582  | 622  | 697  |
| All            | 754  | 808  | 864  | 934  |
| Men            |      |      |      |      |
| 50–74          | 232  | 247  | 262  | 260  |
| 75+            | 225  | 253  | 298  | 379  |
| All            | 457  | 501  | 561  | 639  |

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately € 1.2 billion in 2010 to € 1.6 billion in 2025. The increase was estimated to be particularly marked in men (+40 %) compared to women (+24 %) (Table 18).

Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|                  | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|------------------|-------------------------------------|---------------------------------------|---------------------|-------------------|
| Men              | 8                                   | 51                                    | 43                  | 84                |
| Women            | 53                                  | 172                                   | 119                 | 69                |

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 1.38 % in 2001 to 4.22 % in 2011.

Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Finland were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these
estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 84% and 69% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

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Epidemiology and Economic Burden of Osteoporosis in France

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in France.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in France, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in France was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 377,000 new fragility fractures were sustained in France, comprising 74,000 hip fractures, 56,000 vertebral fractures, 56,000 forearm fractures and 191,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €4,853 million for the same year. Incident fractures represented 66 % of this cost, long-term fracture care 27 % and pharmacological prevention 7 %. Previous and incident fractures also accounted for 139,400 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 491,000 in 2025, representing an increase of 115,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 24,500, 17,200, 12,900 and 60,000, respectively. The burden of fractures in France in 2025 was estimated to increase by 26 % to €6,111 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. A substantial minority of women at high fracture risk did not receive active treatment.
**Conclusions** In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

**Introduction**

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in France in 2010 and beyond.

**Methods**

The literature on fracture incidence and costs of fractures in France was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

**Epidemiology of osteoporosis in France**

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 10,287,000 and 12,358,000 respectively in France in 2010 (Table 1).

**Table 1** Population at risk: men and women over the age of 50 in France, 2010 [1]

| Age (years) | Women   | Men     | All     |
|-------------|---------|---------|---------|
| 50–59       | 4,222,000 | 4,006,000 | 8,228,000 |
| 60–69       | 3,330,000 | 3,122,000 | 6,452,000 |
| 70–79       | 2,578,000 | 2,015,000 | 4,593,000 |
| 80–89       | 1,877,000 | 1,034,000 | 2,911,000 |
| 90+         | 351,000   | 110,000  | 461,000  |
| 50+         | 12,358,000 | 10,287,000 | 22,645,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 3,480,000 (Table 2). There are 29.1 DXA scan machines per million (m) inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for France [5]. Given that country specific incidence of vertebral, forearm and, “other” fractures were not found,

**Table 2** Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in France by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women   | Men     |
|-------------|---------|---------|
| 50–54       | 134,757 | 50,850  |
| 55–59       | 199,968 | 69,020  |
| 60–64       | 284,141 | 109,330 |
| 65–69       | 271,286 | 91,538  |
| 70–74       | 361,305 | 84,474  |
| 75–79       | 481,125 | 95,996  |
| 80+         | 1,051,616 | 189,904 |
| 50+         | 2,784,198 | 691,112 |

**Table 3** Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in France by age

| Age (years) | Hip | Vertebral | Forearm | Other |
|-------------|-----|-----------|---------|-------|
| Women       |     |           |         |       |
| 50–54       | 20  | 50        | 124     | 128   |
| 55–59       | 36  | 99        | 273     | 313   |
| 60–64       | 62  | 109       | 234     | 238   |
| 65–69       | 107 | 156       | 261     | 367   |
| 70–74       | 218 | 307       | 391     | 618   |
| 75–79       | 483 | 470       | 471     | 1,017 |
| 80–84       | 1,076 | 676   | 674     | 1,830 |
| 85+         | 1,894 | 891   | 808     | 3,182 |

| Age (years) | Hip | Vertebral | Forearm | Other |
|-------------|-----|-----------|---------|-------|
| Men         |     |           |         |       |
| 50–54       | 28  | 71        | 25      | 123   |
| 55–59       | 39  | 67        | 59      | 360   |
| 60–64       | 52  | 124       | 98      | 511   |
| 65–69       | 72  | 114       | 109     | 467   |
| 70–74       | 120 | 183       | 77      | 616   |
| 75–79       | 239 | 276       | 68      | 639   |
| 80–84       | 508 | 353       | 99      | 1,352 |
| 85+         | 942 | 632       | 173     | 2,727 |
these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 168 and 443 respectively. The number of incident fractures in 2010 was estimated at 377,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 74,000, 56,000, 56,000 and 191,000 respectively. 68 % of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.92 % for hip and 1.92 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 435,000 and 436,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 4,233 (Table 8). Hip, vertebral and “other” fractures accounted for 2,098, 1,256 and 880 deaths respectively. Overall, approximately 51 % of deaths occurred in women.

### Table 4 Estimated number of incident fractures in France, 2010

| Age (years) | Hip fracture | Vertebral fracture | Forearm fracture | Other fractures | All fractures |
|-------------|--------------|--------------------|------------------|----------------|--------------|
|              | Fracture at the |                    |                  |                |              |
|              | vertebra | forearm | other |                |              |
| Women       |           |         |       |                |              |
| 50–74       | 7,791    | 12,194  | 23,416 | 30,422         | 73,823       |
| 75+         | 47,143   | 23,875  | 23,716 | 87,530         | 182,264      |
| Total       | 54,935   | 36,069  | 47,131 | 117,952        | 256,087      |
| Men         |           |         |       |                |              |
| 50–74       | 5,265    | 9,493   | 6,186  | 35,642         | 56,586       |
| 75+         | 13,430   | 10,063  | 2,783  | 37,825         | 64,101       |
| Total       | 18,695   | 19,556  | 8,969  | 73,467         | 120,687      |
| Men and Women |         |         |       |                |              |
| 50–74       | 13,057   | 21,687  | 29,602 | 66,063         | 130,409      |
| 75+         | 60,573   | 33,938  | 26,498 | 125,355        | 246,365      |
| Total       | 73,630   | 55,625  | 56,100 | 191,418        | 376,774      |

### Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in France, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.1          | 0.2                |
| 55–59       | 0.2          | 0.5                |
| 60–64       | 0.4          | 0.9                |
| 65–69       | 0.8          | 1.4                |
| 70–74       | 1.6          | 2.5                |
| 75–79       | 3.2          | 3.9                |
| 80–84       | 6.7          | 5.9                |
| 85+         | 14.8         | 10.0               |
| Men         |              |                    |
| 50–54       | 0.1          | 0.2                |
| 55–59       | 0.3          | 0.4                |
| 60–64       | 0.4          | 0.8                |
| 65–69       | 0.7          | 1.1                |
| 70–74       | 1.0          | 1.5                |
| 75–79       | 1.7          | 2.1                |
| 80–84       | 3.3          | 2.9                |
| 85+         | 7.1          | 6.0                |

### Cost of osteoporosis in France including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALY’s lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010; (iii) cost of fractures sustained prior to year 2010 and with no further costs in 2010.

### Table 6 Number of men and women in France with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 46,310       | 82,943             |
| 75+         | 282,354      | 228,000            |
| Total       | 328,664      | 310,943            |
| Men         |              |                    |
| 50–74       | 34,370       | 56,063             |
| 75+         | 71,639       | 68,501             |
| Total       | 106,009      | 124,564            |
| Men and Women |          |                    |
| 50–74       | 80,680       | 139,006            |
| 75+         | 353,993      | 296,501            |
| Total       | 434,674      | 435,507            |
in 2010 ("long-term disability cost"); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs ("pharmacological fracture prevention costs"). See Chapter 4 of the main report for further details.

The cost of a hip fracture in France was not available. Therefore, it was imputed from the UK cost of a hip fracture by adjusting for differences in health care price levels and estimated at €12,030 [6,7]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€31,512 [6], imputed from the UK long term care cost adjusting for differences in the health care price levels) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9. In addition, it was assumed that patients on

| Age (years) | Hip (€) | Clinical vertebral (€) | "Other" fracture (€) |
|-------------|---------|------------------------|---------------------|
| Women       |         |                        |                     |
| 50–54       | 564     | 850                    | 17                  |
| 55–59       | 739     | 908                    | 22                  |
| 60–64       | 958     | 1,112                  | 30                  |
| 65–69       | 1,062   | 1,164                  | 40                  |
| 70–74       | 1,413   | 1,458                  | 64                  |
| 75–79       | 1,815   | 1,753                  | 114                 |
| 80–84       | 1,905   | 1,686                  | 212                 |
| 85–89       | 2,470   | 1,920                  | 433                 |
| 90+         | 2,225   | 1,255                  | 774                 |
| Men         |         |                        |                     |
| 50–54       | 2,326   | 2,790                  | 36                  |
| 55–59       | 2,476   | 2,814                  | 51                  |
| 60–64       | 2,616   | 2,813                  | 71                  |
| 65–69       | 2,592   | 2,629                  | 93                  |
| 70–74       | 3,207   | 3,054                  | 145                 |
| 75–79       | 3,956   | 3,508                  | 235                 |
| 80–84       | 4,863   | 3,949                  | 408                 |
| 85–89       | 6,411   | 4,686                  | 693                 |
| 90+         | 8,589   | 5,589                  | 1,074               |

Table 8 The number of deaths in men and women in France in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | hip | Fracture at the vertebra | “other” |
|-------------|-----|--------------------------|---------|
| Women       |     |                          |         |
| 50–74       | 99  | 158                      | 15      |
| 75+         | 1,004 | 369                    | 533     |
| Total       | 1,103 | 527                    | 547     |
| Men         |     |                          |         |
| 50–74       | 158 | 284                      | 34      |
| 75+         | 837  | 444                      | 299     |
| Total       | 994  | 729                      | 333     |

Table 10 Cost of osteoporosis (€) in France by age in men and women, 2010

| Age (years) | First year fracture cost (€) | Long term disability costs (€) | Fracture prevention cost (€) | Total cost (€) |
|-------------|-------------------------------|-------------------------------|-------------------------------|---------------|
| Women       |                               |                               |                               |               |
| 50–74       | 364,928,299                   | 92,548,930                    | 175,079,905                   | 632,557,134   |
| 75+         | 1,867,451,272                 | 893,294,694                   | 127,925,092                   | 2,888,761,058 |
| All         | 2,232,379,571                 | 985,843,623                   | 303,004,997                   | 3,521,228,191 |
| Men         |                               |                               |                               |               |
| 50–74       | 313,374,227                   | 79,613,811                    | 27,665,751                    | 420,653,790   |
| 75+         | 632,976,473                   | 263,320,557                   | 14,853,148                    | 911,150,178   |
| All         | 946,350,700                   | 342,934,369                   | 42,518,899                    | 1,331,803,967 |
| Women and Men |                               |                               |                               |               |
| 50–74       | 678,302,526                   | 172,162,741                   | 202,745,657                   | 1,053,210,923 |
| 75+         | 2,500,427,745                 | 1,156,615,251                 | 142,778,239                   | 3,799,821,235 |
| All         | 3,178,730,271                 | 1,328,777,992                 | 345,523,896                   | 4,853,032,159 |
treatment made an annual physician visit costing € 50 [8] and a DXA scan costing € 41 [9] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at € 4,853 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to € 3,179 million, € 1,329 million and € 346 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 7.1 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€ 2,588 million) followed by “other” (€ 1,689 million), spine (€ 153 million) and forearm fractures (€ 77 million) (Table 11 and Fig. 1). Please note that

Table 11 Total cost (€) in 2010 by fracture site in men and women in France. Note that costs for fracture prevention therapy and monitoring are not included

| Age  | Hip       | Spine     | Forearm | Other | All          |
|------|-----------|-----------|---------|-------|--------------|
|      | Women     |           |         |       |              |
| 50–74| 189,583,968 | 35,429,049 | 32,171,716 | 200,292,495 | 457,477,228 |
| 75+  | 1,776,270,641 | 65,776,322 | 32,583,811 | 886,115,193 | 2,760,745,966 |
| All  | 1,965,854,609 | 101,205,370 | 64,755,527 | 1,086,407,688 | 3,218,223,194 |
|      | Men       |           |         |       |              |
| 50–74| 141,366,495 | 26,449,976 | 8,499,727 | 216,671,840 | 392,988,038 |
| 75+  | 480,749,009 | 25,309,641 | 3,823,464 | 386,414,916 | 896,297,030 |
| All  | 622,115,505 | 51,759,617 | 12,323,190 | 603,086,756 | 1,289,285,068 |
|      | Women and Men |         |         |       |              |
| 50–74| 330,950,463 | 61,879,025 | 40,671,443 | 416,964,336 | 850,465,267 |
| 75+  | 2,257,019,650 | 91,085,963 | 36,407,274 | 1,272,530,109 | 3,657,042,996 |
| All  | 2,587,970,113 | 152,964,988 | 77,078,717 | 1,689,494,445 | 4,507,508,263 |

Fig. 1 Share (%) of fracture cost by fracture site in France. Note that costs for fracture prevention therapy and monitoring are not included

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in France according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 1,870 | 9,717 | 11,587 |
| Incident vertebral fractures | 4,031 | 6,757 | 10,788 |
| Incident forearm fractures | 828 | 715 | 1,542 |
| Incident other fractures | 3,650 | 8,989 | 12,640 |
| Prior hip fractures | 7,266 | 37,697 | 44,963 |
| Prior vertebral fractures | 4,645 | 10,950 | 15,595 |
| Total       | 22,290 | 74,825 | 97,115 |
| Men         |       |     |     |
| Incident hip fractures | 1,287 | 3,193 | 4,480 |
| Incident vertebral fractures | 3,164 | 3,185 | 6,350 |
| Incident forearm fractures | 215 | 90 | 305 |
| Incident other fractures | 4,229 | 4,288 | 8,518 |
| Prior hip fractures | 5,379 | 10,558 | 15,937 |
| Prior vertebral fractures | 3,119 | 3,594 | 6,713 |
| Total       | 17,394 | 24,909 | 42,303 |
| Men and Women |       |     |     |
| Incident hip fractures | 3,158 | 12,910 | 16,067 |
| Incident vertebral fractures | 7,196 | 9,943 | 17,138 |
| Incident forearm fractures | 1,043 | 805 | 1,847 |
| Incident other fractures | 7,879 | 13,278 | 21,157 |
| Prior hip fractures | 12,645 | 48,255 | 60,900 |
| Prior vertebral fractures | 7,764 | 14,544 | 22,308 |
| Total       | 39,684 | 99,734 | 139,418 |
costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 139,400 (Table 12). 70% of the total QALY loss was incurred in women. Prior fractures accounted for 60% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €8.31 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €13.16 billion in France in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 24%, 10%, 3%, and 63% respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 22.6 million in 2010 to 27.1 million in 2025, corresponding to an increase of 20% (Table 14).

The total number of fractures was estimated to rise from 377,000 in 2010 to 491,000 in 2025 (Table 15), corresponding to an increase of 30%. Hip, clinical spine, forearm and other fractures increased by 24,500, 17,200, 12,900 and 60,000 respectively. The increase in the number of fractures ranged from 23% to 33%, depending on fracture site. The increase was estimated to be particularly marked in men (36%) compared to women (28%).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €4.9 billion in 2010 to €6.1 billion in 2025, corresponding to an increase of 26% (Table 16). Costs incurred in women and men increased by 23% and 35% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 139,400 in 2010 to 167,900 in 2025, corresponding to an increase of 20% (Table 17). The increase was estimated to be particularly marked in men (29%) compared to women (17%). Incident and prior fractures accounted for 61% and 39% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €13.2 billion in 2010 to €16.1 billion in 2025. The increase was estimated to be particularly marked in men (+31%) compared to women (+19%) (Table 18).

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2). Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age...
of 50 years who were treated increased from 1.21 % in 2001 to 7.18 % in 2008, but fell back to 6.30 % in 2011.

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in France were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 26 % and 43 % respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

### Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in France

|            | Hip 2010 | 2025 | Spine 2010 | 2025 | Forearm 2010 | 2025 | Other 2010 | 2025 |
|------------|----------|------|------------|------|--------------|------|------------|------|
| Women      |          |      |            |      |              |      |            |      |
| 50−74      | 7,791    | 10,358 | 12,194     | 15,563 | 23,416       | 28,427 | 30,422     | 38,256 |
| 75+        | 47,143   | 61,137 | 23,875     | 30,339 | 23,716       | 29,126 | 87,530     | 113,646 |
| All        | 54,935   | 71,495 | 36,069     | 45,903 | 47,131       | 57,553 | 117,952    | 151,902 |
| Men        |          |      |            |      |              |      |            |      |
| 50−74      | 5,265    | 6,696  | 9,493      | 11,641 | 6,186        | 7,297  | 35,642     | 43,073 |
| 75+        | 13,430   | 19,958 | 10,063     | 15,259 | 2,783        | 4,197  | 37,825     | 56,485 |
| All        | 18,695   | 26,654 | 19,556     | 26,900 | 8,969        | 11,494 | 73,467     | 99,557 |

### Table 16 Current and future cost (€ 000, 000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in France

|            | 2010 | 2015 | 2020 | 2025 |
|------------|------|------|------|------|
| Women      |      |      |      |      |
| 50−74      | 633  | 686  | 787  | 807  |
| 75+        | 2,889 | 3,125 | 3,278 | 3,508 |
| All        | 3,521 | 3,811 | 4,065 | 4,314 |
| Men        |      |      |      |      |
| 50−74      | 421  | 458  | 513  | 527  |
| 75+        | 911  | 1,026 | 1,124 | 1,269 |
| All        | 1,332 | 1,484 | 1,637 | 1,796 |
| Women and Men |      |      |      |      |
| 50−74      | 1,053 | 1,144 | 1,301 | 1,333 |
| 75+        | 3,800 | 4,151 | 4,402 | 4,777 |
| All        | 4,853 | 5,295 | 5,702 | 6,111 |

### Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in France

|            | Incident fractures | Prior fractures | All fractures |
|------------|-------------------|----------------|--------------|
| 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women | | | | | | | | | | |
| 50−74 | 10,379 | 13,161 | 11,911 | 13,285 | 22,290 | 26,446 |
| 75+ | 26,178 | 33,384 | 48,647 | 53,600 | 74,825 | 86,984 |
| All | 36,558 | 46,545 | 60,557 | 66,885 | 97,115 | 113,430 |
| Men | | | | | | | | | | |
| 50−74 | 8,896 | 10,861 | 8,498 | 9,777 | 17,394 | 20,638 |
| 75+ | 10,757 | 16,085 | 14,152 | 17,775 | 24,909 | 33,859 |
| All | 19,653 | 26,946 | 22,650 | 27,552 | 42,303 | 54,497 |
| Women and Men | | | | | | | | | | |
| 50−74 | 19,275 | 24,022 | 20,409 | 23,061 | 39,684 | 47,084 |
| 75+ | 36,935 | 49,468 | 62,799 | 71,375 | 99,734 | 120,843 |
| All | 56,210 | 73,491 | 83,208 | 94,436 | 139,418 | 167,927 |
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Table 18 Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in France assuming the uptake of treatment remains unchanged

|            | 2010   | 2015   | 2020   | 2025   |
|------------|--------|--------|--------|--------|
|            | 2010   | 2015   | 2020   | 2025   |
|            | Women  | Men    | Women  | Men    |
| 50–74      | 1,961  | 1,457  | 2,088  | 1,544  |
| 75+        | 7,348  | 2,396  | 7,868  | 2,619  |
| All        | 9,309  | 3,853  | 9,956  | 4,163  |

Fig. 2 Treatment uptake in France (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|            | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|------------|------------------------------------|---------------------------------------|---------------------|-------------------|
| Men        | 208                                | 282                                   | 74                  | 26                |
| Women      | 1,390                              | 2,437                                 | 1,047               | 43                |
Epidemiology and Economic Burden of Osteoporosis in Germany

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Germany.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Germany, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Germany was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 725,000 new fragility fractures were sustained in Germany, comprising 130,000 hip fractures, 114,000 vertebral fractures, 118,000 forearm fractures and 363,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at € 9,008 million for the same year. Incident fractures represented 73 % of this cost, long-term fracture care 23 % and pharmacological prevention 4 %. Previous and incident...
fractures also accounted for 246,300 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 928,000 in 2025, representing an increase of 203,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 42,900, 28,000, 23,200 and 108,800, respectively. The burden of fractures in Germany in 2025 was estimated to increase by 25 % to €11,261 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Germany in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Germany was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Germany

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 15,246,000 and 17,764,000 respectively in Germany in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis— as defined by the WHO diagnostic criteria— was estimated at 5,020,000 (Table 2). There are 29.1 DXA scan machines per million (m) inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Germany [4] and are in the process of being updated [5]. Given that country specific incidence of vertebral, forearm and “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 218 and 522 respectively.

The number of incident fractures in 2010 was estimated at 725,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 130,000, 114,000, 118,000 and 363,000 respectively. 67 % of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age,
the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 2.03% for hip and 2.35% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 670,000 and 776,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 8,777 (Table 8). Hip, vertebral and "other" fractures accounted for 4,285,
2,965 and 1,527 deaths respectively. Overall, approximately 57% of deaths occurred in women.

Table 7 Incidence (per 100,000) of causally related deaths in Germany within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
|             |     |                    |                  |
| Women       |     |                    |                  |
| 50–54       | 625 | 812                | 16               |
| 55–59       | 756 | 930                | 22               |
| 60–64       | 1,038 | 1,205           | 33               |
| 65–69       | 1,298 | 1,423           | 49               |
| 70–74       | 1,838 | 1,896           | 84               |
| 75–79       | 2,493 | 2,409           | 156              |
| 80–84       | 2,743 | 2,427           | 306              |
| 85–89       | 3,412 | 2,652           | 598              |
| 90+         | 3,231 | 1,822           | 1,123            |

| Men         |     |                    |                  |
|-------------|-----|--------------------|------------------|
| 50–54       | 1,870 | 2,243           | 29               |
| 55–59       | 2,264 | 2,574           | 46               |
| 60–64       | 2,466 | 2,653           | 67               |
| 65–69       | 2,870 | 2,911           | 103              |
| 70–74       | 3,680 | 3,503           | 166              |
| 75–79       | 4,755 | 4,217           | 282              |
| 80–84       | 5,466 | 4,439           | 459              |
| 85–89       | 7,355 | 5,376           | 795              |
| 90+         | 10,651 | 6,931         | 1,332            |

Table 8 The number of deaths in men and women in Germany in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | hip | Fracture at the vertebra | “other” |
|-------------|-----|--------------------------|--------|
|             |     |                          |        |
| Women       |     |                          |        |
| 50–74       | 407 | 610                      | 58     |
| 75+         | 2,096 | 829                   | 985    |
| Total       | 2,503 | 1,439                 | 1,042  |

| Men         |     |                          |        |
|-------------|-----|--------------------------|--------|
| 50–74       | 502 | 803                      | 109    |
| 75+         | 1,280 | 723                    | 376    |
| Total       | 1,782 | 1,526                 | 484    |

| Men and Women |     |                          |        |
|---------------|-----|--------------------------|--------|
| 50–74         | 909 | 1,413                    | 166    |
| 75+           | 3,376 | 1,552                | 1,361  |
| Total         | 4,285 | 2,965                | 1,527  |

Table 9 One year costs for relevant pharmaceuticals in Germany, 2010

| Annual drug cost (€) |  |
|----------------------|--|
| Alendronate          | 245 |
| Risedronate          | 509 |
| Etidronate           | 475 |
| Ibandronate          | 576 |
| Zoledronic acid      | 562 |
| Raloxifene           | 540 |
| Strontium ranelate   | 611 |
| Parathyroid hormone  | 7,853 |
| Teriparatide         | 7,700 |

Cost of osteoporosis in Germany including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 ("first year costs"); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 ("long–term disability cost"); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs ("pharmacological fracture prevention costs"). See Chapter 4 of the main report for further details.

In Germany, the cost of a hip fracture and the cost of a vertebral fracture has been estimated at €19,218 [6] and €5,585 [7], respectively. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Table 10 Cost of osteoporosis (€) in Germany by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
|             |                          |                            |                          |            |
| Women       |                          |                            |                          |            |
| 50–74       | 1,646,685,324            | 261,062,700                | 183,782,417              | 2,091,530,441 |
| 75+         | 2,701,964,706            | 1,198,625,682              | 111,062,638              | 4,011,653,026 |
| All         | 4,348,650,031            | 1,459,688,381              | 294,845,055              | 6,103,183,467 |

| Men         |                          |                            |                          |            |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| 50–74       | 1,355,813,528            | 202,019,829                | 28,980,787               | 1,586,814,143 |
| 75+         | 912,406,759              | 392,845,880                | 12,497,508               | 1,371,750,147 |
| All         | 2,268,220,287            | 594,865,709                | 41,478,294               | 2,904,564,290 |

| Women and Men |                          |                            |                          |            |
|---------------|--------------------------|----------------------------|--------------------------|------------|
| 50–74         | 3,002,498,852            | 463,082,528                | 212,763,204              | 3,678,344,584 |
| 75+           | 3,614,371,465            | 1,591,471,562              | 123,560,146              | 5,329,403,173 |
| All           | 6,616,870,317            | 2,054,554,090              | 336,323,349              | 9,007,747,757 |
Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€34,534 [8], an average of 4 long term care facilities) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €38 [9] and a DXA scan costing €36 [10] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €9,008 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €6,617 million, €2,055 million and €336 million respectively.

**Table 11**  Total cost (€) in 2010 by fracture site in men and women in Germany. Note that costs for fracture prevention therapy and monitoring are not included

| Age   | Hip       | Spine      | Forearm    | Other     | All          |
|-------|-----------|------------|------------|-----------|--------------|
|       | Women     |            |            |           |              |
| 50–74 | 710,114,350 | 208,266,755 | 73,857,882 | 915,509,037 | 1,907,748,024 |
| 75+   | 2,387,202,082 | 231,058,012 | 42,444,601 | 1,239,885,693 | 3,900,590,388 |
| All   | 3,097,316,432 | 439,324,767 | 116,302,483 | 2,155,394,730 | 5,808,338,412 |
|       | Men       |            |            |           |              |
| 50–74 | 465,017,625  | 133,888,003 | 17,982,685  | 940,945,043  | 1,557,833,356 |
| 75+   | 688,836,534  | 83,518,933  | 4,714,177   | 528,182,995  | 1,305,252,640 |
| All   | 1,153,854,159 | 217,406,936 | 22,696,863  | 1,469,128,038 | 2,863,085,996 |
|       | Women and Men |        |            |           |              |
| 50–74 | 1,175,131,975 | 342,154,757 | 91,840,568  | 1,856,454,080 | 3,465,581,380 |
| 75+   | 3,076,038,616 | 314,576,946 | 47,158,778  | 1,768,068,687 | 5,205,843,028 |
| All   | 4,251,170,591 | 656,731,703 | 138,999,346 | 3,624,522,768 | 8,671,424,408 |

**Table 12**  Number of QALYs lost due to fractures during 2010 in men and women in Germany according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 5,848 | 14,937 | 20,785 |
| Incident vertebral fractures | 12,043 | 10,850 | 22,893 |
| Incident forearm fractures | 2,208 | 1,097 | 3,305 |
| Incident other fractures | 10,246 | 13,438 | 23,684 |
| Prior hip fractures | 18,917 | 49,742 | 68,659 |
| Prior vertebral fractures | 11,963 | 16,575 | 28,537 |
| Total       | 61,225 | 106,639 | 167,864 |
| Men         |       |     |     |
| Incident hip fractures | 3,654 | 4,641 | 8,294 |
| Incident vertebral fractures | 8,238 | 4,688 | 12,926 |
| Incident forearm fractures | 532 | 132 | 664 |
| Incident other fractures | 11,260 | 6,009 | 17,269 |
| Prior hip fractures | 12,547 | 14,805 | 27,352 |
| Prior vertebral fractures | 7,011 | 4,947 | 11,958 |
| Total       | 43,242 | 35,222 | 78,464 |
| Men and Women |     |     |     |
| Incident hip fractures | 9,501 | 19,578 | 29,080 |
| Incident vertebral fractures | 20,282 | 15,538 | 35,820 |
| Incident forearm fractures | 2,740 | 1,229 | 3,969 |
| Incident other fractures | 21,506 | 19,447 | 40,953 |
| Prior hip fractures | 31,464 | 64,547 | 96,011 |
| Prior vertebral fractures | 18,974 | 21,522 | 40,495 |
| Total       | 104,467 | 141,861 | 246,327 |
respectively. It is notable that pharmacological fracture prevention costs amounted to only 3.7% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€4,251 million) followed by "other" (€3,625 million), spine (€657 million) and forearm fractures (€139 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 246,300 (Table 12). 68% of the total QALY loss was incurred in women. Prior fractures accounted for 55% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €14.93 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €23.94 billion in Germany in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 28%, 9%, 1% and 62% respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 33 million in 2010 to 38.5 million in 2025, corresponding to an increase of 17% (Table 14).

The total number of fractures was estimated to rise from 725,000 in 2010 to 928,000 in 2025 (Table 15), corresponding to an increase of 28%. Hip, clinical spine, forearm and other fractures increased by 42,900, 28,000, 23,200 and 108,800 respectively. The increase in the number of fractures ranged from 20% to 33%, depending on fracture site. The increase was estimated to be particularly marked in men (37%) compared to women (24%).

| Table 13 Value of lost QALYs (€) in men and women in Germany in 2010 |
|--------------------------|--------------------------|--------------------------|
|                          | 1 × GDP/capita           | 2 × GDP/capita           | 3 × GDP/capita           |
| Incident hip fractures   | 881,109,143              | 1,762,218,285            | 2,643,327,428            |
| Incident vertebral fractures | 1,085,336,609            | 2,170,673,218            | 3,256,009,827            |
| Incident forearm fractures | 120,265,846              | 240,531,692              | 360,797,537              |
| Incident other fractures | 1,240,870,037            | 2,481,740,073            | 3,722,610,110            |
| Prior hip fractures      | 2,909,128,253            | 5,818,256,507            | 8,727,384,760            |
| Prior vertebral fractures | 1,227,012,854            | 2,454,025,708            | 3,681,038,562            |
| Total                    | 7,463,722,741            | 14,927,445,482           | 22,391,168,223           |

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €9 billion in 2010 to €11 billion in 2025, corresponding to an increase of 25% (Table 16). Costs incurred in women and men increased by 21% and 34% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 246,300 in 2010 to 296,800 in 2025, corresponding to an increase of 20% (Table 17). The increase was estimated to be particularly marked in men (31%) compared to women (16%). Incident and prior fractures accounted for 60% and 40% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €23.9 billion in 2010 to €29.2 billion in 2025. The increase was estimated to be particularly marked in men (+32%) compared to women (+17%) (Table 18).

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5
of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 1.59% in 2001 to 2.67% in 2011.

Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Germany were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 80% and 77% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Germany

|          | Hip 2010 | Hip 2025 | Spine 2010 | Spine 2025 | Forearm 2010 | Forearm 2025 | Other 2010 | Other 2025 |
|----------|----------|----------|------------|------------|--------------|--------------|------------|------------|
| **Women**|          |          |            |            |              |              |            |            |
| 50–74    | 24,384   | 26,522   | 36,569     | 40,162     | 62,941       | 70,447       | 85,975     | 94,838     |
| 75+      | 71,288   | 96,761   | 37,767     | 49,232     | 36,171       | 46,052       | 129,296    | 175,020    |
| All      | 95,672   | 123,283  | 74,336     | 89,393     | 99,112       | 116,500      | 215,271    | 269,858    |
| **Men**  |          |          |            |            |              |              |            |            |
| 50–74    | 14,906   | 16,705   | 24,693     | 27,862     | 15,325       | 18,491       | 94,879     | 110,254    |
| 75+      | 19,272   | 32,747   | 14,598     | 24,421     | 4,017        | 6,703        | 52,692     | 91,520     |
| All      | 34,178   | 49,451   | 39,291     | 52,284     | 19,342       | 25,194       | 147,572    | 201,774    |

Table 16 Current and future cost (£ 000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Germany

|          | 2010 | 2015 | 2020 | 2025 |
|----------|------|------|------|------|
| **Women**|      |      |      |      |
| 50–74    | 2,092| 1,989| 2,105| 2,258|
| 75+      | 4,012| 4,468| 4,780| 5,101|
| All      | 6,103| 6,457| 6,885| 7,359|
| **Men**  |      |      |      |      |
| 50–74    | 1,587| 1,565| 1,684| 1,799|
| 75+      | 1,318| 1,623| 1,908| 2,104|
| All      | 2,905| 3,188| 3,592| 3,902|

Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Germany

|          | Incident fractures | Prior fractures | All fractures |
|----------|--------------------|----------------|--------------|
|          | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| **Women**|      |      |      |      |      |      |
| 50–74    | 50–74 | 30,345 | 33,418 | 30,879 | 31,782 | 61,225 | 65,201 |
| 75+      | 40,322 | 53,484 | 66,317 | 75,347 | 106,639 | 128,832 |
| All      | 70,667 | 86,903 | 97,196 | 107,130 | 167,864 | 194,032 |
| **Men**  |      |      |      |      |      |      |
| 50–74    | 23,684 | 27,080 | 19,558 | 21,421 | 43,242 | 48,500 |
| 75+      | 15,470 | 26,327 | 19,752 | 27,902 | 35,222 | 54,229 |
| All      | 39,154 | 53,407 | 39,310 | 49,322 | 78,464 | 102,729 |

| **Women and Men**|      |      |      |      |
| 50–74    | 3,678 | 3,553 | 3,789 | 4,056 |
| 75+      | 5,329 | 6,092 | 6,688 | 7,205 |
| All      | 9,008 | 9,645 | 10,477 | 11,261 |
Acknowledgements

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Epidemiology and Economic Burden of Osteoporosis in Greece

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract
Summary This report describes epidemiology, burden, and treatment of osteoporosis in Greece.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Greece, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Greece was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 86,000 new fragility fractures were sustained in Greece, comprising 15,000 hip fractures, 13,000 vertebral fractures, 15,000 forearm fractures and 43,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €680 million for the same year. Incident fractures represented 72 % of this cost, long-term fracture care 15 % and pharmacological prevention 13 %. Previous and incident fractures also accounted for 31,000 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 107,000 in 2025, representing an increase of 21,000 fractures.

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Hip, clinical spine, forearm and other fractures were estimated to increase by 4,100, 3,000, 2,800 and 11,300, respectively. The burden of fractures in Greece in 2025 was estimated to increase by 20 % to € 814 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. A substantial minority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap in women and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Greece in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Greece was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Greece

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 1,959,000 and 2,277,000 respectively in Greece in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at c. 640,000 (Table 2). There are 37.5 DXA scan machines per million (m) inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3] and have been recently updated [4]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Greece [6] which has very recently been updated [7]. We used the earlier report which was available at the time of writing [6]. Given that country specific incidence of the vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 213 and 494 respectively.

The number of incident fractures in 2010 was estimated at 86,000 (Table 4). Incident hip, clinical vertebral, forearm and “other” fractures were estimated at 15,000, 13,000, 15,000 and 43,000 respectively. 64 % of fractures occurred in women.

In the population aged 50 years or more, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 2.06 % for hip and 2.40 % for vertebral fractures. The estimated proportions of men and women with prior hip and clinical vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 87,000 and 102,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

Table 1 Population at risk: men and women over the age of 50 in Greece, 2010 [1]

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–59      | 749,000 | 725,000 | 1,474,000 |
| 60–69      | 615,000 | 555,000 | 1,170,000 |
| 70–79      | 583,000 | 459,000 | 1,042,000 |
| 80–89      | 288,000 | 199,000 | 487,000 |
| 90+        | 42,000 | 21,000 | 63,000 |
| 50+        | 2,277,000 | 1,959,000 | 4,236,000 |

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Greece by age using female-derived reference ranges at the femoral neck, 2010 [5]

| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 24,822 | 9,500 |
| 55–59      | 34,080 | 12,075 |
| 60–64      | 48,620 | 18,270 |
| 65–69      | 55,550 | 17,760 |
| 70–74      | 87,048 | 19,344 |
| 75–79      | 101,625 | 21,733 |
| 80+        | 155,760 | 36,520 |
| 50+        | 507,505 | 135,202 |
Table 3  Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Greece by age

| Age (years) | Fracture at the vertebra (per 100,000) | Forearm | Other |
|-------------|---------------------------------------|---------|-------|
| Women       |                                       |         |       |
| 50–54       | 2                                     | 5       | 12    | 12    |
| 55–59       | 61                                    | 170     | 469   | 537   |
| 60–64       | 120                                   | 213     | 455   | 464   |
| 65–69       | 198                                   | 288     | 480   | 675   |
| 70–74       | 436                                   | 614     | 783   | 1,235 |
| 75–79       | 707                                   | 688     | 690   | 1,488 |
| 80–84       | 1,281                                 | 805     | 802   | 2,178 |
| 85+         | 1,855                                 | 872     | 792   | 3,116 |
| Men         |                                       |         |       |
| 50–54       | 21                                    | 55      | 20    | 94    |
| 55–59       | 45                                    | 79      | 69    | 420   |
| 60–64       | 69                                    | 165     | 130   | 678   |
| 65–69       | 102                                   | 161     | 154   | 660   |
| 70–74       | 220                                   | 336     | 141   | 1,132 |
| 75–79       | 363                                   | 418     | 103   | 968   |
| 80–84       | 725                                   | 503     | 141   | 1,927 |
| 85+         | 1,087                                 | 730     | 199   | 3,148 |

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 1,128 (Table 8). Hip, vertebral and “other” fractures accounted for 566, 352 and 210 deaths respectively. Overall, approximately 54 % of deaths occurred in women.

Table 4  Estimated number of incident fractures in Greece, 2010

| Age (years) | Fracture at the vertebra (All fractures) |
|-------------|------------------------------------------|
| Women       |                                          |         |
| 50–74       | 2,865                                    | 4,271   | 7,973 | 10,749 | 25,857 |
| 75+         | 7,077                                    | 3,978   | 4,336 | 13,734 | 29,125 |
| Total       | 9,942                                    | 8,248   | 12,309| 24,483 | 54,982 |
| Men         |                                          |         |
| 50–74       | 1,539                                    | 2,616   | 1,586 | 9,646  | 15,388 |
| 75+         | 3,202                                    | 2,444   | 682   | 8,820  | 15,148 |
| Total       | 4,741                                    | 5,061   | 2,268 | 18,466 | 30,536 |

Table 5  Proportion of men and women (%) with a prior hip or clinical vertebral fracture in Greece, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.2          | 0.6                |
| 60–64       | 0.7          | 1.5                |
| 65–69       | 1.4          | 2.5                |
| 70–74       | 2.9          | 4.3                |
| 75–79       | 4.9          | 6.5                |
| 80–84       | 8.2          | 8.0                |
| 85+         | 12.3         | 8.7                |

| Men         |              |                    |
| 50–54       | 0.1          | 0.1                |
| 55–59       | 0.3          | 0.4                |
| 60–64       | 0.5          | 0.9                |
| 65–69       | 0.8          | 1.4                |
| 70–74       | 1.4          | 2.1                |
| 75–79       | 2.4          | 3.0                |
| 80–84       | 4.2          | 3.8                |
| 85+         | 8.1          | 6.1                |

Cost of osteoporosis in Greece including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still

Table 6  Number of men and women in Greece with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 16,252       | 27,664             |
| 75+         | 45,650       | 44,471             |
| Total       | 61,902       | 72,135             |
| Men         |              |                    |
| 50–74       | 8,073        | 13,132             |
| 75+         | 17,438       | 16,493             |
| Total       | 25,510       | 29,625             |

Table 6  Number of men and women in Greece with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 24,325       | 40,796             |
| 75+         | 63,088       | 60,963             |
| Total       | 87,413       | 101,760            |

Cost of osteoporosis in Greece including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still
incurred costs in 2010 ("long-term disability cost"); and
(iii) cost of pharmacological fracture prevention includ-
ing administration and monitoring costs ("pharmacolog-
ical fracture prevention costs"). See Chapter 4 of the
main report for further details.

As from March 2012 the Greek National Health System
reimburses €470 (2 days admission) for a hip fracture treated
with osteosynthesis and €1,463 (7 days admission) for a hip
fracture treated by hemiarthroplasty. More than 90% of all hip
fractures are treated surgically, usually by hemiarthroplasty.
Specific data for the cost of a hip fracture was not available for
Greece before 2012, and the cost of hip fracture was estimated
at €12,550 using information from Italy [8]. Given that no
cost data for the other fracture sites were found, these were
imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the
yearly cost of residing in nursing home (€13,271 [9, 10], based on
Bulgarian cost of nursing home, purchasing power parity adjust-
ed) with the simulated number of individuals with prior fractures
that had been transferred to nursing home due to the fracture.

Annual drug costs (€) for individual treatments are shown in
Table 9. In addition, since patients can be followed either
in a private or in a public setting, it was assumed that

| Table 7 | Incidence (per 100,000) of causally related deaths in Greece within the first year after fracture (adjusted for comorbidities), 2010 |
|---------|---------------------------------------------------------------------------------------------------------------|
| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|----------|-----|-------------------|----------------|
| Women    |     |                   |                |
| 50–54    | 409 | 531               | 11             |
| 55–59    | 607 | 746               | 18             |
| 60–64    | 867 | 1,007             | 28             |
| 65–69    | 1,162 | 1,273            | 44             |
| 70–74    | 1,431 | 1,476            | 65             |
| 75–79    | 2,138 | 2,066            | 134            |
| 80–84    | 2,753 | 2,436            | 307            |
| 85–89    | 4,702 | 3,655            | 824            |
| 90+      | 9,119 | 5,142            | 3,170          |
| Men      |     |                   |                |
| 50–54    | 1,656 | 1,986            | 26             |
| 55–59    | 2,139 | 2,431            | 44             |
| 60–64    | 2,267 | 2,438            | 61             |
| 65–69    | 2,986 | 3,029            | 107            |
| 70–74    | 3,214 | 3,060            | 145            |
| 75–79    | 4,243 | 3,763            | 252            |
| 80–84    | 5,128 | 4,165            | 431            |
| 85–89    | 7,278 | 5,320            | 786            |
| 90+      | 17,298 | 11,257           | 2,164          |

Table 8 The number of deaths in men and women in Greece in the first
year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip fracture | Fracture at the vertebra | “Other” |
|-------------|--------------|--------------------------|---------|
| Women       |              |                          |         |
| 50–74       | 37           | 54                       | 6       |
| 75+         | 273          | 106                      | 128     |
| Total       | 310          | 160                      | 133     |
| Men         |              |                          |         |
| 50–74       | 46           | 75                       | 10      |
| 75+         | 210          | 117                      | 67      |
| Total       | 256          | 192                      | 77      |
| Men and Women |          |                          |         |
| 50–74       | 82           | 129                      | 16      |
| 75+         | 484          | 223                      | 194     |
| Total       | 566          | 352                      | 210     |

Table 9 One year costs for relevant pharmaceuticals in Greece, 2010 [13]

| Annual drug cost (€) | Alendronate | Risedronate | Etidronate | Ibandronate | Zoledronic acid | Raloxifene | Strontium ranelate | Parathyroid hormone | Teriparatide |
|----------------------|-------------|-------------|------------|-------------|----------------|------------|-------------------|---------------------|-------------|
| €470                 | 239         | 286         | 79         | 235         | 357            | 332        | 494               | 3,630               | 5,289       |

Table 9 One year costs for relevant pharmaceuticals in Greece, 2010 [13]

| Annual drug cost (€) | Alendronate | Risedronate | Etidronate | Ibandronate | Zoledronic acid | Raloxifene | Strontium ranelate | Parathyroid hormone | Teriparatide |
|----------------------|-------------|-------------|------------|-------------|----------------|------------|-------------------|---------------------|-------------|
| €470                 | 239         | 286         | 79         | 235         | 357            | 332        | 494               | 3,630               | 5,289       |

As from March 2012 the Greek National Health System
reimburses €470 (2 days admission) for a hip fracture treated
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ed) with the simulated number of individuals with prior fractures
that had been transferred to nursing home due to the fracture.

Annual drug costs (€) for individual treatments are shown in
Table 9. In addition, since patients can be followed either
in a private or in a public setting, it was assumed that

Table 10 Cost of osteoporosis (€) in Greece by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|------------|--------------------------|---------------------------|--------------------------|-----------|
| Women      |                          |                           |                          |           |
| 50–74      | 126,179,047              | 13,566,786                | 48,308,311               | 188,054,144 |
| 75+        | 176,314,529              | 53,674,429                | 31,301,517               | 261,290,475 |
| All        | 302,493,576              | 67,241,215                | 79,609,828               | 449,344,619 |
| Men        |                          |                           |                          |           |
| 50–74      | 89,420,133               | 8,154,928                 | 7,084,676                | 104,659,738 |
| 75+        | 95,779,435               | 26,217,569                | 4,090,752                | 126,087,756 |
| All        | 185,199,568              | 34,372,497                | 11,175,428               | 230,747,493 |
| Women and Men |                    |                           |                          |           |
| 50–74      | 215,599,180              | 21,721,714                | 55,392,987               | 292,713,881 |
| 75+        | 272,093,964              | 79,891,997                | 35,392,269               | 387,378,231 |
| All        | 487,693,144              | 101,613,711               | 90,785,256               | 680,092,112 |
patients on treatment made an annual physician visit costing €8 [11] and a DXA scan at two sites costing €115 [12] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €680 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €488 million, €102 million and €91 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 13.4 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€260 million) followed by “other” (€284 million), spine (€34 million) and forearm fractures (€11 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 31,000 (Table 12). 66 % of the total QALY loss was incurred in women. Prior fractures accounted for 58 % of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €1.26 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €1.94 billion in Greece in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 25 %, 5 %, 5 % and 65 % respectively.

Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 4.2 million in 2010 to 5.1 million in 2025, corresponding to an increase of 20 % (Table 14).

The total number of fractures was estimated to rise from 86,000 in 2010 to 107,000 in 2025 (Table 15), corresponding to an increase of 24 %. Hip, clinical spine, forearm and other fractures increased by 4,100, 3,000, 2,800 and 11,300 respectively. The increase in the number of fractures ranged from 19 % to 28 %, depending on fracture site. The increase was estimated to be particularly marked in men (28 %) compared to women (23 %).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €680 million in 2010 to €814 million in 2025, corresponding to an increase of 20 % (Table 16).

| Table 11 | Total cost (€) in 2010 by fracture site in men and women in Greece. Note that costs for fracture prevention therapy and monitoring are not included |
|----------|---------------------------------|
| Age      | Hip                | Vertebra  | Forearm   | Other        | All                |
|----------|--------------------|-----------|-----------|--------------|--------------------|
|          |                    | Women     |           | Men          | Women and Men     |
| 50–74    | 48,369,258         | 11,486,508| 6,113,659 | 73,776,407   | 139,745,833       |
| 75+      | 127,379,563        | 9,637,933 | 3,324,635 | 89,646,828   | 229,988,958       |
| All      | 175,748,821        | 21,124,441| 9,438,294 | 163,423,235  | 369,734,791       |
| 50–74    | 26,076,779         | 6,758,503 | 1,216,407 | 63,523,373   | 97,575,062        |
| 75+      | 58,263,114         | 5,674,285 | 522,484   | 57,536,757   | 121,997,003       |
| All      | 84,339,893         | 12,432,788| 1,739,255 | 121,060,130  | 219,572,065       |
| 50–74    | 74,446,037         | 18,245,011| 7,330,666 | 137,299,780  | 237,320,894       |
| 75+      | 185,642,677        | 15,312,218| 3,847,483 | 147,183,584  | 351,985,962       |
| All      | 260,088,713        | 33,557,229| 11,177,549| 284,483,365  | 589,306,856       |

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Fig. 1 Share (%) of fracture cost by fracture site in Greece. Note that costs for fracture prevention therapy and monitoring are not included.
16). Costs incurred in women and men increased by 18 % and 24 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 31,000 in 2010 to 35,200 in 2025, corresponding to an increase of 14 % (Table 17). The increase was estimated to be particularly marked in men (21 %) compared to women (10 %). Incident and prior fractures accounted for about 67 % and 33 % of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately € 1.9 billion in 2010 to € 2.2 billion in 2025. The increase was estimated to be particularly marked in men (+22 %) compared to women (+13 %) (Table 18).

### Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Greece according to age

| Age (years) | 50–74 | 75+ | 50+ |
|------------|-------|-----|-----|
| **Women**  |       |     |     |
| Incident hip fractures | 685 | 1,525 | 2,210 |
| Incident vertebral fractures | 1,403 | 1,167 | 2,570 |
| Incident forearm fractures | 280 | 134 | 413 |
| Incident other fractures | 1,281 | 1,463 | 2,744 |
| Prior hip fractures | 2,533 | 6,286 | 8,818 |
| Prior vertebral fractures | 1,537 | 2,203 | 3,739 |
| Total | 7,717 | 12,778 | 20,495 |
| **Men**   |       |     |     |
| Incident hip fractures | 374 | 769 | 1,144 |
| Incident vertebral fractures | 867 | 783 | 1,649 |
| Incident forearm fractures | 55 | 22 | 77 |
| Incident other fractures | 1,140 | 1,006 | 2,146 |
| Prior hip fractures | 1,259 | 2,583 | 3,842 |
| Prior vertebral fractures | 728 | 871 | 1,598 |
| Total | 4,423 | 6,034 | 10,457 |
| **Men and Women** | | | |
| Incident hip fractures | 1,059 | 2,295 | 3,354 |
| Incident vertebral fractures | 2,269 | 1,950 | 4,219 |
| Incident forearm fractures | 335 | 156 | 491 |
| Incident other fractures | 2,421 | 2,469 | 4,890 |
| Prior hip fractures | 3,792 | 8,869 | 12,660 |
| Prior vertebral fractures | 2,264 | 3,074 | 5,338 |
| Total | 12,140 | 18,812 | 30,952 |

### Table 13 Value of lost QALYs (€) in men and women in Greece in 2010

|              | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|--------------|----------------|----------------|----------------|
| Incident hip fractures | 68,416,328 | 136,832,656 | 205,248,984 |
| Incident vertebral fractures | 86,072,643 | 172,145,287 | 258,217,930 |
| Incident forearm fractures | 10,008,139 | 20,016,278 | 30,024,417 |
| Incident other fractures | 99,760,468 | 199,520,936 | 299,281,404 |
| Prior hip fractures | 258,272,433 | 516,544,867 | 774,817,300 |
| Prior vertebral fractures | 108,891,599 | 217,783,198 | 326,674,797 |
| Total | 631,421,611 | 1,262,843,222 | 1,894,264,833 |

### Table 14 Population projections in Greece by age and sex [14]

|          | 2010 | 2015 | 2020 | 2025 |
|----------|------|------|------|------|
| **Women** |      |      |      |      |
| 50–59    | 749,000 | 789,000 | 838,000 | 876,000 |
| 60–69    | 615,000 | 680,000 | 724,000 | 765,000 |
| 70–79    | 583,000 | 555,000 | 544,000 | 604,000 |
| 80–89    | 288,000 | 340,000 | 358,000 | 333,000 |
| 90+      | 42,000  | 50,000  | 77,000  | 94,000  |
| **Men**  |      |      |      |      |
| 50–59    | 725,000 | 761,121 | 829,000 | 896,000 |
| 60–69    | 555,000 | 626,000 | 668,000 | 706,000 |
| 70–79    | 459,000 | 422,000 | 448,000 | 509,000 |
| 80–89    | 199,000 | 238,000 | 245,000 | 230,000 |
| 90+      | 21,000  | 28,000  | 44,000  | 53,000  |
| **All**  |      |      |      |      |
| 50–59    | 1,474,000 | 1,550,121 | 1,667,000 | 1,772,000 |
| 60–69    | 1,170,000 | 1,306,000 | 1,392,000 | 1,471,000 |
| 70–79    | 1,042,000 | 957,000  | 992,000  | 1,113,000 |
| 80–89    | 487,000  | 578,000  | 603,000  | 563,000  |
| 90+      | 63,000   | 78,000   | 121,000  | 147,000  |

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 1.67 % in 2001 to 9.1 % in 2009 but subsequently decreased to 8.2 % in 2011.
Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Greece were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. For men, the data indicate that the volume of sold osteoporosis drugs would be sufficient to cover treatment for more patients than the number that fall above the fracture threshold. It should be noted, however, that the results from this analysis should be interpreted with some caution since it has been assumed that the distribution of drug use between genders observed in Sweden is valid for all countries. The treatment gap in men and women were estimated at \(-25%\) and \(31\%\) respectively (Table 19). Also note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

| Table 15 | Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Greece |
|-----------|---------------------------------------------------------------|
|           | Hip 2010 | Hip 2025 | Spine 2010 | Spine 2025 | Forearm 2010 | Forearm 2025 | Other 2010 | Other 2025 |
| Women     |          |          |           |           |              |              |           |           |
| 50-74     | 2,865    | 3,320    | 4,271     | 4,992     | 7,973        | 9,400        | 10,749    | 12,649    |
| 75+       | 7,077    | 9,357    | 3,978     | 4,926     | 4,336        | 5,139        | 13,734    | 17,978    |
| All       | 9,942    | 12,677   | 8,248     | 9,919     | 12,309       | 14,539       | 24,483    | 30,627    |
| Men       |          |          |           |           |              |              |           |           |
| 50-74     | 1,539    | 1,887    | 2,616     | 3,188     | 1,586        | 1,985        | 9,646     | 11,909    |
| 75+       | 3,202    | 4,182    | 2,444     | 3,198     | 682          | 887          | 8,820     | 11,734    |
| All       | 4,741    | 6,070    | 5,061     | 6,386     | 2,268        | 2,872        | 18,466    | 23,644    |
| Women and Men |        |          |           |           |              |              |           |           |
| 50-74     | 4,404    | 5,207    | 6,887     | 8,180     | 9,559        | 11,386       | 20,395    | 24,558    |
| 75+       | 10,279   | 13,539   | 6,422     | 8,124     | 5,018        | 6,025        | 22,554    | 29,713    |
| All       | 14,683   | 18,747   | 13,309    | 16,305    | 14,577       | 17,411       | 42,949    | 54,271    |

Table 16 Current and future cost (€,000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Greece

| Table 16 | Current and future cost (€,000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Greece |
|-------------------|---------------------------------------------------------------|
|                   | 2010 | 2015 | 2020 | 2025 |
| Women             |      |      |      |      |
| 50-74             | 188  | 187  | 206  | 216  |
| 75+               | 261  | 289  | 296  | 313  |
| All               | 449  | 476  | 502  | 529  |
| Men               |      |      |      |      |
| 50-74             | 105  | 108  | 120  | 128  |
| 75+               | 126  | 142  | 148  | 157  |
| All               | 231  | 249  | 267  | 285  |
| Women and Men     |      |      |      |      |
| 50-74             | 293  | 295  | 325  | 344  |
| 75+               | 387  | 430  | 444  | 470  |
| All               | 680  | 725  | 769  | 814  |

Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Greece

| Table 17 | Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Greece |
|-------------------|---------------------------------------------------------------|
|                   | Incident fractures 2010 | Prior fractures 2010 | All fractures 2010 |
|                   | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women             |      |      |      |      |      |      |
| 50-74             | 3,648| 4,275| 4,069| 4,070| 7,717| 8,345|
| 75+               | 4,289| 5,473| 4,849| 4,899| 12,778| 14,173|
| All               | 7,937| 9,749| 12,558| 12,679| 20,495| 22,518|
| Men               |      |      |      |      |      |      |
| 50-74             | 2,436| 2,992| 1,987| 2,214| 4,423| 5,206|
| 75+               | 2,580| 3,393| 3,454| 4,054| 6,034| 7,447|
| All               | 5,017| 6,385| 5,440| 6,267| 10,457|12,653|
| Women and Men     |      |      |      |      |      |      |
| 50-74             | 6,084| 7,268| 6,056| 6,284| 12,140| 13,551|
| 75+               | 6,870| 8,866| 11,942| 12,753| 18,812| 21,619|
| All               | 12,954|16,134|17,998|19,037|30,952|35,171|

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### Table 18
Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Greece assuming the uptake of treatment remains unchanged

| Age Group | 2010 | 2015 | 2020 | 2025 |
|-----------|------|------|------|------|
| **Women** |      |      |      |      |
| 50–74     | 503  | 505  | 536  | 557  |
| 75+       | 783  | 842  | 860  | 891  |
| All       | 1,286| 1,347| 1,397| 1,448|
| **Men**   |      |      |      |      |
| 50–74     | 285  | 291  | 318  | 340  |
| 75+       | 372  | 404  | 424  | 461  |
| All       | 657  | 695  | 741  | 802  |
| **Women and Men** |      |      |      |      |
| 50–74     | 788  | 796  | 854  | 897  |
| 75+       | 1,155| 1,246| 1,284| 1,352|
| All       | 1,943| 2,042| 2,138| 2,249|

### Table 19
Number of men and women eligible for treatment, treated and treatment gap in 2010

| Year     | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|----------|-------------------------------------|----------------------------------------|---------------------|-------------------|
| **Men**  | 50                                  | 40                                     | –10                 | –25               |
| **Women**| 333                                 | 482                                    | 149                 | 31                |

### Fig. 2
Treatment uptake in Greece (defined daily doses [DDDs] per 100,000 persons aged 50 years or above)
Epidemiology and Economic Burden of Osteoporosis in Hungary

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract
Summary This report describes epidemiology, burden, and treatment of osteoporosis in Hungary.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Hungary, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Hungary was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 102,000 new fragility fractures were sustained in Hungary, comprising 13,000 hip fractures, 11,000 vertebral fractures, 39,000 forearm fractures and 38,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €197 million for the same year. Incident fractures represented 64 %

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of this cost, long-term fracture care 15% and pharmacological prevention 20%. Previous and incident fractures also accounted for 23,700 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 116,000 in 2025, representing an increase of 13,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 2,900, 1,700, 2,700 and 6,000, respectively. The burden of fractures in Hungary in 2025 was estimated to increase by 15% to €226 million.

Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. A substantial minority of women at high fracture risk did not receive active treatment. Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Hungary in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Hungary was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Hungary

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 1,540,000 and 2,143,000 respectively in Hungary in 2010 (Table 1).

Table 1 Population at risk: men and women over the age of 50 in Hungary, 2010 [1]

| Age (years) | Women | Men | All  |
|------------|-------|-----|------|
| 50–59      | 762,000 | 671,000 | 1,433,000 |
| 60–69      | 633,000 | 481,000 | 1,114,000 |
| 70–79      | 472,000 | 272,000 | 744,000  |
| 80–89      | 246,000 | 106,000 | 352,000  |
| 90+        | 30,000  | 10,000  | 40,000   |
| 50+        | 2,143,000 | 1,540,000 | 3,683,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 550,000 (Table 2). There are 6 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence and forearm incidence are available for Hungary [5]. Given that country specific incidence of the vertebral and “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 274.1 and 560.6 respectively.

The number of incident fractures in 2010 was estimated at 102,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 13,000, 11,000, 39,000 and 38,000 respectively. 67% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals who had suffered a prior fracture were 67% in men and 87% in women.

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Hungary by age using femur-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 22,806 | 8,200 |
| 55–59      | 38,400 | 12,005 |
| 60–64      | 47,762 | 15,486 |
| 65–69      | 60,398 | 15,836 |
| 70–74      | 71,145 | 12,012 |
| 75–79      | 81,375 | 12,154 |
| 80+        | 130,272 | 19,256 |
| 50+        | 452,158 | 94,949 |

In the population at risk, previous and incident fractures also accounted for 23,700 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 116,000 in 2025, representing an increase of 13,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 2,900, 1,700, 2,700 and 6,000, respectively. The burden of fractures in Hungary in 2025 was estimated to increase by 15% to €226 million.

Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. A substantial minority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.
fracture prior to 2010 were estimated at 1.55 % for hip and 1.65 % for vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 57,000 and 61,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 1,241 (Table 8). Hip, vertebral and “other” fractures accounted for 592, 460 and 189 deaths respectively. Overall, approximately 51 % of deaths occurred in women.

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Hungary by age

| Age (years) | Fracture at the vertebral | forearm | other |
|-------------|--------------------------|---------|-------|
| Women       |                          |         |       |
| 50-54       | 10                       | 25      | 216   | 63   |
| 55-59       | 46                       | 126     | 950   | 400  |
| 60-64       | 91                       | 161     | 1,335 | 352  |
| 65-69       | 156                      | 228     | 1,449 | 534  |
| 70-74       | 285                      | 402     | 1,593 | 808  |
| 75-79       | 557                      | 542     | 1,745 | 1,173|
| 80-84       | 1,385                    | 870     | 2,327 | 2,355|
| 85+         | 2,684                    | 1,263   | 2,642 | 4,509|

| Men          |                          |         |       |
|-------------|--------------------------|---------|-------|
| 50-54       | 13                       | 33      | 190   | 57   |
| 55-59       | 66                       | 115     | 551   | 614  |
| 60-64       | 107                      | 255     | 663   | 1,050|
| 65-69       | 142                      | 224     | 579   | 918  |
| 70-74       | 190                      | 290     | 520   | 976  |
| 75-79       | 377                      | 435     | 642   | 1,007|
| 80-84       | 872                      | 606     | 978   | 2,319|
| 85+         | 1,660                    | 1,115   | 1,390 | 4,807|

Table 4 Estimated number of incident fractures in Hungary, 2010

| Age (years) | Fracture at the vertebral | forearm | other | All fractures |
|-------------|--------------------------|---------|-------|---------------|
| Women       |                          |         |       |               |
| 50-74       | 1,996                    | 3,088   | 19,242| 7,719         | 32,045|
| 75+         | 7,708                    | 4,056   | 10,590| 14,365        | 36,719|
| Total       | 9,704                    | 7,144   | 29,832| 22,084        | 68,764|

| Men         |                          |         |       |               |
|-------------|--------------------------|---------|-------|---------------|
| 50-74       | 1,394                    | 2,492   | 6,982 | 9,980         | 20,848|
| 75+         | 2,303                    | 1,732   | 2,374 | 6,435         | 12,844|
| Total       | 3,698                    | 4,224   | 9,356 | 16,415        | 33,692|

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Hungary, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50-54       | 0.0          | 0.1                |
| 55-59       | 0.2          | 0.5                |
| 60-64       | 0.5          | 1.0                |
| 65-69       | 0.9          | 1.6                |
| 70-74       | 1.7          | 2.6                |
| 75-79       | 3.1          | 3.6                |
| 80-84       | 6.0          | 5.3                |
| 85+         | 14.2         | 9.9                |

| Men         |              |                    |
|-------------|--------------|--------------------|
| 50-54       | 0.0          | 0.1                |
| 55-59       | 0.2          | 0.4                |
| 60-64       | 0.5          | 0.8                |
| 65-69       | 0.8          | 1.2                |
| 70-74       | 1.2          | 1.4                |
| 75-79       | 1.8          | 1.9                |
| 80-84       | 3.6          | 2.7                |
| 85+         | 9.4          | 6.3                |

Table 6 Number of men and women in Hungary with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50-74       | 9,664        | 17,020             |
| 75+         | 32,753       | 27,882             |
| Total       | 42,416       | 44,902             |

| Men         |              |                    |
|-------------|--------------|--------------------|
| 50-74       | 5,959        | 8,638              |
| 75+         | 8,850        | 7,054              |
| Total       | 14,808       | 15,692             |

Table 7 Number and proportion of causally related deaths (per 100,000) in the first year after fracture by age

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50-54       | 592          | 1241               |
| 55-59       | 460          | 1241               |
| 60-64       | 189          | 1241               |
| 65-69       | 531          | 1241               |
| 70-74       | 1,449        | 1241               |
| 75-79       | 2,327        | 1241               |
| 80-84       | 3,239        | 1241               |
| 85+         | 4,509        | 1241               |

| Men         |              |                    |
|-------------|--------------|--------------------|
| 50-54       | 592          | 1241               |
| 55-59       | 460          | 1241               |
| 60-64       | 189          | 1241               |
| 65-69       | 531          | 1241               |
| 70-74       | 1,449        | 1241               |
| 75-79       | 2,327        | 1241               |
| 80-84       | 3,239        | 1241               |
| 85+         | 4,509        | 1241               |
Cost of osteoporosis in Hungary including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of a hip fracture was not available specifically for Hungary, therefore the hip fracture cost was estimated at €3,594 based on the cost in Slovenia [6]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€5,789 [7]) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug costs for individual treatments are shown in Table 9. In addition, it was assumed that patients on

### Table 7 Incidence (per 100,000) of causally related deaths in Hungary within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|-----------------|
| Women       |     |                    |                 |
| 50–54       | 1,232 | 1,601              | 32              |
| 55–59       | 1,550 | 1,907              | 46              |
| 60–64       | 2,008 | 2,331              | 64              |
| 65–69       | 2,277 | 2,496              | 85              |
| 70–74       | 3,121 | 3,221              | 142             |
| 75–79       | 3,693 | 3,568              | 232             |
| 80–84       | 3,750 | 3,318              | 418             |
| 85–89       | 4,098 | 3,186              | 718             |
| 90+         | 2,675 | 1,508              | 930             |

| Men         |     |                    |                 |
| 50–54       | 4,540 | 5,446              | 71              |
| 55–59       | 5,668 | 6,444              | 116             |
| 60–64       | 5,976 | 6,428              | 162             |
| 65–69       | 6,001 | 6,087              | 215             |
| 70–74       | 6,289 | 5,988              | 284             |
| 75–79       | 7,165 | 6,354              | 425             |
| 80–84       | 7,289 | 5,919              | 612             |
| 85–89       | 8,708 | 6,364              | 941             |
| 90+         | 8,017 | 5,217              | 1,003           |

### Table 8 The number of deaths in men and women in Hungary in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Fracture at the vertebra | “Other” |
|-------------|-----|--------------------------|---------|
| Women       |     |                          |         |
| 50–74       | 53  | 84                       | 8       |
| 75+         | 269 | 115                      | 106     |
| Total       | 321 | 199                      | 114     |

| Men         |     |                          |         |
| 50–74       | 87  | 159                      | 19      |
| 75+         | 183 | 103                      | 56      |
| Total       | 270 | 262                      | 75      |

| Men and Women |     |                          |         |
| 50–74        | 139 | 243                      | 27      |
| 75+          | 452 | 218                      | 162     |
| Total        | 592 | 460                      | 189     |

### Table 9 One year costs for relevant pharmaceuticals in Hungary, 2010 [9]

| Annual drug cost (€) |
|----------------------|
| Alendronate          | 115  |
| Risedronate          | 247  |
| Etidronate           | -    |
| Ibandronate          | 329  |
| Zoledronic acid      | 254  |
| Raloxifene           | 383  |
| Strontium ranelate   | 449  |
| Parathyroid hormone  | -    |
| Teriparatide         | 4,663|

### Table 10 Cost of osteoporosis (€) in Hungary by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|---------------------------|--------------------------|-----------|
| Women       |                          |                           |                          |           |
| 50–74       | 27,845,242               | 3,502,828                 | 22,262,260               | 53,610,330|
| 75+         | 54,928,269               | 18,406,104                | 12,607,815               | 85,942,188|
| All         | 82,773,512               | 21,908,932                | 34,870,075               | 139,552,519|

| Men         |                          |                           |                          |           |
| 50–74       | 24,603,984               | 2,547,996                 | 3,521,168                | 30,673,148|
| 75+         | 19,656,923               | 5,996,767                 | 1,387,668                | 27,041,558|
| All         | 44,260,907               | 8,544,763                 | 4,909,036                | 57,714,706|

| Women and Men |                          |                           |                          |           |
| 50–74        | 52,449,226               | 6,050,824                 | 25,783,428               | 84,283,479|
| 75+          | 74,585,192               | 24,402,871                | 13,995,683               | 112,983,746|
| All          | 127,034,418              | 30,453,695                | 39,779,111               | 197,267,225|
treatment made an annual physician visit costing €43 (approximated by adjusting Romanian cost for health adjusted price levels [8]) and a DXA scan costing €7 [7] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €197 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €127 million, €30 million and €40 million respectively. It is notable that pharmacological fracture prevention costs amounted to only 20.3% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€71 million) followed by “other” (€69 million), forearm (€9 million) and spine fractures (€8 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

### Table 11
Total cost (€) in 2010 by fracture site in men and women in Hungary. Note that costs for fracture prevention therapy and monitoring are not included

| Age | Hip     | Spine  | Forearm | Other | All  |
|-----|---------|--------|---------|-------|------|
|     | Women   |        |         |       |      |
| 50–74 | 10,208,204 | 2,293,720 | 4,225,703 | 14,620,443 | 31,348,070 |
| 75+  | 42,182,582  | 2,836,233  | 2,325,631  | 25,990,127  | 73,334,373  |
| All  | 52,390,586 | 5,129,953 | 6,551,335 | 40,610,570 | 104,682,443 |
|     | Men      |        |         |       |      |
| 50–74 | 6,817,487   | 1,683,319   | 1,533,364   | 17,117,810   | 27,151,980   |
| 75+  | 12,269,348  | 1,103,148  | 521,255    | 11,759,939  | 25,653,690  |
| All  | 19,086,835  | 2,786,467  | 2,054,619  | 28,877,750  | 52,805,670  |
|     | Women and Men |        |         |       |      |
| 50–74 | 17,025,690  | 3,977,039   | 5,759,067  | 31,738,254  | 58,500,050  |
| 75+  | 54,451,730  | 3,939,380  | 2,846,886  | 37,750,066  | 98,988,063  |
| All  | 71,477,421  | 7,916,420  | 8,605,953  | 69,488,320  | 157,488,113  |

*Fig. 1* Share (%) of fracture cost (%) by fracture site in Hungary. Note that costs for fracture prevention therapy and monitoring are not included.

### Table 12
Number of QALYs lost due to fractures during 2010 in men and women in Hungary according to age

| Age (years) |     | 50–74 | 75+ | 50+ |
|-------------|-----|-------|-----|-----|
|            | Men |       |     |     |
| Incident hip fractures | 487 | 1,633 | 2,120 |
| Incident vertebral fractures | 1,034 | 1,176 | 2,210 |
| Incident forearm fractures | 678 | 325 | 1,003 |
| Incident other fractures | 926 | 1,499 | 2,425 |
| Prior hip fractures | 1,514 | 4,429 | 5,944 |
| Prior vertebral fractures | 951 | 1,355 | 2,306 |
| Total | 5,590 | 10,418 | 16,008 |
|            | Women |       |     |     |
| Incident hip fractures | 353 | 560 | 914 |
| Incident vertebral fractures | 857 | 559 | 1,416 |
| Incident forearm fractures | 243 | 78 | 321 |
| Incident other fractures | 1,187 | 734 | 1,921 |
| Prior hip fractures | 931 | 1,305 | 2,236 |
| Prior vertebral fractures | 480 | 371 | 851 |
| Total | 4,052 | 3,606 | 7,659 |

### Table 13
Value of lost QALYs (€) in men and women in Hungary in 2010

| 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|----------------|----------------|----------------|
| Incident hip fractures | 29,729,410 | 59,458,819 | 89,188,229 |
| Incident vertebral fractures | 35,535,859 | 71,071,717 | 106,607,576 |
| Incident forearm fractures | 12,972,073 | 25,944,146 | 38,916,219 |
| Incident other fractures | 42,596,507 | 85,193,013 | 127,789,520 |
| Prior hip fractures | 80,158,522 | 160,317,044 | 240,475,526 |
| Prior vertebral fractures | 30,940,008 | 61,880,016 | 92,820,023 |
| Total | 231,932,378 | 463,864,756 | 695,797,134 |
The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 23,700 (Table 12). 68% of the total QALY loss was incurred in women. Prior fractures accounted for 48% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €460 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €660 million in Hungary in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 19%, 5%, 6%, and 70% respectively.

### Table 14 Population projections in Hungary by age and sex [10]

| Population | 2010 | 2015 | 2020 | 2025 |
|------------|------|------|------|------|
| **Women**  |      |      |      |      |
| 50–59      | 762,000 | 651,000 | 624,000 | 697,000 |
| 60–69      | 633,000 | 698,000 | 702,000 | 604,000 |
| 70–79      | 472,000 | 486,000 | 518,000 | 580,000 |
| 80–89      | 246,000 | 252,000 | 257,000 | 275,000 |
| 90+        | 30,000  | 44,000  | 53,000  | 58,000  |
| **Men**    |      |      |      |      |
| 50–59      | 671,000 | 584,047 | 585,000 | 671,000 |
| 60–69      | 481,000 | 540,000 | 547,000 | 484,000 |
| 70–79      | 272,000 | 286,000 | 318,000 | 367,000 |
| 80–89      | 106,000 | 108,000 | 107,000 | 119,000 |
| 90+        | 10,000  | 15,000  | 16,000  | 17,000  |
| **All**    | 3,683,000 | 3,847,047 | 3,850,000 | 4,368,000 |

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 23,700 (Table 12). 68% of the total QALY loss was incurred in women. Prior fractures accounted for 48% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €460 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €660 million in Hungary in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 19%, 5%, 6% and 70% respectively.

### Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Hungary

| Fracture Site | 2010 | 2025 |
|--------------|------|------|
| **Hip**      |      |      |
| 50–74        | 1,996 | 2,183 |
| 75+          | 7,708 | 9,819 |
| All          | 9,704 | 12,001 |
| **Spine**    |      |      |
| 50–74        | 3,088 | 3,257 |
| 75+          | 4,056 | 5,022 |
| All          | 7,144 | 8,279 |
| **Forearm**  |      |      |
| 50–74        | 19,242 | 19,278 |
| 75+          | 10,590 | 12,532 |
| All          | 29,832 | 31,811 |
| **Other**    |      |      |
| 50–74        | 7,197 | 8,019 |
| 75+          | 14,365 | 18,243 |

### Table 16 Current and future cost (€ 000, 000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Hungary

| Year | Women | Men | All |
|------|-------|-----|-----|
| 2010 |       |     |     |
| 2015 |       |     |     |
| 2020 |       |     |     |
| 2025 |       |     |     |

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 23,700 (Table 12). 68% of the total QALY loss was incurred in women. Prior fractures accounted for 48% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €460 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €660 million in Hungary in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 19%, 5%, 6% and 70% respectively.
Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 3.7 million in 2010 to 3.9 million in 2025, corresponding to an increase of 5% (Table 14).

The total number of fractures was estimated to rise from 102,000 in 2010 to 116,000 in 2025 (Table 15), corresponding to an increase of 13%. Hip, clinical spine, forearm and other fractures increased by 2,900, 1,700, 2,700 and 6,000 respectively. The increase in the number of fractures ranged from 7% to 22%, depending on fracture site. The increase was estimated to be 11% in men and 14% in women.

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €197 million in 2010 to €226 million in 2025, corresponding to an increase of 15% (Table 16). Costs incurred in women and men increased by 15% and 14% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 23,700 in 2010 to 26,200 in 2025, corresponding to an increase of 11% (Table 17). The increase was estimated to be 12% in men and 11% in women. Incident and prior fractures accounted for 71% and 29% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €660 million in 2010 to €740 million in 2025. The increase was estimated to be 12% in both men and women (Table 18).

Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Hungary

| Incident fractures | Prior fractures | All fractures |
|--------------------|----------------|--------------|
|                    | 2010           | 2025         | 2010 | 2025 | 2010 | 2025 |
| Women              |                |              |      |      |      |      |
| 50–74              | 3,124          | 3,250        | 2,465| 2,460| 5,590| 5,710|
| 75+                | 4,633          | 5,769        | 5,785| 6,220| 10,418|11,989|
| All                | 7,758          | 9,019        | 8,250| 8,680| 16,008|17,699|
| Men                |                |              |      |      |      |      |
| 50–74              | 2,641          | 2,807        | 1,411| 1,503| 4,052| 4,310|
| 75+                | 1,931          | 2,341        | 1,675| 1,889| 3,606| 4,230|
| All                | 4,572          | 5,149        | 3,087| 3,392| 7,659| 8,541|
| Women and Men     |                |              |      |      |      |      |
| 50–74              | 5,765          | 6,057        | 3,876| 3,963| 9,642|10,020|
| 75+                | 6,565          | 8,110        | 7,460| 8,109|14,025|16,219|
| All                | 12,330         | 14,167       | 11,337|12,072|23,667|26,239|

Table 18 Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Hungary assuming the uptake of treatment remains unchanged

|                   | 2010  | 2015  | 2020  | 2025  |
|-------------------|-------|-------|-------|-------|
|                   |       |       |       |       |
| Women             |       |       |       |       |
| 50–74             | 163   | 165   | 167   | 169   |
| 75+               | 290   | 305   | 320   | 338   |
| All               | 453   | 470   | 486   | 507   |
| Men               |       |       |       |       |
| 50–74             | 110   | 112   | 113   | 118   |
| 75+               | 98    | 100   | 104   | 115   |
| All               | 208   | 212   | 218   | 233   |
| Women and Men     |       |       |       |       |
| 50–74             | 273   | 277   | 280   | 287   |
| 75+               | 388   | 405   | 424   | 453   |
| All               | 661   | 683   | 704   | 740   |

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|                   | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|-------------------|-----------------------------------|----------------------------------------|---------------------|-------------------|
|                   |                                   |                                        |                     |                   |
| Men               |                                   |                                        |                     |                   |
| 50–74             | 36                                | 60                                     | 24                  | 41                |
| 75+               | 238                               | 332                                    | 94                  | 28                |
| Women             |                                   |                                        |                     |                   |
Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.97% in 2001 to 7.6% in 2011.

**Treatment gap**

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Hungary were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 41% and 28% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk. Notwithstanding, there is some evidence that hip fracture rates are declining in Hungary, a phenomenon attributed to pharmaceutical treatment [11].

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Epidemiology and Economic Burden of Osteoporosis in Ireland

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Ireland.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fracture fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Ireland, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Ireland was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 18,000 new fragility fractures were sustained in Ireland, comprising 3,200 hip fractures, 2,700 vertebral fractures, 3,000 forearm fractures and 9,200 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €223 million for the same year. Incident fractures represented 56 % of this cost, long-term fracture care 28 % and pharmacological prevention 16 %. Previous and incident fractures also accounted for 6,100 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 28,000 in 2025, representing an increase of 9,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 1,800, 1,400, 1,400 and 4,900, respectively. The burden of fractures in Ireland in 2025 was estimated to increase by 44 % to €320 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. A substantial minority of women at high fracture risk did not receive active treatment.
Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Ireland in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Ireland was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Ireland

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 599,000 and 647,000 respectively in Ireland in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 170,000 (Table 2). There are 10 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Ireland [5]. Given that country specific incidence of vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) was estimated at 170,000 (Table 2). There are 10 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Ireland by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women | Men |
|-------------|-------|-----|
| 50–54       | 8,442 | 3,350 |
| 55–59       | 11,520 | 4,235 |
| 60–64       | 15,301 | 6,264 |
| 65–69       | 16,968 | 6,068 |
| 70–74       | 18,693 | 4,836 |
| 75–79       | 20,625 | 4,738 |
| 80+         | 37,760 | 7,636 |
| 50+         | 129,309 | 37,127 |

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Ireland by age

| Fracture at the | Age (years) | hip | vertebra | forearm | other |
|-----------------|-------------|-----|----------|---------|-------|
| Women           |             |     |          |         |       |
| 50–54           | 13          | 33  | 81       | 83      |
| 55–59           | 35          | 97  | 270      | 309     |
| 60–64           | 71          | 125 | 267      | 272     |
| 65–69           | 147         | 214 | 358      | 503     |
| 70–74           | 302         | 426 | 543      | 856     |
| 75–79           | 614         | 597 | 599      | 1,292   |
| 80–84           | 1,231       | 774 | 771      | 2,094   |
| 85+             | 2,143       | 1,008 | 915    | 3,600   |

| Men             |             |     |          |         |       |
| 50–54           | 22          | 56  | 20       | 97      |
| 55–59           | 30          | 52  | 45       | 276     |
| 60–64           | 47          | 114 | 89       | 467     |
| 65–69           | 76          | 119 | 114      | 490     |
| 70–74           | 143         | 219 | 92       | 737     |
| 75–79           | 264         | 304 | 75       | 704     |
| 80–84           | 519         | 361 | 101      | 1,381   |
| 85+             | 1,014       | 681 | 186      | 2,935   |

Table 1 Population at risk: men and women over the age of 50 in Ireland, 2010 [1]

| Age (years) | Women | Men | All |
|-------------|-------|-----|-----|
| 50–59       | 254,000 | 255,000 | 509,000 |
| 60–69       | 191,000 | 190,000 | 381,000 |
| 70–79       | 122,000 | 108,000 | 230,000 |
| 80–89       | 67,000  | 41,000  | 108,000 |
| 90+         | 13,000  | 5,000   | 18,000  |
| 50+         | 647,000 | 599,000 | 1,246,000 |
in men and women ≥50 years of age was estimated at 167 and 488 respectively.

The number of incident fractures in 2010 was estimated at 18,000 (Table 4). Incident hip, clinical spine and forearm fractures were each estimated at 3,000, and “other” fractures were estimated at 9,000. 66% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.38% for hip and 1.50% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 17,000 and 19,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 209 (Table 8). Hip, vertebral and “other” fractures accounted for 104, 68 and 38 deaths respectively. Overall, approximately 53% of deaths occurred in women.

Cost of osteoporosis in Ireland including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of a hip fracture has been estimated at €15,230 in Ireland based on first year hospital costs [6]. Given that no cost data for the other fracture sites were

### Table 4 Estimated number of incident fractures in Ireland, 2010

| Age (years) | Hip | Vertebra | Forearm | Other | All fractures |
|-------------|-----|----------|---------|-------|---------------|
| **Women**   |     |          |         |       |               |
| 50–74       | 504 | 766      | 1,526   | 2,014 | 4,811         |
| 75+         | 1,790| 911      | 993     | 3,515 | 7,209         |
| Total       | 2,294| 1,677    | 2,519   | 5,530 | 12,020        |
| **Men**     |     |          |         |       |               |
| 50–74       | 320 | 562      | 361     | 2,091 | 3,334         |
| 75+         | 571 | 434      | 121     | 1,604 | 2,731         |
| Total       | 892 | 996      | 482     | 3,695 | 6,065         |
| **Men and Women** | | | | | |
| 50–74       | 824 | 1,328    | 1,887   | 4,105 | 8,144         |
| 75+         | 2,361| 1,345    | 1,114   | 5,120 | 9,440         |
| Total       | 3,186| 2,673    | 3,000   | 9,225 | 18,084        |

### Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Ireland, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| **Women**   |              |                   |
| 50–54       | 0.0          | 0.1               |
| 55–59       | 0.1          | 0.4               |
| 60–64       | 0.4          | 0.9               |
| 65–69       | 0.8          | 1.5               |
| 70–74       | 1.8          | 2.7               |
| 75–79       | 3.4          | 4.2               |
| 80–84       | 6.5          | 6.1               |
| 85+         | 14.9         | 10.5              |
| **Men**     |              |                   |
| 50–54       | 0.0          | 0.1               |
| 55–59       | 0.2          | 0.3               |
| 60–64       | 0.3          | 0.6               |
| 65–69       | 0.5          | 0.9               |
| 70–74       | 0.9          | 1.3               |
| 75–79       | 1.6          | 2.0               |
| 80–84       | 2.8          | 2.5               |
| 85+         | 6.7          | 5.7               |

### Table 6 Number of men and women in Ireland with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
| **Women**   |              |                   |
| 50–74       | 2,528        | 4,576             |
| 75+         | 10,349       | 8,881             |
| Total       | 12,877       | 13,458            |
| **Men**     |              |                   |
| 50–74       | 1,635        | 2,637             |
| 75+         | 2,734        | 2,648             |
| Total       | 4,370        | 5,284             |
| **Men and Women** | | | |
| 50–74       | 4,164        | 7,213             |
| 75+         | 13,083       | 11,529            |
| Total       | 17,247       | 18,742            |
found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€39,073 [7,8], based on purchasing power parity adjusted UK cost of public nursing home) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug costs for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €46 [9] and a DXA scan costing €99 [10] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €223 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €125 million, €62 million and €35 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 15.8% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€105 million) followed by “other” (€72 million), spine (€8 million) and forearm fractures (€3 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

| Table 7 | Incidence (per 100,000) of causally related deaths in Ireland within the first year after fracture (adjusted for comorbidities), 2010 |
| --- | --- |
| Age (years) | Hip | Clinical vertebral | “Other” fracture |
| --- | --- | --- | --- |
| | Women | | |
| 50–54 | 458 | 595 | 12 |
| 55–59 | 607 | 746 | 18 |
| 60–64 | 1,034 | 1,201 | 33 |
| 65–69 | 1,318 | 1,445 | 49 |
| 70–74 | 2,119 | 2,186 | 96 |
| 75–79 | 2,494 | 2,409 | 156 |
| 80–84 | 2,727 | 2,413 | 304 |
| 85–89 | 3,249 | 2,526 | 569 |
| 90+ | 2,640 | 1,489 | 918 |
| | Men | | |
| 50–54 | 1,452 | 1,741 | 23 |
| 55–59 | 1,775 | 2,018 | 36 |
| 60–64 | 2,319 | 2,494 | 63 |
| 65–69 | 2,720 | 2,759 | 98 |
| 70–74 | 3,346 | 3,186 | 151 |
| 75–79 | 4,444 | 3,941 | 264 |
| 80–84 | 6,088 | 4,944 | 511 |
| 85–89 | 7,252 | 5,301 | 783 |
| 90+ | 8,382 | 5,455 | 1,049 |

| Table 8 | The number of deaths in men and women in Ireland in the first year after fracture attributable to the fracture event (causally related), 2010 |
| --- | --- |
| Age (years) | Hip | Fracture at the vertebra | “other” |
| --- | --- | --- | --- |
| | Women | | |
| 50–74 | 8 | 13 | 1 |
| 75+ | 48 | 19 | 22 |
| Total | 56 | 31 | 24 |
| | Men | | |
| 50–74 | 9 | 16 | 2 |
| 75+ | 38 | 21 | 12 |
| Total | 47 | 36 | 15 |
| | Men and Women | | |
| 50–74 | 18 | 28 | 3 |
| 75+ | 86 | 40 | 35 |
| Total | 104 | 68 | 38 |

| Table 9 | One year costs for relevant pharmaceuticals in Ireland, 2010 [11] |
| --- | --- |
| | Annual drug cost (€) |
| Alendronate | 240 |
| Risedronate | 514 |
| Etidronate | 138 |
| Ibandronate | 432 |
| Zoledronic acid | 433 |
| Raloxifene | 420 |
| Strontium ranelate | 631 |
| Parathyroid hormone | 6,519 |
| Teriparatide | 7,111 |

| Table 10 | Cost of osteoporosis (€) in Ireland by age in men and women, 2010 |
| --- | --- | --- | --- | --- | --- |
| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
| --- | --- | --- | --- | --- |
| Women | | | | |
| 50–74 | 27,594,675 | 6,177,242 | 20,557,255 | 54,329,172 |
| 75+ | 54,529,973 | 39,173,573 | 10,418,501 | 104,122,047 |
| All | 82,124,649 | 45,350,815 | 30,975,756 | 158,451,220 |
| Men | | | | |
| 50–74 | 22,749,134 | 4,711,662 | 3,133,310 | 30,594,106 |
| 75+ | 20,592,990 | 12,199,108 | 1,227,946 | 34,020,044 |
| All | 43,342,124 | 16,910,770 | 4,361,256 | 64,614,150 |
| Men and Women | | | | |
| 50–74 | 50,343,809 | 10,888,904 | 23,690,565 | 84,923,278 |
| 75+ | 75,122,964 | 51,372,681 | 11,646,447 | 138,142,091 |
| All | 125,466,773 | 62,261,585 | 35,337,012 | 223,065,369 |
The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 6,100 (Table 12). 68 % of the total QALY loss was incurred in women. Prior fractures accounted for 56 % of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALY’s lost was estimated at € 430 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 650 million in Ireland in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 19 %, 10 %, 5 % and 66 % respectively.

### Table 11
Total cost (€) in 2010 by fracture site in men and women in Ireland. Note that costs for fracture prevention therapy and monitoring are not included.

| Age      | Hip          | Spine         | Forearm        | Other         | All           |
|----------|--------------|---------------|----------------|---------------|---------------|
|          | Women        |               |                |               |               |
| 50–74    | 13,535,514   | 2,477,816     | 1,420,062      | 16,338,525    | 33,771,917    |
| 75+      | 63,272,487   | 2,774,360     | 923,719        | 26,732,981    | 93,703,546    |
| All      | 76,808,002   | 5,252,175     | 2,343,781      | 43,071,506    | 127,475,464   |
|          | Men          |               |                |               |               |
| 50–74    | 9,243,189    | 1,766,309     | 335,501        | 16,115,797    | 27,460,796    |
| 75+      | 19,101,355   | 1,218,791     | 112,681        | 12,359,272    | 32,792,098    |
| All      | 28,344,544   | 2,985,100     | 448,182        | 28,475,068    | 60,252,894    |
|          | Women and Men|               |                |               |               |
| 50–74    | 22,778,703   | 4,244,125     | 1,755,563      | 32,454,322    | 61,232,713    |
| 75+      | 82,373,842   | 3,993,150     | 1,036,400      | 39,092,252    | 126,495,645   |
| All      | 105,152,545  | 8,237,275     | 2,791,963      | 71,546,574    | 187,728,358   |

### Table 12
Number of QALYs lost due to fractures during 2010 in men and women in Ireland according to age.

| Age (years) |      |      |
|-------------|------|------|
| Women       |      |      |
| Incident hip fractures | 122 | 373 |
| Incident vertebral fractures | 254 | 261 |
| Incident forearm fractures | 54  | 30  |
| Incident other fractures | 241 | 364 |
| Prior hip fractures | 396 | 1,389 |
| Prior vertebral fractures | 256 | 429 |
| Total       | 1,322 | 2,845 |

| Men         |      |      |
| Incident hip fractures | 78  | 137  |
| Incident vertebral fractures | 186 | 138 |
| Incident forearm fractures | 12  | 4   |
| Incident other fractures | 248 | 182 |
| Prior hip fractures | 255 | 404  |
| Prior vertebral fractures | 146 | 139 |
| Total       | 927  | 1,004 |

| Men and Women|      |      |
| Incident hip fractures | 200 | 510 |
| Incident vertebral fractures | 440 | 399 |
| Incident forearm fractures | 66  | 34  |
| Incident other fractures | 489 | 546 |
| Prior hip fractures | 651 | 1,793 |
| Prior vertebral fractures | 402 | 568 |
| Total       | 2,248 | 3,849 |

Fig. 1 Share (%) of fracture cost by fracture site in Ireland. Note that costs for fracture prevention therapy and monitoring are not included.
Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 1.2 million in 2010 to 1.8 million in 2025, corresponding to an increase of 42 % (Table 14). The total number of fractures was estimated to rise from 18,000 in 2010 to 28,000 in 2025 (Table 15), corresponding to an increase of 53 %. Hip, clinical spine, forearm and other fractures increased by 1,800, 1,400, 1,400 and 4,900 respectively. The increase in the number of fractures ranged from 47 % to 56 %, depending on fracture site. The increase was estimated to be 57 % in men and 50 % in women.

