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ORIGINAL ARTICLE

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:

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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

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List of abbreviations

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.

Epidemiology and Economic Burden of Osteoporosis in Austria

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 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.

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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).

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

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

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

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

Age (years)	Fracture at the hip	vertebra	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	1,109	3,014
85+	3,132	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

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 4 Estimated number of incident fractures in Austria, 2010

Age (years)	Fracture at the hip	vertebra	forearm	other	All fractures
		Women			
50–74	2,159	3,328	6,166	8,204	19,857
75+	9,675	4,952	4,883	17,824	37,335
Total	11,835	8,280	11,049	26,029	57,192
		Men			
50–74	1,603	2,819	1,820	10,509	16,751
75+	2,650	2,004	554	7,385	12,593
Total	4,254	4,822	2,373	17,894	29,343
		Men and Women			
50–74	3,763	6,146	7,986	18,713	36,608
75+	12,326	6,956	5,437	25,209	49,928
Total	16,088	13,102	13,422	43,923	86,536

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	
50–74	77	128	15
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

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

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

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

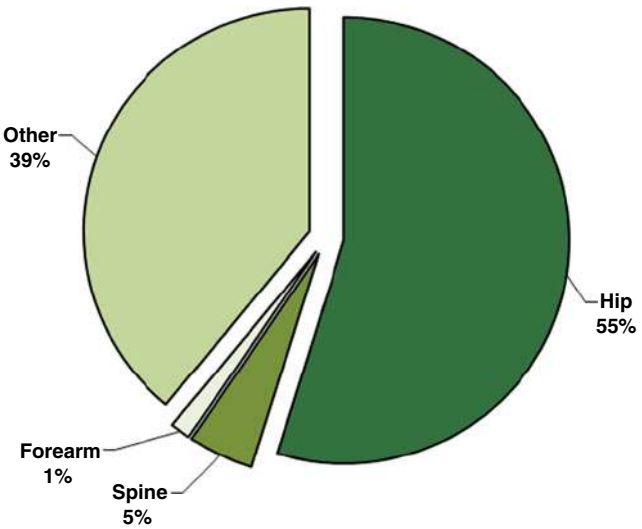

Fig. 1 Share (%) of fracture cost by fracture site in Austria. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	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].

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

	1 × GDP/ capita	2 × GDP/ capita	3 × GDP/ capita
Incident hip fractures	121,258,606	242,517,213	363,775,819
Incident vertebral fractures	139,325,710	278,651,420	417,977,130
Incident forearm fractures	15,209,448	30,418,897	45,628,345
Incident other fractures	167,398,442	334,796,883	502,195,325
Prior hip fractures	360,280,447	720,560,893	1,080,841,340
Prior vertebral fractures	147,816,230	295,632,461	443,448,691
Total	951,288,883	1,902,577,766	2,853,866,649

Table 14 Population projections in Austria by age and sex [12]

	Population			
	2010	2015	2020	2025
	Women			
50–59	556,000	646,000	689,000	642,000
60–69	477,000	481,000	536,000	624,000
70–79	351,000	402,000	425,000	433,000
80–89	238,000	220,000	235,000	275,000
90+	38,000	59,000	66,000	66,000
	Men			
50–59	545,000	642,979	688,000	633,000
60–69	435,000	443,000	501,000	597,000
70–79	275,000	324,000	350,000	362,000
80–89	116,000	129,000	151,000	185,000
90+	10,000	17,000	24,000	28,000
	All			
50–59	1,101,000	1,288,979	1,377,000	1,275,000
60–69	912,000	924,000	1,037,000	1,221,000
70–79	626,000	726,000	775,000	795,000
80–89	354,000	349,000	386,000	460,000
90+	48,000	76,000	90,000	94,000
	3,041,000			3,845,000

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

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
				Women				
50–74	2,159	2,645	3,328	4,083	6,166	7,606	8,204	10,061
75+	9,675	12,528	4,952	6,362	4,883	6,185	17,824	23,076
All	11,835	15,173	8,280	10,445	11,049	13,791	26,029	33,136
				Men				
50–74	1,603	2,041	2,819	3,608	1,820	2,382	10,509	13,631
75+	2,650	4,616	2,004	3,492	554	961	7,385	13,031
All	4,254	6,657	4,822	7,100	2,373	3,343	17,894	26,662
				Women and Men				
50–74	3,763	4,686	6,146	7,692	7,986	9,989	18,713	23,691
75+	12,326	17,144	6,956	9,853	5,437	7,145	25,209	36,107
All	16,088	21,830	13,102	17,545	13,422	17,134	43,923	59,798

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.