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €223 million in 2010 to €320 million in 2025, corresponding to an increase of 44 % (Table 16). Costs incurred in women and men increased by 40 % and 52 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 6,100 in 2010 to 8,200 in 2025, corresponding to an increase of 34 % (Table 17). The

Table 13 Value of lost QALYs (€) in men and women in Ireland in 2010

| Fracture Type                      | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|-----------------------------------|----------------|----------------|----------------|
| Incident hip fractures            | 24,752,860     | 49,505,719     | 74,258,579     |
| Incident vertebral fractures      | 29,289,392     | 58,578,785     | 87,868,177     |
| Incident forearm fractures        | 3,500,853      | 7,001,707      | 10,502,560     |
| Incident other fractures          | 36,108,044     | 72,216,088     | 108,324,133    |
| Prior hip fractures               | 85,284,615     | 170,569,230    | 255,853,844    |
| Prior vertebral fractures         | 33,866,552     | 67,733,103     | 101,599,655    |
| Total                             | 212,802,316    | 425,604,632    | 638,406,948    |

Table 14 Population projections in Ireland by age and sex [12]

| Age Group | 2010 | 2015 | 2020 | 2025 |
|-----------|------|------|------|------|
| Women     |      |      |      |      |
| 50–59     | 254,000 | 279,000 | 302,000 | 330,000 |
| 60–69     | 191,000 | 221,000 | 244,000 | 269,000 |
| 70–79     | 122,000 | 140,000 | 170,000 | 198,000 |
| 80–89     | 67,000  | 73,000  | 81,000  | 94,000  |
| 90+       | 13,000  | 16,000  | 21,000  | 23,000  |
| All       | 509,000 | 555,963 | 605,000 | 662,000 |

| Men       |      |      |      |      |
| 50–59     | 255,000 | 276,963 | 303,000 | 332,000 |
| 60–69     | 190,000 | 219,000 | 238,000 | 261,000 |
| 70–79     | 108,000 | 126,000 | 155,000 | 180,000 |
| 80–89     | 41,000  | 49,000  | 58,000  | 70,000  |
| 90+       | 5,000   | 6,000   | 8,000   | 10,000  |
| All       | 509,000 | 555,963 | 605,000 | 662,000 |

| Overall   |      |      |      |      |
| 50–59     | 254,000 | 279,000 | 302,000 | 330,000 |
| 60–69     | 191,000 | 221,000 | 244,000 | 269,000 |
| 70–79     | 122,000 | 140,000 | 170,000 | 198,000 |
| 80–89     | 67,000  | 73,000  | 81,000  | 94,000  |
| 90+       | 13,000  | 16,000  | 21,000  | 23,000  |
| All       | 1,246,000 | 1,767,000 |        |        |

Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Ireland

| Fracture Site | 2010 Women | 2025 Women | 2010 Men | 2025 Men | 2010 Women | 2025 Women | 2010 Men | 2025 Men |
|--------------|------------|------------|----------|----------|------------|------------|----------|----------|
| Hip          |            |            |          |          |            |            |          |          |
| Spine        |            |            |          |          |            |            |          |          |
| Forearm      |            |            |          |          |            |            |          |          |
| Other        |            |            |          |          |            |            |          |          |
| 50–74        |            |            |          |          |            |            |          |          |
| 75+          |            |            |          |          |            |            |          |          |
| All          |            |            |          |          |            |            |          |          |

Table 16 Current and future cost (€000, 000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Ireland

| Age Group | 2010 | 2015 | 2020 | 2025 |
|-----------|------|------|------|------|
| Women     |      |      |      |      |
| 50–74     | 54   | 62   | 71   | 77   |
| 75+       | 104  | 113  | 127  | 145  |
| All       | 158  | 175  | 198  | 222  |
| Men       |      |      |      |      |
| 50–74     | 31   | 35   | 39   | 43   |
| 75+       | 34   | 39   | 46   | 55   |
| All       | 65   | 73   | 85   | 98   |
| Women and Men |      |      |      |      |
| 50–74     | 85   | 97   | 110  | 120  |
| 75+       | 138  | 151  | 173  | 200  |
| All       | 223  | 248  | 283  | 320  |
increase was estimated to be particularly marked in men (46%) compared to women (29%). Incident and prior fractures accounted for 68% and 32% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €650 million in 2010 to €890 million in 2025. The increase was estimated to be particularly marked in men (+48%) compared to women (+33%) (Table 18).

### Table 17: Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Ireland

| Incident fractures | Prior fractures | All fractures |
|-------------------|----------------|--------------|
| 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| **Women** | | | | | | |
| 50–74 | 670 | 972 | 651 | 732 | 1,322 | 1,704 |
| 75+ | 1,027 | 1,577 | 1,818 | 2,088 | 2,845 | 3,665 |
| All | 1,697 | 2,549 | 2,469 | 2,820 | 4,167 | 5,369 |
| **Men** | | | | | | |
| 50–74 | 525 | 746 | 402 | 495 | 927 | 1,241 |
| 75+ | 461 | 815 | 543 | 762 | 1,004 | 1,577 |
| All | 986 | 1,561 | 945 | 1,257 | 1,931 | 2,818 |
| **Women and Men** | | | | | | |
| 50–74 | 1,195 | 1,718 | 1,053 | 1,227 | 2,248 | 2,945 |
| 75+ | 1,488 | 2,392 | 2,361 | 2,850 | 3,849 | 5,242 |
| All | 2,683 | 4,109 | 3,414 | 4,077 | 6,097 | 8,187 |

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

The proportion of persons over the age of 50 years who were treated increased from 1.57% in 2001 to 8.56% in 2011.

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Ireland were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a 'fracture threshold' (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 20% and 26% respectively (Table 19).

Note that the estimate of the treatment gap is conservative given that it

### Table 18: Present and future cost (€000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Ireland assuming the uptake of treatment remains unchanged

| | 2010 | 2015 | 2020 | 2025 |
|-------------------|----------------|----------------|----------------|----------------|
| **Women** | | | | |
| 50–74 | 147 | 163 | 181 | 196 |
| 75+ | 303 | 326 | 360 | 400 |
| All | 449 | 489 | 541 | 597 |
| **Men** | | | | |
| 50–74 | 95 | 105 | 117 | 130 |
| 75+ | 104 | 115 | 135 | 165 |
| All | 199 | 220 | 252 | 295 |
| **Women and Men** | | | | |
| 50–74 | 242 | 268 | 298 | 326 |
| 75+ | 407 | 441 | 495 | 566 |
| All | 649 | 709 | 793 | 892 |

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 1.57% in 2001 to 8.56% in 2011.

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

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### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Ireland were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a 'fracture threshold' (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 20% and 26% respectively (Table 19).

Note that the estimate of the treatment gap is conservative given that it

### Table 19: Number of men and women eligible for treatment, treated and treatment gap in 2010

| Number potentially treated | Number eligible for treatment | Difference | Treatment gap (%) |
|---------------------------|-------------------------------|------------|-------------------|
| Men | 14 | 17 | 3 | 20 |
| Women | 91 | 124 | 33 | 26 |

| Number potentially treated | Number eligible for treatment | Difference | Treatment gap (%) |
|---------------------------|-------------------------------|------------|-------------------|
| Men | 14 | 17 | 3 | 20 |
| Women | 91 | 124 | 33 | 26 |
assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

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Epidemiology and Economic Burden of Osteoporosis in Italy

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Italy.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Italy, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Italy was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 465,000 new fragility fractures were sustained in Italy, comprising 91,000 hip fractures, 71,000 clinical vertebral fractures, 72,000
forearm fractures and 232,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at € 7,032 million for the same year. Incident fractures represented 61 % of this cost, long-term fracture care 34 % and pharmacological prevention 5 %. Previous and incident fractures also accounted for 171,300 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 598,000 in 2025, representing an increase of 132,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 27,900, 18,800, 15,400 and 70,300, respectively. The burden of fractures in Italy in 2025 was estimated to increase by 23 % to € 8,644 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Italy in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Italy was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

| Table 1 | Population at risk: men and women over the age of 50 in Italy, 2010 [1] |
|---------|-----------------------------|
| Age (years) | Women | Men | All |
| 50–59 | 3,928,000 | 3,799,000 | 7,727,000 |
| 60–69 | 3,595,000 | 3,307,000 | 6,902,000 |
| 70–79 | 3,134,000 | 2,478,000 | 5,612,000 |
| 80–89 | 1,997,000 | 1,092,000 | 3,089,000 |
| 90+ | 343,000 | 115,000 | 458,000 |
| 50+ | 12,997,000 | 10,791,000 | 23,788,000 |

Epidemiology of osteoporosis in Italy

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 10,791,000 and 12,997,000 respectively in Italy in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 3,790,000 (Table 2). There are 18.6 DXA scan machines per million (m) inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Italy [5]. Given that country specific incidence of the vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 189.5 and 498.4 respectively.

The number of incident fractures in 2010 was estimated at 465,000 (Table 4). Incident hip, clinical spine, forearm
and “other” fractures were estimated at 91,000, 71,000, 72,000 and 232,000 respectively. 69% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 2.17% for hip and 2.27% for vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 517,000 and 539,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Italy by age

| Age (years) | Hip | Vertebra | Forearm | Other |
|-------------|-----|----------|---------|-------|
| Women       |     |          |         |       |
| 50–54       | 24  | 62       | 153     | 158   |
| 55–59       | 45  | 125      | 346     | 396   |
| 60–64       | 78  | 139      | 296     | 302   |
| 65–69       | 144 | 209      | 349     | 491   |
| 70–74       | 293 | 414      | 527     | 832   |
| 75–79       | 613 | 596      | 598     | 1,289 |
| 80–84       | 1,214 | 763 | 760     | 2,064 |
| 85+         | 2,105 | 990 | 899     | 3,537 |

| Men         |     |          |         |       |
|-------------|-----|----------|---------|-------|
| 50–54       | 34  | 86       | 31      | 149   |
| 55–59       | 40  | 69       | 61      | 372   |
| 60–64       | 51  | 122      | 96      | 503   |
| 65–69       | 75  | 118      | 113     | 484   |
| 70–74       | 135 | 206      | 86      | 693   |
| 75–79       | 277 | 320      | 79      | 740   |
| 80–84       | 579 | 402      | 112     | 1,540 |
| 85+         | 1,145 | 769 | 210     | 3,317 |

Table 4 Estimated number of incident fractures in Italy, 2010

| Age (years) | Hip | Vertebra | Forearm | Other |
|-------------|-----|----------|---------|-------|
| Women       |     |          |         |       |
| 50–74       | 12,298 | 18,582 | 32,856  | 145,243 |
| 75+         | 55,297  | 29,339 | 28,667  | 86,478  |
| Total       | 67,595  | 47,921 | 61,523  | 231,721 |

| Men         |     |          |         |       |
|-------------|-----|----------|---------|-------|
| 50–74       | 6,345 | 11,053 | 6,721   | 40,133  |
| 75+         | 16,598  | 12,488 | 3,435   | 46,345  |
| Total       | 22,944  | 23,540 | 10,156  | 86,478  |

| Men and Women |     |          |         |       |
|------------|-----|----------|---------|-------|
| 50–74      | 18,644 | 29,635 | 39,577  | 84,487  |
| 75+        | 71,895  | 41,827 | 32,102  | 147,234 |
| Total      | 90,539  | 71,461 | 71,679  | 231,721 |

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Italy, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.2          | 0.7                |
| 60–64       | 0.5          | 1.3                |
| 65–69       | 1.1          | 2.0                |
| 70–74       | 2.1          | 3.1                |
| 75–79       | 3.9          | 4.7                |
| 80–84       | 7.1          | 6.4                |
| 85+         | 15.1         | 10.1               |

| Men         |              |                    |
|-------------|--------------|--------------------|
| 50–54       | 0.1          | 0.2                |
| 55–59       | 0.3          | 0.5                |
| 60–64       | 0.4          | 0.8                |
| 65–69       | 0.7          | 1.2                |
| 70–74       | 1.2          | 1.8                |
| 75–79       | 2.2          | 2.6                |
| 80–84       | 3.7          | 3.2                |
| 85+         | 8.3          | 6.4                |

Table 6 Number of men and women in Italy with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 69,419       | 125,404            |
| 75+         | 315,111      | 262,194            |
| Total       | 384,530      | 387,597            |

| Men         |              |                    |
|-------------|--------------|--------------------|
| 50–74       | 42,079       | 69,780             |
| 75+         | 90,517       | 81,659             |
| Total       | 132,596      | 151,438            |

| Men and Women |              |                    |
|---------------|--------------|--------------------|
| 50–74         | 111,498      | 195,183            |
| 75+           | 405,628      | 343,852            |
| Total         | 517,126      | 539,036            |
The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 5,476 (Table 8). Hip, vertebral and “other” fractures accounted for 2,778, 1,659 and 1,039 deaths respectively. Overall, approximately 53% of deaths occurred in women.

Cost of osteoporosis in Italy including and excluding value of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”), and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

Total first year costs after fracture were imputed by applying the inpatient cost for Italy to the ratio of inpatient cost to total first year costs observed in Sweden, resulting in an

Table 7 Incidence (per 100,000) of causally related deaths in Italy within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
|             |     |                    |                  |
| Women       |     |                    |                  |
| 50–54       | 426 | 554                | 11               |
| 55–59       | 595 | 732                | 18               |
| 60–64       | 893 | 1,037              | 28               |
| 65–69       | 1,135| 1,244              | 43               |
| 70–74       | 1,533| 1,583              | 70               |
| 75–79       | 2,024| 1,955              | 127              |
| 80–84       | 2,250| 1,991              | 251              |
| 85–89       | 2,757| 2,143              | 483              |
| 90+         | 2,705| 1,525              | 941              |
| Men         |     |                    |                  |
| 50–54       | 1,233| 1,479              | 19               |
| 55–59       | 1,633| 1,856              | 34               |
| 60–64       | 2,032| 2,185              | 55               |
| 65–69       | 2,441| 2,476              | 88               |
| 70–74       | 3,110| 2,961              | 140              |
| 75–79       | 4,176| 3,703              | 248              |
| 80–84       | 5,154| 4,186              | 433              |
| 85–89       | 6,708| 4,903              | 725              |
| 90+         | 9,981| 6,495              | 1,249            |

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 5,476 (Table 8). Hip, vertebral and “other” fractures accounted for 2,778, 1,659 and 1,039 deaths respectively. Overall, approximately 53% of deaths occurred in women.

Table 8 The number of deaths in men and women in Italy in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Fracture at the vertebra | “Other” |
|-------------|-----|--------------------------|---------|
|             |     |                          |         |
| Women       |     |                          |         |
| 50–54       | 165 | 247                      | 24      |
| 75+         | 1,342| 536                      | 605     |
| Total       | 1,507| 784                      | 628     |
| Men         |     |                          |         |
| 50–54       | 173 | 286                      | 37      |
| 75+         | 1,098| 589                      | 373     |
| Total       | 1,271| 875                      | 411     |

Table 9 One year costs for relevant pharmaceuticals in Italy, 2010 [9]

| Annual drug cost (€) | Alendronate 294 | Risedronate 474 | Etidronate 97 | Ibandronate 524 | Zoledronic acid 529 | Raloxifene 452 | Strontium ranelate 665 | Parathyroid hormone 6,528 | Teriparatide 7,445 |
|----------------------|-----------------|-----------------|---------------|-----------------|--------------------|-----------------|------------------------|------------------------|---------------------|

Table 10 Cost of osteoporosis (€) in Italy by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention costs | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
|             |                          |                            |                          |            |
| Women       |                          |                            |                          |            |
| 50–74       | 823,498,045              | 216,991,128                | 183,526,818              | 1,224,015,991 |
| 75+         | 2,110,554,205            | 1,508,825,198              | 132,865,817              | 3,752,245,221 |
| All         | 2,934,052,250            | 1,725,816,327              | 316,392,635              | 4,976,261,212 |
| Men         |                          |                            |                          |            |
| 50–74       | 570,667,695              | 156,286,640                | 28,831,907               | 755,786,242 |
| 75+         | 763,862,895              | 520,311,116                | 15,585,496               | 1,299,759,507 |
| All         | 1,334,530,589            | 676,597,756                | 44,417,403               | 2,055,545,748 |

Table 11 Cost of osteoporosis (€) in Italy by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention costs | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
|             |                          |                            |                          |            |
| Women       |                          |                            |                          |            |
| 50–74       | 1,394,165,739            | 373,277,768                | 212,358,725              | 1,979,802,233 |
| 75+         | 2,874,417,100            | 2,029,136,314              | 148,451,313              | 5,052,004,727 |
| All         | 4,268,582,839            | 2,402,414,082              | 360,810,039              | 7,031,806,960 |
estimated total first year hip fracture cost of € 19,602. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€ 50,202 [6]) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 50 [7] and a DXA scan costing € 81 [8] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at € 7,032 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to € 4,269 million, € 2,402 million and € 361 million respectively. It is notable that pharmacological fracture prevention costs amounted to only 5.1 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€ 3,977 million) followed by “other” (€ 2,324 million), spine (€ 284 million) and forearm fractures (€ 86 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 171,300 (Table 12). 70 % of the total QALY loss was incurred in women. Prior fractures accounted for 59 % of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALY’s lost was estimated at € 8.77 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 15.8 billion in Italy in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 27 %, 15 %, 2 % and 56 % respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 23.8 million in 2010 to 29.2 million in 2025, corresponding to an increase of 23 % (Table 14).

The total number of fractures was estimated to rise from 465,000 in 2010 to 598,000 in 2025 (Table 15), corresponding to an increase of 28 %. Hip, clinical spine, forearm and other fractures increased by 27,900, 18,800, 15,400 and 70,300 respectively. The increase in the number of fractures ranged from 21 % to 31 %, depending on fracture site. The
The increase was estimated to be particularly marked in men (37%) compared to women (24%).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €7 billion in 2010 to €8.6 billion in 2025, corresponding to an increase of 23% (Table 16). Costs incurred in women and men increased by 20% and 31% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 171,300 in 2010 to 205,100 in 2025, corresponding to an increase of 20% (Table 17). The increase was estimated to be particularly marked in men (28%) compared to women (16%). Incident and prior fractures accounted for 59% and 41% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €15.8 billion in 2010 to €19.1 billion in 2025. The increase was estimated to be particularly marked in men (+29%) compared to women (+18%) (Table 18).

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Italy according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 2,942 | 11,550 | 14,491 |
| Incident vertebral fractures | 6,110 | 8,412 | 14,522 |
| Incident forearm fractures | 1,155 | 871 | 2,026 |
| Incident other fractures | 5,293 | 10,460 | 15,753 |
| Prior hip fractures | 10,851 | 42,351 | 53,202 |
| Prior vertebral fractures | 7,002 | 12,696 | 19,698 |
| Total       | 33,354 | 86,338 | 119,692 |
| Men         |       |     |     |
| Incident hip fractures | 1,544 | 3,969 | 5,512 |
| Incident vertebral fractures | 3,663 | 3,972 | 7,635 |
| Incident forearm fractures | 233 | 112 | 345 |
| Incident other fractures | 4,754 | 5,265 | 10,020 |
| Prior hip fractures | 6,570 | 13,362 | 19,931 |
| Prior vertebral fractures | 3,874 | 4,294 | 8,168 |
| Total       | 20,637 | 30,973 | 51,611 |
| Men and Women |   |     |     |
| Incident hip fractures | 4,485 | 15,518 | 20,004 |
| Incident vertebral fractures | 9,773 | 12,383 | 22,157 |
| Incident forearm fractures | 1,388 | 983 | 2,371 |
| Incident other fractures | 10,048 | 15,725 | 25,772 |
| Prior hip fractures | 17,421 | 55,712 | 73,133 |
| Prior vertebral fractures | 10,876 | 16,990 | 27,866 |
| Total       | 53,991 | 117,312 | 171,303 |

Table 13 Value of lost QALYs (£) in men and women in Italy in 2010

|                             | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|-----------------------------|----------------|----------------|----------------|
| Incident hip fractures      | 512,093,317    | 1,024,186,634  | 1,536,279,952  |
| Incident vertebral fractures| 567,207,399    | 1,134,414,797  | 1,701,622,196  |
| Incident forearm fractures  | 60,693,357     | 121,386,713    | 182,080,070    |
| Incident other fractures    | 659,775,142    | 1,319,550,284  | 1,979,325,426  |
| Prior hip fractures         | 1,872,214,580  | 3,744,429,160  | 5,616,643,740  |
| Prior vertebral fractures   | 713,370,642    | 1,426,741,285  | 2,140,111,927  |
| Total                       | 4,385,354,437  | 8,770,708,874  | 13,156,063,310 |

Table 14 Population projections in Italy by age and sex [10]

| Age (years) | 2010 | 2015 | 2020 | 2025 |
|-------------|------|------|------|------|
| Women       |      |      |      |      |
| 50–59       | 3,928,000 | 4,357,000 | 4,768,000 | 4,853,000 |
| 60–69       | 3,595,000 | 3,733,000 | 3,825,000 | 4,241,000 |
| 70–79       | 3,134,000 | 3,137,000 | 3,284,000 | 3,422,000 |
| 80–89       | 1,997,000 | 2,092,000 | 2,213,000 | 2,246,000 |
| 90+         | 343,000   | 509,000   | 625,000   | 705,000   |
| Men         |      |      |      |      |
| 50–59       | 3,799,000 | 3,402,238 | 3,744,429,160 | 4,063,000 |
| 60–69       | 3,307,000 | 3,476,000 | 3,578,000 | 4,063,000 |
| 70–79       | 2,478,000 | 2,553,000 | 2,749,000 | 2,902,000 |
| 80–89       | 1,092,000 | 1,228,000 | 1,388,000 | 1,454,000 |
| 90+         | 115,000   | 178,000   | 226,000   | 272,000   |
| All         | 7,727,000 | 8,659,238 | 9,600,000 | 9,886,000 |

Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for
further details). The proportion of persons over the age of 50 years who were treated increased from 1.03% in 2001 to 5.2% in 2010 but subsequently decreased to 5.14% in 2011.

**Treatment gap**

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Italy were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 30% and 59% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

### Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Italy

|            | Hip 2010 | Hip 2025 | Spine 2010 | Spine 2025 | Forearm 2010 | Forearm 2025 | Other 2010 | Other 2025 |
|------------|----------|----------|------------|------------|--------------|--------------|------------|------------|
| **Women**  |          |          |            |            |              |              |            |            |
| 50–74      | 12,298   | 13,889   | 18,582     | 21,294     | 32,856       | 38,412       | 44,355     | 51,307     |
| 75+        | 55,297   | 72,269   | 29,339     | 37,006     | 28,667       | 35,184       | 100,888    | 131,662    |
| All        | 67,595   | 86,158   | 47,921     | 58,301     | 61,523       | 73,596       | 145,243    | 182,969    |
| **Men**    |          |          |            |            |              |              |            |            |
| 50–74      | 6,345    | 7,623    | 11,053     | 13,380     | 6,721        | 8,377        | 40,133     | 49,373     |
| 75+        | 16,598   | 24,662   | 12,488     | 18,605     | 3,435        | 5,100        | 46,345     | 69,637     |
| All        | 22,944   | 32,286   | 23,540     | 31,985     | 10,156       | 13,477       | 86,478     | 119,009    |
| **Women and Men** |          |          |            |            |              |              |            |            |
| 50–74      | 18,644   | 21,512   | 29,635     | 34,675     | 39,577       | 46,789       | 84,487     | 100,680    |
| 75+        | 71,895   | 96,931   | 41,827     | 55,611     | 32,102       | 40,284       | 147,234    | 201,299    |
| All        | 90,539   | 118,444  | 71,461     | 90,286     | 71,679       | 87,073       | 231,721    | 301,979    |

### Table 16 Current and future cost (€ 000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Italy

|            | 2010 | 2015 | 2020 | 2025 |
|------------|------|------|------|------|
| **Women**  |      |      |      |      |
| 50–74      | 1,224| 1,256| 1,329| 1,368|
| 75+        | 3,752| 4,027| 4,277| 4,587|
| All        | 4,976| 5,282| 5,606| 5,955|
| **Men**    |      |      |      |      |
| 50–74      | 756  | 787  | 849  | 893  |
| 75+        | 1,300| 1,451| 1,606| 1,796|
| All        | 2,056| 2,238| 2,454| 2,689|
| **Women and Men** |      |      |      |      |
| 50–74      | 1,980| 2,043| 2,178| 2,261|
| 75+        | 5,052| 5,478| 5,882| 6,383|
| All        | 7,032| 7,521| 8,060| 8,644|

### Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Italy

|            | Incident fractures | Prior fractures | All fractures |          |          |          |          |
|------------|--------------------|----------------|---------------|----------|----------|----------|----------|
|            | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| **Women**  |      |      |      |      |      |      |      |      |
| 50–74      | 15,500 | 17,829 | 17,853 | 18,579 | 33,354 | 36,408 |
| 75+        | 31,292 | 39,992 | 55,047 | 62,511 | 86,338 | 102,503 |
| All        | 46,792 | 57,821 | 72,900 | 81,090 | 119,692 | 138,911 |
| **Men**    |      |      |      |      |      |      |      |      |
| 50–74      | 10,194 | 12,438 | 10,443 | 11,541 | 20,637 | 23,979 |
| 75+        | 13,317 | 19,856 | 17,656 | 22,313 | 30,973 | 42,169 |
| All        | 23,512 | 32,294 | 28,099 | 33,854 | 51,611 | 66,148 |
| **Women and Men** |      |      |      |      |      |      |      |      |
| 50–74      | 25,695 | 30,267 | 28,297 | 30,120 | 53,991 | 60,387 |
| 75+        | 44,609 | 59,848 | 72,703 | 84,824 | 117,312 | 144,672 |
| All        | 70,303 | 90,115 | 100,999 | 114,944 | 171,303 | 205,059 |
Table 18 Present and future cost (£ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Italy assuming the uptake of treatment remains unchanged

|          | 2010    | 2015    | 2020    | 2025    |
|----------|---------|---------|---------|---------|
| **Women**|         |         |         |         |
| 50–74    | 2,932   | 3,003   | 3,142   | 3,232   |
| 75+      | 8,173   | 8,751   | 9,235   | 9,835   |
| All      | 11,104  | 11,753  | 12,377  | 13,067  |
| **Men**  |         |         |         |         |
| 50–74    | 1,812   | 1,873   | 2,003   | 2,121   |
| 75+      | 2,886   | 3,164   | 3,488   | 3,955   |
| All      | 4,698   | 5,036   | 5,492   | 6,076   |

|          |         |         |         |         |
|----------|---------|---------|---------|---------|
| **Women and Men** |         |         |         |         |
| 50–74    | 4,744   | 4,875   | 5,146   | 5,353   |
| 75+      | 11,058  | 11,915  | 12,723  | 13,790  |
| All      | 15,803  | 16,790  | 17,869  | 19,143  |

Fig. 2 Treatment uptake in Italy (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|                | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|----------------|------------------------------------|----------------------------------------|---------------------|-------------------|
| **Men**        | 160                                | 228                                    | 68                  | 30                |
| **Women**      | 1,069                              | 2,635                                  | 1,566               | 59                |

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Epidemiology and Economic Burden of Osteoporosis in Latvia

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract
Summary This report describes epidemiology, burden, and treatment of osteoporosis in Latvia.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Latvia, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Latvia was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 14,000 new fragility fractures were sustained in Latvia, comprising 3,000 hip fractures, 2,000 vertebral fractures, 2,000 forearm fractures and 7,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral

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fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €38 million for the same year. Incident fractures represented 78% of this cost, long-term fracture care 17% and pharmacological prevention 5%. Previous and incident fractures also accounted for 4,500 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 16,000 in 2025, representing an increase of 2,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 500, 300, 100 and 1,100, respectively. The burden of fractures in Latvia in 2025 was estimated to increase by 13% to €43 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Latvia in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Latvia was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Latvia

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 313,000 and 499,000 respectively in Latvia in 2010 (Table 1).

Table 1 Population at risk: men and women over the age of 50 in Latvia, 2010 [1]

| Age (years) | Women | Men | All     |
|------------|-------|-----|---------|
| 50–59      | 163,000 | 136,000 | 299,000 |
| 60–69      | 139,000 | 93,000  | 232,000 |
| 70–79      | 125,000 | 63,000  | 188,000 |
| 80–89      | 64,000  | 20,000  | 84,000  |
| 90+        | 8,000   | 1,000   | 9,000   |
| 50+        | 499,000 | 313,000 | 812,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 130,000 (Table 2). There are 4.9 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model for the assessment of fracture risk is not available for Latvia.

Incidence data was not available for Latvia, therefore data for hip fractures was imputed from Finnish age-standardized incidence rates [5]. Fracture incidence is presented in Table 3. Standardized to the EU27 population, this hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 238.0 and 440.0 respectively.

The number of incident fractures in 2010 was estimated at 14,300 (Table 4). Incident hip, clinical spine, forearm and other fractures were estimated at 2,600, 2,300, 2,400 and 7,000 respectively. 69% of fractures occurred in women. The number of hip fractures is close to recent but unpublished estimates [6].

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years before 2010. In the population ≥50 years of age,
the proportions of individuals who had suffered a fracture prior to 2010 were estimated at 1.46% for hip and 1.43% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 12,000 and 12,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 241 (Table 8). Hip, vertebral and other fractures accounted for 116, 92 and

Table 3  Incidence per 100,000 person years of hip, clinical vertebral, forearm, and other fractures in Latvia by age

| Age (years) | Hip | Vertebra | Forearm | Other |
|-------------|-----|----------|---------|-------|
| Women       |     |          |         |       |
| 50–54       | 21  | 53       | 132     | 136   |
| 55–59       | 38  | 105      | 292     | 334   |
| 60–64       | 63  | 111      | 237     | 242   |
| 65–69       | 116 | 169      | 282     | 396   |
| 70–74       | 248 | 350      | 446     | 704   |
| 75–79       | 541 | 526      | 527     | 1,137 |
| 80–84       | 1,068 | 671    | 669     | 1,816 |
| 85+         | 1,825 | 858    | 779     | 3,066 |
| Men         |     |          |         |       |
| 50–54       | 35  | 89       | 32      | 154   |
| 55–59       | 54  | 94       | 82      | 503   |
| 60–64       | 77  | 183      | 144     | 753   |
| 65–69       | 116 | 183      | 175     | 750   |
| 70–74       | 197 | 301      | 126     | 1,012 |
| 75–79       | 377 | 435      | 107     | 1,008 |
| 80–84       | 708 | 492      | 137     | 1,882 |
| 85+         | 1,254 | 842    | 230     | 3,632 |

Table 5  Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Latvia, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.2          | 0.5                |
| 60–64       | 0.4          | 0.8                |
| 65–69       | 0.8          | 1.2                |
| 70–74       | 1.5          | 2.0                |
| 75–79       | 2.9          | 3.2                |
| 80–84       | 5.5          | 4.6                |
| 85+         | 11.9         | 7.7                |
| Men         |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.2          | 0.3                |
| 60–64       | 0.4          | 0.6                |
| 65–69       | 0.7          | 0.8                |
| 70–74       | 1.1          | 1.0                |
| 75–79       | 1.8          | 1.8                |
| 80–84       | 3.1          | 2.5                |
| 85+         | 6.8          | 5.1                |

Table 4  Estimated number of incident fractures in Latvia, 2010

| Age (years) | All fractures |
|-------------|---------------|
|              | Hip | vertebra | forearm | other |
| Women        |     |          |         |       |
| 50–74        | 442 | 669      | 1,134   | 1,553 |
| 75+          | 1,580 | 889    | 851     | 2,815 |
| Total        | 2,022 | 1,558   | 1,985   | 4,368 |
| Men          |     |          |         |       |
| 50–74        | 266 | 460      | 293     | 1,731 |
| 75+          | 347 | 268      | 74      | 933   |
| Total        | 613 | 728      | 367     | 2,664 |
| Men and Women|     |          |         |       |
| 50–74        | 708 | 1,130    | 1,428   | 3,284 |
| 75+          | 1,927 | 1,157   | 924     | 3,748 |
| Total        | 2,634 | 2,286   | 2,352   | 7,032 |

Table 6  Number of men and women in Latvia with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 2,070        | 3,194              |
| 75+         | 7,362        | 5,956              |
| Total       | 9,433        | 9,150              |
| Men         |              |                    |
| 50–74       | 1,084        | 1,291              |
| 75+         | 1,346        | 1,134              |
| Total       | 2,430        | 2,425              |
| Men and Women|             |                    |
| 50–74       | 3,154        | 4,485              |
| 75+         | 8,708        | 7,091              |
| Total       | 11,862       | 11,575             |
33 deaths respectively. Overall, approximately 56% of deaths occurred in women.

Table 7 Incidence (per 100,000) of causally related deaths in Latvia within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
| Women       |     |                    |                  |
| 50–54       | 884 | 1,149              | 23               |
| 55–59       | 1,430| 1,759              | 42               |
| 60–64       | 1,879| 2,182              | 60               |
| 65–69       | 1,955| 2,143              | 73               |
| 70–74       | 2,778| 2,867              | 127              |
| 75–79       | 3,297| 3,185              | 207              |
| 80–84       | 3,557| 3,147              | 396              |
| 85–89       | 4,086| 3,176              | 716              |
| 90+         | 3,503| 1,975              | 1,218            |
| Men         |     |                    |                  |
| 50–54       | 5,146| 6,173              | 81               |
| 55–59       | 5,051| 5,742              | 104              |
| 60–64       | 6,549| 7,044              | 177              |
| 65–69       | 6,406| 6,498              | 230              |
| 70–74       | 6,851| 6,523              | 309              |
| 75–79       | 7,168| 6,357              | 425              |
| 80–84       | 7,937| 6,445              | 667              |
| 85–89       | 8,290| 6,059              | 896              |
| 90+         | 10,964| 7,135             | 1,372            |

Cost of osteoporosis in Latvia including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

As the cost of a hip fracture was not available in Latvia, the cost of a hip fracture has been estimated at €4,522 in Latvia based on the cost in Finland [7]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€6,169 [8], average for all municipalities and other organizations administering adult social care centers) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug cost for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing at €9 [9] and a DXA scan at €18 [9] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €38 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €29 million, €7 million and €2 million respectively. It is notable that pharmacological fracture prevention costs amounted to only 5.0% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€17 million) followed by other (€17 million), spine (€2 million) and forearm fractures (€1 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

Table 8 The number of deaths in men and women in Latvia in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Clinical vertebral | “Other” |
|-------------|-----|--------------------|---------|
| Women       |     |                    |         |
| 50–74       | 11  | 17                 | 2       |
| 75+         | 57  | 26                 | 20      |
| Total       | 69  | 44                 | 22      |
| Men         |     |                    |         |
| 50–74       | 18  | 31                 | 4       |
| 75+         | 29  | 17                 | 8       |
| Total       | 47  | 48                 | 11      |
| Men and Women|   |                    |         |
| 50–74       | 29  | 48                 | 5       |
| 75+         | 86  | 44                 | 28      |
| Total       | 116 | 92                 | 33      |

Table 9 One year costs for relevant pharmaceuticals in Latvia, 2010 [10]

| Annual drug cost (€) |          |
|----------------------|----------|
| Alendronate          | 85       |
| Risedronate          | 186      |
| Etidronate           | -        |
| Ibandronate          | 315      |
| Zoledronic acid      | 420      |
| Raloxifene           | -        |
| Strontium ranelate   | 431      |
| Parathyroid hormone  | -        |
| Teriparatide         | 5,101    |
The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 4,500 (Table 12). 73% of the total QALY loss was incurred in women. Prior fractures accounted for 51% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at € 72 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at $2 \times GDP), the cost of osteoporosis amounted to € 110 million in Latvia in 2010.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 4,500 (Table 12). 73% of the total QALY loss was incurred in women. Prior fractures accounted for 51% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at € 72 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 110 million in Latvia in 2010.

The burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase modestly from 0.81 million in 2010 to 0.84 million in 2025, corresponding to an increase of 4% (Table 14). The total number of fractures was estimated to rise from 14,000 in 2010 to 16,000 in 2025 (Table 15), corresponding to an increase of 13%. Hip, clinical spine, forearm and other fractures increased by 500, 300, 100 and 1,100 respectively. The increase in the number of fractures ranged from 5 % to 13 %.

Table 10 Cost of osteoporosis (€) in Latvia by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| Women       |                          |                            |                          |            |
| 50–74       | 6,677,139                | 799,118                    | 1,026,945                | 8,503,201  |
| 75+         | 13,685,894               | 4,295,540                  | 639,010                  | 18,620,444 |
| All         | 20,363,032               | 5,094,658                  | 1,665,955                | 27,123,645 |
| Men         |                          |                            |                          |            |
| 50–74       | 5,426,800                | 506,078                    | 169,512                  | 6,102,390  |
| 75+         | 3,627,557                | 955,584                    | 65,211                   | 4,648,351  |
| All         | 9,054,356                | 1,461,662                  | 234,722                  | 10,750,741 |
| Women and Men |                        |                            |                          |            |
| 50–74       | 12,103,938               | 1,305,196                  | 1,196,456                | 14,605,591 |
| 75+         | 17,313,450               | 5,251,124                  | 704,221                  | 23,268,795 |
| All         | 29,417,388               | 6,556,320                  | 1,900,677                | 37,874,386 |

Fig. 1 Share (%) of fracture cost by fracture site in Latvia. Note that costs for fracture prevention therapy and monitoring are not included

Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 27%, 6%, 2% and 66% respectively.

Table 11 Total cost (€) in 2010 by fracture site in men and women in Latvia. Note that costs for fracture prevention therapy and monitoring are not included

| Age (years) | Hip | Spine | Forearm | Other | All  |
|-------------|-----|-------|---------|-------|------|
| Women       |     |       |         |       |      |
| 50–74       | 2,669,357 | 626,957 | 313,333 | 3,866,610 | 7,476,257 |
| 75+         | 10,424,696 | 783,177 | 235,056 | 6,538,505 | 17,981,434 |
| All         | 13,094,053 | 1,410,134 | 548,389 | 10,405,115 | 25,457,691 |
| Men         |     |       |         |       |      |
| 50–74       | 1,514,639 | 213,007 | 81,080  | 3,950,082 | 5,932,878 |
| 75+         | 2,135,896 | 213,007 | 20,346  | 2,213,891 | 4,583,140 |
| All         | 3,650,536 | 600,084 | 101,426 | 6,163,973 | 10,516,018 |
| Women and Men |     |       |         |       |      |
| 50–74       | 4,183,996 | 1,014,034 | 394,413 | 7,816,692 | 13,409,135 |
| 75+         | 12,560,592 | 996,184 | 255,402 | 8,752,396 | 22,564,574 |
| All         | 16,744,588 | 2,010,218 | 649,815 | 16,569,088 | 35,973,709 |
18 %, depending on fracture site. The increase was estimated to be particularly marked in men (20 %) compared to women (10 %).

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Latvia according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 107   | 339 | 446 |
| Incident vertebral fractures | 223   | 261 | 483 |
| Incident forearm fractures | 40    | 26  | 66  |
| Incident other fractures | 185   | 296 | 482 |
| Prior hip fractures | 324   | 1,001 | 1,325 |
| Prior vertebral fractures | 178   | 291 | 469 |
| Total       | 1,057 | 2,214 | 3,271 |
| Men         |       |     |     |
| Incident hip fractures | 68    | 85  | 153 |
| Incident vertebral fractures | 159   | 88  | 247 |
| Incident forearm fractures | 10    | 2   | 13  |
| Incident other fractures | 206   | 107 | 313 |
| Prior hip fractures | 169   | 200 | 370 |
| Prior vertebral fractures | 72    | 60  | 132 |
| Total       | 684   | 543 | 1,227 |
| Men and Women |       |     |     |
| Incident hip fractures | 175   | 424 | 599 |
| Incident vertebral fractures | 382   | 348 | 730 |
| Incident forearm fractures | 50    | 29  | 79  |
| Incident other fractures | 392   | 403 | 795 |
| Prior hip fractures | 493   | 1,201 | 1,694 |
| Prior vertebral fractures | 250   | 351 | 601 |
| Total       | 1,741 | 2,756 | 4,498 |

Table 13 Value of lost QALYs (€) in men and women in Latvia in 2010

|                     | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|---------------------|----------------|----------------|----------------|
| Incident hip fractures | 4,790,861     | 9,581,722      | 14,372,583     |
| Incident vertebral fractures | 5,840,330     | 11,680,661     | 17,520,991     |
| Incident forearm fractures | 628,292      | 1,256,584      | 1,884,876      |
| Incident other fractures | 6,360,827       | 12,721,653    | 19,082,480     |
| Prior hip fractures | 13,553,267     | 27,106,534     | 40,659,801     |
| Prior vertebral fractures | 4,809,703       | 9,619,406      | 14,429,109     |
| Total               | 35,983,280     | 71,966,559     | 107,949,839    |

Table 14 Population projections in Latvia by age and sex [11]

|                | 2010 | 2015 | 2020 | 2025 |
|----------------|------|------|------|------|
| Women          |      |      |      |      |
| 50–59          | 163,000 | 166,000 | 155,000 | 146,000 |
| 60–69          | 139,000 | 139,000 | 150,000 | 153,000 |
| 70–79          | 125,000 | 125,000 | 114,000 | 116,000 |
| 80–89          | 64,000  | 68,000  | 70,000  | 72,000  |
| 90+            | 8,000   | 10,000  | 13,000  | 15,000  |
| Men            |      |      |      |      |
| 50–59          | 136,000 | 140,583 | 136,000 | 134,000 |
| 60–69          | 93,000  | 96,000  | 108,000 | 114,000 |
| 70–79          | 63,000  | 64,000  | 59,000  | 63,000  |
| 80–89          | 20,000  | 23,000  | 25,000  | 25,000  |
| 90+            | 1,000   | 2,000   | 3,000   | 4,000   |
| All            | 359,000 | 386,583 | 382,000 | 380,000 |

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from € 38 million in 2010 to € 43 million in 2025, corresponding to an increase of 13 % (Table 16). Costs incurred in women and men increased by 10 % and 18 % respectively.

Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site, age and sex in men and women in Latvia

|                | Hip | Spine | Forearm | Other |
|----------------|-----|-------|---------|-------|
| 2010           |     |       |         |       |
| Women          |     |       |         |       |
| 50–74          | 442 | 439   | 669     | 660   |
| 75+            | 1,580 | 1,902 | 889     | 1,009 |
| All            | 2,022 | 2,340 | 1,558   | 1,669 |
| Men            |     |       |         |       |
| 50–74          | 266 | 291   | 460     | 511   |
| 75+            | 347 | 469   | 268     | 358   |
| All            | 613 | 761   | 728     | 868   |
| Women and Men  |     |       |         |       |
| 50–74          | 708 | 730   | 1,130   | 1,171 |
| 75+            | 1,927 | 2,371 | 1,157   | 1,366 |
| All            | 2,634 | 3,101 | 2,286   | 2,537 |

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from € 38 million in 2010 to € 43 million in 2025, corresponding to an increase of 13 % (Table 16). Costs incurred in women and men increased by 10 % and 18 % respectively.
The total number of QALYs lost due to fracture was estimated to rise from 4,500 in 2010 to 5,000 in 2025, corresponding to an increase of 11% (Table 17). The increase was estimated to be particularly marked in men (17%) compared to women (9%). Incident and prior fractures accounted for 58% and 42% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €110 million in 2010 to €123 million in 2025. The increase was estimated to be particularly marked in men (+17%) compared to women (+9%) (Table 18).

### Table 16

Current and future cost (€, 000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Latvia

|  | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|
| **Women** | | | | |
| 50–74 | 9 | 8 | 8 | 8 |
| 75+ | 19 | 20 | 21 | 22 |
| All | 27 | 28 | 29 | 30 |
| **Men** | | | | |
| 50–74 | 6 | 6 | 6 | 7 |
| 75+ | 5 | 5 | 6 | 6 |
| All | 11 | 11 | 12 | 13 |
| **Women and Men** | | | | |
| 50–74 | 15 | 14 | 14 | 15 |
| 75+ | 23 | 25 | 27 | 28 |
| All | 38 | 40 | 41 | 43 |

### Table 17

Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Latvia

|  | Incident fractures | Prior fractures | All fractures |
|---|---|---|---|
|  | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| **Women** | | | | | | |
| 50–74 | 555 | 547 | 502 | 502 | 1,057 | 1,049 |
| 75+ | 922 | 1,074 | 1,292 | 1,439 | 2,214 | 2,513 |
| All | 1,477 | 1,621 | 1,794 | 1,941 | 3,271 | 3,562 |
| **Men** | | | | | | |
| 50–74 | 443 | 489 | 241 | 257 | 684 | 746 |
| 75+ | 282 | 382 | 260 | 304 | 543 | 686 |
| All | 726 | 871 | 501 | 561 | 1,227 | 1,432 |
| **Women and Men** | | | | | | |
| 50–74 | 998 | 1,035 | 743 | 759 | 1,741 | 1,795 |
| 75+ | 1,204 | 1,456 | 1,552 | 1,743 | 2,756 | 3,199 |
| All | 2,203 | 2,492 | 2,295 | 2,502 | 4,498 | 4,993 |

### Table 18

Present and future cost (€, 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Latvia assuming the uptake of treatment remains unchanged

|  | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|
| **Women** | | | | |
| 50–74 | 25 | 25 | 24 | 25 |
| 75+ | 54 | 58 | 60 | 62 |
| All | 79 | 82 | 84 | 87 |
| **Men** | | | | |
| 50–74 | 17 | 17 | 17 | 19 |
| 75+ | 13 | 15 | 16 | 17 |
| All | 30 | 32 | 33 | 36 |
| **Women and Men** | | | | |
| 50–74 | 42 | 42 | 42 | 44 |
| 75+ | 67 | 72 | 76 | 79 |
| All | 110 | 114 | 117 | 123 |

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2). Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.06% in 2001 to 2.12% in 2008 but subsequently decreased to 1.5% in 2011.

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Latvia...
were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 93% and 85% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

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Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|         | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|---------|------------------------------------|---------------------------------------|---------------------|------------------|
| Men     | 2                                  | 24                                    | 22                  | 93               |
| Women   | 12                                 | 80                                    | 68                  | 85               |

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Epidemiology and Economic Burden of Osteoporosis in Lithuania

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract
Summary This report describes epidemiology, burden, and treatment of osteoporosis in Lithuania.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Lithuania, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Lithuania was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 15,000 new fragility fractures were sustained in Lithuania, comprising 3,000 hip fractures, 2,000 vertebral fractures, 3,000 forearm fractures and 7,000 other fractures (i.e. fractures of the pelvis, rib, humerus, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €47 million for the same year. Incident fractures represented 68 % of this cost, long-term fracture care 26 % and pharmacological prevention 6 %. Previous and incident fractures also accounted for 4,900 quality-adjusted life years (QALYs) lost during 2010. The economic burden of incident and previous fragility fractures was estimated at €47 million for the same year. Incident fractures represented 68 % of this cost, long-term fracture care 26 % and pharmacological prevention 6 %. Previous and incident fractures also accounted for 4,900 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 17,000 in 2025, representing an increase of 2,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 500, 300, 300 and 1,300, respectively. The burden of fractures in Lithuania in 2025 was estimated to increase by 14 % to €54 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in
the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Lithuania in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Lithuania was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Lithuania

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 442,000 and 685,000 respectively in Lithuania in 2010 (Table 1).

Table 1 Population at risk: men and women over the age of 50 in Lithuania, 2010

| Age (years) | Women | Men | All |
|-------------|-------|-----|-----|
| 50–54       | 236,000 | 195,000 | 431,000 |
| 60–69       | 189,000 | 127,000 | 316,000 |
| 70–79       | 169,000 | 88,000 | 257,000 |
| 80–89       | 83,000  | 30,000  | 113,000 |
| 90+         | 8,000   | 2,000   | 10,000  |
| 50+         | 685,000 | 442,000 | 1,127,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 180,000 (Table 2). There are 2.4 DXA scan machines per million (m) inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

At the time of writing the report, national data on the incidence of fracture was not available for Lithuania, therefore data for hip fractures was imputed from Polish age-standardized incidence rates [5]. Since then, data have become available from Vilnius [6]. Fracture incidence is presented in Table 3. Standardized to the EU27 population, this hip fracture inci-
The number of incident fractures in 2010 was estimated at 15,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 2,600, 2,400, 2,500 and 7,500 respectively. 67% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals who had suffered a fracture prior to 2010 were estimated at 1.16% for hip and 1.13% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and clinical vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 13,000 and 13,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 244 (Table 8). Hip, vertebral and “other” fractures accounted for 114, 98 and 32 deaths respectively. Overall, approximately 52% of deaths occurred in women.

**Table 4** Estimated number of incident fractures in Lithuania, 2010

| Age (years) | Hip | Vertebra | Forearm | Other | All fractures |
|-------------|-----|----------|---------|-------|---------------|
| Women       |     |          |         |       |               |
| 50–74       | 462 | 719      | 1,264   | 1,685 | 4,130         |
| 75+         | 1,524 | 865    | 823     | 2,700 | 5,912         |
| Total       | 1,986 | 1,584  | 2,087   | 4,385 | 10,042        |
| Men         |     |          |         |       |               |
| 50–74       | 334 | 595      | 390     | 2,251 | 3,570         |
| 75+         | 312 | 241      | 66      | 844   | 1,463         |
| Total       | 646 | 835      | 456     | 3,095 | 5,033         |
| Men and Women |     |          |         |       |               |
| 50–74       | 797 | 1,314    | 1,654   | 3,936 | 7,700         |
| 75+         | 1,836 | 1,106  | 889     | 3,544 | 7,375         |
| Total       | 2,632 | 2,419  | 2,543   | 7,480 | 15,075        |

**Table 5** Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Lithuania, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.2          | 0.5                |
| 60–64       | 0.4          | 0.8                |
| 65–69       | 0.7          | 1.1                |
| 70–74       | 1.3          | 1.7                |
| 75–79       | 2.4          | 2.5                |
| 80–84       | 4.3          | 3.4                |
| 85+         | 9.2          | 5.5                |

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of a hip fracture has been estimated at €4,810 based on Finnish costs [7]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

**Table 6** Number of men and women in Lithuania with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 2,551        | 3,926              |
| 75+         | 7,420        | 5,759              |
| Total       | 9,971        | 9,686              |

| Men         |              |                    |
| 50–74       | 1,529        | 1,900              |
| 75+         | 1,546        | 1,196              |
| Total       | 3,075        | 3,096              |

| Men and Women |              |                    |
| 50–74         | 4,081        | 5,826              |
| 75+           | 8,965        | 6,955              |
| Total         | 13,046       | 12,782             |
Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€10,691 [8]) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €3 [9] and a DXA scan costing €28 [9] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €47 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €32 million, €12 million and €3 million respectively. It is notable that pharmacological fracture prevention costs amounted to only 5.5 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€23 million) followed by "other" (€18 million), spine (€2 million) and forearm fractures (€1 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

Table 7 Incidence (per 100,000) of causally related deaths in Lithuania within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|-----------------|
| Women       |     |                    |                 |
| 50–54       | 1,097 | 1,425              | 28              |
| 55–59       | 1,207 | 1,484              | 36              |
| 60–64       | 2,066 | 2,399              | 66              |
| 65–69       | 1,971 | 2,160              | 74              |
| 70–74       | 2,455 | 2,533              | 112             |
| 75–79       | 3,259 | 3,149              | 204             |
| 80–84       | 3,435 | 3,039              | 383             |
| 85–89       | 4,427 | 3,441              | 776             |
| 90+         | 3,238 | 1,825              | 1,126           |
| Men         |     |                    |                 |
| 50–54       | 4,747 | 5,693              | 74              |
| 55–59       | 6,298 | 7,160              | 129             |
| 60–64       | 6,425 | 6,910              | 174             |
| 65–69       | 7,370 | 7,476              | 264             |
| 70–74       | 6,712 | 6,391              | 303             |
| 75–79       | 7,140 | 6,332              | 423             |
| 80–84       | 6,901 | 5,604              | 580             |
| 85–89       | 9,950 | 7,273              | 1,075           |
| 90+         | 12,236 | 7,963              | 1,531           |

Table 9 One year costs for relevant pharmaceuticals in Lithuania, 2010 [10]

| Annual drug cost (€) |    |
|----------------------|--|
| Alendronate          | 146|
| Risedronate          | 321|
| Etidronate           | 402|
| Ibandronate          | 516|
| Zoledronic acid      | 512|
| Raloxifene           | 5,428|
| Strontium ranelate   | 5,758|

Table 10 Cost of osteoporosis (€) in Lithuania by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|---------------------------|-------------------------|------------|
| Women       |                          |                           |                         |            |
| 50–74       | 7,465,118                | 1,695,643                 | 1,401,163               | 10,561,924 |
| 75+         | 14,054,267               | 7,327,891                 | 849,683                 | 22,231,842 |
| All         | 21,519,385               | 9,023,534                 | 2,250,846               | 32,793,765 |
| Men         |                          |                           |                         |            |
| 50–74       | 7,229,340                | 1,200,128                 | 225,794                 | 8,655,261  |
| 75+         | 3,455,749                | 1,877,945                 | 91,174                  | 5,424,868  |
| All         | 10,685,088               | 3,078,073                 | 316,968                 | 14,080,129 |
| Women and Men |                      |                           |                         |            |
| 50–74       | 14,694,458               | 2,895,771                 | 1,626,957               | 19,217,185 |
| 75+         | 17,510,016               | 9,205,836                 | 940,857                 | 27,656,709 |
| All         | 32,204,473               | 12,101,607                | 2,567,814               | 46,873,894 |
The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 4,900 (Table 12). 70% of the total QALY loss was incurred in women. Prior fractures accounted for 52% of the total QALY loss.

The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €80 m.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €130 million in Lithuania in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 25%, 9%, 2% and 63% respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 1.1 million in 2010 to 1.2 million in 2025, corresponding to an increase of 8% (Table 14).

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**Table 11** Total cost (€) in 2010 by fracture site in men and women in Lithuania. Note that costs for fracture prevention therapy and monitoring are not included.

| Age | Hip | Vertebral | Forearm | Other | All    |
|-----|-----|-----------|---------|-------|--------|
|     |     |           |         |       |        |
| Women |     |           |         |       |        |
| 50–74 | 3,787,138 | 720,220   | 371,450 | 4,281,953 | 9,160,761 |
| 75+   | 13,637,941 | 813,728   | 241,936 | 6,688,554  | 21,382,158 |
| All   | 17,425,079 | 1,533,948 | 613,385 | 10,970,507 | 30,542,919 |
| Men   |     |           |         |       |        |
| 50–74 | 2,557,315 | 532,132   | 114,770 | 5,225,251  | 8,429,467 |
| 75+   | 2,998,047 | 202,736   | 19,342  | 2,113,569  | 5,333,694 |
| All   | 5,555,362 | 734,868   | 134,112 | 7,338,819  | 13,763,161 |
| Women and Men |     |           |         |       |        |
| 50–74 | 6,344,453 | 1,252,352 | 486,220 | 9,507,204  | 17,590,228 |
| 75+   | 16,635,988 | 1,016,464 | 261,277 | 8,802,122  | 26,715,852 |
| All   | 22,980,441 | 2,268,816 | 747,497 | 18,309,326 | 44,306,080 |

**Fig. 1** Share (%) of fracture cost by fracture site in Lithuania. Note that costs for fracture prevention therapy and monitoring are not included.

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**Table 12** Number of QALYs lost due to fractures during 2010 in men and women in Lithuania according to age.

| Age (years) | 50–74 | 75+ | All |
|------------|-------|-----|-----|
| Women      |       |     |     |
| Incident hip fractures | 112   | 327 | 439 |
| Incident vertebral fractures | 240   | 254 | 494 |
| Incident forearm fractures | 45    | 25  | 70  |
| Incident other fractures | 202   | 285 | 487 |
| Prior hip fractures | 399   | 1,014 | 1,413 |
| Prior vertebral fractures | 220   | 283 | 502 |
| Total      | 1,217 | 2,188 | 3,405 |
| Men        |       |     |     |
| Incident hip fractures | 85    | 77  | 162 |
| Incident vertebral fractures | 206   | 78  | 285 |
| Incident forearm fractures | 14    | 2   | 16  |
| Incident other fractures | 269   | 97  | 365 |
| Prior hip fractures | 239   | 230 | 469 |
| Prior vertebral fractures | 106   | 63  | 169 |
| Total      | 919   | 547 | 1,466 |
| Men and Women |     |     |     |
| Incident hip fractures | 197   | 404 | 601 |
| Incident vertebral fractures | 446   | 333 | 779 |
| Incident forearm fractures | 58    | 27  | 86  |
| Incident other fractures | 471   | 382 | 852 |
| Prior hip fractures | 639   | 1,244 | 1,882 |
| Prior vertebral fractures | 325   | 346 | 672 |
| Total      | 2,137 | 2,735 | 4,872 |

**Table 13** Value of lost QALYs (€) in men and women in Lithuania in 2010.

|               | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|---------------|----------------|----------------|----------------|
| Incident hip fractures | 4,991,011 | 9,982,021 | 14,973,032 |
| Incident vertebral fractures | 6,463,375 | 12,926,749 | 19,390,124 |
| Incident forearm fractures | 710,674 | 1,421,348 | 2,132,022 |
| Incident other fractures | 7,073,665 | 14,147,329 | 21,220,994 |
| Prior hip fractures | 15,623,405 | 31,246,811 | 46,870,216 |
| Prior vertebral fractures | 5,574,601 | 11,149,202 | 16,723,803 |
| Total | 40,436,730 | 80,873,461 | 121,310,191 |
The total number of fractures was estimated to rise from 15,000 in 2010 to 17,000 in 2025 (Table 15), corresponding to an increase of 16%. Hip, clinical spine, forearm and other fractures increased by 500, 300, 300 and 1,300 respectively. The increase in the number of fractures ranged from 11% to 19%, depending on fracture site. The increase was estimated to be 16% in both men and women.

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from €47 million in 2010 to €54 million in 2025, corresponding to an increase of 15% (Table 16). Costs incurred in women and men increased by 15% and 13% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 4,900 in 2010 to 5,500 in 2025, corresponding to an increase of 13% (Table 17). The increase was estimated to be 12% in men and 13% in women. Incident and prior fractures accounted for 57% and 43% of the increase respectively.

### Table 14 Population projections in Lithuania by age and sex [11]

| Age Group | 2010 | 2015 | 2020 | 2025 |
|-----------|------|------|------|------|
| Women     |      |      |      |      |
| 50–59     | 236,000 | 257,000 | 245,000 | 224,000 |
| 60–69     | 189,000 | 192,000 | 216,000 | 238,000 |
| 70–79     | 169,000 | 163,000 | 156,000 | 160,000 |
| 80–89     | 83,000  | 91,000  | 93,000  | 92,000  |
| 90+       | 8,000   | 12,000  | 17,000  | 19,000  |
| Men       |      |      |      |      |
| 50–59     | 195,000 | 215,509 | 211,000 | 195,000 |
| 60–69     | 127,000 | 131,000 | 152,000 | 170,000 |
| 70–79     | 88,000  | 84,000  | 80,000  | 85,000  |
| 80–89     | 30,000  | 33,000  | 34,000  | 33,000  |
| 90+       | 2,000   | 2,000   | 3,000   | 4,000   |

### Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Lithuania

| Fracture Site | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
|---------------|------|------|------|------|------|------|------|------|
| Women         |      |      |      |      |      |      |      |      |
| Hip           | 462  | 496  | 719  | 769  | 1,264 | 1,352 | 1,685 | 1,799 |
| 50–74         | 1,524 | 1,911 | 865 | 1,016 | 823 | 938 | 2,700 | 3,379 |
| 75+           | 1,986 | 2,407 | 1,584 | 1,786 | 2,087 | 2,290 | 4,385 | 5,178 |
| All           | 50–74 | 234 | 380 | 595 | 679 | 390 | 464 | 2,251 | 2,605 |
| 75+           | 365 | 241 | 272 | 66 | 74 | 844 | 982 |
| All           | 646 | 737 | 835 | 952 | 456 | 538 | 3,095 | 3,587 |
| Men           |      |      |      |      |      |      |      |      |
| Hip           | 574  | 659  | 345  | 379  | 919  | 1,038 |
| 50–74         | 598  | 640  | 619  | 652  | 1,217 | 1,292 |
| 75+           | 891  | 1,077 | 1,297 | 1,473 | 2,188 | 2,550 |
| All           | 1,490 | 1,717 | 1,916 | 2,125 | 3,405 | 3,843 |
| Women and Men |      |      |      |      |      |      |      |      |
| Hip           | 797  | 876  | 1,314 | 1,448 | 1,654 | 1,816 | 3,936 | 4,405 |
| 50–74         | 1,836 | 2,267 | 1,106 | 1,289 | 889 | 1,012 | 3,544 | 4,360 |
| 75+           | 2,632 | 3,143 | 2,419 | 2,737 | 2,543 | 2,828 | 7,480 | 8,765 |

### Table 16 Current and future cost (€ 000, 000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Lithuania

| Year | 2010 | 2015 | 2020 | 2025 |
|------|------|------|------|------|
| Women |      |      |      |      |
| 50–74 | 11  | 11  | 11  | 11  |
| 75+   | 22  | 24  | 26  | 27  |
| All   | 33  | 35  | 36  | 38  |
| Men   |      |      |      |      |
| 50–74 | 9   | 9   | 9   | 10  |
| 75+   | 5   | 6   | 6   | 6   |
| All   | 14  | 15  | 15  | 16  |
| Women and Men |      |      |      |      |
| 50–74 | 19  | 19  | 20  | 21  |
| 75+   | 28  | 30  | 31  | 33  |
| All   | 47  | 49  | 52  | 54  |
The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €128 million in 2010 to €145 million in 2025. The increase was estimated to be 12 % in men and 14 % in women (Table 18).

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.4 % in 2001 to 1.38 % in 2008 but subsequently decreased to 1.21 % in 2011.

The treatment gaps in men and women were estimated at 95 % and 90 % respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Lithuania were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 95 % and 90 % respectively (Table 19).

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Epidemiology and Economic Burden of Osteoporosis in Luxembourg

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Luxembourg.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Luxembourg, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Luxembourg was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 2,700 new fragility fractures were sustained in Luxembourg, comprising 470 hip fractures, 410 vertebral fractures, 460 forearm fractures and 1,400 other fractures (i.e. fractures of the pelvis, rib, humerus,ibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €22 million for the same year. Incident fractures represented 71 % of this cost, long-term fracture care 20 % and pharmacological prevention 9 %. Previous and incident fractures also accounted for 900 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 4,000 in 2025, representing an increase of 1,300 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 240, 200, 180 and 700, respectively. The burden of fractures in Luxembourg in 2025 was estimated to increase by 41 % to €31 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. A substantial minority of women at high fracture risk did not receive active treatment.
Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap in women and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Luxembourg in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Luxembourg was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Luxembourg

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 75,000 and 83,000 respectively in Luxembourg in 2010 (Table 1). It should be noted that this includes a substantial proportion of French, Belgian and German nationals.

| Age (years) | Women | Men | All |
|-------------|-------|-----|-----|
| 50–59       | 32,000| 33,000| 65,000|
| 60–69       | 22,000| 23,000| 45,000|
| 70–79       | 17,000| 14,000| 31,000|
| 80–89       | 11,000| 5,000| 16,000|
| 90+         | 1,000 | 0 | 1,000|
| 50+         | 83,000| 75,000| 158,000|

Table 1 Population at risk: men and women over the age of 50 in Luxembourg, 2010 [1]

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 22,000 (Table 2). There are 2 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model for the assessment of fracture risk is not available for Luxembourg.

Incidence data was not available for Luxembourg, therefore data for hip fractures was imputed from Belgian age-standardized incidence rates [5]. Fracture incidence is presented in Table 3. Standardized to the EU27 population, this hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 228.5 and 538.7 respectively.

| Age (years) | Women | Men |
|-------------|-------|-----|
| 50–54       | 1,071 | 450 |
| 55–59       | 1,440 | 525 |
| 60–64       | 1,716 | 754 |
| 65–69       | 2,020 | 740 |
| 70–74       | 2,511 | 624 |
| 75–79       | 3,000 | 618 |
| 80+         | 5,664 | 830 |
| 50+         | 17,422| 4,541|

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Luxembourg by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Fracture at the | Age (years) |
|----------------|-------------|
| hip            | Women       |
| vertebra       | Men         |
| forearm        |             |
| other          |             |
| 50–54          | 27          |
| 55–59          | 53          |
| 60–64          | 84          |
| 65–69          | 140         |
| 70–74          | 271         |
| 75–79          | 606         |
| 80–84          | 1,263       |
| 85+            | 2,371       |
| 50–54          | 70          |
| 55–59          | 148         |
| 60–64          | 149         |
| 65–69          | 203         |
| 70–74          | 382         |
| 75–79          | 589         |
| 80–84          | 794         |
| 85+            | 1,115       |
| 50–54          | 173         |
| 55–59          | 410         |
| 60–64          | 317         |
| 65–69          | 339         |
| 70–74          | 486         |
| 75–79          | 591         |
| 80–84          | 791         |
| 85+            | 1,012       |
| 50–54          | 179         |
| 55–59          | 469         |
| 60–64          | 324         |
| 65–69          | 477         |
| 70–74          | 768         |
| 75–79          | 1,274       |
| 80–84          | 2,148       |
| 85+            | 3,983       |

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Luxembourg by age
The number of incident fractures in 2010 was estimated at 2,700 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 470, 400, 460 and 1,400 respectively. 66 % of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportions of individuals who had suffered a fracture prior to 2010 were estimated at 1.55 % for hip and 1.77 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred within the first year after fracture (adjusted for comorbidities) is shown in Table 7.
before 2010 was estimated at 2,400 and 2,800 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 28 (Table 8). Hip, vertebral and “other” fractures accounted for 14, 10 and 4 deaths respectively. Overall, approximately 56 % of deaths occurred in women.

### Cost of osteoporosis in Luxembourg including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of a hip fracture was not available specifically for Luxembourg, therefore hip fracture costs has been estimated at €12,616 based on Belgian costs [6]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€19,787 [7,8], based on Belgian cost of public nursing home) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug cost for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €30 [9] and a DXA scan at €59 [9] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €22 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €15 million, €4 million and €2 million respectively. It is notable that pharmacological fracture prevention costs amounted to only 9.1 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€10 million) followed by “other” (€9 million), spine (€1 million) and forearm fractures (€0.4 million) (Table 11 and Fig. 1). Please note that costs for

### Table 8 The number of deaths in men and women in Luxembourg in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | hip | Fracture at the vertebra | “other” |
|-------------|-----|--------------------------|--------|
| **Women**   |     |                          |        |
| 50–74       | 1   | 2                        | 0      |
| 75+         | 7   | 3                        | 3      |
| Total       | 8   | 5                        | 3      |
| **Men**     |     |                          |        |
| 50–74       | 1   | 3                        | 0      |
| 75+         | 4   | 2                        | 1      |
| Total       | 6   | 5                        | 1      |
| **Men and Women** | | | |
| 50–74       | 2   | 4                        | 0      |
| 75+         | 11  | 5                        | 4      |
| Total       | 14  | 10                       | 4      |

### Table 9 One year costs for relevant pharmaceuticals in Luxembourg, 2010 [9]

| Annual drug cost (€) | Alendronate | Risedronate | Etidronate | Ibandronate | Zoledronic acid | Raloxifene | Strontium ranelate | Parathyroid hormone | Teriparatide |
|----------------------|-------------|-------------|------------|-------------|----------------|------------|-------------------|---------------------|-------------|
| 109                  |             |             |            |             |                 |            |                   |                     |             |
| 226                  |             |             |            |             |                 |            |                   |                     |             |
| 223                  |             |             |            |             |                 |            |                   |                     |             |
| 379                  |             |             |            |             |                 |            |                   |                     |             |
| 355                  |             |             |            |             |                 |            |                   |                     |             |
| 446                  |             |             |            |             |                 |            |                   |                     |             |
| 375                  |             |             |            |             |                 |            |                   |                     |             |
| -                    |             |             |            |             |                 |            |                   |                     |             |
| 4,666                |             |             |            |             |                 |            |                   |                     |             |

### Table 10 Cost of osteoporosis (€) in Luxembourg by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| **Women**   |                          |                            |                          |            |
| 50–74       | 3,109,998                | 443,188                    | 1,063,439                | 4,616,625  |
| 75+         | 6,894,237                | 2,624,118                  | 665,431                  | 10,183,785 |
| All         | 10,004,235               | 3,067,306                  | 1,728,869                | 14,800,411 |
| **Men**     |                          |                            |                          |            |
| 50–74       | 3,155,820                | 461,756                    | 175,575                  | 3,793,152  |
| 75+         | 2,244,929                | 759,313                    | 67,901                   | 3,072,143  |
| All         | 5,400,749                | 1,221,069                  | 243,476                  | 6,865,294  |
| **Women and Men** | | |   |            |
| 50–74       | 6,265,819                | 904,945                    | 1,239,014                | 8,409,777  |
| 75+         | 9,139,165                | 3,383,431                  | 733,332                  | 13,255,928 |
| All         | 15,404,984               | 4,288,375                  | 1,972,346                | 21,665,705 |
pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites. The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 900 (Table 12). 67 % of the total QALY loss was incurred in women. Prior fractures accounted for 55 % of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €150 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €170 million in Luxembourg in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 9 %, 3 %, 1 % and 87 % respectively.

Table 11 Total cost (£) in 2010 by fracture site in men and women in Luxembourg. Note that costs for fracture prevention therapy and monitoring are not included

| Age (years) | Hip   | Spine | Forearm | Other | All   |
|-------------|-------|-------|---------|-------|-------|
| Women       |       |       |         |       |       |
| 50–74       | 1,270,805 | 295,197 | 172,044 | 1,815,141 | 3,553,186 |
| 75+         | 5,704,652 | 367,548 | 119,147 | 3,327,007 | 9,518,355 |
| All         | 6,975,457 | 662,745 | 291,191 | 5,142,148 | 13,071,541 |
| Men         |       |       |         |       |       |
| 50–74       | 1,093,837 | 251,733 | 49,092  | 2,222,915 | 3,617,577 |
| 75+         | 1,522,705 | 131,840 | 11,915  | 1,337,782 | 3,004,241 |
| All         | 2,616,542 | 383,573 | 61,007  | 3,560,697 | 6,621,818 |
| Women and Men |       |       |         |       |       |
| 50–74       | 2,364,641 | 546,930 | 221,136 | 4,038,056 | 7,170,763 |
| 75+         | 7,227,357 | 499,388 | 131,062 | 4,664,789 | 12,522,596 |
| All         | 9,591,999 | 1,046,318 | 352,197 | 8,702,845 | 19,693,359 |

Fig. 1 Share (%) of fracture cost by fracture site in Luxembourg. Note that costs for fracture prevention therapy and monitoring are not included

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Luxembourg according to age

| Age (years) | Incident Hip Fractures | Incident Vertebral Fractures | Incident Forearm Fractures | Incident Other Fractures | Prior Hip Fractures | Prior Vertebral Fractures | Total |
|-------------|-------------------------|-----------------------------|---------------------------|-------------------------|---------------------|--------------------------|-------|
| Women       |                         |                             |                           |                         |                     |                          |       |
| 50–74       | 16                      | 37                          | 8                         | 35                      | 56                  | 40                       | 191   |
| 75+         | 57                      | 42                          | 5                         | 54                      | 193                 | 61                       | 412   |
| 50+         | 74                      | 78                          | 13                        | 89                      | 249                 | 101                      | 604   |
| Men         |                         |                             |                           |                         |                     |                          |       |
| 50–74       | 13                      | 32                          | 2                         | 43                      | 50                  | 28                       | 169   |
| 75+         | 18                      | 18                          | 1                         | 23                      | 52                  | 17                       | 128   |
| 50+         | 31                      | 50                          | 3                         | 66                      | 102                 | 45                       | 296   |
| Men and Women |                       |                             |                           |                         |                     |                          |       |
| 50–74       | 30                      | 75                          | 10                         | 78                      | 245                 | 67                       | 105   |
| 75+         | 69                      | 59                          | 128                        | 77                      | 245                 | 79                       | 128   |
| 50+         | 105                     | 128                         | 351                        | 155                     | 351                 | 146                      | 900   |

Table 13 Value of lost QALYs (£) in men and women in Luxembourg in 2010

| Incident Hip Fractures | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|------------------------|----------------|----------------|----------------|
| 8,583,304              | 17,166,608     | 25,749,911     |                |
| 10,492,614             | 20,985,228     | 31,477,842     |                |
| 1,260,591              | 2,521,181      | 3,781,772      |                |
| 12,706,581             | 25,413,161     | 38,119,742     |                |
| 28,851,341             | 57,702,681     | 86,554,022     |                |
| 12,004,972             | 24,009,944     | 36,014,916     |                |
| Total                  | 73,899,402     | 147,798,804    | 221,698,206    |
The population above 50 years of age is expected to increase from 158,000 in 2010 to 220,000 in 2025, corresponding to an increase of 39 % (Table 14).

The total number of fractures was estimated to rise from approximately 2,700 in 2010 to 4,000 in 2025 (Table 15), corresponding to an increase of 49 %. Hip, clinical spine, forearm and other fractures increased by 200, 200, 200 and 700 respectively. The increase in the number of fractures ranged from 40 % to 52 %, depending on fracture site. The increase was estimated to be particularly marked in men (66 %) compared to women (41 %).

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from € 22 million in 2010 to € 31 million in 2025, corresponding to an increase of 41 % (Table 16). Costs incurred in women and men increased by 33 % and 59 % respectively.

The total number of fractures was estimated to rise from approximately 2,700 in 2010 to 4,000 in 2025 (Table 15), corresponding to an increase of 49 %. Hip, clinical spine, forearm and other fractures increased by 200, 200, 200 and 700 respectively. The increase in the number of fractures ranged from 40 % to 52 %, depending on fracture site. The increase was estimated to be particularly marked in men (66 %) compared to women (41 %).

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from € 22 million in 2010 to € 31 million in 2025, corresponding to an increase of 41 % (Table 16). Costs incurred in women and men increased by 33 % and 59 % respectively.

### Table 14: Population projections in Luxembourg by age and sex [10]

| Population | 2010 | 2015 | 2020 | 2025 |
|------------|------|------|------|------|
| Women      |      |      |      |      |
| 50–59      | 32,000 | 37,000 | 40,000 | 42,000 |
| 60–69      | 22,000 | 26,000 | 30,000 | 35,000 |
| 70–79      | 17,000 | 17,000 | 19,000 | 23,000 |
| 80–89      | 11,000 | 12,000 | 12,000 | 12,000 |
| 90+        | 1,000  | 2,000  | 3,000  | 3,000  |
| All        | 65,000 | 75,001 | 82,000 | 83,000 |
| Men        |      |      |      |      |
| 50–59      | 33,000 | 38,001 | 42,000 | 41,000 |
| 60–69      | 23,000 | 26,000 | 29,000 | 34,000 |
| 70–79      | 14,000 | 15,000 | 17,000 | 21,000 |
| 80–89      | 5,000  | 7,000  | 8,000  | 8,000  |
| 90+        | 0      | 1,000  | 1,000  | 1,000  |
| All        | 65,000 | 75,001 | 82,000 | 83,000 |

### Table 15: Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Luxembourg

| Fracture Site | Hip | Spine | Forearm | Other |
|---------------|-----|-------|---------|-------|
| 2010 | 2025 | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women | | | | | | | | |
| 50–74 | 68 | 101 | 110 | 160 | 223 | 321 | 287 | 416 |
| 75+  | 272 | 384 | 144 | 194 | 155 | 198 | 521 | 731 |
| All   | 340 | 485 | 254 | 354 | 378 | 519 | 808 | 1,146 |
| Men   | | | | | | | | |
| 50–74 | 54 | 76 | 96 | 136 | 64 | 90 | 363 | 515 |
| 75+  | 73 | 150 | 55 | 113 | 15 | 31 | 200 | 421 |
| All   | 127 | 226 | 151 | 249 | 79 | 121 | 563 | 935 |

### Table 16: Current and future cost (€000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Luxembourg

| Calendar Year | 2010 | 2015 | 2020 | 2025 |
|---------------|------|------|------|------|
| Women | | | | |
| 50–74 | 5 | 5 | 6 | 7 |
| 75+  | 10 | 12 | 12 | 13 |
| All   | 15 | 17 | 18 | 20 |
| Men   | | | | |
| 50–74 | 4 | 4 | 5 | 5 |
| 75+  | 3 | 5 | 5 | 6 |
| All   | 7 | 9 | 10 | 11 |

### Table 17: Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Luxembourg

| Fracture Type | Incident fractures | Prior fractures | All fractures |
|---------------|--------------------|-----------------|---------------|
| 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women | | | | | | |
| 50–74 | 96 | 139 | 96 | 112 | 112 | 191 |
| 75+  | 158 | 215 | 254 | 264 | 264 | 412 |
| All   | 254 | 354 | 350 | 376 | 376 | 604 |
| Men   | | | | | | |
| 50–74 | 90 | 128 | 78 | 97 | 97 | 169 |
| 75+  | 59 | 121 | 69 | 93 | 93 | 128 |
| All   | 149 | 249 | 147 | 190 | 190 | 296 |

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 158,000 in 2010 to 220,000 in 2025, corresponding to an increase of 39 % (Table 14).
The total number of QALYs lost due to fracture was estimated to rise from 900 in 2010 to 1,200 in 2025, corresponding to an increase of 30% (Table 17). The increase was estimated to be particularly marked in men (48%) compared to women (21%). Incident and prior fractures accounted for 75% and 25% of the increase respectively. The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €170 million in 2010 to €220 million in 2025. The increase was estimated to be particularly marked in men (+49%) compared to women (+23%) (Table 18).

Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 4.65% in 2001 to 8.25% in 2006 but subsequently decreased to 5.78% in 2011.

Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Luxembourg were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. For men, the data indicate that the volume of sold osteoporosis drugs would be sufficient to cover treatment for more patients than the number that fall above the fracture threshold. It should be noted, however, that the results from this analysis should be interpreted with some caution since it has been assumed that the distribution of drug use between genders observed in Sweden is valid for all countries. The treatment gaps in men and women were estimated at −35% and 43% respectively (Table 19). Also note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk. This has been shown not to be the case [11].

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Epidemiology and Economic Burden of Osteoporosis in Malta

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Malta.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Malta, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Malta was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 2,600 new fragility fractures were sustained in Malta, comprising 450 hip fractures, 430 vertebral fractures, 470 forearm fractures and 1,300 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €17 million for the same year. Incident fractures represented 65 % of this cost, long-term fracture care 24 % and pharmacological prevention 12 %. Previous and incident fractures also accounted for 800 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 3,800 in 2025, representing an increase of 1,100 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 230, 190, 140 and 580, respectively. The burden of fractures in Malta in 2025 was estimated to increase by 39 % to €24 million.

Conclusions There is a high cost of osteoporosis with a substantial projected increase of the economic burden driven by aging populations, suggesting that a change in healthcare policy concerning the disease is warranted.
Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Malta in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Malta was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Malta

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 71,000 and 81,000 respectively in Malta in 2010 (Table 1). In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at c. 20,000 (Table 2). There are 9.7 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Malta for the years 2003–2007 [5]. Given that country specific incidence of the vertebral, forearm and “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 206.1 and 502.5 respectively.

The number of incident fractures in 2010 was estimated at 2,600 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 450, 430, 470 and 1,300 respectively. 68 % of fractures occurred in women. These figures may be conservative since hip fracture rates appear to have increased recently. Thus, the annual number of hip fractures in men and women appears to have risen from approximately 450

Table 1 Population at risk: men and women over the age of 50 in Malta, 2010 [1]

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–59      | 31,000| 31,000| 62,000|
| 60–69      | 24,000| 23,000| 47,000|
| 70–79      | 17,000| 13,000| 30,000|
| 80–89      | 8,000 | 4,000 | 12,000|
| 90+        | 1,000 | 0     | 1,000|
| 50+        | 81,000| 71,000| 152,000|

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Malta by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 1,008 | 400 |
| 55–59      | 1,440 | 525 |
| 60–64      | 2,145 | 870 |
| 65–69      | 1,818 | 592 |
| 70–74      | 2,790 | 624 |
| 75–79      | 2,625 | 515 |
| 80+        | 4,248 | 664 |
| 50+        | 16,074| 4,190|

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Malta by age

| Age (years) | Fracture at the | Women | |
|------------|----------------|-------|-----|
|            | vertebra | forearm | other |
| 50–54      | 26 | 67 | 167 | 172 |
| 55–59      | 39 | 109 | 302 | 346 |
| 60–64      | 85 | 150 | 320 | 327 |
| 65–69      | 200 | 291 | 486 | 684 |
| 70–74      | 448 | 631 | 804 | 1,269 |
| 75–79      | 856 | 832 | 835 | 1,801 |
| 80–84      | 1,426| 896 | 893 | 2,425 |
| 85+        | 2,062| 970 | 880 | 3,465 |

Table 4 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Malta by age
using the source data for 2003–2007 to 550/year for the years 2009–2011 [6].

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.30 % for hip and 1.52 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 2,000 and 2,300 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 30 (Table 8). Hip, vertebral and “other” fractures accounted for 15, 11 and 4 deaths respectively. Overall, approximately 56 % of deaths occurred in women.

Cost of osteoporosis in Malta including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details. As the cost of a hip fracture was not available specifically for Malta, the cost of a hip fracture has been estimated at € 9,084 based on Italian costs [7]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€ 23,265 [7,8],

| Table 4 Estimated number of incident fractures in Malta, 2010 |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Age (years) | Hip | Vertebra | Forearm | Other | All fractures |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Women |
| 50–74 | 103 | 153 | 269 | 364 | 889 |
| 75+ | 228 | 130 | 133 | 426 | 918 |
| Total | 331 | 283 | 403 | 790 | 1,807 |
| Men |
| 50–74 | 54 | 95 | 56 | 333 | 538 |
| 75+ | 64 | 50 | 14 | 170 | 297 |
| Total | 117 | 144 | 70 | 503 | 835 |
| Men and Women |
| 50–74 | 156 | 248 | 326 | 697 | 1,427 |
| 75+ | 292 | 180 | 147 | 596 | 1,215 |
| Total | 448 | 428 | 473 | 1,293 | 2,642 |

| Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Malta, 2010 |
|---------------------------------|-----------------|-----------------|
| Age (years) | Hip fracture | Vertebral fracture |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Women |
| 50–54 | 0.0 | 0.1 |
| 55–59 | 0.2 | 0.6 |
| 60–64 | 0.5 | 1.1 |
| 65–69 | 1.0 | 1.7 |
| 70–74 | 1.9 | 2.8 |
| 75–79 | 3.6 | 4.4 |
| 80–84 | 6.6 | 9.1 |
| 85+ | 13.4 | 9.2 |
| Men |
| 50–54 | 0.1 | 0.2 |
| 55–59 | 0.2 | 0.5 |
| 60–64 | 0.4 | 0.8 |
| 65–69 | 0.6 | 1.0 |
| 70–74 | 1.0 | 1.4 |
| 75–79 | 1.6 | 1.9 |
| 80–84 | 3.0 | 2.5 |
| 85+ | 5.6 | 3.9 |

| Table 6 Number of men and women in Malta with a prior hip or clinical vertebral fracture after the age of 50 years, 2010 |
|---------------------------------|-----------------|-----------------|
| Age (years) | Hip fracture | Vertebral fracture |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Women |
| 50–74 | 394 | 719 |
| 75+ | 1,115 | 978 |
| Total | 1,509 | 1,697 |
| Men |
| 50–74 | 236 | 410 |
| 75+ | 229 | 209 |
| Total | 465 | 619 |
| Men and Women |
| 50–74 | 630 | 1,129 |
| 75+ | 1,344 | 1,187 |
| Total | 1,974 | 2,316 |
approximated using the PPP adjusted Italian cost of public nursing home) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 23 [8] (approximated using the PPP adjusted Italian cost) and a DXA scan costing € 184 [9] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at € 17 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to € 11 million, € 4 million and € 2 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 11.8 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€ 8 million) followed by “other” (€ 6 million), spine (€ 0.8 million) and forearm fractures (€ 0.3 million) (Table 11 and Fig. 1). As noted above, the fracture rates may be underestimated by about 20 % so that the costs may be proportionately higher. Note also that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

| Table 7 | Incidence (per 100,000) of causally related deaths in Malta within the first year after fracture (adjusted for comorbidities), 2010 |
|---------|---------------------------------------------------------------------------------------------------|
| Age (years) | Hip | Clinical vertebral | “Other” fracture |
| Women | | | |
| 50–54 | 668 | 868 | 17 |
| 55–59 | 707 | 870 | 21 |
| 60–64 | 920 | 1,069 | 29 |
| 65–69 | 1,806 | 1,980 | 68 |
| 70–74 | 1,382 | 1,426 | 63 |
| 75–79 | 2,186 | 2,112 | 137 |
| 80–84 | 3,076 | 2,722 | 343 |
| 85–89 | 3,696 | 2,873 | 647 |
| 90+ | 3,153 | 1,778 | 1,096 |
| Men | | | |
| 50–54 | 981 | 1,177 | 15 |
| 55–59 | 1,183 | 1,345 | 24 |
| 60–64 | 2,207 | 2,374 | 60 |
| 65–69 | 3,894 | 3,950 | 140 |
| 70–74 | 4,345 | 4,137 | 196 |
| 75–79 | 5,127 | 4,546 | 304 |
| 80–84 | 6,390 | 5,189 | 537 |
| 85–89 | 10,880 | 7,952 | 1,175 |
| 90+ | 15,476 | 10,071 | 1,936 |

| Table 8 | The number of deaths in men and women in Malta in the first year after fracture attributable to the fracture event (causally related), 2010 |
|---------|---------------------------------------------------------------------------------------------------|
| Age (years) | Hip | Fracture at the vertebral | “other” |
| Women | | | |
| 50–74 | 2 | 2 | 0 |
| 75+ | 7 | 3 | 2 |
| Total | 9 | 6 | 3 |
| Men | | | |
| 50–74 | 2 | 3 | 0 |
| 75+ | 5 | 3 | 1 |
| Total | 6 | 5 | 2 |
| Men and Women | | | |
| 50–74 | 3 | 5 | 1 |
| 75+ | 12 | 6 | 4 |
| Total | 15 | 11 | 4 |

| Table 9 | One year costs for relevant pharmaceuticals in Malta, 2010 [10] |
|---------|---------------------------------------------------------------------------------------------------|
| Annual drug cost (€) | |
| Alendronate | 190 |
| Risedronate | 491 |
| Etidronate | - |
| Ibandronate | 434 |
| Zoledronic acid | 560 |
| Raloxifene | 461 |
| Strontium ranelate | 606 |
| Parathyroid hormone | - |
| Teriparatide | 7,170 |

| Table 10 | Cost of osteoporosis (€) in Malta by age in men and women, 2010 |
|---------|---------------------------------------------------------------------------------------------------|
| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
| Women | | | | |
| 50–74 | 3,159,484 | 574,338 | 1,245,473 | 4,979,295 |
| 75+ | 4,145,346 | 2,411,612 | 585,634 | 7,142,593 |
| All | 7,304,830 | 2,985,950 | 1,831,107 | 12,121,888 |
| Men | | | | |
| 50–74 | 2,236,877 | 387,516 | 195,189 | 2,819,581 |
| 75+ | 1,374,171 | 607,215 | 63,002 | 2,044,388 |
| All | 3,611,048 | 994,731 | 258,191 | 4,863,970 |
| Women and Men | | | | |
| 50–74 | 5,396,361 | 961,854 | 1,440,662 | 7,798,877 |
| 75+ | 5,519,518 | 3,018,827 | 648,637 | 9,186,981 |
| All | 10,915,878 | 3,980,681 | 2,089,298 | 16,985,858 |
The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 800 (Table 12). 70% of the total QALY loss was incurred in women. Prior fractures accounted for 50% of the total QALY loss. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €24 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €41 million in Malta in 2010. Incident fractures, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 27%, 10%, 5%, 58% respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 152,000 in 2010 to 176,000 in 2025, corresponding to an increase of 16% (Table 14).

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**Table 11** Total cost (€) in 2010 by fracture site in men and women in Malta. Note that costs for fracture prevention therapy and monitoring are not included.

| Age   | Hip         | Spine       | Forearm     | Other       | All          |
|-------|-------------|-------------|-------------|-------------|--------------|
| Women |             |             |             |             |              |
| 50–74 | 1,472,718   | 295,956     | 149,458     | 1,815,690   | 3,733,822    |
| 75+   | 4,244,795   | 236,517     | 73,953      | 2,001,693   | 6,556,958    |
| All   | 5,717,514   | 532,473     | 223,412     | 3,817,383   | 10,290,781   |
| Men   |             |             |             |             |              |
| 50–74 | 839,056     | 177,657     | 31,305      | 1,576,374   | 2,624,393    |
| 75+   | 1,063,713   | 82,724      | 7,641       | 827,308     | 1,981,386    |
| All   | 1,902,769   | 260,381     | 38,947      | 2,403,683   | 4,605,779    |

**Table 12** Number of QALYs lost due to fractures during 2010 in men and women in Malta according to age

| Age (years) | Women | Men | Women and Men |
|-------------|-------|-----|---------------|
|             | 50–74 | 75+ | 50+           |
| Incident hip fractures | 25    | 13  | 38            |
| Incident vertebral fractures | 50    | 31  | 64            |
| Incident forearm fractures | 9     | 2   | 11            |
| Incident other fractures | 43    | 37  | 64            |
| Prior hip fractures | 62     | 37  | 97            |
| Prior vertebral fractures | 40   | 23  | 145           |
| Total       | 230   | 145 | 375           |

**Table 13** Value of lost QALYs (€) in men and women in Malta in 2010

| Fracture Site          | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|------------------------|----------------|----------------|----------------|
| Incident hip fractures | 1,510,316      | 3,020,631      | 4,530,947      |
| Incident vertebral fractures | 2,013,445    | 4,026,889      | 6,040,334      |
| Incident forearm fractures | 236,228      | 472,457        | 708,685        |
| Incident other fractures | 2,177,910    | 4,355,820      | 6,533,730      |
| Prior hip fractures    | 4,213,340     | 8,426,680      | 12,640,021     |
| Prior vertebral fractures | 1,806,697   | 3,613,394      | 5,420,091      |
| Total                  | 11,957,936    | 23,915,872     | 35,873,807     |
The total number of fractures was estimated to rise from approximately 2,600 in 2010 to 3,800 in 2025 (Table 15), corresponding to an increase of 43%. Hip, clinical spine, forearm and other fractures increased by 200, 200, 100 and 600 respectively. The increase in the number of fractures ranged from 30% to 52%, depending on fracture site. The increase was estimated to be particularly marked in men (58%) compared to women (36%).