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 QALYs lost) by age and calendar year in men and women in Austria

	2010	2015	2020	2025
		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 QALYs lost due to incident and prior fractures for the years 2010 and 2025 by age in men and women in Austria

	Incident fractures		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	2025
			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

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

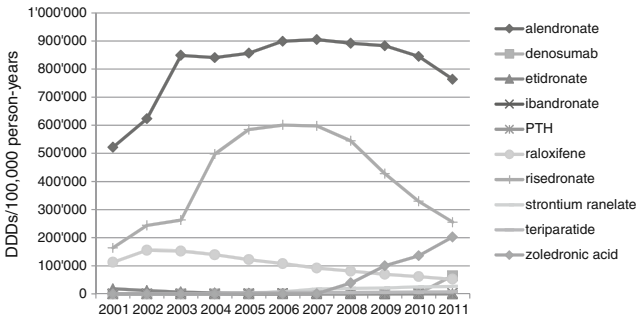

Fig. 2 Treatment uptake in Austria (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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

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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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.

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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

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
		Women		
50–54	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
		Men		
50–54	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

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

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	All fractures
		Women			
50–74	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
		Men			
50–74	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
		Men and Women			
50–74	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 6 Number of men and women in Belgium with a prior hip or clinical vertebral fracture 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

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

estimated at 74,000 and 81,000 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. 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 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

Cost of osteoporosis in Belgium 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 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 cost	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	157,433,737	29,431,890	606,113,207

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
			Women and Men		
50–74	58,492,345	12,407,909	4,922,956	90,192,643	166,015,853
75+	249,737,157	15,354,306	3,704,361	141,869,640	410,665,465
All	308,229,502	27,762,216	8,627,318	232,062,283	576,681,318

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].

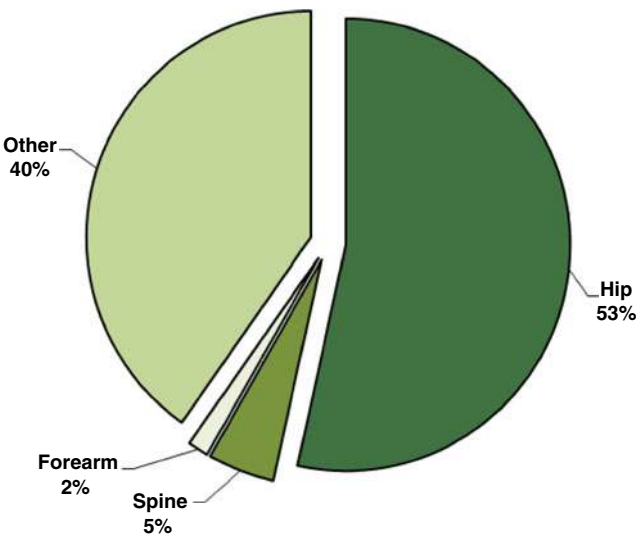

Fig 1 Share (%) of fracture cost by fracture site in Belgium. Note that costs for fracture prevention therapy and monitoring are not included

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

The cost of osteoporosis in 2010 was estimated at € 606 million (Table 10). First year costs, subsequent year costs and pharmacological fracture prevention costs

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

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

	Population			
	2010	2015	2020	2025
	Women			
50–59	727,000	770,000	775,000	747,000
60–69	568,000	652,000	696,000	738,000
70–79	480,000	454,000	506,000	583,000
80–89	308,000	319,000	316,000	305,000
90+	47,000	68,000	83,000	92,000
	Men			
50–59	728,000	769,358	778,000	747,000
60–69	540,000	622,000	664,000	707,000
70–79	379,000	372,000	430,000	499,000
80–89	168,000	187,000	194,000	195,000
90+	14,000	23,000	29,000	36,000
	All			
50–59	1,455,000	1,539,358	1,553,000	1,494,000
60–69	1,108,000	1,274,000	1,360,000	1,445,000
70–79	859,000	826,000	936,000	1,082,000
80–89	476,000	506,000	510,000	500,000
90+	61,000	91,000	112,000	128,000
	3,959,000			4,649,000

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.

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 Belgium

	2010	2015	2020	2025
	Women			
50–74	101	107	119	124
75+	308	326	336	355
All	409	433	455	479
	Men			
50–74	82	89	98	103
75+	115	126	136	151
All	197	215	234	254
	Women and Men			
50–74	184	196	217	227
75+	423	452	472	507
All	606	648	689	733

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 %

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

	Hip		Vertebra		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	1,829	2,293	2,890	3,532	5,562	6,601	7,230	8,750
75+	8,932	10,853	4,676	5,525	4,701	5,388	16,579	20,137
All	10,761	13,146	7,566	9,057	10,263	11,989	23,809	28,887
	Men							
50–74	1,280	1,614	2,293	2,826	1,490	1,823	8,571	10,531
75+	2,919	4,060	2,187	3,084	605	849	8,148	11,451
All	4,199	5,675	4,480	5,910	2,095	2,672	16,720	21,981
	Women and Men							
50–74	3,109	3,907	5,182	6,358	7,052	8,424	15,802	19,281
75+	11,851	14,913	6,863	8,609	5,306	6,236	24,727	31,587
All	14,960	18,820	12,046	14,967	12,358	14,661	40,529	50,868