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from €17 million in 2010 to €24 million in 2025, corresponding to an increase of 40% (Table 16). Costs incurred in women and men increased by 33% and 55% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 800 in 2010 to 1,100 in 2025, corresponding to an increase of 32% (Table 17). The increase was estimated to be particularly marked in men (47%) compared to women (36%).

Table 14  Population projections in Malta by age and sex [11]

| Population | 2010  | 2015  | 2020  | 2025  |
|------------|-------|-------|-------|-------|
| Women      |       |       |       |       |
| 50–59      | 31,000| 30,000| 27,000| 25,000|
| 60–69      | 24,000| 30,000| 30,000| 29,000|
| 70–79      | 17,000| 16,000| 21,000| 26,000|
| 80–89      | 8,000 | 8,000 | 10,000| 10,000|
| 90+        | 1,000 | 1,000 | 1,000 | 2,000 |
| Men        |       |       |       |       |
| 50–59      | 31,000| 30,096| 28,000| 26,000|
| 60–69      | 23,000| 29,000| 29,000| 28,000|
| 70–79      | 13,000| 13,000| 18,000| 22,000|
| 80–89      | 4,000 | 5,000 | 6,000 | 7,000 |
| 90+        | 0     | 1,000 | 1,000 | 1,000 |
| All        | 62,000| 60,096| 55,000| 51,000|

The total number of fractures was estimated to rise from approximately 2,600 in 2010 to 3,800 in 2025 (Table 15), corresponding to an increase of 43%. Hip, clinical spine, forearm and other fractures increased by 200, 200, 100 and 600 respectively. The increase in the number of fractures ranged from 30% to 52%, depending on fracture site. The increase was estimated to be particularly marked in men (58%) compared to women (36%).

Table 15  Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Malta

| Fracture Site | 2010 | 2025 | 2020 | 2025 |
|---------------|------|------|------|------|
|                   |       |       |       |       |
| Women           |       |       |       |       |
| Hip 50–74       | 103   | 135   | 153   | 192   |
| 75+             | 228   | 338   | 130   | 196   |
| All             | 331   | 473   | 283   | 388   |
| Forearm 50–74   | 54    | 70    | 95    | 118   |
| 75+             | 64    | 138   | 50    | 109   |
| All             | 117   | 208   | 144   | 227   |
| Other 50–74     | 156   | 205   | 248   | 310   |
| 75+             | 292   | 476   | 180   | 305   |
| All             | 448   | 681   | 428   | 614   |

Table 16  Current and future cost (€000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Malta

| Age Group | 2010 | 2015 | 2020 | 2025 |
|-----------|------|------|------|------|
| Women     |      |      |      |      |
| 50–74     | 5    | 5    | 6    | 6    |
| 75+       | 7    | 7    | 8    | 10   |
| All       | 12   | 13   | 14   | 16   |
| Men       |      |      |      |      |
| 50–74     | 3    | 3    | 4    | 4    |
| 75+       | 2    | 3    | 2    | 4    |
| All       | 5    | 6    | 7    | 8    |
| Women and Men | | | | |
| 50–74 | 8  | 8  | 10  | 10 |
| 75+    | 9  | 10 | 11  | 14 |
| All    | 17 | 19 | 21  | 24 |

Table 17  Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Malta

| Fracture Type | 2010 | 2025 | 2020 | 2025 |
|---------------|------|------|------|------|
| Women         |      |      |      |      |
| Incident      | 128  | 159  | 102  | 112  |
| Prior         | 136  | 203  | 200  | 235  |
| All           | 264  | 362  | 302  | 347  |
| Men           |      |      |      |      |
| Incident      | 86   | 107  | 60   | 67   |
| Prior         | 52   | 113  | 45   | 68   |
| All           | 137  | 220  | 105  | 136  |
| Women and Men |     |     |     |     |
| Incident      | 213  | 266  | 162  | 179  |
| Prior         | 188  | 316  | 245  | 304  |
| All           | 401  | 582  | 407  | 483  |
to women (25%). Incident and prior fractures accounted for about 70% and 33% of the increase respectively. The cost of osteoporosis including value of QALY’s lost was estimated to increase from approximately €41 million in 2010 to €55 million in 2025. The increase was estimated to be particularly marked in men (+50%) compared to women (+29%) (Table 18).

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### Table 18

|                | 2010 | 2015 | 2020 | 2025 |
|----------------|------|------|------|------|
| **Women**      |      |      |      |      |
| 50–74          | 12   | 12   | 14   | 14   |
| 75+            | 17   | 18   | 19   | 23   |
| All            | 29   | 30   | 33   | 37   |
| **Men**        |      |      |      |      |
| 50–74          | 7    | 8    | 9    | 9    |
| 75+            | 5    | 6    | 7    | 9    |
| All            | 12   | 14   | 16   | 18   |
| **Women and Men** |    |      |      |      |
| 50–74          | 19   | 20   | 23   | 23   |
| 75+            | 22   | 24   | 26   | 32   |
| All            | 41   | 44   | 49   | 55   |
Abstract

This report describes epidemiology, burden, and treatment of osteoporosis in the Netherlands. Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in the Netherlands, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods

The literature on fracture incidence and costs of fractures in the Netherlands was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap. Results

It was estimated that approximately 76,000 new fragility fractures were sustained in the Netherlands, comprising 13,000 hip fractures, 12,000 vertebral fractures, 12,000 forearm fractures and 38,000 other fractures (i.e. fractures of the pelvis, rib, humerus, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at € 824 million for the same year. Incident fractures represented 44 % of this cost, long-term fracture care 53 % and pharmacological prevention 4 %. Previous and incident fractures also accounted for 26,300 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 107,000 in
2025, representing an increase of 31,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 6,100, 4,800, 3,900 and 15,900, respectively. The burden of fractures in the Netherlands in 2025 was estimated to increase by 30 % to €1,069 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions
In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction
Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in the Netherlands in 2010 and beyond.

Methods
The literature on fracture incidence and costs of fractures in the Netherlands was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

| Age (years) | Women | Men | All |
|-------------|-------|-----|-----|
| 50–54       | 37,107| 14,900| 52,007|
| 55–59       | 51,936| 19,215| 71,151|
| 60–64       | 76,648| 31,378| 108,026|
| 65–69       | 79,790| 28,564| 108,354|
| 70–74       | 91,233| 22,854| 114,087|
| 75–79       | 105,000| 22,145| 127,145|
| 80+         | 201,544| 36,188| 237,732|
| 50+         | 643,258| 175,244| 818,502|

Epidemiology of osteoporosis in the Netherlands
For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 2,798,000 and 3,095,000 respectively in the Netherlands in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 820,000 (Table 2). There are 10.7 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A

| Age (years) | Women | Men |
|-------------|-------|-----|
| 50–54       | 21    | 54  |
| 55–59       | 39    | 107 |
| 60–64       | 60    | 106 |
| 65–69       | 108   | 158 |
| 70–74       | 220   | 310 |
| 75–79       | 480   | 467 |
| 80–84       | 887   | 558 |
| 85+         | 1,468 | 691 |

| Fracture at the |
| Age (years) | Hip | Vertebra | Forearm | Other |
|-------------|-----|----------|---------|-------|
| Women       |     |          |         |       |
| 50–54       | 21  | 54       | 133     | 137   |
| 55–59       | 39  | 107      | 296     | 339   |
| 60–64       | 60  | 106      | 227     | 232   |
| 65–69       | 108 | 158      | 263     | 370   |
| 70–74       | 220 | 310      | 395     | 623   |
| 75–79       | 480 | 467      | 469     | 1,011 |
| 80–84       | 887 | 558      | 555     | 1,509 |
| 85+         | 1,468 | 691   | 627     | 2,466 |

| Men         |     |          |         |       |
|-------------|-----|----------|---------|-------|
| 50–54       | 20  | 52       | 19      | 90    |
| 55–59       | 29  | 51       | 45      | 274   |
| 60–64       | 43  | 104      | 82      | 427   |
| 65–69       | 73  | 115      | 110     | 471   |
| 70–74       | 127 | 194      | 81      | 652   |
| 75–79       | 247 | 284      | 70      | 659   |
| 80–84       | 528 | 367      | 102     | 1,405 |
| 85+         | 919 | 617      | 169     | 2,663 |

Table 1 Population at risk: men and women over the age of 50 in the Netherlands, 2010 [1]

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in the Netherlands by age using female-derived reference ranges at the femoral neck, 2010 [4]
country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for the Netherlands [5]. Given that country specific incidence of the vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 163.8 and 368.3 respectively.

The number of incident fractures in 2010 was estimated at 76,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 13,000, 12,000, 12,000 and 38,000 respectively. 64 % of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.27 % for hip and 1.39 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 75,000 and 82,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 870 (Table 8). Hip, vertebral and “other” fractures accounted for 431, 285 and 154 deaths respectively. Overall, approximately 50 % of deaths occurred in women.

### Table 4 Estimated number of incident fractures in the Netherlands, 2010

| Age (years) | Hip | Vertebral | Forearm | Other | All fractures |
|-------------|-----|-----------|---------|-------|---------------|
| **Women**   |     |           |         |       |               |
| 50–74       | 2,100 | 3,327    | 6,445   | 8,353 | 20,224        |
| 75+         | 7,267 | 3,842    | 3,873   | 13,591| 28,574        |
| Total       | 9,367 | 7,169    | 10,318  | 21,944| 48,797        |
| **Men**     |     |           |         |       |               |
| 50–74       | 1,404 | 2,467    | 1,602   | 9,215 | 14,488        |
| 75+         | 2,624 | 1,988    | 550     | 7,299 | 12,461        |
| Total       | 4,028 | 4,455    | 2,152   | 16,514| 27,149        |
| **Men and Women** | | | | | |
| 50–74       | 3,503 | 5,794    | 8,047   | 17,567| 34,111        |
| 75+         | 9,892 | 5,830    | 4,423   | 20,890| 41,034        |
| Total       | 13,395| 11,624   | 12,470  | 38,457| 75,946        |

### Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in the Netherlands, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| **Women**   |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.2          | 0.5                |
| 60–64       | 0.4          | 0.9                |
| 65–69       | 0.8          | 1.3                |
| 70–74       | 1.4          | 2.2                |
| 75–79       | 2.7          | 3.5                |
| 80–84       | 5.3          | 5.0                |
| 85+         | 11.3         | 7.8                |
| **Men**     |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.2          | 0.3                |
| 60–64       | 0.3          | 0.6                |
| 65–69       | 0.6          | 0.9                |
| 70–74       | 0.9          | 1.2                |
| 75–79       | 1.6          | 1.8                |
| 80–84       | 2.8          | 2.6                |
| 85+         | 6.3          | 4.8                |

### Table 6 Number of men and women in the Netherlands with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| **Women**   |              |                    |
| 50–74       | 11,262       | 20,555             |
| 75+         | 42,920       | 37,084             |
| Total       | 54,182       | 57,639             |
| **Men**     |              |                    |
| 50–74       | 7,873        | 13,111             |
| 75+         | 12,539       | 11,455             |
| Total       | 20,412       | 24,566             |
| **Men and Women** | | | |
| 50–74       | 19,135       | 33,666             |
| 75+         | 55,459       | 48,539             |
| Total       | 74,594       | 82,206             |

### Cost of osteoporosis in the Netherlands including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures...
that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of a hip fracture has been estimated at €10,458 in the Netherlands [6]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€63,685 [7]) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €23 [8] and a DXA scan at €84 [8] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €824 million (Table 10). First year costs, subsequent year costs

Table 7 Incidence (per 100,000) of causally related deaths in the Netherlands within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
| Women       |     |                    |                  |
| 50–54       | 680 | 884                | 18               |
| 55–59       | 848 | 1,043              | 25               |
| 60–64       | 1,104 | 1,283             | 35               |
| 65–69       | 1,436 | 1,574             | 54               |
| 70–74       | 1,804 | 1,862             | 82               |
| 75–79       | 2,172 | 2,098             | 136              |
| 80–84       | 2,455 | 2,173             | 274              |
| 85–89       | 2,856 | 2,220             | 500              |
| 90+         | 2,755 | 1,553             | 958              |
| Men         |     |                    |                  |
| 50–54       | 1,225 | 1,469             | 19               |
| 55–59       | 1,614 | 1,835             | 33               |
| 60–64       | 1,968 | 2,116             | 53               |
| 65–69       | 2,532 | 2,569             | 91               |
| 70–74       | 3,236 | 3,081             | 146              |
| 75–79       | 4,469 | 3,963             | 265              |
| 80–84       | 5,520 | 4,483             | 464              |
| 85–89       | 7,038 | 5,144             | 760              |
| 90+         | 9,705 | 6,315             | 1,214            |

Table 8 The number of deaths in men and women in the Netherlands in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Fracture at the vertebra | “Other” |
|-------------|-----|--------------------------|---------|
| Women       |     |                          |         |
| 50–74       | 32  | 52                       | 5       |
| 75+         | 187 | 75                       | 85      |
| Total       | 219 | 126                      | 90      |
| Men         |     |                          |         |
| 50–74       | 38  | 64                       | 8       |
| 75+         | 174 | 95                       | 56      |
| Total       | 212 | 159                      | 65      |
| Men and Women|    |                          |         |
| 50–74       | 71  | 116                      | 13      |
| 75+         | 360 | 169                      | 141     |
| Total       | 431 | 285                      | 154     |

Table 9 One year costs for relevant pharmaceuticals in the Netherlands for 2010 [9]

| Annual drug cost (€) |
|----------------------|
| Alendronate 4         |
| Risedronate 23        |
| Etidronate 354        |
| Ibandronate 302       |
| Zoledronic acid 377   |
| Raloxifene 325        |
| Strontium ranelate 433|
| Parathyroid hormone 5,705|
| Teriparatide 5,811    |

Table 10 Cost of osteoporosis (€) in the Netherlands by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| Women       |                          |                            |                          |            |
| 50–74       | 77,335,965               | 44,567,025                 | 16,334,056               | 138,237,046|
| 75+         | 149,330,380              | 261,832,402                | 9,086,295                | 420,249,077|
| Total       | 226,666,344              | 306,399,427                | 25,420,351               | 558,486,123|
| Men         |                          |                            |                          |            |
| 50–74       | 68,719,726               | 36,970,037                 | 2,567,776                | 108,257,539|
| 75+         | 64,746,573               | 91,085,493                 | 1,010,578                | 156,842,644|
| Total       | 133,466,299              | 128,055,530                | 3,578,354                | 265,100,183|
| Men and Women|                         |                            |                          |            |
| 50–74       | 146,055,691              | 81,537,062                 | 18,901,832               | 246,494,584|
| 75+         | 214,076,953              | 352,917,895                | 10,096,873               | 577,091,721|
| Total       | 360,132,643              | 434,454,958                | 28,998,705               | 823,586,306|
Table 11 Total cost (€) in 2010 by fracture site in men and women in the Netherlands. Note that costs for fracture prevention therapy and monitoring are not included

| Age     | Hip          | Spine        | Forearm      | Other         | All            |
|---------|--------------|--------------|--------------|---------------|----------------|
|         | Women        | Men          | Women        | Men           | Women          |
| 50–74   | 65,689,649   | 50,676,403   | 7,407,122    | 4,117,967     | 44,688,252     |
| 75+     | 329,294,607  | 112,887,327  | 8,080,393    | 2,474,901     | 71,312,881     |
| All     | 394,984,256  | 163,563,730  | 15,487,515   | 6,592,868     | 116,001,132    |

|         | Men          | Women        | Men          | Women        | Men and Women  |
|---------|--------------|--------------|--------------|--------------|----------------|
| 50–74   | 50,676,403   | 116,366,053  | 5,141,874    | 93,328,066   | 227,592,753    |
| 75+     | 112,887,327  | 442,181,933  | 2,826,021    | 110,070,512  | 566,994,848    |
| All     | 163,563,730  | 558,547,986  | 7,967,895    | 203,398,578  | 794,587,601    |

and pharmacological fracture prevention costs amounted to € 360 million, € 434 million and € 29 million respectively. It is notable that pharmacological fracture prevention costs amounted to only 3.5 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€ 559 million) followed by “other” (€ 203 million), spine (€ 25 million) and forearm fractures (€ 8 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 26,300 (Table 12). 66 % of the total QALY loss was incurred in women. Prior fractures accounted for 57 % of the total QALY loss. The monetary value of a QALY

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in the Netherlands according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 506   | 1,519 | 2,025 |
| Incident vertebral fractures | 1,105 | 1,103 | 2,207 |
| Incident forearm fractures | 228   | 118  | 346  |
| Incident other fractures | 1,004 | 1,410 | 2,414 |
| Prior hip fractures | 1,771 | 5,770 | 7,540 |
| Prior vertebral fractures | 1,153 | 1,797 | 2,949 |
| Total       | 5,767 | 11,715 | 17,482 |
| Men         |       |     |     |
| Incident hip fractures | 341   | 629  | 970  |
| Incident vertebral fractures | 817   | 634  | 1,451 |
| Incident forearm fractures | 56    | 18   | 73   |
| Incident other fractures | 1,091 | 830  | 1,920 |
| Prior hip fractures | 1,230 | 1,854 | 3,084 |
| Prior vertebral fractures | 729   | 603  | 1,332 |
| Total       | 4,263 | 4,567 | 8,830 |
| Men and Women |       |     |     |
| Incident hip fractures | 848   | 2,147 | 2,995 |
| Incident vertebral fractures | 1,921 | 1,736 | 3,658 |
| Incident forearm fractures | 284   | 136  | 419  |
| Incident other fractures | 2,095 | 2,240 | 4,334 |
| Prior hip fractures | 3,001 | 7,623 | 10,624 |
| Prior vertebral fractures | 1,881 | 2,400 | 4,281 |
| Total       | 10,030 | 16,282 | 26,312 |
was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €1.86 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €2.69 billion in Netherlands in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 13 %, 16 %, 1 % and 69 %, respectively.

**Burden of osteoporosis up to 2025**

The population above 50 years of age is expected to increase from 5.9 million in 2010 to 7.4 million in 2025, corresponding to an increase of 26 % (Table 14).

The total number of fractures was estimated to rise from 76,000 in 2010 to 107,000 in 2025 (Table 15), corresponding to an increase of 41 %. Hip, clinical spine, forearm and other fractures increased by 6,100, 4,800, 3,900 and 15,900 respectively. The increase in the number of fractures ranged from 31 % to 45 %, depending on fracture site. The increase was estimated to be particularly marked in men (51 %) compared to women (35 %).

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from €824 million in 2010 to €1,069 million in 2025, corresponding to an increase of 30 % (Table 16). Costs incurred in women and men increased by 23 % and 44 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 26,300 in 2010 to 33,800 in 2025, corresponding to an increase of 28 % (Table 17). The increase was estimated to be particularly marked in men (41 %) compared to women (22 %). Incident and prior fractures accounted for 63 % and 37 % of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €2.7 billion in 2010 to €3.5 billion in 2025. The increase was estimated to be particularly marked in men (+42 %) compared to women (+22 %) (Table 18).

**Treatment uptake**

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who

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**Table 13** Value of lost QALYs (€) in men and women in the Netherlands in 2010

|                          | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|--------------------------|----------------|----------------|----------------|
| Incident hip fractures   | 106,032,591    | 212,065,182    | 318,097,773    |
| Incident vertebral fractures | 129,487,389   | 258,974,778    | 388,462,167    |
| Incident forearm fractures | 14,843,773     | 29,687,545     | 44,531,318     |
| Incident other fractures  | 153,439,417    | 306,878,834    | 460,318,251    |
| Prior hip fractures       | 376,090,222    | 752,180,445    | 1,128,270,667  |
| Prior vertebral fractures | 151,554,259    | 303,108,518    | 454,662,777    |
| Total                    | 931,447,651    | 1,862,895,302  | 2,794,342,954  |

**Table 14** Population projections in the Netherlands by age and sex [10]

|                | 2010  | 2015  | 2020  | 2025  |
|----------------|-------|-------|-------|-------|
|                | Women |       |       |       |
| 50–59          | 1,130,000 | 1,214,000 | 1,258,000 | 1,208,000 |
| 60–69          | 931,000  | 1,045,000 | 1,078,000 | 1,160,000 |
| 70–79          | 607,000  | 665,000  | 824,000  | 927,000  |
| 80–89          | 360,000  | 375,000  | 399,000  | 448,000  |
| 90+            | 67,000   | 85,000   | 99,000   | 109,000  |
|                | Men    |       |       |       |
| 50–59          | 1,145,000 | 1,230,333 | 1,283,000 | 1,217,000 |
| 60–69          | 927,000  | 1,037,000 | 1,062,000 | 1,147,000 |
| 70–79          | 508,000  | 590,000  | 751,000  | 843,000  |
| 80–89          | 198,000  | 230,000  | 267,000  | 322,000  |
| 90+            | 20,000   | 29,000   | 37,000   | 46,000   |
|                | All    |       |       |       |
| 50–59          | 2,275,000 | 2,444,333 | 2,541,000 | 2,425,000 |
| 60–69          | 1,858,000 | 2,082,000 | 2,140,000 | 2,307,000 |
| 70–79          | 1,115,000 | 1,255,000 | 1,575,000 | 1,770,000 |
| 80–89          | 558,000  | 605,000  | 666,000  | 770,000  |
| 90+            | 87,000   | 114,000  | 136,000  | 155,000  |

|                |       |       |       |       |
|----------------|-------|-------|-------|-------|
|                | 5,893,000 |       | 7,427,000 |       |
were treated increased from 2.2% in 2001 to 4.69% in 2011.

**Treatment gap**

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in the Netherlands were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 52% and 60% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

**Table 15** Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in the Netherlands

|          | Hip 2010 | Spine 2010 | Forearm 2010 | Other 2010 | Hip 2025 | Spine 2025 | Forearm 2025 | Other 2025 |
|----------|----------|------------|--------------|------------|----------|------------|--------------|------------|
| Women    |          |            |              |            |          |            |              |            |
| 50−74    | 2,100    | 2,780      | 3,327        | 4,263      | 6,445    | 7,950      | 8,353        | 10,575     |
| 75+      | 7,267    | 10,154     | 3,842        | 5,424      | 3,873    | 5,442      | 13,591       | 19,077     |
| All      | 9,367    | 12,934     | 7,169        | 9,687      | 10,318   | 13,392     | 21,944       | 29,652     |
| Men      |          |            |              |            |          |            |              |            |
| 50−74    | 1,404    | 1,852      | 2,467        | 3,160      | 1,602    | 1,982      | 9,215        | 11,697     |
| 75+      | 2,624    | 4,678      | 1,988        | 3,580      | 550      | 987        | 7,299        | 13,036     |
| All      | 4,028    | 6,530      | 4,455        | 6,739      | 2,152    | 2,969      | 16,514       | 24,733     |
| Women and Men |        |            |              |            |          |            |              |            |
| 50−74    | 3,503    | 4,632      | 5,794        | 7,423      | 8,047    | 9,932      | 17,567       | 22,272     |
| 75+      | 9,892    | 14,833     | 5,830        | 9,004      | 4,423    | 6,429      | 20,890       | 32,113     |
| All      | 13,395   | 19,465     | 11,624       | 16,427     | 12,470   | 16,361     | 38,457       | 54,386     |

**Table 16** Current and future cost (€ 000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in the Netherlands

|          | 2010   | 2015   | 2020   | 2025   |
|----------|--------|--------|--------|--------|
| Women    |        |        |        |        |
| 50−74    | 138    | 152    | 167    | 172    |
| 75+      | 420    | 437    | 466    | 517    |
| All      | 558    | 589    | 633    | 689    |
| Men      |        |        |        |        |
| 50−74    | 108    | 120    | 132    | 137    |
| 75+      | 157    | 174    | 201    | 243    |
| All      | 265    | 294    | 333    | 381    |
| Women and Men |    |        |        |        |
| 50−74    | 246    | 272    | 299    | 309    |
| 75+      | 577    | 611    | 667    | 760    |
| All      | 824    | 882    | 966    | 1,069  |

**Table 17** Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in the Netherlands

|          | Incident fractures | Prior fractures | All fractures |
|----------|--------------------|----------------|---------------|
|          | 2010   | 2015   | 2020   | 2025   | 2010   | 2015   | 2020   | 2025   | 2010   | 2015   | 2020   | 2025   |
| Women    |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 50−74    | 2,843  | 3,624  | 2,924  | 3,258  | 5,767  | 6,882  |
| 75+      | 4,149  | 5,816  | 7,566  | 8,624  | 11,715 | 14,440 |
| All      | 6,992  | 9,441  | 10,490 | 11,881 | 17,482 | 21,322 |
| Men      |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 50−74    | 2,954  | 2,945  | 1,959  | 2,298  | 4,263  | 5,244  |
| 75+      | 2,110  | 3,711  | 2,457  | 3,473  | 4,567  | 7,244  |
| All      | 4,414  | 6,716  | 4,416  | 5,771  | 8,830  | 12,487 |
| Women and Men |    |        |        |        |        |        |        |        |        |        |        |        |        |
| 50−74    | 5,148  | 6,570  | 4,882  | 5,556  | 10,030 | 12,126 |
| 75+      | 6,259  | 9,587  | 10,023 | 12,097 | 16,282 | 21,684 |
| All      | 11,407 | 16,157 | 14,905 | 17,652 | 26,312 | 33,809 |
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Table 18 Present and future cost (£ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in the Netherlands assuming the uptake of treatment remains unchanged

|        | 2010  | 2015  | 2020  | 2025  |
|--------|-------|-------|-------|-------|
| Women  |       |       |       |       |
| 50–74  | 547   | 590   | 637   | 659   |
| 75+    | 1,250 | 1,315 | 1,400 | 1,539 |
| All    | 1,796 | 1,905 | 2,036 | 2,198 |
| Men    |       |       |       |       |
| 50–74  | 410   | 444   | 483   | 509   |
| 75+    | 480   | 529   | 614   | 756   |
| All    | 890   | 973   | 1,097 | 1,265 |
| Women and Men | | | | |
| 50–74  | 957   | 1,033 | 1,119 | 1,168 |
| 75+    | 1,730 | 1,844 | 2,014 | 2,296 |
| All    | 2,686 | 2,877 | 3,133 | 3,463 |

Fig. 2 Treatment uptake in the Netherlands (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|         | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|---------|-----------------------------------|---------------------------------------|---------------------|-------------------|
| Men     | 36                                | 76                                    | 40                  | 52                |
| Women   | 242                               | 605                                   | 363                 | 60                |
Epidemiology and Economic Burden of Osteoporosis in Poland

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Poland.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Poland, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in the EU27 was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 168,000 new fragility fractures were sustained in Poland, comprising 28,000 hip fractures, 26,000 vertebral fractures, 28,000 forearm fractures and 85,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula,
Sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €593 million for the same year. Incident fractures represented 60% of this cost, long-term fracture care 27% and pharmacological prevention 13%. Previous and incident fractures also accounted for 53,300 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 209,000 in 2025, representing an increase of 42,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 9,200, 6,800, 4,600 and 21,100, respectively. The burden of fractures in Poland in 2025 was estimated to increase by 27% to €753 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by an aging population, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Poland in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Poland was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Poland

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 5,822,000 and 7,528,000 respectively in Poland in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria by DXA at the femoral neck [2]—was estimated at 1,850,000 (Table 2). There are 4.3 DXA scan machines per million inhabitants [3], and guidelines for the assessment and treatment of osteoporosis are available [4]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Poland [6]. Given that country specific incidence of vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 166.5 and 333.2 respectively.

The number of incident fractures in 2010 was estimated at 168,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 28,000, 26,000, 28,000 and 85,000 respectively. 61% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e.

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–59      | 3,111,000 | 2,872,000 | 5,983,000 |
| 60–69      | 1,938,000 | 1,575,000 | 3,513,000 |
| 70–79      | 1,562,000 | 988,000 | 2,550,000 |
| 80–89      | 827,000 | 359,000 | 1,186,000 |
| 90+        | 90,000 | 28,000 | 118,000 |
| 50+        | 7,528,000 | 5,822,000 | 13,350,000 |

Table 1 Population at risk: men and women over the age of 50 in Poland, 2010 [1]

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–54      | 98,532 | 37,075 |
| 55–59      | 148,512 | 48,615 |
| 60–64      | 166,738 | 57,420 |
| 65–69      | 228,222 | 42,588 |
| 70–74      | 279,000 | 45,526 |
| 80+        | 1,509,772 | 338,756 |

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Poland by age using female-derived reference ranges at the femoral neck, 2010 [5].
2010) which had occurred after the age of 50 years and before 2010. In the population \( \geq 50 \) years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.04% for hip and 1.09% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Poland by age

| Age (years) | Fracture at the | Women | | | |
| --- | --- | --- | --- | --- | --- |
| | hip | vertebral | forearm | other | |
| 50–54 | 19 | 49 | 121 | 124 | |
| 55–59 | 34 | 93 | 258 | 296 | |
| 60–64 | 57 | 101 | 217 | 221 | |
| 65–69 | 95 | 139 | 232 | 326 | |
| 70–74 | 176 | 248 | 316 | 499 | |
| 75–79 | 377 | 366 | 368 | 793 | |
| 80–84 | 794 | 499 | 497 | 1,351 | |
| 85+ | 1,356 | 638 | 579 | 2,278 | |

| Age (years) | Fracture at the | Men | | | |
| --- | --- | --- | --- | --- | --- |
| | hip | vertebral | forearm | other | |
| 50–54 | 40 | 102 | 37 | 177 | |
| 55–59 | 59 | 102 | 90 | 548 | |
| 60–64 | 75 | 179 | 141 | 735 | |
| 65–69 | 109 | 171 | 164 | 702 | |
| 70–74 | 163 | 249 | 105 | 840 | |
| 75–79 | 234 | 270 | 66 | 626 | |
| 80–84 | 422 | 293 | 82 | 1,122 | |
| 85+ | 713 | 479 | 131 | 2,066 | |

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 139,000 and 145,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 2,343 (Table 8). Hip,
vertebral and “other” fractures accounted for 1,083, 941 and 319 deaths respectively. Overall, approximately 49% of deaths occurred in women.

Table 7  Incidence (per 100,000) of causally related deaths in Poland within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|-----------------|
|             |     |                    |                 |
| Women       |     |                    |                 |
| 50–54       | 833 | 1,083              | 22              |
| 55–59       | 1,113 | 1,369             | 33              |
| 60–64       | 1,634 | 1,897             | 52              |
| 65–69       | 2,006 | 2,199             | 75              |
| 70–74       | 2,406 | 2,482             | 110             |
| 75–79       | 3,061 | 2,957             | 192             |
| 80–84       | 3,224 | 2,852             | 359             |
| 85–89       | 3,833 | 2,979             | 671             |
| 90+         | 3,074 | 1,733             | 1,069           |
| Men         |     |                    |                 |
| 50–54       | 3,762 | 4,512             | 59              |
| 55–59       | 4,247 | 4,828             | 87              |
| 60–64       | 4,828 | 5,192             | 131             |
| 65–69       | 5,261 | 5,337             | 189             |
| 70–74       | 5,638 | 5,368             | 254             |
| 75–79       | 6,221 | 5,517             | 369             |
| 80–84       | 6,684 | 5,428             | 561             |
| 85–89       | 7,996 | 5,844             | 864             |
| 90+         | 9,811 | 6,384             | 1,227           |

Table 8  The number of deaths in men and women in Poland in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | hip | Fracture at the vertebra | “other” |
|-------------|-----|--------------------------|--------|
|             |     |                          |        |
| Women       |     |                          |        |
| 50–74       | 94  | 155                      | 13     |
| 75+         | 492 | 221                      | 178    |
| Total       | 586 | 377                      | 191    |
| Men         |     |                          |        |
| 50–74       | 212 | 399                      | 46     |
| 75+         | 285 | 166                      | 82     |
| Total       | 497 | 564                      | 128    |
| Men and Women |   |                          |        |
| 50–74       | 305 | 554                      | 59     |
| 75+         | 777 | 387                      | 260    |
| Total       | 1,083 | 941                    | 319    |

Table 10  Cost of osteoporosis (€) in Poland by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|---------------------------|--------------------------|------------|
| Women       |                          |                           |                          |            |
| 50–74       | 76,051,767               | 19,459,338                | 42,540,306               | 138,051,410 |
| 75+         | 142,746,486              | 93,089,492                | 24,371,014               | 260,206,993 |
| All         | 218,798,253              | 112,548,830               | 66,911,320               | 398,258,404 |
| Men         |                          |                           |                          |            |
| 50–74       | 93,235,897               | 18,920,290                | 6,818,347                | 118,974,533 |
| 75+         | 43,307,481               | 30,231,492                | 2,607,353                | 76,146,326 |
| All         | 136,543,378              | 49,151,780                | 9,425,700                | 195,120,860 |
| Women and Men |                     |                           |                          |            |
| 50–74       | 169,287,663              | 38,379,628                | 49,358,652               | 257,025,944 |
| 75+         | 186,053,968              | 123,320,985               | 26,978,367               | 336,353,320 |
| All         | 355,341,631              | 161,700,613               | 76,337,020               | 593,379,263 |

Cost of osteoporosis in Poland including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

As the cost of a hip fracture was not available specifically for Poland, hip fracture costs were estimated at € 4,881 based on data from the Czech Republic [7]. No other fracture costs were available. Given that no cost data for the
other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€ 13,242 \[8, 9\], an average of 4 long term care facilities in Germany, PPP adjusted) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 17 \[10\] and a DXA scan costing € 10 \[11\] every second year to monitor treatment.

Table 11 Total cost (€) in 2010 by fracture site in men and women in Poland. Note that costs for fracture prevention therapy and monitoring are not included.

| Age | Hip     | Spine   | Forearm | Other     | All       |
|-----|---------|---------|---------|-----------|-----------|
|     | Women   |         |         |           |           |
| 50–74|40,388,779|7,574,863|4,198,680|43,348,783|95,511,105|
| 75+ |157,503,072|8,138,204|2,425,701|67,769,002|235,835,979|
| All |197,891,852|15,713,067|6,624,381|111,117,784|331,347,083|

|     | Men     |         |         |           |           |
|-----|---------|---------|---------|-----------|-----------|
| 50–74|36,877,575|7,281,384|1,555,314|66,441,914|112,156,187|
| 75+ |44,580,225|2,576,620|239,586 |26,142,542|73,538,974 |
| All |81,457,801|9,858,004|1,794,900|92,584,456|185,695,160|

|     | Women and Men |         |         |           |           |
|-----|----------------|---------|---------|-----------|-----------|
| 50–74|77,266,354|14,856,247|5,753,994|109,790,696|207,667,291|
| 75+ |202,083,298|10,714,823|2,665,287|93,911,544|309,374,952|
| All |279,349,652|25,571,071|8,419,281|203,702,240|517,042,244|

Annual drug costs (€) for individual treatments are shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing € 17 \[10\] and a DXA scan costing € 10 \[11\] every second year to monitor treatment.

Table 11 Total cost (€) in 2010 by fracture site in men and women in Poland. Note that costs for fracture prevention therapy and monitoring are not included.

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|-----|---------|---------|---------|-----------|-----------|
|     | Women   |         |         |           |           |
| 50–74|40,388,779|7,574,863|4,198,680|43,348,783|95,511,105|
| 75+ |157,503,072|8,138,204|2,425,701|67,769,002|235,835,979|
| All |197,891,852|15,713,067|6,624,381|111,117,784|331,347,083|

|     | Men     |         |         |           |           |
|-----|---------|---------|---------|-----------|-----------|
| 50–74|36,877,575|7,281,384|1,555,314|66,441,914|112,156,187|
| 75+ |44,580,225|2,576,620|239,586 |26,142,542|73,538,974 |
| All |81,457,801|9,858,004|1,794,900|92,584,456|185,695,160|

|     | Women and Men |         |         |           |           |
|-----|----------------|---------|---------|-----------|-----------|
| 50–74|77,266,354|14,856,247|5,753,994|109,790,696|207,667,291|
| 75+ |202,083,298|10,714,823|2,665,287|93,911,544|309,374,952|
| All |279,349,652|25,571,071|8,419,281|203,702,240|517,042,244|

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**Fig. 1** Share (%) of fracture cost by fracture site in Poland. Note that costs for fracture prevention therapy and monitoring are not included.
The cost of osteoporosis in 2010 was estimated at €593 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €355 million, €162 million and €76 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 12.8% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€279 million) followed by "other" (€204 million), spine (€26 million) and forearm fractures (€8 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 53,300 (Table 12). Prior fractures accounted for 52% of the total loss and 64% of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €990 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €1,580 million in Poland in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 22%, 10%, 5%, and 63% respectively.

**Burden of osteoporosis up to 2025**

The population above 50 years of age is expected to increase from 13.4 million in 2010 to 14.7 million in 2025, corresponding to an increase of 10% (Table 14).

The total number of fractures was estimated to rise from 168,000 in 2010 to 209,000 in 2025 (Table 15), corresponding to an increase of 25%. Hip, clinical spine, forearm and other fractures increased by 9,200, 6,800, 4,600 and 21,100 respectively. The increase in the number of fractures ranged from 16% to 33%, depending on fracture site. The increase was estimated to be particularly marked in women (27%) compared to men (22%).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €593 million in 2010 to €753 million in 2025, corresponding to an increase of 27% (Table 16). Costs incurred in women and men both increased by 27%.

The total number of QALYs lost due to fracture was estimated to rise from 53,300 in 2010 to 64,800 in 2025, corresponding to an increase of 22%. The increase was estimated to be 21% in men and 22% in women. Incident and prior fractures accounted for 57% and 43% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €1.6 billion in 2010 to €2.0 billion in 2025. The increase was estimated to be 23% in men and 24% in women (Table 18).

**Treatment uptake**

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to
derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.59 % in 2001 to 2.46 % in 2007 but subsequently decreased to 2.10 % in 2011.

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Poland were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis

| Table 15  | Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Poland |
|-----------|---------------------------------------------------------------------------------------------------------------|
|           | Hip 2010 | Spine 2010 | Forearm 2010 | Other 2010 | Hip 2025 | Spine 2025 | Forearm 2025 | Other 2025 |
|-----------|----------|------------|--------------|-----------|----------|------------|--------------|-----------|
| **Women** |          |            |              |           |          |            |              |           |
| 50–74     | 4,519    | 6,186      | 7,390        | 9,276     | 14,078   | 15,745     | 17,989       | 21,567    |
| 75+       | 15,145   | 20,281     | 8,445        | 10,820    | 8,133    | 10,070     | 27,134       | 36,491    |
| All       | 19,665   | 26,467     | 15,835       | 20,096    | 22,211   | 25,815     | 45,124       | 58,058    |
| **Men**   |          |            |              |           |          |            |              |           |
| 50–74     | 4,181    | 5,353      | 7,678        | 9,258     | 5,215    | 5,932      | 29,884       | 34,535    |
| 75+       | 3,799    | 5,038      | 2,931        | 3,931     | 803      | 1,073      | 10,337       | 13,831    |
| All       | 7,981    | 10,391     | 10,609       | 13,189    | 6,018    | 7,005      | 40,221       | 48,366    |
| **Women and Men** |          |            |              |           |          |            |              |           |
| 50–74     | 8,700    | 11,539     | 15,068       | 18,534    | 19,292   | 21,677     | 47,873       | 56,101    |
| 75+       | 18,945   | 25,319     | 11,376       | 14,751    | 8,936    | 11,143     | 37,471       | 50,323    |
| All       | 27,645   | 36,858     | 26,444       | 33,285    | 28,229   | 32,820     | 85,345       | 106,424   |

| Table 16  | Current and future cost (€000,000 of osteoporosis (excluding value of QALYs lost)) by age and calendar year in men and women in Poland |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------|
|           | 2010 | 2015 | 2020 | 2025 |
|-----------|------|------|------|------|
| **Women** |      |      |      |      |
| 50–74     | 138  | 146  | 167  | 179  |
| 75+       | 260  | 283  | 296  | 327  |
| All       | 398  | 429  | 463  | 505  |
| **Men**   |      |      |      |      |
| 50–74     | 119  | 130  | 145  | 152  |
| 75+       | 76   | 83   | 86   | 96   |
| All       | 195  | 213  | 231  | 247  |
| **Women and Men** |      |      |      |      |
| 50–74     | 257  | 276  | 312  | 330  |
| 75+       | 336  | 365  | 381  | 422  |
| All       | 593  | 641  | 694  | 753  |

| Table 17  | Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Poland |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------|
|           | Incident fractures | Prior fractures | All fractures |
|           | 2010 | 2015 | 2020 | 2025 | 2010 | 2025 | 2010 | 2025 |
|-----------|------|------|------|------|------|------|------|------|
| **Women** |      |      |      |      |      |      |      |      |
| 50–74     | 6,239| 7,692| 5,893| 7,087| 12,132| 14,778|
| 75+       | 8,790| 11,454| 13,199| 15,330| 21,989| 26,784|
| All       | 15,029| 19,145| 19,092| 22,417| 34,121| 41,562|
| **Men**   |      |      |      |      |      |      |      |      |
| 50–74     | 7,429| 8,803| 4,685| 5,608| 12,114| 14,412|
| 75+       | 3,077| 4,100| 3,959| 4,707| 7,036| 8,807|
| All       | 10,507| 12,903| 8,644| 10,316| 19,150| 23,219|
| **Women and Men** |      |      |      |      |      |      |      |      |
| 50–74     | 13,668| 16,495| 10,578| 12,695| 24,246| 29,190|
| 75+       | 11,867| 15,553| 17,158| 20,037| 29,025| 35,591|
| All       | 25,536| 32,048| 27,736| 32,732| 53,272| 64,781|
of IMS Health data. The treatment gaps in men and women were estimated at 91% and 78% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

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**Table 18** Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Poland assuming the uptake of treatment remains unchanged

|          | 2010  | 2015  | 2020  | 2025  |
|----------|-------|-------|-------|-------|
|          | Women |       |       |       |
| 50–74    | 364   | 380   | 422   | 453   |
| 75+      | 669   | 722   | 756   | 825   |
| All      | 1,033 | 1,102 | 1,178 | 1,278 |
|          | Men   |       |       |       |
| 50–74    | 344   | 366   | 397   | 420   |
| 75+      | 207   | 221   | 230   | 259   |
| All      | 551   | 586   | 627   | 679   |
|          | Women and Men | | | |
| 50–74    | 708   | 746   | 819   | 873   |
| 75+      | 876   | 943   | 986   | 1,084 |
| All      | 1,584 | 1,689 | 1,805 | 1,957 |

**Fig. 2** Treatment uptake in Poland (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

**Table 19** Number of men and women eligible for treatment, treated and treatment gap in 2010

|          | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|----------|-----------------------------------|---------------------------------------|---------------------|-------------------|
| Men      | 37                                | 414                                   | 377                 | 91                |
| Women    | 245                               | 1,127                                 | 882                 | 78                |
Epidemiology and Economic Burden of Osteoporosis in Portugal

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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creased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Portugal, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods

The literature on fracture incidence and costs of fractures in the EU27 was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results

It was estimated that approximately 52,000 new fragility fractures were sustained in Portugal, comprising 10,000 hip fractures, 8,000 vertebral fractures, 8,000 forearm fractures and 26,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €577 million for the same year. Incident fractures represented 51% of this cost, long-term fracture care 46% and pharmacological prevention 3%. Previous and incident fractures also accounted for 17,900 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 69,000 in 2025, representing an increase of 17,000 fractures. Hip, clinical spine (vertebral), forearm and other fractures were estimated to increase by 3,700, 2,400, 2,000 and 9,100, respectively. The burden of fractures in Portugal in 2025 was estimated to increase by 24% to €717 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received
treatment declined in the past few years. A substantial minority of women at high fracture risk did not receive active treatment. Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by an aging population, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Portugal in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Portugal was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Portugal

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 1,762,000 and 2,160,000 respectively in Portugal in 2010 (Table 1).

Table 1 Population at risk: men and women over the age of 50 in Portugal, 2010 [1]

| Age (years) | Women  | Men    | All     |
|-------------|--------|--------|---------|
| 50–54       | 720,000| 674,000| 1,394,000|
| 55–59       | 612,000| 528,000| 1,140,000|
| 60–64       | 516,000| 387,000| 903,000  |
| 65–69       | 271,000| 158,000| 429,000  |
| 70–74       | 41,000  | 15,000  | 56,000   |
| 80–89       | 2,160,000| 1,762,000| 3,922,000|

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Portugal by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women | Men |
|-------------|-------|-----|
| 50–54       | 23,373| 8,800|
| 55–59       | 33,504| 11,270|
| 60–64       | 46,475| 16,704|
| 65–69       | 57,974| 17,760|
| 70–74       | 76,167| 16,770|
| 75–79       | 91,125| 17,716|
| 80+         | 147,264| 28,718|
| 50+         | 475,882| 117,738|

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 590,000 (Table 2). There are 26.9 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Portugal [5]. Given that country specific incidence of vertebral, forearm, and “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Portugal by age

| Fracture at the | Women | Men |
|----------------|-------|-----|
| Age (years)    |       |     |
| 50–54          | 9     | 24  |
| 55–59          | 24    | 68  |
| 60–64          | 47    | 83  |
| 65–69          | 98    | 143 |
| 70–74          | 239   | 338 |
| 75–79          | 516   | 501 |
| 80–84          | 983   | 618 |
| 85+            | 1,700 | 800 |

Table 4 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Portugal by age

| Fracture at the | Women | Men |
|----------------|-------|-----|
| Age (years)    |       |     |
| 50–54          | 7     | 18  |
| 55–59          | 19    | 32  |
| 60–64          | 32    | 77  |
| 65–69          | 61    | 96  |
| 70–74          | 128   | 195 |
| 75–79          | 226   | 261 |
| 80–84          | 424   | 294 |
| 85+            | 789   | 530 |

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Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 139.0 and 408.2 respectively.

The number of incident fractures in 2010 was estimated at 52,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 10,000, 8,000, 8,000 and 26,000 respectively. 70 % of fractures occurred in women.

In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.33 % for hip and 1.37 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 52,000 and 54,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 665 (Table 8). Hip, vertebral and “other” fractures accounted for 336, 204 and 124 deaths respectively. Overall, approximately 55 % of deaths occurred in women.

Cost of osteoporosis in Portugal including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”) and; (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

Table 4 Estimated number of incident fractures in Portugal, 2010

| Age (years) | Fracture at the | All fractures |
|-------------|-----------------|---------------|
|             | hip vertebra forearm other |               |
| Women       |                 |               |
| 50–74       | 1,427 2,072 3,730 5,151 12,380 |               |
| 75+         | 5,931 3,160 3,323 11,350 23,764 |               |
| Total       | 7,358 5,232 7,053 16,501 36,144 |               |
| Men         |                 |               |
| 50–74       | 756 1,247 751 4,608 7,363 |               |
| 75+         | 1,174 1,326 369 8,747 5,315 |               |
| Total       | 2,502 2,573 1,120 9,482 15,677 |               |
| Men and Women |                 |               |
| 50–74       | 2,183 3,319 4,481 9,759 19,742 |               |
| 75+         | 7,677 4,486 3,692 16,224 32,079 |               |
| Total       | 9,860 7,805 8,173 25,983 51,821 |               |

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Portugal, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.0          | 0.1                |
| 55–59       | 0.1          | 0.3                |
| 60–64       | 0.3          | 0.6                |
| 65–69       | 0.6          | 1.1                |
| 70–74       | 1.4          | 2.1                |
| 75–79       | 2.9          | 3.5                |
| 80–84       | 5.6          | 5.1                |
| 85+         | 12.0         | 8.2                |
| Men         |              |                    |
| 50–54       | 0.0          | 0.0                |
| 55–59       | 0.1          | 0.1                |
| 60–64       | 0.2          | 0.3                |
| 65–69       | 0.4          | 0.6                |
| 70–74       | 0.8          | 1.0                |
| 75–79       | 1.4          | 1.6                |
| 80–84       | 2.6          | 2.1                |
| 85+         | 5.5          | 4.2                |

Table 6 Number of men and women in Portugal with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 6,665        | 12,019             |
| 75+         | 33,146       | 28,770             |
| Total       | 39,811       | 40,789             |
| Men         |              |                    |
| 50–74       | 3,473        | 5,161              |
| 75+         | 8,822        | 7,703              |
| Total       | 12,295       | 12,864             |
| Men and Women |          |                     |
| 50–74       | 10,138       | 17,180             |
| 75+         | 41,968       | 36,473             |
| Total       | 52,106       | 53,653             |
The cost of a hip fracture has been estimated at €12,031 in Portugal [6]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€54,140 [7], based on nursing home costs in Spain) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug cost for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €3 [8] and a DXA scan costing €5 [9] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €577 million (Table 10). First year costs, subsequent year costs

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
| Women       |     |                    |                  |
| 50–54       | 598 | 777                | 15               |
| 55–59       | 674 | 829                | 20               |
| 60–64       | 961 | 1,116              | 31               |
| 65–69       | 1,281| 1,404              | 48               |
| 70–74       | 1,610| 1,661              | 73               |
| 75–79       | 2,311| 2,233              | 145              |
| 80–84       | 2,804| 2,481              | 312              |
| 85–89       | 3,709| 2,883              | 650              |
| 90+         | 3,025| 1,705              | 1,052            |
| Men         |     |                    |                  |
| 50–54       | 2,268| 2,721              | 36               |
| 55–59       | 2,263| 2,573              | 46               |
| 60–64       | 2,521| 2,712              | 68               |
| 65–69       | 3,055| 3,099              | 110              |
| 70–74       | 3,488| 3,321              | 157              |
| 75–79       | 4,380| 3,884              | 260              |
| 80–84       | 5,660| 4,596              | 475              |
| 85–89       | 7,681| 5,614              | 830              |
| 90+         | 9,541| 6,209              | 1,194            |

Table 8  The number of deaths in men and women in Portugal in the first year after fracture attributable to the fracture event (causally related), 2010

Table 9  One year costs for relevant pharmaceuticals in Portugal, 2010 [10]

| Annual drug | Cost (€) |
|-------------|---------|
| Alendronate | 16      |
| Risedronate | 139     |
| Etidronate  | -       |
| Ibandronate | 270     |
| Zoledronic acid | 443   |
| Raloxifene | 401     |
| Strontium ranelate | 552  |
| Parathyroid hormone | 6,106 |
| Teriparatide | 6,192   |

Table 10  Cost of osteoporosis (€) in Portugal by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention costs | Total cost |
|-------------|--------------------------|----------------------------|---------------------------|------------|
| Women       |                          |                            |                           |            |
| 50–74       | 59,496,589               | 22,916,814                 | 10,593,500                | 93,006,903 |
| 75+         | 141,746,733              | 171,432,956                | 6,703,164                 | 319,882,854 |
| All         | 201,243,322              | 194,349,771                | 17,296,664                | 412,889,757 |
| Men         |                          |                            |                           |            |
| 50–74       | 42,242,758               | 14,723,914                 | 1,613,631                 | 58,580,304 |
| 75+         | 49,414,534               | 55,086,411                 | 817,057                   | 105,318,002 |
| All         | 91,657,293               | 69,810,325                 | 2,430,688                 | 163,898,306 |
| Women and Men |                      |                            |                           |            |
| 50–74       | 101,739,347              | 37,640,729                 | 12,207,131                | 151,587,207 |
| 75+         | 191,161,268              | 226,519,367                | 7,520,221                 | 425,200,856 |
| All         | 292,900,615              | 264,160,096                | 19,727,352                | 576,788,063 |
and pharmacological fracture prevention costs amounted to €293 million, €264 million and €20 million respectively. It is notable that pharmacological fracture prevention costs amounted to only 3.5% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€368 million) followed by “other” (€164 million), spine (€19 million) and forearm fractures (€6 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 17,900 (Table 12). Prior fractures accounted for 57% of the total loss and 71% of the loss occurred in women. The monetary value of a QALY was varied

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**Table 11** Total cost (€) in 2010 by fracture site in men and women in Portugal. Note that costs for fracture prevention therapy and monitoring are not included.

| Age       | Hip       | Spine     | Forearm   | Other     | All        |
|-----------|-----------|-----------|-----------|-----------|------------|
| Women     |           |           |           |           |            |
| 50–74     | 39,441,072| 5,313,247 | 2,742,066 | 34,917,018| 82,413,403 |
| 75+       | 234,017,319| 7,577,455 | 2,442,681 | 69,142,234| 313,179,690|
| All       | 273,458,391| 12,890,703| 5,184,747 | 104,059,253| 395,593,093|
| Men       |           |           |           |           |            |
| 50–74     | 23,090,819 | 3,063,718 | 552,069   | 30,260,067| 56,966,673 |
| 75+       | 71,550,938 | 2,916,600 | 271,221   | 29,762,186| 104,500,945|
| All       | 94,641,757 | 5,980,317 | 823,290   | 60,022,253| 161,467,618|
| Women and Men |           |           |           |           |            |
| 50–74     | 62,531,891 | 8,376,965 | 3,294,135 | 65,177,085| 139,380,076|
| 75+       | 305,568,257| 10,494,055| 2,713,902 | 98,904,421| 417,680,635|
| All       | 368,100,148| 18,871,020| 6,008,037 | 164,081,506| 557,060,711|

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**Table 12** Number of QALYs lost due to fractures during 2010 in men and women in Portugal according to age.

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 341  | 1,248 | 1,588 |
| Incident vertebral fractures | 680  | 912  | 1,592 |
| Incident forearm fractures | 131  | 101  | 232  |
| Incident other fractures | 612  | 1,184 | 1,796 |
| Prior hip fractures | 1,038 | 4,486 | 5,524 |
| Prior vertebral fractures | 668  | 1,402 | 2,070 |
| Total       | 3,470 | 9,332 | 12,802 |
| Men         |       |     |     |
| Incident hip fractures | 184  | 420  | 604  |
| Incident vertebral fractures | 413  | 424  | 837  |
| Incident forearm fractures | 26   | 12   | 38   |
| Incident other fractures | 544  | 555  | 1,098 |
| Prior hip fractures | 541  | 1,305 | 1,845 |
| Prior vertebral fractures | 286  | 406  | 691  |
| Total       | 1,993 | 3,120 | 5,114 |
| Men and Women |       |     |     |
| Incident hip fractures | 525  | 1,667 | 2,192 |
| Incident vertebral fractures | 1,093 | 1,335 | 2,428 |
| Incident forearm fractures | 156  | 113  | 270  |
| Incident other fractures | 1,156 | 1,738 | 2,894 |
| Prior hip fractures | 1,579 | 5,791 | 7,370 |
| Prior vertebral fractures | 954  | 1,807 | 2,761 |
| Total       | 5,463 | 12,453 | 17,915 |
between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at € 580 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 1.16 billion in Portugal in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 25 %, 23 %, 2 %, 50 % respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 3.9 million in 2010 to 4.8 million in 2025, corresponding to an increase of 21 % (Table 14).

The total number of fractures was estimated to rise from 52,000 in 2010 to 69,000 in 2025 (Table 15), corresponding to an increase of 33 %. Hip, clinical spine, forearm and other fractures increased by 3,700, 2,400, 2,000 and 9,100 respectively. The increase in the number of fractures ranged from 25 % to 38 %, depending on fracture site. The increase was estimated to be particularly marked in men (38 %) compared to women (31 %).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from € 577 million in 2010 to € 717 million in 2025, corresponding to an increase of 24 % (Table 16). Costs incurred in women and men increased by 22 % and 30 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 17,900 in 2010 to 21,700 in 2025, corresponding to an increase of 21 % (Table 17). The increase was estimated to be particularly marked in men (30 %) compared to women (18 %).

Incident and prior fractures accounted for 67 % and 33 % of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately € 1.2 billion in 2010 to € 1.4 billion in 2025. The increase was estimated to be particularly marked in men (+30 %) compared to women (+20 %) (Table 18).

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 2.22 % in 2001 to 8.65 % in 2008 but subsequently decreased to 7.12 % in 2011.
In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Portugal were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 24 % and 37 % respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

### Treatment gap

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### Table 15  Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Portugal

|          | 2010 | 2025 |          | 2010 | 2025 |          | 2010 | 2025 |          | 2010 | 2025 |
|----------|------|------|----------|------|------|----------|------|------|----------|------|------|
|          |      |      | Hip      |      |      | Spine    |      |      | Forearm  |      |      |
| Women    |      |      |          |      |      |          |      |      |          |      |      |
| 50–74    | 1,427| 1,691| 2,072    | 2,448| 3,730| 4,390    | 5,151| 6,076|
| 75+      | 5,931| 8,355| 3,160    | 4,246| 3,323| 4,310    | 11,350| 15,852|
| All      | 7,358| 10,046| 5,232    | 6,694| 7,053| 8,700    | 16,501| 21,928|
| Men      |      |      |          |      |      |          |      |      |          |      |      |
| 50–74    | 756  | 945  | 1,247    | 1,554| 751  | 939      | 4,608| 5,733|
| 75+      | 1,746| 2,604| 1,326    | 1,980| 369  | 548      | 4,874| 7,386|
| All      | 2,502| 3,549| 2,573    | 3,534| 1,120| 1,487    | 9,482| 13,119|
| Women and Men |      |      |          |      |      |          |      |      |          |      |      |
| 50–74    | 2,183| 2,636| 3,319    | 4,003| 4,481| 5,329    | 9,759| 11,809|
| 75+      | 7,677| 10,959| 4,486    | 6,225| 3,692| 4,858    | 16,224| 23,237|
| All      | 9,860| 13,595| 7,805    | 10,228| 8,173| 10,187    | 25,983| 35,046|

### Table 16  Current and future cost (€ 000, 000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Portugal

|          | 2010 | 2015 | 2020 | 2025 |
|----------|------|------|------|------|
|          |      |      |      |      |
| 50–74    | 93   | 96   | 102  | 106  |
| 75+      | 320  | 342  | 368  | 397  |
| All      | 413  | 438  | 469  | 503  |
| Men      |      |      |      |      |
| 50–74    | 59   | 62   | 67   | 71   |
| 75+      | 105  | 116  | 127  | 142  |
| All      | 164  | 178  | 194  | 213  |
| Women and Men |      |      |      |      |
| 50–74    | 152  | 157  | 168  | 177  |
| 75+      | 425  | 458  | 495  | 539  |
| All      | 577  | 616  | 663  | 717  |

### Table 17  Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Portugal

|          | Incident fractures | Prior fractures | All fractures |
|----------|--------------------|----------------|---------------|
|          | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women    |      |      |      |      |      |      |
| 50–74    | 1,763| 2,083| 1,706| 1,738| 3,470| 3,821|
| 75+      | 3,444| 4,707| 5,888| 6,565| 9,332| 11,272|
| All      | 5,207| 6,790| 7,594| 8,303| 12,802| 15,093|
| Men      |      |      |      |      |      |      |
| 50–74    | 1,167| 1,453| 826  | 930  | 1,993| 2,383|
| 75+      | 1,410| 2,110| 1,710| 2,134| 3,120| 4,244|
| All      | 2,577| 3,563| 2,537| 3,065| 5,114| 6,628|
| Women and Men |      |      |      |      |      |      |
| 50–74    | 2,930| 3,536| 2,533| 2,669| 5,463| 6,204|
| 75+      | 4,854| 6,817| 7,598| 8,699| 12,453| 15,516|
| All      | 7,785| 10,353| 10,131| 11,368| 17,915| 21,720|
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Table 18 Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Portugal assuming the uptake of treatment remains unchanged

|        | 2010  | 2015  | 2020  | 2025  |
|--------|-------|-------|-------|-------|
| Women  |       |       |       |       |
| 50–74  | 205   | 211   | 221   | 230   |
| 75+    | 622   | 666   | 712   | 763   |
| All    | 828   | 878   | 933   | 992   |
| Men    |       |       |       |       |
| 50–74  | 123   | 128   | 138   | 149   |
| 75+    | 206   | 225   | 247   | 279   |
| All    | 330   | 354   | 385   | 428   |
| Women and Men |       |       |       |       |
| 50–74  | 329   | 340   | 360   | 378   |
| 75+    | 829   | 892   | 959   | 1,042 |
| All    | 1,157 | 1,231 | 1,318 | 1,420 |

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|        | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|--------|-----------------------------------|---------------------------------------|---------------------|------------------|
| Men    | 40                                | 53                                    | 13                  | 24               |
| Women  | 269                               | 425                                   | 156                 | 37               |

Fig. 2 Treatment uptake in Portugal (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)
Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Romania.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Romania, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in the EU27 was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 94,000 new fragility fractures were sustained in Romania, comprising 14,000 hip fractures, 16,000 vertebral fractures, 16,000 forearm fractures and 48,000 other fractures (i.e. fractures of the pelvis, rib, humerus,ibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €129 million for the same year. Incident fractures represented 68 % of this cost, long-term fracture care 27 % and pharmacological prevention 5 %. Previous and incident fractures also accounted for 29,700 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 110,000 in 2025, representing an increase of 16,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 3,000, 2,400, 2,300 and 8,200, respectively. The burden of fractures in Romania in 2025 was estimated to increase by 17 % to €151 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above that received treatment remained at very
low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by an aging population, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Romania in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Romania was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Romania

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 3,212,000 and 4,077,000 respectively in Romania in 2010 (Table 1).

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–54      | 1,525,000 | 1,401,000 | 2,926,000 |
| 55–59      | 1,124,000 | 916,000 | 2,040,000 |
| 60–64      | 991,000   | 666,000  | 1,657,000 |
| 65–69      | 408,000   | 218,000  | 626,000  |
| 70–74      | 29,000    | 11,000   | 40,000   |
| 75–79      | 4,077,000 | 3,212,000 | 7,289,000 |

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤-2.5 SD) in Romania by age using female-derived reference ranges at the femoral neck, 2010 [3]

| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 48,069 | 17,925 |
| 55–59      | 73,152 | 23,940 |
| 60–64      | 89,661 | 30,798 |
| 65–69      | 100,394 | 28,490 |
| 70–74      | 154,845 | 30,264 |
| 75–79      | 163,500 | 28,634 |
| 80+        | 206,264 | 38,014 |
| 50+        | 835,885 | 198,065 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 1,030,000 (Table 2). There are 2.4 DXA scan machines per million inhabitants, and guidelines for osteoporosis treatment are available [2]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Romania [4]. Given that country specific incidence of vertebral, forearm and “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3.

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Romania by age

| Age (years) | Hip | Vertebral | Forearm | Other |
|------------|-----|----------|---------|-------|
| Women      |     |          |         |       |
| 50–54      | 17  | 44       | 108     | 112   |
| 55–59      | 34  | 94       | 260     | 298   |
| 60–64      | 60  | 105      | 225     | 230   |
| 65–69      | 115 | 168      | 280     | 394   |
| 70–74      | 228 | 321      | 409     | 646   |
| 75–79      | 407 | 396      | 397     | 856   |
| 80–84      | 667 | 419      | 417     | 1,133 |
| 85+        | 1,048 | 493      | 447     | 1,761 |

Men

| Age (years) | Hip | Vertebral | Forearm | Other |
|------------|-----|----------|---------|-------|
| 50–54      | 50  | 129      | 46      | 223   |
| 55–59      | 70  | 121      | 106     | 648   |
| 60–64      | 94  | 225      | 177     | 924   |
| 65–69      | 124 | 194      | 186     | 797   |
| 70–74      | 186 | 283      | 119     | 954   |
| 75–79      | 274 | 316      | 78      | 732   |
| 80–84      | 410 | 285      | 80      | 1,091 |
| 85+        | 587 | 394      | 108     | 1,701 |
Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 170.3 and 282.3 respectively.

The number of incident fractures in 2010 was estimated at 94,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 14,000, 16,000, 16,000 and 48,000 respectively. 56 % of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 0.99 % for hip and 1.14 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 72,000 and 83,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 1,609 (Table 8). Hip, vertebral and “other” fractures accounted for 723, 712 and 174 deaths respectively. Overall, approximately 47 % of deaths occurred in women.

Cost of osteoporosis in Romania including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

Table 4 Estimated number of incident fractures in Romania, 2010

| Age (years) | Hip | Vertebra | Forearm | Other | All fractures |
|-------------|-----|----------|---------|-------|---------------|
|             | Women |          |         |       |               |
| 50–74       | 3,269 | 5,061    | 8,787   | 11,764 | 28,881        |
| 75+         | 6,063 | 3,708    | 3,588   | 10,873 | 24,232        |
| Total       | 9,332 | 8,768    | 12,375  | 22,638 | 53,113        |
|             | Men  |          |         |       |               |
| 50–74       | 2,893 | 5,249    | 3,429   | 19,896 | 31,467        |
| 75+         | 2,082 | 1,653    | 451     | 5,517  | 9,704         |
| Total       | 4,975 | 6,901    | 3,880   | 25,413 | 41,170        |
|             | Men and Women |          |         |       |               |
| 50–74       | 6,163 | 10,309   | 12,216  | 31,661 | 60,348        |
| 75+         | 8,145 | 5,360    | 4,039   | 16,390 | 33,935        |
| Total       | 14,308 | 15,670   | 16,255  | 48,051 | 94,283        |

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Romania, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
|             | Women        | Men               |
| 50–54       | 0.0          | 0.1               |
| 55–59       | 0.2          | 0.4               |
| 60–64       | 0.4          | 0.7               |
| 65–69       | 0.7          | 1.2               |
| 70–74       | 1.3          | 1.9               |
| 75–79       | 2.3          | 2.7               |
| 80–84       | 3.8          | 3.2               |
| 85+         | 6.8          | 4.6               |

Table 6 Number of men and women in Romania with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
|             | Women        | Men               |
| 50–74       | 14,391       | 14,637            |
| 75+         | 31,610       | 11,386            |
| Total       | 46,001       | 26,023            |

Table 7 Number of men and women in Romania with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|-------------------|
|             | Women        | Men               |
| 50–74       | 29,028       | 29,028            |
| 75+         | 42,997       | 42,997            |
| Total       | 72,024       | 72,024            |
As the cost of a hip fracture was not specifically available for Romania, hip fracture costs were estimated at €2,168 based on costs in Slovenia [5]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Table 7 Incidence (per 100,000) of causally related deaths in Romania within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|-------------------|-----------------|
| Women       |     |                   |                 |
| 50–54       | 973 | 1,265             | 25              |
| 55–59       | 1,366 | 1,681             | 40              |
| 60–64       | 1,991 | 2,312             | 63              |
| 65–69       | 2,553 | 2,799             | 96              |
| 70–74       | 3,261 | 3,365             | 149             |
| 75–79       | 4,455 | 4,304             | 279             |
| 80–84       | 4,293 | 3,798             | 478             |
| 85–89       | 5,321 | 4,136             | 932             |
| 90+         | 6,487 | 3,657             | 2,255           |
| Men         |     |                   |                 |
| 50–54       | 4,437 | 5,322             | 70              |
| 55–59       | 5,223 | 5,938             | 107             |
| 60–64       | 6,097 | 6,558             | 165             |
| 65–69       | 6,245 | 6,335             | 224             |
| 70–74       | 6,493 | 6,182             | 293             |
| 75–79       | 7,411 | 6,572             | 439             |
| 80–84       | 7,729 | 6,277             | 649             |
| 85–89       | 10,173 | 7,436             | 1,099           |
| 90+         | 19,560 | 12,728            | 2,447           |

As the cost of a hip fracture was not specifically available for Romania, hip fracture costs were estimated at €2,168 based on costs in Slovenia [5]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Table 8 The number of deaths in men and women in Romania in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Fracture at the vertebra | “Other” |
|-------------|-----|-------------------------|--------|
| Women       |     |                         |        |
| 50–74       | 93  | 143                     | 13     |
| 75+         | 279 | 143                     | 78     |
| Total       | 372 | 286                     | 91     |
| Men         |     |                         |        |
| 50–74       | 171 | 315                     | 37     |
| 75+         | 181 | 111                     | 46     |
| Total       | 351 | 426                     | 83     |
| Men and Women |   |                       |        |
| 50–74       | 264 | 458                     | 50     |
| 75+         | 459 | 254                     | 124    |
| Total       | 723 | 712                     | 174    |

Table 9 One year costs for relevant pharmaceuticals in Romania, 2010 [8]

| Drug Name               | Annual drug cost (€) |
|-------------------------|----------------------|
| Alendronate             | 53                   |
| Risedronate             | 106                  |
| Etidronate              | -                    |
| Ibandronate             | 195                  |
| Zoledronic acid         | 747                  |
|Raloxifene               | -                    |
|Strontium ranelate       | 414                  |
|Parathyroid hormone      | -                    |
|Teriparatide             | 4,266                |

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€5,756 [6]) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €26 [7] and a DXA scan reimbursed at €5 [7] every second year to monitor treatment. In practice, the price of DXA is much higher and borne by the patient.

The cost of osteoporosis in 2010 was estimated at €129 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €88 million, €35 million and €7 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 5.2% of the total cost.

Table 10 Cost of osteoporosis (€) in Romania by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| Women       |                          |                            |                          |            |
| 50–74       | 23,616,069               | 5,219,913                  | 3,890,507                | 32,726,489 |
| 75+         | 25,453,787               | 16,271,196                 | 2,051,296                | 43,776,280 |
| All         | 49,069,856               | 21,491,109                 | 5,941,804                | 76,502,769 |
| Men         |                          |                            |                          |            |
| 50–74       | 28,376,886               | 6,135,464                  | 594,664                  | 35,107,014 |
| 75+         | 10,418,603               | 7,172,582                  | 242,144                  | 17,833,329 |
| All         | 38,795,488               | 13,308,047                 | 836,808                  | 52,940,343 |
| Women and Men |                      |                            |                          |            |
| 50–74       | 51,992,955               | 11,355,377                 | 4,485,171                | 67,833,503 |
| 75+         | 35,872,390               | 23,443,779                 | 2,293,441                | 61,609,609 |
| All         | 87,865,345               | 34,799,156                 | 6,778,612                | 129,443,112 |
When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€ 61 million) followed by “other” (€ 53 million), spine (€ 7 million) and forearm fractures (€ 2 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 29,700 (Table 12). Prior fractures accounted for 51 % of the total loss and 58 % of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at € 340 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 470 million in Romania in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 19 %, 7 %, 1 %, 72 % respectively.

### Table 11
Total cost (€) in 2010 by fracture site in men and women in Romania. Note that costs for fracture prevention therapy and monitoring are not included.

| Age (years) | Hip (€) | Spine (€) | Forearm (€) | Other (€) | All (€) |
|-------------|---------|----------|-------------|----------|---------|
| **Women**   |         |          |             |          |         |
| 50–74       | 11,804,197 | 2,259,003 | 1,163,900   | 13,608,883 | 28,835,982 |
| 75+         | 27,269,158 | 1,531,657 | 475,296     | 12,448,873 | 41,724,984 |
| All         | 39,073,354 | 3,790,660 | 1,639,195   | 26,057,756 | 70,560,965 |
| **Men**     |         |          |             |          |         |
| 50–74       | 11,523,671 | 2,160,474 | 454,210     | 20,373,995 | 34,512,350 |
| 75+         | 10,542,194 | 626,605   | 59,773      | 6,362,613  | 17,591,185 |
| All         | 22,065,864 | 2,787,079 | 513,983     | 26,736,609 | 52,103,535 |
| **Women and Men** |         |          |             |          |         |
| 50–74       | 23,327,867 | 4,419,477 | 1,618,110   | 33,982,878 | 63,348,332 |
| 75+         | 37,811,351 | 2,158,262 | 535,069     | 18,811,486 | 59,316,169 |
| All         | 61,139,219 | 6,577,739 | 2,153,179   | 52,794,364 | 122,664,501 |

![Fig. 1](image)

**Fig. 1** Share of fracture cost (%) by fracture site in Romania. Note that costs for fracture prevention therapy and monitoring are not included.

### Table 12
Number of QALYs lost due to fractures during 2010 in men and women in Romania according to age.

| Age (years) | Women | Men |
|-------------|-------|-----|
| 50–74       | 797   | 733 |
| 75+         | 1,337 | 515 |
| Total       | 2,134 | 1,248 |

### Table 13
Value of lost QALYs (€) in men and women in Romania in 2010.

| Incident hip fractures | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|------------------------|----------------|----------------|----------------|
| 19,276,074             | 38,552,148     | 57,828,222     |

Incident vertebral fractures

Incident forearm fractures

Incident other fractures

Prior hip fractures

Prior vertebral fractures

Total

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Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 7.3 million in 2010 to 8.2 million in 2025, corresponding to an increase of 12% (Table 14).

The total number of fractures was estimated to rise from 94,000 in 2010 to 110,000 in 2025 (Table 15), corresponding to an increase of 17%. Hip, clinical spine, forearm and other fractures increased by 3,000, 2,400, 2,300 and 8,200 respectively. The increase in the number of fractures ranged from 14% to 21%, depending on fracture site. The increase was estimated to be 13% in men and 20% in women.

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €129 million in 2010 to €151 million in 2025, corresponding to an increase of 17% (Table 16). Costs incurred in women and men increased by 20% and 13% respectively.

Table 14  Population projections in Romania by age and sex [9]

|         | 2010       | 2015       | 2020       | 2025       |
|---------|------------|------------|------------|------------|
| Women   |            |            |            |            |
| 50–59   | 1,525,000  | 1,338,000  | 1,423,000  | 1,638,000  |
| 60–69   | 1,124,000  | 1,328,000  | 1,420,000  | 1,252,000  |
| 70–79   | 991,000    | 911,000    | 919,000    | 1,102,000  |
| 80–89   | 408,000    | 467,000    | 517,000    | 483,000    |
| 90+     | 29,000     | 52,000     | 74,000     | 91,000     |
| Men     |            |            |            |            |
| 50–59   | 1,401,000  | 1,239,000  | 1,354,000  | 1,573,000  |
| 60–69   | 916,000    | 1,087,000  | 1,167,000  | 1,044,000  |
| 70–79   | 666,000    | 596,000    | 614,000    | 743,000    |
| 80–89   | 218,000    | 239,000    | 249,000    | 225,000    |
| 90+     | 11,000     | 18,000     | 23,000     | 25,000     |
| All     | 2,926,000  | 2,577,000  | 2,777,000  | 3,211,000  |
|         |            |            |            |            |
| Women   | 7,289,000  |            |            |            |
| Men     |            | 8,176,000  |            |            |

Table 15  Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Romania

|         | Hip 2010 | Spine 2010 | Forearm 2010 | Other 2010 |
|---------|----------|------------|--------------|------------|
| Women   |          |            |              |            |
| 50–74   | 3,269    | 5,802      | 9,894        | 11,764     |
| 75+     | 6,063    | 4,514      | 4,264        | 10,873     |
| All     | 9,332    | 10,316     | 12,375       | 22,638     |
| Men     |          |            |              |            |
| 50–74   | 2,893    | 5,924      | 3,429        | 19,896     |
| 75+     | 2,082    | 1,818      | 451          | 5,517      |
| All     | 4,975    | 7,742      | 3,880        | 25,413     |
| Women and Men | 14,308 | 18,058 | 18,537 | 48,051 |

Table 16  Current and future cost (€ 000,000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Romania

|         | 2010     | 2015     | 2020     | 2025     |
|---------|----------|----------|----------|----------|
| Women   |          |          |          |          |
| 50–74   | 33       | 32       | 35       | 37       |
| 75+     | 44       | 48       | 50       | 54       |
| All     | 77       | 80       | 85       | 91       |
| Men     |          |          |          |          |
| 50–74   | 35       | 35       | 38       | 40       |
| 75+     | 18       | 19       | 19       | 19       |
| All     | 53       | 54       | 57       | 60       |
| Women and Men | 129 | 134 | 142 | 151 |
The total number of QALYs lost due to fracture was estimated to rise from 29,700 in 2010 to 33,800 in 2025, corresponding to an increase of 14% (Table 17). The increase was estimated to be 11% in men and 16% in women. Incident and prior fractures accounted for 59% and 41% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €468 million in 2010 to €537 million in 2025. The increase was estimated to be 12% in men and 17% in women (Table 18).

The total number of QALYs lost due to fracture was estimated to rise from 29,700 in 2010 to 33,800 in 2025, corresponding to an increase of 14% (Table 17). The increase was estimated to be 11% in men and 16% in women. Incident and prior fractures accounted for 59% and 41% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €468 million in 2010 to €537 million in 2025. The increase was estimated to be 12% in men and 17% in women (Table 18).

Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 0.05% in 2001 to 1.65% in 2011.

Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Romania were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 94% and 83% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Romania

| Incident fractures | Prior fractures | All fractures |
|--------------------|----------------|--------------|
|                    | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women              |      |      |      |      |      |      |
| 50–74              | 4,207| 4,823| 3,641| 3,963| 7,848| 8,786|
| 75+                | 3,729| 4,660| 5,766| 6,622| 9,495| 11,281|
| All                | 7,937| 9,482| 9,406|10,585|17,343|20,067|
| Men                |      |      |      |      |      |      |
| 50–74              | 5,032| 5,726| 3,424| 3,761| 8,456| 9,487|
| 75+                | 1,708| 1,884| 2,214| 2,377| 3,922| 4,262|
| All                | 6,740| 7,610| 5,638| 6,138|12,378|13,748|
| Women and Men      |      |      |      |      |      |      |
| 50–74              | 9,240|10,549| 7,065| 7,724|16,305|18,273|
| 75+                | 5,437| 6,544| 7,980| 8,999|13,417|15,543|
| All                |14,677|17,092|15,044|16,723|29,721|33,815|

Table 18 Present and future cost (€ 000,000) of fracture (direct cost and cost of QALY’s) by age and calendar year in men and women in Romania assuming the uptake of treatment remains unchanged

|                  | 2010 | 2015 | 2020 | 2025 |
|------------------|------|------|------|------|
| Women            |      |      |      |      |
| 50–74            | 122  | 120  | 129  | 138  |
| 75+              | 152  | 165  | 171  | 183  |
| All              | 274  | 285  | 300  | 320  |
| Men              |      |      |      |      |
| 50–74            | 132  | 130  | 139  | 149  |
| 75+              | 63   | 65   | 64   | 68   |
| All              | 194  | 195  | 203  | 216  |
| Women and Men    |      |      |      |      |
| 50–74            | 254  | 250  | 268  | 286  |
| 75+              | 215  | 229  | 235  | 250  |
| All              | 468  | 479  | 503  | 537  |
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Epidemiology and Economic Burden of Osteoporosis in Slovakia

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Slovakia.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Slovakia, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in Slovakia was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 39,000 new fragility fractures were sustained in Slovakia, comprising 6,000 hip fractures, 6,000 vertebral fractures, 7,000 forearm fractures and 20,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €107 million for the same year. Incident fractures represented 71% of this cost, long-term fracture care 18% and pharmacological prevention 10%. Previous and incident...
fractures also accounted for 11,700 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 50,000 in 2025, representing an increase of 11,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 2,100, 1,900, 1,600 and 5,700, respectively. The burden of fractures in Slovakia in 2025 was estimated to increase by 31% to €140 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment remained at very low levels in the past few years. A substantial minority of women at high fracture risk did not receive active treatment. Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by aging populations, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Slovakia in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Slovakia was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Slovakia

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 755,000 and 975,000 respectively in Slovakia in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 230,000 (Table 2). There are 10.7 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on hip fracture incidence are available for Slovakia [5]. Given that country specific incidence of the vertebral, forearm and “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 326 and 572 respectively.

The number of incident fractures in 2010 was estimated at 39,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 6,000, 6,000, 7,000 and 20,000 respectively. 57% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.62% for hip and 1.88% for clinical vertebral fractures.

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–59      | 405,000 | 379,000 | 784,000 |
| 60–69      | 279,000 | 221,000 | 500,000 |
| 70–79      | 187,000 | 111,000 | 298,000 |
| 80–89      | 95,000  | 41,000  | 136,000 |
| 90+        | 9,000   | 3,000   | 12,000  |
| 50+        | 975,000 | 755,000 | 1,730,000 |

Table 1 Population at risk: men and women over the age of 50 in Slovakia, 2010 [1]

| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 12,789 | 4,875 |
| 55–59      | 19,392 | 6,440 |
| 60–64      | 22,165 | 7,540 |
| 65–69      | 25,048 | 6,734 |
| 70–74      | 28,179 | 4,992 |
| 75–79      | 32,250 | 4,841 |
| 80+        | 49,088 | 7,304 |
| 50+        | 188,911 | 42,726 |

Table 2 Number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Slovakia by age using female-derived reference ranges at the femoral neck, 2010 [4]
The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 28,000 and 32,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 574 (Table 8). Hip, vertebral and “other” fractures accounted for 261, 241 and 71 deaths respectively. Overall, approximately 47 % of deaths occurred in women.

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Cost of osteoporosis in Slovakia including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

As the cost of a hip fracture was not available specifically for Slovakia, hip fracture costs were estimated at €4,690 based on costs in the Czech Republic [6]. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€8,030 [7]) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €16 [8] (approximated by adjusting Polish cost for health adjusted price levels) and a DXA scan costing €32 [9] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €107 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €76 million, €19 million and €11 million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 10.6% of the total cost.

Table 7 Incidence (per 100,000) of causally related deaths in Slovakia within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
| Women       |     |                    |                  |
| 50–54       | 930 | 1,209              | 24               |
| 55–59       | 1,031 | 1,268             | 30               |
| 60–64       | 1,557 | 1,808             | 50               |
| 65–69       | 2,171 | 2,380             | 81               |
| 70–74       | 2,716 | 2,803             | 124              |
| 75–79       | 3,656 | 3,532             | 229              |
| 80–84       | 3,913 | 3,462             | 436              |
| 85–89       | 4,667 | 3,628             | 818              |
| 90+         | 3,304 | 1,863             | 1,149            |
| Men         |     |                    |                  |
| 50–54       | 3,126 | 3,750             | 49               |
| 55–59       | 4,208 | 4,784             | 86               |
| 60–64       | 4,555 | 4,899             | 123              |
| 65–69       | 5,276 | 5,352             | 189              |
| 70–74       | 5,950 | 5,665             | 268              |
| 75–79       | 6,401 | 5,677             | 380              |
| 80–84       | 7,233 | 5,874             | 608              |
| 85–89       | 8,943 | 6,537             | 966              |
| 90+         | 9,833 | 6,399             | 1,230            |

Table 8 The number of deaths in men and women in Slovakia in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | spine | other |
|-------------|-----|-------|-------|
| Women       |     |       |       |
| 50–74       | 25  | 41    | 4     |
| 75+         | 110 | 52    | 35    |
| Total       | 136 | 93    | 39    |
| Men         |     |       |       |
| 50–74       | 58  | 109   | 12    |
| 75+         | 68  | 39    | 20    |
| Total       | 126 | 149   | 32    |
| Men and Women|   |       |       |
| 50–74       | 83  | 150   | 16    |
| 75+         | 178 | 91    | 55    |
| Total       | 261 | 241   | 71    |

Table 9 One year costs for relevant pharmaceuticals in Slovakia, 2010 [10]

| Drug                  | Annual drug cost (€) |
|-----------------------|----------------------|
| Alendronate           | 116                  |
| Risedronate           | 320                  |
| Etidronate            | -                    |
| Ibandronate           | 404                  |
| Zoledronic acid       | 480                  |
| Raloxifene            | 509                  |
| Strontium ranelate    | 610                  |
| Parathyroid hormone   | 5,651                |
| Teriparatide          | 6,414                |
When stratifying costs of osteoporosis by fracture type, other fractures were most costly (€45 million) followed by hip (€43 million), spine (€6 million) and forearm fractures (€2 million) (Table 11 and Fig. 1).

Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 11,700 (Table 12). Prior fractures accounted for 50% of the total loss and 60% of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €280 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €390 million in Slovakia in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 20%, 5%, 3%, 73%, respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 1.7 million in 2010 to 2.1 million in 2025, corresponding to an increase of 21% (Table 14).

The total number of fractures was estimated to rise from 39,000 in 2010 to 50,000 in 2025 (Table 15), corresponding to an increase of 29%. Hip, clinical spine, forearm and other fractures increased by 2,100, 1,900, 1,600 and 5,700 respectively. The increase in the number of fractures ranged from 23% to 35%, depending on fracture site. The increase was estimated to be the same in both men and women (29%).

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from €107 million in 2010 to €140 million in 2025, corresponding to an increase of 31% (Table 16). Costs incurred in women and men increased by 30% and 33% respectively.

### Table 10 Cost of osteoporosis (€) in Slovakia by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|------------|--------------------------|---------------------------|--------------------------|------------|
| Women      |                          |                           |                          |            |
| 50–74      | 17,906,196               | 2,578,139                 | 6,638,817                | 27,123,153 |
| 75+        | 25,739,097               | 10,207,158                | 3,285,115                | 39,231,370 |
| All        | 43,645,293               | 12,785,297                | 9,923,932                | 66,354,523 |
| Men        |                          |                           |                          |            |
| 50–74      | 23,893,275               | 2,927,826                 | 1,059,711                | 27,880,812 |
| 75+        | 8,850,935                | 3,588,805                 | 339,274                  | 12,779,014 |
| All        | 32,744,209               | 6,516,632                 | 1,398,985                | 40,659,826 |

| Women and Men          |                          |                           |                          |            |
| 50–74      | 41,799,471               | 5,505,966                 | 7,698,528                | 55,003,965 |
| 75+        | 34,590,032               | 13,795,963                | 3,624,389                | 52,010,384 |
| All        | 76,389,503               | 19,301,929                | 11,322,918               | 107,014,349|

### Table 11 Total cost (€) in 2010 by fracture site in men and women in Slovakia. Note that costs for fracture prevention therapy and monitoring are not included

| Age (years) | Hip | Spine | Forearm | Other | All |
|------------|-----|-------|---------|-------|-----|
| Women      |     |       |         |       |     |
| 50–74      | 7,407,091 | 1,756,990 | 1,009,062 | 10,311,193 | 27,123,153 |
| 75+        | 21,449,488 | 1,456,571 | 465,887 | 12,574,308 | 35,946,255 |
| All        | 28,856,580 | 3,213,561 | 1,474,949 | 22,885,501 | 56,430,590 |
| Men        |     |       |         |       |     |
| 50–74      | 7,497,448 | 1,867,933 | 410,587 | 17,045,134 | 27,880,812 |
| 75+        | 8,850,935 | 3,588,805 | 49,580 | 5,414,921 | 12,779,014 |
| All        | 16,348,383 | 5,456,738 | 459,167 | 22,459,055 | 39,231,370 |

| Women and Men |     |       |         |       |     |
| 50–74        | 41,799,471 | 5,505,966 | 7,698,528 | 55,003,965 |
| 75+          | 34,590,032 | 13,795,963 | 3,624,389 | 52,010,384 |
| All          | 76,389,503 | 19,301,929 | 11,322,918 | 107,014,349|

Figure 1: Share (%) of fracture cost by fracture site in Slovakia. Note that costs for fracture prevention therapy and monitoring are not included.
The total number of QALYs lost due to fracture was estimated to rise from 11,700 in 2010 to 14,500 in 2025, corresponding to an increase of 24% (Table 17). The increase was estimated to be particularly marked in men (26%) compared to women (22%). Incident and prior fractures accounted for 64% and 36% of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately €390 million in 2010 to €490 million in 2025. The increase was estimated

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Slovakia according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 266   | 608 | 874 |
| Incident vertebral fractures | 601   | 474 | 1,075 |
| Incident forearm fractures | 125   | 50  | 175 |
| Incident other fractures | 541   | 549 | 1,089 |
| Prior hip fractures | 808   | 1,874 | 2,682 |
| Prior vertebral fractures | 559   | 558 | 1,116 |
| Total       | 2,899 | 4,113 | 7,012 |
| Men         |       |     |     |
| Incident hip fractures | 280   | 200 | 480 |
| Incident vertebral fractures | 706   | 204 | 909 |
| Incident forearm fractures | 50    | 6   | 56  |
| Incident other fractures | 966   | 256 | 1,222 |
| Prior hip fractures | 825   | 590 | 1,415 |
| Prior vertebral fractures | 446   | 171 | 617 |
| Total       | 3,273 | 1,427 | 4,700 |
| Men and Women |     |     |     |
| Incident hip fractures | 547   | 808 | 1,354 |
| Incident vertebral fractures | 1,307 | 678 | 1,984 |
| Incident forearm fractures | 175   | 56  | 231 |
| Incident other fractures | 1,507 | 805 | 3,212 |
| Prior hip fractures | 1,633 | 2,464 | 4,097 |
| Prior vertebral fractures | 1,004 | 729 | 1,733 |
| Total       | 6,172 | 5,539 | 11,712 |

Table 13 Value of lost QALYs (€) in men and women in Slovakia in 2010

|                        | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|------------------------|----------------|----------------|----------------|
| Incident hip fractures | 16,389,056     | 32,778,111     | 49,167,167     |
| Incident vertebral fractures | 24,011,984     | 48,023,967     | 72,035,951     |
| Incident forearm fractures | 2,792,210      | 5,584,419      | 8,376,629      |
| Incident other fractures | 27,969,960     | 55,939,921     | 83,909,881     |
| Prior hip fractures    | 49,575,092     | 99,150,184     | 148,725,276    |
| Prior vertebral fractures | 20,974,906     | 41,949,812     | 62,924,718     |
| Total                  | 141,713,207    | 283,426,414    | 425,139,621    |

Table 14 Population projections in Slovakia by age and sex [11]

| Year | Women 50–59 | 2015 50–59 | 2020 50–59 | 2025 50–59 | Men 50–59 | 2015 50–59 | 2020 50–59 | 2025 50–59 | All 50–59 | 2015 All | 2020 All | 2025 All |
|------|-------------|-------------|-------------|-------------|-----------|-------------|-------------|-------------|-----------|-----------|-----------|-----------|
| 2010 | 405,000     | 388,000     | 362,000     | 377,000     | 279,000   | 342,000     | 379,000     | 364,000     | 764,000   | 730,000   | 741,000   | 741,000   |

Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Slovakia

| Age (years) | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
|-------------|------|------|------|------|------|------|------|------|
| Women       |      |      |      |      |      |      |      |      |
| 50–74       | 1,092| 1,509| 1,792| 2,310| 3,521| 4,173| 4,480| 5,561|
| 75+         | 2,807| 3,772| 1,602| 2,130| 1,626| 2,130| 5,175| 6,970|
| All         | 3,899| 5,281| 3,395| 4,440| 5,147| 6,303| 9,655| 12,530|
| Men         |      |      |      |      |      |      |      |      |
| 50–74       | 1,111| 1,511| 2,057| 2,697| 1,433| 1,768| 8,085| 10,164|
| 75+         | 816  | 1,097| 627  | 857  | 173  | 236  | 2,238| 2,989|
| All         | 1,927| 2,609| 2,683| 3,553| 1,606| 2,004| 10,322| 13,153|
| Women and Men |      |      |      |      |      |      |      |      |
| 50–74       | 2,203| 3,020| 3,849| 5,007| 4,954| 5,940| 12,564| 15,724|
| 75+         | 3,623| 4,869| 2,229| 2,987| 1,799| 2,367| 7,413| 9,959|
| All         | 5,826| 7,889| 6,078| 7,994| 6,753| 8,307| 19,977| 25,683|
to be particularly marked in men (+28 %) compared to women (+24 %) (Table 18).

**Treatment uptake**

To estimate uptake of individual osteoporosis treatments, sales data from IMS health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 1.07 % in 2001 to 5.08 % in 2011.

**Treatment gap**

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Slovakia were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 78 % and 49 % respectively (Table 19). Note that the estimate of the treatment gap is conservative 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 1.07 % in 2001 to 5.08 % in 2011.

**Table 16** Current and future cost (€ 000,000) of osteoporosis (excluding values of QALYs lost) by age and calendar year in men and women in Slovakia

|          | 2010 | 2015 | 2020 | 2025 |
|----------|------|------|------|------|
| Women    |      |      |      |      |
| 50–74    | 27   | 30   | 33   | 36   |
| 75+      | 39   | 41   | 45   | 50   |
| All      | 66   | 71   | 78   | 86   |
| Men      |      |      |      |      |
| 50–74    | 28   | 31   | 35   | 38   |
| 75+      | 13   | 13   | 14   | 17   |
| All      | 41   | 45   | 49   | 54   |
| Women and Men | 50–74 | 55   | 61   | 68   | 73   |
| 75+      | 52   | 55   | 59   | 67   |
| All      | 107  | 116  | 127  | 140  |

**Table 17** Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Slovakia

| Incident fractures | Prior fractures | All fractures |          |          |          |
|--------------------|----------------|---------------|----------|----------|----------|
|                    | 2010           | 2025          | 2010     | 2025     | 2010     | 2025     |
| Women              |                |               |          |          |          |          |
| 50–74              | 1,533          | 1,948         | 1,366    | 1,591    | 2,899    | 3,538    |
| 75+                | 1,681          | 2,239         | 2,432    | 2,768    | 4,113    | 5,007    |
| All                | 3,214          | 4,186         | 3,799    | 4,359    | 7,012    | 8,546    |
| Men                |                |               |          |          |          |          |
| 50–74              | 2,002          | 2,575         | 1,271    | 1,547    | 3,273    | 4,122    |
| 75+                | 666            | 988           | 761      | 913      | 1,427    | 1,810    |
| All                | 2,668          | 3,472         | 2,032    | 2,460    | 4,700    | 5,932    |
| Women and Men      |                |               |          |          |          |          |
| 50–74              | 3,535          | 4,522         | 2,638    | 3,138    | 6,172    | 7,661    |
| 75+                | 2,346          | 3,136         | 3,193    | 3,681    | 5,539    | 6,817    |
| All                | 5,881          | 7,659         | 5,831    | 6,819    | 11,712   | 14,478   |

**Table 18** Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Slovakia assuming the uptake of treatment remains unchanged

|          | 2010 | 2015 | 2020 | 2025 |
|----------|------|------|------|------|
| Women    |      |      |      |      |
| 50–74    | 97   | 104  | 112  | 121  |
| 75+      | 139  | 145  | 155  | 172  |
| All      | 236  | 249  | 267  | 293  |
| Men      |      |      |      |      |
| 50–74    | 107  | 116  | 125  | 137  |
| 75+      | 47   | 48   | 52   | 60   |
| All      | 154  | 164  | 177  | 198  |

**Fig. 2** Treatment uptake in Slovakia (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)
given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

Sensitivity Analysis

Following the analysis presented in this report, a non-indexed local language publication on the costs of osteoporotic fracture came to our attention. This suggested that we had markedly underestimated the cost of fracture [12]. We estimated the first year direct costs cost of hip, clinical spine and forearm fracture at €4,690, €1,037 and €287, respectively whereas the empirical cost was given as €15,889, €13,774 and €2,249, respectively i.e. 4 to 10 times higher than the assumptions used in the present report. Along with the inclusion of these costs, we also updated costs for pharmaceuticals [13], physician visits and DXA scans [14], and present the results as a sensitivity analysis. Except for the assumptions and costs described above, all other assumptions and costs were the same as in the base case analysis.

Fracture cost for 2010 The cost of osteoporosis in 2010 was estimated at €352 million (Table 20). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €323 million, €19 million and €10 million, respectively. The total cost of €352 million exceeds the base case estimate by approximately 3-fold (see Table 10). It is notable that pharmacological fracture prevention costs amounted to only 2.9 % of the total cost.

When stratifying costs of osteoporosis by fracture type, “other fractures” were most costly (€154 million) followed by hip (€99 million), spine (€74 million) and forearm fractures (€15 million) accounting for 45 %, 29 %, 22 % and 4 % of the total cost, respectively. Note that costs for pharmacological fracture prevention are not included.

As would be expected, when the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP) the costs were substantially higher than given in the base case. The cost of osteoporosis amounted to €636 million in Slovakia for 2010 compared with the estimate of €390 million in the base case (see Table 13). Incident fracture, prior fracture, pharmacological intervention, and

| Table 19 | Number of men and women eligible for treatment, treated and treatment gap in 2010 |
|----------|---------------------------------|-----------------|--------|-------|
|          | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
| Men      | 11                              | 50               | 39     | 78    |
| Women    | 75                              | 148              | 73     | 49    |

| Table 20 | Cost of osteoporosis (€) in Slovakia by age in men and women, 2010 |
|----------|------------------|-----------------|---------|---------|
| Age      | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|          | (1000 s) | (1000 s) | (1000 s) | (1000 s) |
| Women    |                      |                   |                     |            |
| 50–74    | 82,540,244         | 2,578,139        | 6,031,930           | 91,150,313 |
| 75+      | 103,683,374        | 10,207,158       | 2,984,806           | 116,875,338 |
| All      | 186,223,619        | 12,785,297       | 9,016,736           | 208,025,652 |
| Men      |                      |                   |                     |            |
| 50–74    | 101,251,373        | 2,927,826        | 962,838             | 105,142,037 |
| 75+      | 35,315,838         | 3,588,805        | 308,259             | 39,212,903 |
| All      | 136,567,211        | 6,516,632        | 1,271,097           | 144,354,940 |
| Women and Men |                |                   |                     |            |
| 50–74    | 183,791,617        | 5,505,966        | 6,994,768           | 196,292,351 |
| 75+      | 138,999,213        | 13,795,963       | 3,293,066           | 156,088,241 |
| All      | 322,790,830        | 19,301,929       | 10,287,833          | 352,380,592 |

Fracture cost up to 2025 The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from €352 million in 2010 to €467 million in 2025, corresponding to an increase of 33 % (Table 21). This compared to an increase from €107 million in 2010 to €140 million in the base case over the same interval (see Table 16). Costs incurred in women and men increased by 32 % and 34 % respectively.

| Table 21 | Current and future cost (€000,000) of osteoporosis (excluding values of QALYs lost) by age and calendar year in men and women in Slovakia |
|----------|--------------------------------------------------|---------------------|---------------------|
|          | 2010 | 2015 | 2020 | 2025 |
| Women    |      |      |      |      |
| 50–74    | 91   | 100  | 120  | 120  |
| 75+      | 117  | 124  | 153  | 154  |
| All      | 208  | 224  | 273  | 274  |
| Men      |      |      |      |      |
| 50–74    | 105  | 119  | 105  | 141  |
| 75+      | 39   | 41   | 39   | 52   |
| All      | 144  | 160  | 145  | 194  |
| Women and Men |               |         |       |       |
| 50–74    | 196  | 219  | 225  | 261  |
| 75+      | 156  | 165  | 193  | 206  |
| All      | 352  | 384  | 418  | 467  |
The cost of osteoporosis including the value of QALYs lost was estimated to increase from approximately €636 million in 2010 to €818 million in 2025. This compared to an increase from €390 million in 2010 to €491 million in the base case over the same interval (see Table 18). The increase was estimated to be more marked in men (+31%) compared to women (+27%).

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Epidemiology and Economic Burden of Osteoporosis in Slovenia

A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

Moa Ivergård, Axel Svedbom, Emma Hernlund, Juliet Compston, Cyrus Cooper, Judy Stenmark, Eugene V. McCloskey, Bengt Jönsson, Tomaz Kocjan, John A. Kanis

Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Slovenia.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Slovenia, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in the EU27 was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 16,000 new fragility fractures were sustained in Slovenia, comprising 3,000 hip fractures, 2,000 vertebral fractures, 2,000 forearm fractures and 8,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €56 million for the same year. Incident fractures represented 65% of this cost, long-term fracture care 23% and pharmacological prevention 13%. Previous and incident fractures also accounted for 4,900 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 22,000 in 2025, representing an increase of 6,000 fractures. Hip, clinical spine, forearm and other fractures were estimated to increase by 1,400, 900, 700 and 3,400, respectively. The burden of fractures in Slovenia in 2025 was estimated to increase by 37% to €77 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment remained at very low levels in...
In the past few years. A substantial minority of women at high fracture risk did not receive active treatment.

**Conclusions**

In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by an aging population, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

**Introduction**

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Slovenia in 2010 and beyond.

**Methods**

The literature on fracture incidence and costs of fractures in Slovenia was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

**Epidemiology of osteoporosis in Slovenia**

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 343,000 and 416,000 respectively in Slovenia in 2010 (Table 1).

**Table 1**  Population at risk: men and women over the age of 50 in Slovenia, 2010 [1]

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–59      | 151,000 | 155,000 | 306,000 |
| 60–69      | 111,000 | 102,000 | 213,000 |
| 70–79      | 94,000  | 64,000  | 158,000 |
| 80–89      | 54,000  | 21,000  | 75,000  |
| 90+        | 6,000   | 1,000   | 7,000   |
| 50+        | 416,000 | 343,000 | 759,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 110,000 (Table 2). There are 27.1 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model for the assessment of fracture risk is not available for Slovenia.

Detailed incidence data were not available for Slovenia, therefore data for hip fractures were imputed from Hungarian age-standardized incidence rates [5]. The incidences of vertebral, forearm and “other” fractures were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Slovenia by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 4,851 | 1,950 |
| 55–59      | 7,104 | 2,695 |
| 60–64      | 8,866 | 3,422 |
| 65–69      | 9,898 | 3,182 |
| 70–74      | 13,950 | 2,964 |
| 75–79      | 16,500 | 2,678 |
| 80+        | 28,320 | 3,652 |
| 50+        | 89,489 | 20,543 |

**Table 3**  Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Slovenia by age

| Fracture at the | Women | |
|-----------------|-------|-------|
| Age (years)     | hip   | vertebra | forearm | other |
| 50–54           | 10    | 25      | 61      | 63    |
| 55–59           | 46    | 126     | 350     | 400   |
| 60–64           | 91    | 161     | 345     | 352   |
| 65–69           | 156   | 228     | 380     | 534   |
| 70–74           | 285   | 402     | 512     | 808   |
| 75–79           | 557   | 542     | 544     | 1,173 |
| 80–84           | 1,385 | 870     | 867     | 2,355 |
| 85+             | 2,684 | 1,263   | 1,146   | 4,509 |

| Men | |
|-----|-------|
| Age (years)     | hip   | vertebra | forearm | other |
| 50–54           | 13    | 33      | 12      | 57    |
| 55–59           | 66    | 115     | 100     | 614   |
| 60–64           | 107   | 255     | 201     | 1,050 |
| 65–69           | 142   | 224     | 214     | 918   |
| 70–74           | 190   | 290     | 122     | 976   |
| 75–79           | 377   | 435     | 107     | 1,007 |
| 80–84           | 872   | 606     | 169     | 2,319 |
| 85+             | 1,660 | 1,115   | 304     | 4,807 |
the EU27 population, this hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 273.8 and 558.6 respectively.

The number of incident fractures in 2010 was estimated at approximately 15,500 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 2,800, 2,300, 2,500 and 7,900 respectively. 64 % of fractures occurred in women.

In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.64 % for hip and 1.88 % for vertebral fractures. The estimated proportions of men and women with prior hip and clinical vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 12,000 and 14,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 192 (Table 8). Hip, vertebral and “other” fractures accounted for 95, 66 and 31 deaths respectively. Overall, approximately 54 % of deaths occurred in women.

Cost of osteoporosis in Slovenia including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

In Slovenia, the costs of hip, vertebral, and forearm fractures have been estimated at € 5,306, € 810, and

| Table 4 | Estimated number of incident fractures in Slovenia, 2010 |
|---------|---------------------------------------------------------|
| Age (years) | Hip | Vertebral | Forearm | Other | All |
|---------|-----|-----------|---------|-------|-----|
| Women: 50–74 | 373 | 578 | 1,090 | 1,433 | 3,474 |
| 75+ | 1,659 | 873 | 887 | 3,069 | 6,487 |
| Total | 2,032 | 1,451 | 1,977 | 4,502 | 9,962 |
| Men: 50–74 | 314 | 563 | 392 | 2,235 | 3,504 |
| 75+ | 434 | 327 | 91 | 1,192 | 2,044 |
| Total | 748 | 890 | 483 | 3,427 | 5,548 |
| Men and Women: 50–74 | 687 | 1,141 | 1,482 | 3,668 | 6,979 |
| 75+ | 2,092 | 1,200 | 978 | 4,261 | 8,531 |
| Total | 2,780 | 2,341 | 2,460 | 7,929 | 15,510 |

| Table 5 | Proportion of men and women (in %) with a prior hip or clinical fracture in Slovenia, 2010 |
|---------|---------------------------------|
| Age (years) | Hip fracture | Vertebral fracture |
|---------|-------------|-------------------|
| Women: 50–54 | 0.0 | 0.1 |
| 55–59 | 0.2 | 0.5 |
| 60–64 | 0.5 | 1.1 |
| 65–69 | 1.0 | 1.8 |
| 70–74 | 1.7 | 2.9 |
| 75–79 | 3.1 | 4.2 |
| 80–84 | 6.3 | 6.1 |
| 85+ | 14.5 | 10.4 |
| Men: 50–54 | 0.0 | 0.1 |
| 55–59 | 0.3 | 0.5 |
| 60–64 | 0.6 | 1.1 |
| 65–69 | 1.0 | 1.7 |
| 70–74 | 1.5 | 2.0 |
| 75–79 | 2.2 | 2.6 |
| 80–84 | 4.2 | 3.6 |
| 85+ | 9.1 | 6.6 |

| Table 6 | Number of men and women in Slovenia with a prior hip or clinical fracture after the age of 50 years, 2010 |
|---------|-------------------------------------------------|
| Age (years) | Hip fracture | Vertebral fracture |
|---------|-------------|-------------------|
| Women: 50–74 | 1,832 | 3,481 |
| 75+ | 7,209 | 6,597 |
| Total | 9,041 | 10,077 |
| Men: 50–74 | 1,547 | 2,549 |
| 75+ | 1,841 | 1,679 |
| Total | 3,388 | 4,229 |
| Men and Women: 50–74 | 3,379 | 6,030 |
| 75+ | 9,050 | 8,276 |
| Total | 12,429 | 14,306 |
€161, respectively [6]. Costs for “other fractures” were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€11,308 [7]) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €15 [8] and a DXA scan costing €29 [8] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €56 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €36 million, €13 million and €7 million respectively. It is notable that pharmacological fracture prevention costs amounted to only 12.5% of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€26 million) followed by “other” (€21 million), spine (€2 million) and forearm fractures (€0.4 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

### Table 7 Incidence (per 100,000) of causally related deaths in Slovenia within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|-------------------|-----------------|
| Women       |     |                   |                 |
| 50–54       | 657 | 854               | 17              |
| 55–59       | 897 | 1,103             | 27              |
| 60–64       | 1,131| 1,314             | 36              |
| 65–69       | 1,455| 1,595             | 55              |
| 70–74       | 1,653| 1,706             | 75              |
| 75–79       | 2,496| 2,412             | 157             |
| 80–84       | 2,833| 2,507             | 316             |
| 85–89       | 3,645| 2,834             | 639             |
| 90+         | 2,953| 1,665             | 1,027           |
| Men         |     |                   |                 |
| 50–54       | 2,251| 2,700             | 35              |
| 55–59       | 2,832| 3,220             | 58              |
| 60–64       | 2,758| 2,966             | 75              |
| 65–69       | 3,633| 3,685             | 130             |
| 70–74       | 4,228| 4,026             | 191             |
| 75–79       | 5,463| 4,845             | 324             |
| 80–84       | 6,108| 4,960             | 513             |
| 85–89       | 7,690| 5,620             | 831             |
| 90+         | 10,085| 6,563            | 1,262           |

### Table 8 The number of deaths in men and women in Slovenia in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | hip | Fracture at the vertebra | “other” |
|-------------|-----|--------------------------|---------|
| Women       |     |                           |         |
| 50–74       | 6   | 9                        | 1       |
| 75+         | 49  | 20                       | 19      |
| Total       | 55  | 29                       | 20      |
| Men         |     |                           |         |
| 50–74       | 11  | 20                       | 3       |
| 75+         | 29  | 17                       | 8       |
| Total       | 41  | 37                       | 11      |
| Men and Women|     |                           |         |
| 50–74       | 17  | 29                       | 3       |
| 75+         | 78  | 36                       | 28      |
| Total       | 95  | 66                       | 31      |

### Table 9 One year costs for relevant pharmaceuticals in Slovenia, 2010 [9]

|          | Annual drug cost (€) |
|----------|----------------------|
| Alendronate | 161                   |
| Risedronate | 332                   |
| Etidronate | -                     |
| Ibandronate | 104                   |
| Zoledronic acid | 360                   |
| Raloxifene | 323                   |
| Strontium ranelate | 474                   |
| Parathyroid hormone | -                   |
| Teriparadite | 5,193                 |

### Table 10 Cost of osteoporosis (€) in Slovenia by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|---------------------------|-------------------------|------------|
| Women       |                          |                           |                         |            |
| 50–74       | 6,511,255                | 1,295,316                 | 3,760,056               | 11,566,627 |
| 75+         | 16,720,093               | 7,799,570                 | 2,386,366               | 26,906,029 |
| All         | 23,231,349               | 9,094,886                 | 6,146,422               | 38,472,657 |
| Men         |                          |                           |                         |            |
| 50–74       | 7,649,012                | 1,301,927                 | 636,428                 | 9,587,367  |
| 75+         | 5,348,734                | 2,391,354                 | 729,696                 | 9,660,783  |
| All         | 12,997,746               | 3,693,281                 | 866,124                 | 17,557,150 |
| Men and Women|                         |                           |                         |            |
| 50–74       | 14,160,267               | 2,597,243                 | 4,396,484               | 21,153,994 |
| 75+         | 22,068,827               | 10,199,923                | 2,616,062               | 34,875,813 |
| All         | 36,229,094               | 12,788,167                | 7,012,546               | 56,029,807 |
The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 4,900 (Table 12). Prior fractures accounted for 52 % of the total loss and 66 % of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at € 170 million.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 220 million in Slovenia in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 16 %, 6 %, 3 %, 75 % respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 760,000 in 2010 to 910,000 in 2025, corresponding to an increase of 20 % (Table 14).

### Table 11 Total cost (€) in 2010 by fracture site in men and women in Slovenia. Note that costs for fracture prevention therapy and monitoring are not included

| Age   | Hip            | Spine | Forearm | Other | All          |
|-------|----------------|-------|---------|-------|--------------|
|       | 50–74          |       |         |       |              |
| Women | 3,195,677      | 450,107 | 175,397 | 3,985,391 | 7,806,572   |
|       | 15,540,455     | 636,964 | 142,667 | 8,199,577 | 24,519,663 |
| All   | 18,736,132     | 1,087,071 | 318,065 | 12,184,967 | 32,326,234 |
|       | 50–74          |       |         |       |              |
| Men   | 2,825,804      | 417,419 | 63,034  | 5,644,682 | 8,950,939   |
|       | 4,227,361      | 221,388 | 14,648  | 8,199,577 | 24,519,663 |
| All   | 7,053,164      | 638,807 | 77,682  | 8,921,373 | 32,326,234 |
|       | 50–74          |       |         |       |              |
| Women and Men | 6,021,480 | 867,526 | 238,431 | 9,630,073 | 16,757,511 |
|       | 19,767,816     | 858,352 | 157,315 | 11,476,268 | 32,259,751 |
| All   | 25,789,296     | 1,725,878 | 395,747 | 21,106,340 | 49,017,261 |

### Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Slovenia according to age

| Age (years) | Women | All |
|-------------|-------|-----|
| 50–74       |       |     |
| Incident hip fractures | 90 | 350 |
| Incident vertebral fractures | 191 | 252 |
| Incident forearm fractures | 38 | 27 |
| Incident other fractures | 172 | 320 |
| Prior hip fractures | 287 | 977 |
| Prior vertebral fractures | 194 | 322 |
| Total | 972 | 2,247 |
| 75+         |       |     |
| Incident hip fractures | 287 | 977 |
| Incident vertebral fractures | 194 | 322 |
| Incident forearm fractures | 38 | 27 |
| Incident other fractures | 172 | 320 |
| Prior hip fractures | 287 | 977 |
| Prior vertebral fractures | 194 | 322 |
| Total | 972 | 2,247 |

### Table 13 Value of lost QALYs (€) in men and women in Slovenia in 2010

| 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|----------------|----------------|----------------|
| Incident hip fractures | 10,751,278 | 21,502,555 | 32,253,833 |
| Incident vertebral fractures | 12,743,578 | 25,487,157 | 38,231,275 |
| Incident forearm fractures | 1,418,350 | 2,836,700 | 4,255,049 |
| Incident other fractures | 15,437,686 | 30,875,372 | 46,313,059 |
| Prior hip fractures | 30,782,194 | 61,564,389 | 92,346,583 |
| Prior vertebral fractures | 12,910,724 | 25,821,448 | 38,732,172 |
| Total | 84,043,990 | 168,087,981 | 252,131,971 |
The total number of fractures was estimated to rise from 16,000 in 2010 to 22,000 in 2025 (Table 15), corresponding to an increase of 41%. Hip, clinical spine, forearm and other fractures increased by 1,400, 900, 700 and 3,400 respectively. The increase in the number of fractures ranged from 27% to 50%, depending on fracture site. The increase was estimated to be particularly marked in men (47%) compared to women (37%).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from € 56 million in 2010 to € 77 million in 2025, corresponding to an increase of 37% (Table 16). Costs incurred in women and men increased by 32% and 47% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 4,900 in 2010 to 6,300 in 2025, corresponding to an increase of 30% (Table 17). The increase was estimated to be particularly marked in men.
(40 %) compared to women (25 %). Incident and prior fractures accounted for 65 % and 35 % of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately € 224 million in 2010 to € 296 million in 2025. The increase was estimated to be particularly marked in men (+41 %) compared to women (+27 %) (Table 18).

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 2.35 % in 2001 to 5.88 % in 2008 but subsequently decreased to 5.11 % in 2011.

### Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Slovenia were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Given that a FRAX model for Slovenia was not available, the FRAX model for Hungary was used as a surrogate. Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 63 % and 44 % respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

### Acknowledgements

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Epidemiology and Economic Burden of Osteoporosis in Spain

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Spain.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Spain, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in the EU27 was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 204,000 new fragility fractures were sustained in Spain, comprising 40,000 hip fractures, 30,000 vertebral fractures, 30,000 forearm fractures and 104,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €2,842 million for the same year. Incident fractures represented 48% of this cost, long-term fracture care 37% and pharmacological prevention 15%. Previous and incident fractures also accounted for 70,800 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at €3,680 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment declined in the past few years.
A substantial minority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by an aging population, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Spain in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in Spain was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in Spain

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 7,277,000 and 8,628,000 respectively in Spain in 2010 (Table 1).

| Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Spain by age using female-derived reference ranges at the femoral neck, 2010 [4] |
| Age (years) | Women | Men |
|------------|-------|-----|
| 50–54      | 96,705 | 37,625 |
| 55–59      | 127,104 | 44,415 |
| 60–64      | 182,039 | 68,382 |
| 65–69      | 217,756 | 71,188 |
| 70–74      | 272,304 | 62,790 |
| 75–79      | 369,375 | 76,014 |
| 80+        | 687,704 | 135,954 |
| 50+        | 1,952,987 | 496,368 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 2,450,000 (Table 2). There are 8.4 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Incidence data for hip fractures were retrieved from mean values of four regional estimates [5–8]. Given that country specific incidence of vertebral, forearm and, “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27

| Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Spain by age |
| Age (years) | hip | vertebra | forearm | other |
|------------|-----|----------|---------|-------|
| Women      |     |          |         |       |
| 50–54      | 8   | 21       | 51      | 53    |
| 55–59      | 24  | 65       | 181     | 207   |
| 60–64      | 44  | 78       | 166     | 170   |
| 65–69      | 75  | 110      | 183     | 258   |
| 70–74      | 179 | 253      | 322     | 508   |
| 75–79      | 386 | 375      | 376     | 811   |
| 80–84      | 858 | 540      | 537     | 1,460 |
| 85+        | 1,709 | 804   | 729     | 2,870 |

Men

| Age (years) | hip | vertebra | forearm | other |
|------------|-----|----------|---------|-------|
| 50–54      | 5   | 14       | 5       | 23    |
| 55–59      | 17  | 30       | 26      | 159   |
| 60–64      | 42  | 102      | 80      | 417   |
| 65–69      | 54  | 85       | 81      | 347   |
| 70–74      | 103 | 157      | 66      | 527   |
| 75–79      | 190 | 219      | 54      | 507   |
| 80–84      | 387 | 269      | 75      | 1,029 |
| 85+        | 811 | 545      | 149     | 2,349 |
population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 125.9 and 353.0 respectively.

The number of incident fractures in 2010 was estimated at 204,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 40,000, 30,000, 30,000 and 104,000 respectively. 68% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.32% for hip and 1.34% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 211,000 and 212,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 2,550 (Table 8). Hip, vertebral and “other” fractures accounted for 1,289, 719 and 542 deaths respectively. Overall, approximately 53% of deaths occurred in women.

Cost of osteoporosis in Spain including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

Table 4 Estimated number of incident fractures in Spain, 2010

| Age (years) | Hip | Vertebral | Forearm | Other | All fractures |
|-------------|-----|-----------|---------|-------|---------------|
| Women       |     |           |         |       |               |
| 50–74       | 4,102 | 6,127 | 11,626 | 15,596 | 37,450        |
| 75+         | 25,929 | 13,028 | 13,529 | 49,483 | 101,969       |
| Total       | 30,030 | 19,155 | 25,155 | 65,079 | 139,419       |
| Men         |     |           |         |       |               |
| 50–74       | 2,694 | 4,723 | 2,946 | 17,304 | 27,667        |
| 75+         | 7,748 | 5,811 | 1,617 | 21,889 | 37,066        |
| Total       | 10,442 | 10,534 | 4,563 | 39,193 | 64,733        |
| Men and Women |     |         |         |       |               |
| 50–74       | 6,796 | 10,850 | 14,572 | 32,900 | 65,117        |
| 75+         | 33,677 | 18,839 | 15,147 | 71,372 | 139,035       |
| Total       | 40,473 | 29,689 | 29,719 | 104,272 | 204,152       |

Table 5 Proportion of men and women (in %) with a prior hip or clinical vertebral fracture in Spain, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–54       | 0.0          | 0.0                |
| 55–59       | 0.1          | 0.3                |
| 60–64       | 0.3          | 0.6                |
| 65–69       | 0.6          | 1.0                |
| 70–74       | 1.1          | 1.8                |
| 75–79       | 2.2          | 2.9                |
| 80–84       | 4.5          | 4.3                |
| 85+         | 11.5         | 7.6                |
| Men         |              |                    |
| 50–54       | 0.0          | 0.0                |
| 55–59       | 0.1          | 0.1                |
| 60–64       | 0.2          | 0.4                |
| 65–69       | 0.4          | 0.8                |
| 70–74       | 0.7          | 1.1                |
| 75–79       | 1.2          | 1.5                |
| 80–84       | 2.3          | 2.0                |
| 85+         | 6.0          | 4.1                |

Table 6 Number of men and women in Spain with a prior hip or clinical vertebral fracture after the age of 50 years, 2010

| Age (years) | Hip fracture | Vertebral fracture |
|-------------|--------------|--------------------|
| Women       |              |                    |
| 50–74       | 22,185       | 40,224             |
| 75+         | 134,852      | 113,704            |
| Total       | 157,037      | 153,927            |
| Men         |              |                    |
| 50–74       | 13,297       | 23,972             |
| 75+         | 40,226       | 34,529             |
| Total       | 53,523       | 58,501             |
| Men and Women |          |                    |
| 50–74       | 35,482       | 64,196             |
| 75+         | 175,078      | 148,233            |
| Total       | 210,560      | 212,428            |
The cost of a hip fracture has been estimated at €9,421 in Spain, imputed from the UK data [9,10] by adjusting for differences in health care price levels. Given that no cost data for the other fracture sites were found, these were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€51,786 [11]) with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9 for 2010. For the purposes of this report drug costs were used for 2010 [12]. In addition, it was assumed that patients on treatment made an annual physician visit costing €109 [13] and a DXA scan costing €79 [14] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €2,842 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €1,372 million, €1,055 million and €414 million, respectively.

### Table 7 Incidence (per 100,000) of causally related deaths in Spain within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|------------------|
| Women       |     |                    |                  |
| 50–54       | 464 | 604                | 12               |
| 55–59       | 509 | 626                | 15               |
| 60–64       | 774 | 898                | 25               |
| 65–69       | 1,049 | 1,150            | 39               |
| 70–74       | 1,410 | 1,455             | 64               |
| 75–79       | 1,979 | 1,912             | 124              |
| 80–84       | 2,260 | 1,999             | 252              |
| 85–89       | 2,962 | 2,303             | 519              |
| 90+         | 2,837 | 1,599            | 986              |
| Men         |     |                    |                  |
| 50–54       | 1,796 | 2,154            | 28               |
| 55–59       | 2,038 | 2,317            | 42               |
| 60–64       | 2,525 | 2,715            | 68               |
| 65–69       | 2,891 | 2,932            | 104              |
| 70–74       | 3,429 | 3,265            | 155              |
| 75–79       | 4,199 | 3,724            | 249              |
| 80–84       | 5,079 | 4,125            | 427              |
| 85–89       | 6,810 | 4,977            | 736              |
| 90+         | 9,709 | 6,318              | 1,215           |

The cost of a hip fracture has been estimated at €9,421 in Spain, imputed from the UK data [9,10] by adjusting for differences in health care price levels. Given that no cost data for the other fracture sites were

### Table 8 The number of deaths in men and women in Spain in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Clinical vertebral | “Other” |
|-------------|-----|--------------------|--------|
| Women       |     |                    |        |
| 50–74       | 51  | 74                 | 8      |
| 75+         | 648 | 233                | 341    |
| Total       | 699 | 308                | 348    |
| Men         |     |                    |        |
| 50–74       | 83  | 141                | 18     |
| 75+         | 507 | 271                | 175    |
| Total       | 590 | 411                | 194    |
| Men and Women |     |                    |        |
| 50–74       | 134 | 215                | 26     |
| 75+         | 1,155 | 504              | 516    |
| Total       | 1,289 | 719              | 542    |

### Table 9 One year costs for relevant pharmaceuticals in Spain, 2010 [12]

| Annual drug cost (€) |
|----------------------|
| Alendronate          | 150    |
| Risedronate          | 238    |
| Etidronate           | 14     |
| Ibandronate          | 156    |
| Zoledronic acid      | 422    |
| Denosumab*           | 480    |
|Raloxifene            | 248    |
| Bazedoxifene*        | 413    |
|Strontium ranelate    | 593    |
|Parathyroid hormone   | 4,754  |
|Teriparatide          | 4,865  |

### Table 10 Cost of osteoporosis (€) in Spain by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| Women       | 50–74                    | 152,012,122               | 72,019,926               | 210,802,334 | 434,834,382 |
| 75+         | 807,370,308              | 67,245,489                | 152,314,690              | 1,646,930,486 |
| All         | 959,382,430              | 759,265,414               | 363,117,024              | 2,081,764,868 |
| Men         | 50–74                    | 127,703,007               | 53,816,151               | 32,436,227  | 213,955,385  |
| 75+         | 285,123,435              | 242,199,475               | 18,525,842               | 545,848,752  |
| All         | 412,826,442              | 296,015,626               | 50,962,069               | 759,804,137  |

### Table 10 Cost of osteoporosis (€) in Spain by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|----------------------------|--------------------------|------------|
| Women       | 50–74                    | 127,703,007               | 53,816,151               | 32,436,227  | 213,955,385  |
| 75+         | 285,123,435              | 242,199,475               | 18,525,842               | 545,848,752  |
| All         | 412,826,442              | 296,015,626               | 50,962,069               | 759,804,137  |
| Men         | 50–74                    | 127,703,007               | 53,816,151               | 32,436,227  | 213,955,385  |
| 75+         | 285,123,435              | 242,199,475               | 18,525,842               | 545,848,752  |
| All         | 412,826,442              | 296,015,626               | 50,962,069               | 759,804,137  |
| Men and Women |                  |                            |                          |            |
| 50–74       | 279,715,129              | 125,836,077               | 243,238,561              | 648,789,767  |
| 75+         | 1,092,493,743            | 929,444,963               | 170,840,532              | 2,192,779,238 |
| All         | 1,372,208,872            | 1,055,281,040             | 414,079,092              | 2,841,569,005 |
million respectively. It is notable that pharmacological fracture prevention costs amounted to only 14.6 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€ 1,591 million) followed by “other” (€ 742 million), spine (€ 63 million) and forearm fractures (€ 32 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 70,800 (Table 12). Prior fractures accounted for 57 % of the total loss and 69 % of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product

| Age       | Hip        | Spine      | Forearm    | Other      | All        |
|-----------|------------|------------|------------|------------|------------|
| **Women** |            |            |            |            |            |
| 50–74     | 112,331,656| 13,963,696 | 12,508,891 | 85,227,804 | 224,032,048|
| 75+       | 1,060,273,826| 27,728,079 | 14,556,654 | 392,057,237| 1,494,615,796|
| All       | 1,172,605,482| 41,691,776 | 27,065,545 | 477,285,041| 1,718,647,844|
| **Men**   |            |            |            |            |            |
| 50–74     | 78,786,762 | 10,293,798 | 3,169,504  | 89,269,094 | 181,519,158|
| 75+       | 339,200,268| 11,368,934 | 1,740,263  | 175,013,446| 527,322,910 |
| All       | 417,987,030| 21,662,732 | 4,909,767  | 264,282,540| 708,842,068 |
| **Women and Men** | | | | | |
| 50–74     | 191,118,418| 24,257,495 | 15,678,395 | 174,496,898| 405,551,206|
| 75+       | 1,399,474,093| 39,097,013 | 16,296,917 | 567,070,683| 2,021,938,706|
| All       | 1,590,592,512| 63,354,508 | 31,975,312 | 741,567,581| 2,427,489,912|

Table 11 Total cost (€) in 2010 by fracture site in men and women in Spain. Note that costs for fracture prevention therapy and monitoring are not included.

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in Spain according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| **Women**   |       |     |     |
| Incident hip fractures | 980  | 5,368 | 6,348 |
| Incident vertebral fractures | 2,014 | 3,697 | 5,710 |
| Incident forearm fractures | 409  | 408  | 817  |
| Incident other fractures | 1,861 | 5,100 | 6,961 |
| Prior hip fractures | 3,466 | 18,038 | 21,504 |
| Prior vertebral fractures | 2,242 | 4,911 | 7,733 |
| Total | 10,970 | 38,102 | 49,073 |
| **Men**     |       |     |     |
| Incident hip fractures | 655  | 1,850 | 2,505 |
| Incident vertebral fractures | 1,563 | 1,845 | 3,408 |
| Incident forearm fractures | 102  | 53   | 154  |
| Incident other fractures | 2,042 | 2,484 | 4,526 |
| Prior hip fractures | 2,071 | 5,926 | 7,998 |
| Prior vertebral fractures | 1,327 | 1,815 | 3,141 |
| Total | 7,760 | 13,973 | 21,733 |
| **Men and Women** |       |     |     |
| Incident hip fractures | 1,635 | 7,218 | 8,853 |
| Incident vertebral fractures | 3,577 | 5,542 | 9,119 |
| Incident forearm fractures | 510  | 461  | 971  |
| Incident other fractures | 3,903 | 7,585 | 11,487 |
| Prior hip fractures | 5,537 | 23,965 | 29,502 |
| Prior vertebral fractures | 3,568 | 7,306 | 10,874 |
| Total | 18,731 | 52,075 | 70,806 |

Fig. 1 Share (%) of fracture cost by fracture site in Spain. Note that costs for fracture prevention therapy and monitoring are not included.
(GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at € 3.27 billion.

When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to € 6.11 billion in Spain in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 22 %, 17 %, 7 %, 54 % respectively.

**Burden of osteoporosis up to 2025**

The population above 50 years of age is expected to increase from 15.9 million in 2010 to 21.5 million in 2025, corresponding to an increase of 35 % (Table 14).

The total number of fractures was estimated to rise from 204,000 in 2010 to 286,000 in 2025 (Table 15), corresponding to an increase of 40 %. Hip, clinical spine, forearm and other fractures increased by 16,700, 11,500, 10,000 and 43,500 respectively. The increase in the number of fractures ranged from 34 % to 42 %, depending on fracture site. The increase was estimated to be particularly marked in men (49 %) compared to women (36 %).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from € 2.8 billion in 2010 to € 3.7 billion in 2025, corresponding to an increase of 30 % (Table 16). Costs incurred in women and men increased by 26 % and 39 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 70,800 in 2010 to 89,000 in 2025, corresponding to an increase of 26 % (Table 17). The increase was estimated to be particularly marked in men (37 %) compared to women (21 %). Incident and prior fractures accounted for 66 % and 34 % of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately € 6.1 billion in 2010 to € 7.8 billion in 2025. The increase was estimated to be particularly marked in men (+38 %) compared to women (+23 %) (Table 18).

**Table 13** Value of lost QALYs (£) in men and women in Spain in 2010

|                      | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|----------------------|----------------|----------------|----------------|
| Incident hip fractures| 204,496,899    | 408,993,798    | 613,490,697    |
| Incident vertebral fractures | 210,643,500  | 421,286,999    | 631,930,499    |
| Incident forearm fractures | 22,430,809   | 44,861,618     | 67,292,428     |
| Incident other fractures | 265,357,330  | 530,714,660    | 796,071,990    |
| Prior hip fractures | 681,493,449    | 1,362,986,897  | 2,044,480,346  |
| Prior vertebral fractures | 251,189,028  | 502,378,055    | 753,567,083    |
| Total                | 1,635,611,014  | 3,271,222,028  | 4,906,833,042  |

**Table 14** Population projections in Spain by age and sex [15]

|       | Population |
|-------|------------|
|       | 2010 | 2015 | 2020 | 2025 |
| Women |      |      |      |      |
| 50–59 | 2,859,000 | 3,276,000 | 3,619,000 | 3,859,000 |
| 60–69 | 2,351,000 | 2,569,000 | 2,824,000 | 3,234,000 |
| 70–79 | 1,961,000 | 1,945,000 | 2,178,000 | 2,387,000 |
| 80–89 | 1,234,000 | 1,387,000 | 1,384,000 | 1,412,000 |
| 90+   | 223,000   | 288,000   | 375,000   | 444,000   |
|       | 2,774,000 | 3,212,585 | 3,632,000 | 3,987,000 |
|       | 2,141,000 | 2,352,000 | 2,622,000 | 3,054,000 |
|       | 1,543,000 | 1,568,000 | 1,790,000 | 1,989,000 |
|       | 735,000   | 865,000   | 889,000   | 946,000   |
|       | 84,000    | 125,000   | 174,000   | 219,000   |
| All   | 5,633,000 | 6,488,585 | 7,251,000 | 7,846,000 |
|       | 4,922,000 | 4,921,000 | 5,446,000 | 6,288,000 |
|       | 3,504,000 | 3,513,000 | 3,968,000 | 4,376,000 |
|       | 1,969,000 | 2,252,000 | 2,273,000 | 2,358,000 |
|       | 307,000   | 413,000   | 549,000   | 663,000   |
|       | 15,905,000|           |           | 21,531,000|

**Treatment uptake**

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who
were treated increased from 2.74% in 2001 to 9.56% in 2009 but subsequently decreased to 8.51% in 2011.

**Treatment gap**

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Spain were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 20% and 25% respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

### Table 15 Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Spain

|          | Hip 2010 | Hip 2025 | Spine 2010 | Spine 2025 | Forearm 2010 | Forearm 2025 | Other 2010 | Other 2025 |
|----------|----------|----------|------------|------------|--------------|--------------|------------|------------|
| **Women** |          |          |            |            |              |              |            |            |
| 50–74    | 4,102    | 5,482    | 6,127      | 8,230      | 11,626       | 15,705       | 15,596     | 21,006     |
| 75+      | 25,929   | 36,096   | 13,028     | 17,425     | 13,529       | 17,346       | 49,483     | 68,389     |
| All      | 30,030   | 41,578   | 19,155     | 25,655     | 25,155       | 33,050       | 65,079     | 89,395     |
| **Men**  |          |          |            |            |              |              |            |            |
| 50–74    | 2,694    | 3,782    | 4,723      | 6,643      | 2,946        | 4,201        | 17,304     | 24,527     |
| 75+      | 7,748    | 11,816   | 5,811      | 8,923      | 1,617        | 2,467        | 21,889     | 33,862     |
| All      | 10,442   | 15,598   | 10,534     | 15,566     | 4,563        | 6,668        | 39,193     | 58,389     |
| **Women and Men** |          |          |            |            |              |              |            |            |
| 50–74    | 6,796    | 9,264    | 10,850     | 14,873     | 14,572       | 19,905       | 32,900     | 45,532     |
| 75+      | 33,677   | 47,912   | 18,839     | 26,347     | 15,147       | 19,813       | 71,372     | 102,252    |
| All      | 40,473   | 57,176   | 29,689     | 41,221     | 29,719       | 39,718       | 104,272    | 147,784    |

### Table 16 Current and future cost (€ 000, 000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Spain

|          | 2010 | 2015 | 2020 | 2025 |
|----------|------|------|------|------|
| **Women** |      |      |      |      |
| 50–74    | 435  | 471  | 521  | 562  |
| 75+      | 1,647| 1,778| 1,909| 2,063|
| All      | 2,082| 2,249| 2,430| 2,625|
| **Men**  |      |      |      |      |
| 50–74    | 214  | 233  | 261  | 289  |
| 75+      | 546  | 612  | 681  | 766  |
| All      | 760  | 845  | 942  | 1,055|
| **Women and Men** |      |      |      |      |
| 50–74    | 649  | 704  | 781  | 852  |
| 75+      | 2,193| 2,390| 2,590| 2,829|
| All      | 2,842| 3,094| 3,371| 3,680|

### Table 17 Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Spain

|          | Incident fractures 2010 | Incident fractures 2025 | Prior fractures 2010 | Prior fractures 2025 | All fractures 2010 | All fractures 2025 |
|----------|------------------------|-------------------------|----------------------|----------------------|--------------------|--------------------|
| **Women** |                        |                         |                      |                      |                    |                    |
| 50–74    | 5,263                  | 7,077                   | 5,708                | 6,183                | 10,970             | 13,259             |
| 75+      | 14,573                 | 19,726                  | 23,529               | 26,281               | 38,102             | 46,007             |
| All      | 19,836                 | 26,803                  | 29,237               | 32,464               | 49,073             | 59,267             |
| **Men**  |                        |                         |                      |                      |                    |                    |
| 50–74    | 4,362                  | 6,159                   | 3,398                | 4,090                | 7,760              | 10,249             |
| 75+      | 6,232                  | 9,546                   | 7,741                | 9,908                | 13,973             | 19,454             |
| All      | 10,594                 | 15,705                  | 11,139               | 13,998               | 21,733             | 29,703             |
| **Women and Men** |                    |                         |                      |                      |                    |                    |
| 50–74    | 9,625                  | 13,236                  | 9,106                | 10,273               | 18,731             | 23,509             |
| 75+      | 20,805                 | 29,272                  | 31,270               | 36,189               | 52,075             | 65,461             |
| All      | 30,430                 | 42,508                  | 40,376               | 46,462               | 70,806             | 88,970             |
Table 18 Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Spain assuming the uptake of treatment remains unchanged

|          | 2010  | 2015  | 2020  | 2025  |
|----------|-------|-------|-------|-------|
| Women    |       |       |       |       |
| 50–74    | 942   | 1,007 | 1,095 | 1,175 |
| 75+      | 3,407 | 3,667 | 3,905 | 4,188 |
| All      | 4,349 | 4,674 | 5,000 | 5,363 |
| Men      |       |       |       |       |
| 50–74    | 572   | 614   | 683   | 763   |
| 75+      | 1,191 | 1,313 | 1,460 | 1,665 |
| All      | 1,764 | 1,927 | 2,142 | 2,428 |

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|          | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|----------|-----------------------------------|----------------------------------------|---------------------|-------------------|
| Men      | 191                               | 239                                    | 48                  | 20                |
| Women    | 1,277                             | 1,709                                   | 432                 | 25                |

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Abstract

Summary This report describes epidemiology, burden, and treatment of osteoporosis in Sweden.

Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in Sweden, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.

Methods The literature on fracture incidence and costs of fractures in the EU27 was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap.

Results It was estimated that approximately 107,000 new fragility fractures were sustained in Sweden, comprising 20,000 hip fractures, 16,000 vertebral fractures, 16,000 forearm fractures and 54,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at €1,486 million for the same year. Incident fractures represented 62 % of this cost, long-term fracture care 36 % and pharmacological prevention 2 %. Previous and incident fractures also accounted for 36,000 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 135,000 in 2025, representing an increase of 28,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 6,100, 4,500, 3,300 and 14,400, respectively. The burden of fractures in Sweden in 2025 was estimated to increase by 23 % to €1,828 million. Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 or above who received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.
**Conclusions** In spite of the high cost of osteoporosis, a substantial treatment gap and projected increase of the economic burden driven by an aging population, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in healthcare policy concerning the disease is warranted.

**Introduction**

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in Sweden in 2010 and beyond.

**Methods**

The literature on fracture incidence and costs of fractures in Sweden was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

**Epidemiology of osteoporosis in Sweden**

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 1,659,000 and 1,830,000 respectively in Sweden in 2010 (Table 1).

| Age (years) | Women | Men | All |
|-------------|-------|-----|-----|
| 50–59       | 571,000 | 580,000 | 1,151,000 |
| 60–69       | 583,000 | 579,000 | 1,162,000 |
| 70–79       | 365,000 | 317,000 | 682,000 |
| 80–89       | 253,000 | 161,000 | 414,000 |
| 90+         | 58,000  | 22,000 | 80,000 |
| 50+         | 1,830,000 | 1,659,000 | 3,489,000 |

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 520,000 (Table 2). There are 10 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Data on incidence for all fracture types under consideration are available for Sweden [5,6]. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 318.6 and 802.8 respectively.

**Table 2** Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Sweden by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women | Men |
|-------------|-------|-----|
| 50–54       | 18,018 | 7,300 |
| 55–59       | 27,360 | 10,080 |
| 60–64       | 44,902 | 18,154 |
| 65–69       | 54,338 | 19,684 |
| 70–74       | 54,963 | 14,118 |
| 75–79       | 63,000 | 14,008 |
| 80+         | 146,792 | 30,378 |
| 50+         | 409,373 | 113,722 |

**Table 3** Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in Sweden by age

| Age (years) | Hip | Vertebra | Forearm | Other |
|-------------|-----|----------|---------|-------|
| Women       |     |          |         |       |
| 50–54       | 63  | 162      | 401     | 414   |
| 55–59       | 57  | 159      | 440     | 504   |
| 60–64       | 138 | 245      | 523     | 534   |
| 65–69       | 264 | 385      | 642     | 903   |
| 70–74       | 456 | 642      | 819     | 1,292 |
| 75–79       | 1,006 | 978 | 981     | 2,116 |
| 80–84       | 1,817 | 1,142 | 1,138 | 3,090 |
| 85+         | 3,082 | 1,450 | 1,315 | 5,178 |

| Age (years) | Hip | Vertebra | Forearm | Other |
|-------------|-----|----------|---------|-------|
| Men         |     |          |         |       |
| 50–54       | 88  | 225      | 81      | 390   |
| 55–59       | 86  | 149      | 131     | 800   |
| 60–64       | 77  | 183      | 144     | 753   |
| 65–69       | 150 | 236      | 225     | 966   |
| 70–74       | 260 | 396      | 166     | 1,334 |
| 75–79       | 495 | 571      | 141     | 1,323 |
| 80–84       | 1,163 | 807 | 225     | 3,091 |
| 85+         | 1,623 | 1,090 | 297     | 4,699 |
The number of incident fractures in 2010 was estimated at 107,000 (Table 4). Incident hip, clinical spine, forearm and “other” fractures were estimated at 20,000, 16,000, 16,000 and 54,000 respectively. 66% of fractures occurred in women.

A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 2.84% for hip and 3.19% for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 99,000 and 111,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 1,171 (Table 8). Hip, vertebral and “other” fractures accounted for 589, 362 and 220 deaths respectively. Overall, approximately 54% of deaths occurred in women.

Cost of osteoporosis in Sweden including and excluding values of QALY’s lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALY’s lost) were considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.
In Sweden, the costs of hip and vertebral fractures have been estimated to range from €12,870 to €19,667, and from €2,048 to €14,219 respectively. The cost of forearm fracture has been estimated at €2,401 [7]. Costs for “other fractures” were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home (€57,247 [7]) with the simulated number of individuals with prior fractures that had been transferred to nursing home due to the fracture.

Annual drug cost (€) for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing €130 [8] and a DXA scan costing €152 [8] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at €1,486 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to €927 million, €529 million and €29 million respectively. It is notable that pharmacological

### Table 7 Incidence (per 100,000) of causally related deaths in Sweden within the first year after fracture (adjusted for comorbidities), 2010

| Age (years) | Hip | Clinical vertebral | “Other” fracture |
|-------------|-----|--------------------|-----------------|
| **Women**   |     |                    |                 |
| 50–54       | 408 | 530                | 11              |
| 55–59       | 648 | 797                | 19              |
| 60–64       | 938 | 1,089              | 30              |
| 65–69       | 1,288 | 1,412            | 48              |
| 70–74       | 1,710 | 1,765            | 78              |
| 75–79       | 1,899 | 1,834            | 119             |
| 80–84       | 2,084 | 1,844            | 232             |
| 85–89       | 2,629 | 2,044            | 461             |
| 90+         | 2,633 | 1,484            | 915             |
| **Men**     |     |                    |                 |
| 50–54       | 1,019 | 1,222           | 16              |
| 55–59       | 1,463 | 1,663            | 30              |
| 60–64       | 1,652 | 1,776            | 45              |
| 65–69       | 2,140 | 2,171            | 77              |
| 70–74       | 2,706 | 2,576            | 122             |
| 75–79       | 3,471 | 3,078            | 206             |
| 80–84       | 4,305 | 3,496            | 362             |
| 85–89       | 6,395 | 4,674            | 691             |
| 90+         | 9,749 | 6,344           | 1,220            |

### Table 8 The number of deaths in men and women in Sweden in the first year after fracture attributable to the fracture event (causally related), 2010

| Age (years) | Hip | Fracture at the vertebral | “other” |
|-------------|-----|---------------------------|--------|
| **Women**   |     |                           |        |
| 50–74       | 41  | 64                        | 6      |
| 75+         | 280 | 106                       | 135    |
| Total       | 321 | 170                       | 140    |
| **Men**     |     |                           |        |
| 50–74       | 44  | 72                        | 9      |
| 75+         | 224 | 121                       | 70     |
| Total       | 268 | 192                       | 79     |
| **Men and Women** |   |                           |        |
| 50–74       | 85  | 135                       | 15     |
| 75+         | 504 | 227                       | 205    |
| Total       | 589 | 362                       | 220    |

### Table 9 One year costs for relevant pharmaceuticals in Sweden, 2010 [9]

| Annual drug cost (€) | Alendronate | Risedronate | Etidronate | Ibandronate | Zoledronic acid | Raloxifene | Strontium ranelate | Parathyroid hormone | Teriparatide |
|----------------------|-------------|-------------|------------|-------------|-----------------|------------|-------------------|---------------------|-------------|
|                      | 27          | 366         | 241        | -           | 443             | 358        | 468                | 4,585                | 5,174       |

### Table 10 Cost of osteoporosis (€) in Sweden by age in men and women, 2010

| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
|-------------|--------------------------|---------------------------|--------------------------|------------|
| **Women**   |                          |                           |                          |            |
| 50–74       | 164,775,011              | 45,041,829                | 15,865,811               | 225,682,651|
| 75+         | 459,502,549              | 299,410,779               | 9,840,865                | 768,754,194|
| All         | 624,277,561              | 344,452,608               | 25,706,677               | 994,436,845|
| **Men**     |                          |                           |                          |            |
| 50–74       | 129,916,509              | 47,296,421                | 2,429,058                | 179,641,988|
| 75+         | 172,932,982              | 137,583,421               | 1,179,974                | 311,696,377|
| All         | 302,849,491              | 184,879,842               | 3,609,032                | 491,338,365|
| **Women and Men** | |                           |                          |            |
| 50–74       | 294,691,520              | 92,338,250                | 18,294,870               | 405,324,640|
| 75+         | 632,435,531              | 436,994,201               | 11,020,839               | 1,080,450,571|
| All         | 927,127,051              | 529,332,450               | 29,315,709               | 1,485,775,210|
fracture prevention costs amounted to only 2.0 % of the total cost.

When stratifying costs of osteoporosis by fracture type, hip fractures were most costly (€823 million) followed by “other” (€421 million), spine (€173 million) and forearm fractures (€39 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 36,000 (Table 12). Prior fractures accounted for 55 % of the total loss and 64 % of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at €2.67 billion.

Table 11  Total cost (€) in 2010 by fracture site in men and women in Sweden. Note that costs for fracture prevention therapy and monitoring are not included

| Age     | Hip       | Spine     | Forearm   | Other     | All       |
|---------|-----------|-----------|-----------|-----------|-----------|
|         | Women     |           |           |           |           |
| 50–74   | 81,377,383| 36,885,074| 18,729,088| 72,825,294| 209,816,840|
| 75+     | 483,864,161| 79,185,730| 13,825,050| 182,038,388| 758,913,329|
| All     | 565,241,544| 116,070,805| 32,554,138| 254,863,682| 968,730,169|
|         | Men       |           |           |           |           |
| 50–74   | 70,172,188| 22,977,830| 4,971,064 | 79,091,848| 177,212,930|
| 75+     | 187,814,028| 33,607,371| 1,840,698 | 87,254,306| 310,516,403|
| All     | 257,986,216| 56,585,201| 6,811,762 | 166,346,154| 487,729,333|
|         | Women and Men|       |           |           |           |
| 50–74   | 151,549,571| 59,862,904| 23,700,152| 151,917,142| 387,029,770|
| 75+     | 671,678,189| 112,793,101| 15,665,748| 269,292,694| 1,069,429,732|
| All     | 823,227,760| 172,656,006| 39,365,900| 421,209,836| 1,456,459,502|

Table 12  Number of QALYs lost due to fractures during 2010 in men and women in Sweden according to age

| Age (years) | 50–74 | 75+ | 50+ |
|-------------|-------|-----|-----|
| Women       |       |     |     |
| Incident hip fractures | 690  | 2,446| 3,136|
| Incident vertebral fractures | 1,449 | 1,740| 3,189|
| Incident forearm fractures | 275  | 174 | 449 |
| Incident other fractures | 1,236| 2,193| 3,430|
| Prior hip fractures | 2,007| 7,189| 9,196|
| Prior vertebral fractures | 1,368| 2,406| 3,775|
| Total | 7,027| 16,148| 23,174|
| Men |       |     |     |
| Incident hip fractures | 450 | 891 | 1,340|
| Incident vertebral fractures | 1,058 | 886 | 1,944|
| Incident forearm fractures | 72  | 25 | 97 |
| Incident other fractures | 1,411| 1,174| 2,584|
| Prior hip fractures | 1,836| 3,051| 4,888|
| Prior vertebral fractures | 1,043| 955 | 1,998|
| Total | 5,869| 6,982| 12,851|
| Men and Women | | | |
| Incident hip fractures | 1,140| 3,336| 4,476|
| Incident vertebral fractures | 2,508| 2,626| 5,133|
| Incident forearm fractures | 347 | 199 | 545 |
| Incident other fractures | 2,647| 3,367| 6,014|
| Prior hip fractures | 3,844| 10,241| 14,084|
| Prior vertebral fractures | 2,411| 3,361| 5,772|
| Total | 12,896| 23,130| 36,025|
When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to €4.15 billion in Sweden in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 22%, 13%, 1%, 64% respectively.

### Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 3.5 million in 2010 to 4.1 million in 2025, corresponding to an increase of 18% (Table 14).

The total number of fractures was estimated to rise from 107,000 in 2010 to 135,000 in 2025 (Table 15), corresponding to an increase of 26%. Hip, clinical spine, forearm and other fractures increased by 6,100, 4,500, 3,300 and 14,400 respectively. The increase in the number of fractures ranged from 20% to 30%, depending on fracture site. The increase was estimated to be particularly marked in men (33%) compared to women (23%).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from €1.5 billion in 2010 to €1.8 billion in 2025, corresponding to an increase of 23% (Table 16). Costs incurred in women and men increased by 19% and 32% respectively.

The total number of QALYs lost due to fracture was estimated to rise from 36,000 in 2010 to 43,300 in 2025, corresponding to an increase of 20% (Table 17). The increase was estimated to be particularly marked in men (27%) compared to women (16%). Incident and prior fractures accounted for 61% and 39% of the increase respectively.

### Treatment uptake

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 1.53% in 2001 to 3.28% in 2011.
Treatment gap

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in Sweden were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. The treatment gaps in men and women were estimated at 63 % and 72 % respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

Table 15  Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in Sweden

|           | Hip   | Spine | Forearm | Other |
|-----------|-------|-------|---------|-------|
|           | 2010  | 2025  | 2010    | 2025  | 2010  | 2025  | 2010  | 2025  |
| Women     |       |       |         |       |       |       |       |       |
| 50–74     | 2,870 | 3,245 | 4,388   | 4,910 | 7,799 | 8,585 | 10,329| 11,505|
| 75+       | 11,819| 15,126| 6,121   | 8,061 | 5,757 | 7,636 | 21,521| 27,437|
| All       | 14,688| 18,370| 10,509  | 12,971| 13,556| 16,221| 31,650| 38,942|
| Men       |       |       |         |       |       |       |       |       |
| 50–74     | 1,852 | 2,112 | 3,195   | 3,602 | 2,070 | 2,228 | 11,889| 13,249|
| 75+       | 3,740 | 5,856 | 2,788   | 4,408 | 767   | 1,212 | 10,342| 16,099|
| All       | 5,592 | 7,968 | 5,983   | 8,010 | 2,837 | 3,440 | 22,231| 29,348|
| Women and Men | | | | | | | | |
| 50–74     | 4,722 | 5,357 | 7,582   | 8,512 | 9,869 | 10,813| 22,218| 24,754|
| 75+       | 15,558| 20,982| 8,909   | 12,469| 6,524 | 8,848 | 31,663| 43,536|
| All       | 20,280| 26,338| 16,492  | 20,981| 16,393| 19,661| 53,881| 68,290|

Table 16  Current and future cost of (€ 000, 000) osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in Sweden

|           | 2010 | 2015 | 2020 | 2025 |
|-----------|------|------|------|------|
| Women     |      |      |      |      |
| 50–74     | 226  | 251  | 258  | 251  |
| 75+       | 769  | 788  | 838  | 929  |
| All       | 994  | 1,039| 1,096| 1,181|
| Men       |      |      |      |      |
| 50–74     | 180  | 198  | 203  | 201  |
| 75+       | 312  | 328  | 377  | 447  |
| All       | 491  | 527  | 580  | 648  |
| Women and Men | | | | |
| 50–74     | 405  | 449  | 461  | 452  |
| 75+       | 1,080| 1,116| 1,215| 1,376|
| All       | 1,486| 1,565| 1,676| 1,828|

Table 17  Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Sweden

|           | Incident fractures | Prior fractures | All fractures |
|-----------|--------------------|-----------------|---------------|
|           | 2010 | 2015 | 2020 | 2025 | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| Women     |      |      |      |      |      |      |      |      |      |      |      |
| 50–74     | 3,651| 4,074| 3,376| 3,542| 7,027| 7,616|      |      |      |      |      |
| 75+       | 6,552| 8,501| 9,595|10,831|16,148|19,331|      |      |      |      |      |
| All       |10,203|12,574|12,971|14,373|23,174|26,947|      |      |      |      |      |
| Men       |      |      |      |      |      |      |      |      |      |      |      |
| 50–74     | 2,990| 3,355| 2,879| 3,081| 5,869| 6,436|      |      |      |      |      |
| 75+       | 2,976| 4,662| 4,006| 5,228| 6,982| 9,890|      |      |      |      |      |
| All       | 5,966| 8,017| 6,885| 8,310|12,851|16,326|      |      |      |      |      |
| Women and Men | | | | | | | | | | | |
| 50–74     | 6,641| 7,429| 6,255| 6,623| 12,896|14,052|      |      |      |      |      |
| 75+       | 9,528|13,162|13,602|16,059|23,130|29,222|      |      |      |      |      |
| All       |16,169|20,591|19,856|22,682|36,025|43,273|      |      |      |      |      |
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Table 18 Present and future cost (€ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in Sweden assuming the uptake of treatment remains unchanged

|       | 2010   | 2015   | 2020   | 2025   |
|-------|--------|--------|--------|--------|
| Women |        |        |        |        |
| 50–74 | 746    | 802    | 821    | 815    |
| 75+   | 1,964  | 2,027  | 2,149  | 2,360  |
| All   | 2,709  | 2,829  | 2,970  | 3,175  |
| Men   |        |        |        |        |
| 50–74 | 614    | 655    | 672    | 677    |
| 75+   | 828    | 866    | 987    | 1,178  |
| All   | 1,442  | 1,521  | 1,659  | 1,856  |
| Women and Men | | | | |
| 50–74 | 1,360  | 1,457  | 1,493  | 1,492  |
| 75+   | 2,792  | 2,892  | 3,136  | 3,538  |
| All   | 4,152  | 4,349  | 4,629  | 5,031  |

Fig. 2 Treatment uptake in Sweden (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|      | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|------|-----------------------------------|--------------------------------------|---------------------|-------------------|
| Men  | 15                                | 41                                   | 26                  | 63                |
| Women| 100                               | 358                                  | 258                 | 72                |
Epidemiology and Economic Burden of Osteoporosis in UK
A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA)

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Abstract
Summary This report describes epidemiology, burden, and treatment of osteoporosis in the UK.
Introduction Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this study is to describe the epidemiology and economic burden of fragility fractures as a consequence of osteoporosis in the UK, as a further detailed addition to the report for the entire European Union (EU27): Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden.
Methods The literature on fracture incidence and costs of fractures in the UK was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Furthermore, data on sales of osteoporosis treatments and the population at high risk were used to estimate treatment uptake and treatment gap. Costs, calculated in Euros, were converted to £ for the purpose of this report (1.00 GBP=€ 1.23; 21st Dec 2012).
Results It was estimated that approximately 536,000 new fragility fractures were sustained in the UK, comprising 79,000 hip fractures, 66,000 vertebral fractures, 69,000 forearm fractures and 322,000 other fractures (i.e. fractures of the pelvis, rib, humerus, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility fractures was estimated at £ 3,496 (€ 5,408) million for the same year. Incident fractures represented 74 % of this cost, long-term fracture care 25 % and pharmacological prevention 2 %. Previous and incident fractures also accounted for 158,700 quality-adjusted life years (QALYs) lost during 2010. When accounting for the demographic projections for 2025, the number of incident fractures was estimated at 682,000 in 2025, representing an increase of 146,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 23,000, 18,000, 15,900 and 89,300, respectively. The burden of fractures in the UK in 2025 was estimated to increase by 24 % to £ 5,465 (€ 6,723) million.

Though the uptake of osteoporosis treatments increased from 2001, the proportion of patients aged 50 years or above that received treatment remained at very low levels in the past few years. The majority of women at high fracture risk did not receive active treatment.

Conclusions In spite of the high cost of osteoporosis, a substantial treatment gap in women and projected increase of the economic burden driven by an aging population, the use of pharmacological prevention of osteoporosis is significantly less than optimal, suggesting that a change in
healthcare policy concerning the disease is warranted.

Introduction

Osteoporosis is characterized by reduced bone mass and disruption of bone architecture, resulting in increased risks of fragility fractures which represent the main clinical consequence of the disease. Fragility fractures are associated with substantial pain and suffering, disability and even death for the affected patients and substantial costs to society. The aim of this report was to characterize the burden of osteoporosis in the UK in 2010 and beyond.

Methods

The literature on fracture incidence and costs of fractures in the UK was reviewed and incorporated into a model estimating the clinical and economic burden of osteoporotic fractures in 2010. Details of the methods used are found in Chapters 3 and 4 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden, published concurrently in Archives of Osteoporosis.

Epidemiology of osteoporosis in the UK

For the purpose of this report, the population at risk of osteoporosis was considered to include men and women ≥50 years. The number of men and women ≥50 years of age amounted to 10,102,000 and 11,534,000 respectively in the UK in 2010 (Table 1).

In the population at risk, the number of individuals with osteoporosis—as defined by the WHO diagnostic criteria—was estimated at 3.21 million (Table 2). There are 8.2 DXA scan machines per million inhabitants [2], and guidelines for the assessment and treatment of osteoporosis are available [3]. A country specific FRAX model is also available for the assessment of fracture risk (http://www.shef.ac.uk/FRAX/).

Incidence data for hip and forearm fractures were retrieved from Singer et al. [5]. Given that country specific incidences of vertebral and “other” fractures were not found, these were imputed using the methods described in Chapter 3 of the main report. Fracture incidence is presented in Table 3. Standardized to the EU27 population, hip fracture incidence (per 100,000 person years) in men and women ≥50 years of age was estimated at 186.0 and 523.5 respectively.

The number of incident fractures in 2010 was estimated at 536,000 (Table 4). Incident hip, clinical vertebral, forearm and “other” fractures were estimated at 79,000, 66,000, 69,000 and 322,000 respectively. 64 % of fractures occurred in women.

Table 1 Population at risk: men and women over the age of 50 in the UK, 2010 [1]

| Age (years) | Women | Men | All |
|------------|-------|-----|-----|
| 50–54      | 3,844,000 | 3,740,000 | 7,584,000 |
| 55–59      | 3,449,000 | 3,262,000 | 6,711,000 |
| 60–64      | 2,418,000 | 2,053,000 | 4,471,000 |
| 65–69      | 1,486,000 | 925,000 | 2,411,000 |
| 70–74      | 337,000 | 122,000 | 459,000 |
| 50+        | 11,534,000 | 10,102,000 | 21,636,000 |

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in the UK by age using female-derived reference ranges at the femoral neck, 2010 [4]

| Age (years) | Women | Men | Men and women |
|------------|-------|-----|---------------|
| 50–54      | 127,134 | 49,275 | 176,409 |
| 55–59      | 175,296 | 61,915 | 237,211 |
| 60–64      | 274,703 | 106,720 | 381,423 |
| 65–69      | 308,656 | 105,228 | 413,884 |
| 70–74      | 365,211 | 90,402 | 455,613 |
| 75–79      | 415,875 | 92,082 | 507,957 |
| 80+        | 860,456 | 173,802 | 1,034,258 |
| 50+        | 2,527,331 | 679,424 | 3,206,755 |

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in the UK by age

| Age (years) | Hip | Vertebral | Forearm | Other |
|------------|-----|-----------|---------|-------|
| Women      |     |           |         |       |
| 50–54      | 33  | 84        | 219     | 414  |
| 55–59      | 51  | 142       | 309     | 504  |
| 60–64      | 81  | 143       | 445     | 534  |
| 65–69      | 132 | 192       | 522     | 903  |
| 70–74      | 282 | 397       | 636     | 1,292|
| 75–79      | 619 | 602       | 775     | 2,116|
| 80–84      | 1,236 | 777 | 696 | 3,090 |
| 85+        | 2,255 | 1,061 | 780 | 5,178|

Table 4 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and “other” fractures in the UK by age

| Age (years) | Hip | Vertebral | Forearm | Other |
|------------|-----|-----------|---------|-------|
| Men        |     |           |         |       |
| 50–54      | 45  | 115       | 100     | 390  |
| 55–59      | 59  | 102       | 110     | 800  |
| 60–64      | 81  | 193       | 34      | 753  |
| 65–69      | 107 | 169       | 62      | 966  |
| 70–74      | 176 | 269       | 65      | 1,334|
| 75–79      | 313 | 361       | 220     | 1,323|
| 80–84      | 623 | 433       | 53      | 3,091|
| 85+        | 1,220 | 819 | 223 | 4,699|
A prior fracture was defined as a fracture in an individual who was alive during the index year (i.e. 2010) which had occurred after the age of 50 years and before 2010. In the population ≥ 50 years of age, the proportion of individuals who had suffered a fracture prior to 2010 was estimated at 1.94 % for hip and 2.02 % for clinical vertebral fractures. The estimated proportions of men and women with prior hip and vertebral fractures by age are presented in Table 5.

In the population over 50 years of age, the number of individuals with hip and vertebral fractures that occurred before 2010 was estimated at 419,000 and 437,000 respectively (Table 6). Note that fractures sustained in 2010 were not included in the estimate.

The incidence of causally related deaths (per 100,000) in the first year after fracture by age is presented in Table 7. The number of causally related deaths in 2010 was estimated at 6,059 (Table 8). Hip, vertebral and “other” fractures accounted for 2,764, 1,795 and 1,500 deaths respectively. Overall, approximately 54 % of deaths occurred in women.

Cost of osteoporosis in the UK including and excluding values of QALYs lost

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs lost) was considered to consist of three components: (i) cost of fractures that occurred in 2010 (“first year costs”); (ii) cost of fractures sustained prior to year 2010 but which still incurred costs in 2010 (“long-term disability cost”); and (iii) cost of pharmacological fracture prevention including administration and monitoring costs (“pharmacological fracture prevention costs”). See Chapter 4 of the main report for further details.

The cost of hip, vertebral and forearm fractures has been estimated at £ 9,390 (€ 11,055), £ 2,341 (€ 2,756), and £ 1,073 (€ 1,263) respectively [6,7]. Costs for “other fractures” were imputed as described in Chapter 4 of the main report.

Long-term disability costs were estimated by multiplying the yearly cost of residing in nursing home £24,444 (€ 33,756) [6]
with the simulated number of individuals with prior fractures that had been transferred to nursing homes due to the fracture. Annual drug cost for individual treatments is shown in Table 9. In addition, it was assumed that patients on treatment made an annual physician visit costing £ 41 (€ 50) [8] and a DXA scan costing £ 41 (€ 51) [6] every second year to monitor treatment.

The cost of osteoporosis in 2010 was estimated at £ 4,397 (€ 5,408) million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs amounted to £3,233 (€ 3,977) million, £ 1,080 (€ 1,328) million and £84 (€ 103) million, respectively. It is notable that pharmacological fracture prevention costs amounted to only 1.9 % of the total cost.

When stratifying costs of osteoporosis by fracture type, “other fractures” were most costly at £2,069 million (€ 2,545 million) followed by hip fractures at £2,039 million (€ 2,508 million), vertebral fractures at £ 134 million (€ 165 million) and forearm fractures at

| Table 7 | Incidence (per 100,000) of causally related deaths in the UK within the first year after fracture (adjusted for comorbidities), 2010 |
|---------|-----------------------------------------------------|
| Age (years) | Hip | Clinical vertebral | “Other” fracture |
| Women | | | |
| 50–54 | 667 | 867 | 17 |
| 55–59 | 824 | 1,014 | 24 |
| 60–64 | 1,131 | 1,313 | 36 |
| 65–69 | 1,606 | 1,760 | 60 |
| 70–74 | 2,194 | 2,264 | 100 |
| 75–79 | 2,869 | 2,772 | 180 |
| 80–84 | 2,867 | 2,536 | 319 |
| 85–89 | 3,323 | 2,583 | 582 |
| 90+ | 2,898 | 1,634 | 1,008 |
| Men | | | |
| 50–54 | 1,599 | 1,918 | 25 |
| 55–59 | 1,910 | 2,172 | 39 |
| 60–64 | 2,192 | 2,357 | 59 |
| 65–69 | 2,761 | 2,801 | 99 |
| 70–74 | 3,551 | 3,381 | 160 |
| 75–79 | 4,577 | 4,059 | 271 |
| 80–84 | 5,629 | 4,571 | 473 |
| 85–89 | 7,369 | 5,386 | 796 |
| 90+ | 10,039 | 6,533 | 1,256 |

| Table 8 | The number of deaths in men and women in the UK in the first year after fracture attributable to the fracture event (causally related), 2010 |
|---------|-----------------------------------------------------|
| Age (years) | hip | Fracture at the vertebra | “other” |
| Women | | | |
| 50–74 | 197 | 304 | 46 |
| 75+ | 1,291 | 513 | 938 |
| Total | 1,487 | 817 | 984 |
| Men | | | |
| 50–74 | 241 | 419 | 72 |
| 75+ | 1,035 | 559 | 444 |
| Total | 1,277 | 978 | 516 |

| Table 9 | One year costs for relevant pharmaceuticals in the UK, 2010 [9] |
|---------|-----------------------------------------------------|
| Annual drug cost | £ | € |
| Alendronate | 11 | 13 |
| Risedronate | 176 | 217 |
| Etidronate | 64 | 79 |
| Ibandronate | 153 | 188 |
| Zoledronic acid | 197 | 242 |
| Raloxifene | 180 | 221 |
| Strontium ranelate | 232 | 285 |
| Parathyroid hormone | 2355 | 2,897 |
| Teriparatide | 2459 | 3,024 |

| Table 10 | Cost of osteoporosis (£) in the UK by age in men and women, 2010 |
|---------|-----------------------------------------------------|
| Age (years) | First year fracture cost | Long term disability costs | Fracture prevention cost | Total cost |
| Women | | | | |
| 50–74 | 495,992,508 | 93,791,815 | 45,809,624 | 635,593,947 |
| 75+ | 1,624,852,298 | 642,093,815 | 27,826,902 | 2,294,773,015 |
| All | 2,120,844,806 | 735,885,630 | 73,636,526 | 2,930,366,962 |
| Men | | | | |
| 50–74 | 446,135,385 | 93,353,413 | 6,946,167 | 546,434,965 |
| 75+ | 1,624,852,298 | 642,093,815 | 27,826,902 | 2,294,773,015 |
| All | 2,120,844,806 | 735,885,630 | 73,636,526 | 2,930,366,962 |

| Women and Men | | | | |
| 50–74 | 942,127,892 | 187,145,228 | 52,755,790 | 1,182,028,910 |
| 75+ | 2,290,857,441 | 892,603,281 | 31,225,398 | 3,214,686,102 |
| All | 3,232,985,333 | 1,079,748,509 | 83,981,188 | 4,396,715,030 |
£71 million (€ 87 million) (Table 11 and Fig. 1). Please note that costs for pharmacological fracture prevention were not included given that they cannot be allocated to specific fracture sites.

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 158,700 (Table 12). Prior fractures accounted for 52% of the total loss and 64% of the loss occurred in women. The monetary value of a QALY was varied between 1 to 3 times the gross domestic product (GDP) per capita (Table 13). Assuming a QALY is valued at 2 times GDP/capita, the total cost of the QALYs lost was estimated at £7.0 billion (€ 8.7 billion).

Table 11 Total cost (£) in 2010 by fracture site in men and women in the UK. Note that costs for fracture prevention therapy and monitoring are not included

| Age   | Hip                  | Vertebral            | Forearm        | Other              | All                |
|-------|----------------------|----------------------|----------------|-------------------|--------------------|
|       | Women                |                      |                |                   |                    |
| 50–74 | 189,976,600          | 35,274,798           | 38,560,324     | 325,972,600       | 589,784,322        |
| 75+   | 1,257,463,765        | 47,466,214           | 22,006,950     | 940,009,184       | 2,266,946,113      |
| All   | 1,447,440,365        | 82,741,012           | 60,567,274     | 1,265,981,784     | 2,856,730,435      |
|       | Men                  |                      |                |                   |                    |
| 50–74 | 163,989,555          | 30,212,644           | 6,848,175      | 338,438,423       | 539,488,797        |
| 75+   | 427,275,894          | 20,940,913           | 3,327,314      | 464,970,489       | 916,514,610        |
| All   | 591,265,449          | 51,153,557           | 10,175,489     | 803,408,912       | 1,456,003,407      |
|       | Women and Men        |                      |                |                   |                    |
| 50–74 | 353,966,155          | 65,487,442           | 45,408,499     | 664,411,024       | 1,129,273,120      |
| 75+   | 1,684,739,659        | 68,407,127           | 25,334,263     | 1,404,979,673     | 3,183,460,722      |
| All   | 2,038,705,814        | 133,894,569          | 70,742,762     | 2,069,390,697     | 4,312,733,842      |

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in the UK according to age

| Age (years) | Women |       |       |       |       |
|-------------|-------|-------|-------|-------|-------|
| 50–74       |       |       |       |       |       |
| Incident hip fractures | 2,539 | 9,516 | 12,055 |
| Incident vertebral fractures | 5,478 | 6,763 | 12,241 |
| Incident forearm fractures | 1,322 | 652   | 1,975  |
| Incident other fractures | 7,702 | 12,987 | 20,691 |
| Prior hip fractures | 8,644 | 31,773 | 40,416 |
| Prior vertebral fractures | 5,496 | 9,312 | 14,808 |
| Total       | 31,183 | 71,003 | 102,185 |
| Men         |       |       |       |       |       |
| Incident hip fractures | 1,972 | 3,607 | 5,579  |
| Incident vertebral fractures | 4,822 | 3,608 | 8,430  |
| Incident forearm fractures | 234  | 106   | 340   |
| Incident other fractures | 8,488 | 6,880 | 15,368 |
| Prior hip fractures | 7,225 | 11,725 | 18,951 |
| Prior vertebral fractures | 4,325 | 3,548 | 7,873  |
| Total       | 27,067 | 29,474 | 56,541 |

| Age (years) | Men and Women |       |       |       |       |
|-------------|---------------|-------|-------|-------|-------|
| 50–74       |               |       |       |       |       |
| Incident hip fractures | 4,511 | 13,123 | 17,634 |
| Incident vertebral fractures | 10,300 | 10,371 | 20,671 |
| Incident forearm fractures | 1,556 | 758 | 2,315 |
| Incident other fractures | 16,190 | 19,869 | 36,059 |
| Prior hip fractures | 15,870 | 43,497 | 59,368 |
| Prior vertebral fractures | 9,822 | 12,859 | 22,681 |
| Total       | 58,249        | 100,477 | 158,726 |
When the cost of osteoporosis was combined with the value for QALYs lost (valued at 2 × GDP), the cost of osteoporosis amounted to £11.47 billion (€14.11 billion) in the UK in 2010. Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 28 %, 9 %, 1 % and 62 %, respectively.

**Burden of osteoporosis up to 2025**

The population above 50 years of age is expected to increase from 21.6 million in 2010 to 26.2 million in 2025, corresponding to an increase of 21 % (Table 14).

The total number of fractures was estimated to rise from 536,000 in 2010 to 682,000 in 2025 (Table 15), corresponding to an increase of 27 %. Hip, clinical vertebral, forearm and other fractures increased by 23,000, 18,000, 15,900 and 89,300 respectively. The increase in the number of fractures ranged from 23 % to 29 %, depending on fracture site. The increase was estimated to be particularly marked in men (32 %) compared to women (24 %).

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from £4.4 billion (€5.4 billion) in 2010 to £5.5 billion (€6.7 billion) in 2025, corresponding to an increase of 24 % (Table 16). Costs incurred in women and men increased by 20 % and 32 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 158,700 in 2010 to 190,500 in 2025, corresponding to an increase of 20 % (Table 17). The increase was estimated to be particularly marked in men (27 %) compared to women (16 %). Incident and prior fractures accounted for 67 % and 33 % of the increase respectively.

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately £11.5 billion (€14.1 billion) in 2010 to £14.0 billion (€17.2 billion) in 2025. The increase was estimated to be particularly marked in men (+29 %) compared to women (+18 %) (Table 18).

**Treatment uptake**

To estimate uptake of individual osteoporosis treatments, sales data from IMS Health (2001–2011) were used to derive the number of defined daily doses (DDDs) sold per 100,000 persons aged 50 years or above (Fig. 2).

Adjusting the sales data for compliance allowed for an estimation of the proportion of population aged 50 years or above who received any osteoporosis treatment (see Chapter 5 of the report on Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden for further details). The proportion of persons over the age of 50 years who were treated increased from 1.11 % in 2001 to 5.5 % in 2011.

**Treatment gap**

In order to assess the potential treatment gap, the numbers of men and women eligible for treatment in

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**Table 13** Value of lost QALYs (£) in men and women in the UK in 2010

| Fracture Type                  | 1 × GDP/capita | 2 × GDP/capita | 3 × GDP/capita |
|-------------------------------|----------------|----------------|----------------|
| Incident hip fractures        | 392,829,516    | 785,659,033    | 1,178,488,549  |
| Incident vertebral fractures  | 460,472,157    | 920,944,314    | 1,381,416,471  |
| Incident forearm fractures    | 51,561,273     | 103,122,546    | 154,683,820    |
| Incident other fractures      | 803,258,637    | 1,606,517,275  | 2,409,775,912  |
| Prior hip fractures           | 1,322,480,924  | 2,644,961,849  | 3,967,442,773  |
| Prior vertebral fractures     | 505,249,355    | 1,010,498,711  | 1,515,748,066  |
| Total                         | 3,535,851,862  | 7,071,703,728  | 10,607,555,591 |

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**Table 14** Population projections in the UK by age and sex [10]

| Year | Women | Men | All |
|------|-------|-----|-----|
|      | 2010  | 2015| 2020| 2025|
| 50–59 | 3,844,000 | 7,584,000 | 8,411,197 | 8,982,000 | 8,641,000 |
| 60–69 | 3,449,000 | 6,711,000 | 7,047,000 | 7,104,000 | 7,918,000 |
| 70–79 | 2,418,000 | 4,471,000 | 4,848,000 | 5,665,000 | 5,975,000 |
| 80–89 | 1,486,000 | 2,411,000 | 2,510,000 | 2,699,000 | 3,004,000 |
| 90+   | 337,000  | 459,000  | 553,000  | 637,000  | 705,000  |
| Total | 3,535,851,862 | 7,071,703,728 | 7,071,703,728 | 7,071,703,728 | 7,071,703,728 |
the UK were defined as individuals with a 10-year fracture probability exceeding that of a woman with a prior fragility fracture derived from FRAX®, equivalent to a ‘fracture threshold’ (See Chapter 5 of the main report for further details). Subsequently, these estimates were compared to the number of individuals who received osteoporosis treatment obtained from the analysis of IMS Health data. For men, the data indicate that the volume of sold osteoporosis drugs would be sufficient to cover treatment for more patients than the number that fall above the fracture threshold. It should be noted, however, that the results from this analysis should be interpreted with some caution since it has been assumed that the distribution of drug use between genders observed in Sweden is valid for all countries. The treatment gaps in men and women were estimated at −34 % and 54 % respectively (Table 19). Note that the estimate of the treatment gap is conservative given that it assumes that current use of osteoporosis treatments are only directed to men and women at high risk.

Table 15  Projected annual number of incident fractures in 2010 and 2025 by fracture site and age in men and women in the UK

|            | Hip 2010 | Hip 2025 | Vertebral 2010 | Vertebral 2025 | Forearm 2010 | Forearm 2025 | Other 2010 | Other 2025 |
|------------|---------|----------|---------------|---------------|--------------|--------------|------------|------------|
| **Women**  |         |          |               |               |              |              |            |            |
| 50–74      | 10,504  | 12,668   | 16,482        | 19,732        | 37,567       | 44,634       | 64,277     | 76,638     |
| 75+        | 45,632  | 57,609   | 23,640        | 30,118        | 21,440       | 27,580       | 125,656    | 160,668    |
| All        | 56,136  | 70,277   | 40,121        | 49,850        | 59,007       | 72,213       | 189,933    | 237,305    |
| **Men**    |         |          |               |               |              |              |            |            |
| 50–74      | 8,070   | 9,684    | 14,485        | 17,171        | 6,672        | 7,811        | 71,410     | 85,326     |
| 75+        | 15,037  | 22,315   | 11,317        | 16,927        | 3,242        | 4,837        | 60,443     | 88,424     |
| All        | 23,107  | 31,999   | 25,803        | 34,098        | 9,913        | 12,649       | 131,853    | 173,749    |
| **Women and Men** |         |          |               |               |              |              |            |            |
| 50–74      | 18,574  | 22,352   | 30,967        | 36,903        | 44,238       | 52,445       | 135,688    | 161,964    |
| 75+        | 60,669  | 79,924   | 34,957        | 47,045        | 24,681       | 32,417       | 186,099    | 249,091    |
| All        | 79,243  | 102,276  | 65,924        | 83,948        | 68,920       | 84,862       | 321,786    | 411,055    |

Table 16  Current and future cost (£ 000, 000) of osteoporosis (excluding value of QALYs lost) by age and calendar year in men and women in the UK

|            | 2010 | 2015 | 2020 | 2025 |
|------------|------|------|------|------|
| **Women**  |      |      |      |      |
| 50–74      | 636  | 690  | 916  | 751  |
| 75+        | 2,295| 2,388| 3,111| 2,775|
| All        | 2,931| 3,078| 4,028| 3,526|
| **Men**    |      |      |      |      |
| 50–74      | 546  | 594  | 786  | 650  |
| 75+        | 920  | 1,011| 1,384| 1,289|
| All        | 1,466| 1,605| 2,170| 1,939|
| **Women and Men** |      |      |      |      |
| 50–74      | 1,182| 1,285| 1,703| 1,402|
| 75+        | 3,215| 3,398| 4,495| 4,064|
| All        | 4,397| 4,683| 6,198| 5,466|

Table 17  Projected QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in the UK

|            | Incident fractures | Prior fractures | All fractures |
|------------|--------------------|----------------|---------------|
|            | 2010 | 2025 | 2010 | 2025 | 2010 | 2025 |
| **Women**  |      |      |      |      |      |      |
| 50–74      | 17,042| 14,141| 15,164| 31,183| 35,515|
| 75+        | 29,919| 41,083| 45,205| 71,003| 83,263|
| All        | 46,961| 55,224| 60,369| 102,185| 118,778|
| **Men**    |      |      |      |      |      |      |
| 50–74      | 15,516| 18,483| 11,551| 12,854| 27,067| 31,337|
| 75+        | 14,202| 20,958| 15,273| 19,380| 29,474| 40,338|
| All        | 29,717| 39,441| 26,824| 32,234| 56,541| 71,675|
| **Women and Men** |      |      |      |      |      |      |
| 50–74      | 32,557| 38,835| 25,692| 28,018| 58,249| 66,852|
| 75+        | 44,121| 59,015| 56,356| 64,586| 100,477| 123,601|
| All        | 76,678| 97,850| 82,048| 92,603| 158,726| 190,453|
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Table 18 Present and future cost (£ 000,000) of fracture (direct cost and cost of QALYs) by age and calendar year in men and women in the UK assuming the uptake of treatment remains unchanged

|          | 2010 | 2015 | 2020 | 2025 |
|----------|------|------|------|------|
| Women    |      |      |      |      |
| 50–74    | 2,025| 2,157| 2,818| 2,333|
| 75+      | 5,459| 5,680| 7,345| 6,484|
| All      | 7,484| 7,837|10,163| 8,817|
| Men      |      |      |      |      |
| 50–74    | 1,752| 1,860| 2,438| 2,046|
| 75+      | 2,233| 2,402| 3,275| 3,087|
| All      | 3,985| 4,262| 5,713| 5,133|
| Women and Men |      |      |      |      |
| 50–74    | 3,777| 4,017| 5,255| 4,380|
| 75+      | 7,691| 8,082|10,620| 9,571|
| All      |11,468|12,099|15,876|13,951|

Fig. 2 Treatment uptake in the UK (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

Table 19 Number of men and women eligible for treatment, treated and treatment gap in 2010

|          | Number potentially treated (1000 s) | Number eligible for treatment (1000 s) | Difference (1000 s) | Treatment gap (%) |
|----------|-------------------------------------|----------------------------------------|---------------------|-------------------|
| Men      | 159                                 | 119                                    | −40                 | −34               |
| Women    | 1,064                               | 2,298                                  | 1,234               | 54                |