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

	Incident fractures		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	2025
Women						
50–74	2,465	3,001	2,444	2,663	4,909	5,664
75+	5,070	6,040	7,893	8,458	12,963	14,499
All	7,535	9,041	10,337	11,121	17,872	20,163
Men						
50–74	2,145	2,643	1,773	2,050	3,918	4,693
75+	2,342	3,275	2,631	3,173	4,974	6,447
All	4,487	5,918	4,405	5,222	8,892	11,140
Women and Men						
50–74	4,609	5,644	4,217	4,713	8,827	10,357
75+	7,413	9,315	10,524	11,631	17,937	20,946
All	12,022	14,959	14,741	16,344	26,763	31,303

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 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

	2010	2015	2020	2025
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
Men				
50–74	336	354	384	407
75+	437	469	503	569
All	773	823	888	976
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

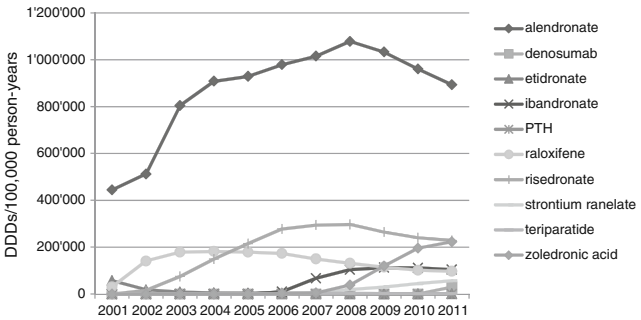

Fig. 2 Treatment uptake in Belgium (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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 %. Hip, clinical vertebral, forearm and other fractures increased by 3,900, 2,900, 2,300 and 10,300 respectively. The increase in the number of fractures ranged from 19 % to 26 %, depending on fracture site. The increase was estimated to be particularly marked in men (32 %) compared to women (20 %). Note that no change in the age and sex specific incidence was assumed over this period.

The cost of osteoporosis (excluding values of QALYs lost) was estimated to rise from € 606 million in 2010 to € 733 million in 2025, corresponding to an increase of 21 % (Table 16). Costs incurred in women and men increased by 17 % and 29 % respectively.

The total number of QALYs lost due to fracture was estimated to rise from 26,800 in 2010 to 31,300 in 2025, corresponding to an increase of 17 % (Table 17). The increase was estimated to be particularly marked in men (25 %) compared to women (13 %). 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 € 2.3 billion in 2010 to € 2.8 billion in 2025. The increase was estimated

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	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 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 45 % and 47 % 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. Not all individuals at high risk as assessed by FRAX are eligible for reimbursement with the present reimbursement criteria.

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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

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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

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

Age (years)	hip	Fracture at the vertebra	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		
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

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].

Table 4 Estimated number of incident fractures in Bulgaria, 2010

Age (years)	hip	Fracture at the vertebra	forearm	other	All fractures
		Women			
50–74	1,298	1,997	3,423	4,594	11,312
75+	2,559	1,562	1,491	4,553	10,164
Total	3,857	3,558	4,914	9,147	21,476
		Men			
50–74	1,139	2,075	1,380	7,822	12,416
75+	922	730	198	2,454	4,304
Total	2,061	2,805	1,579	10,277	16,721
		Men and Women			
50–74	2,437	4,072	4,803	12,416	23,729
75+	3,481	2,291	1,689	7,007	14,468
Total	5,918	6,363	6,493	19,424	38,197

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 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.

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	Fracture at the vertebra	"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

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 9 One year costs for relevant pharmaceuticals in Bulgaria, 2010 [15]

	Annual drug cost (€)
Alendronate	80
Risedronate	147
Etidronate	-
Ibandronate	142
Zoledronic acid	309
Raloxifene	279
Strontium ranelate	389
Parathyroid hormone	-
Teriparatide	3,198

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
		Women and Men		
50–74	17,314,171	3,157,466	841,678	21,313,315
75+	12,916,102	7,617,040	455,683	20,988,825
All	30,230,273	10,774,506	1,297,361	42,302,140

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	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
			Women and Men		
50–74	7,156,170	1,474,556	535,815	11,305,097	20,471,637
75+	12,818,537	779,759	188,425	6,746,422	20,533,142
All	19,974,707	2,254,314	724,239	18,051,519	41,004,779

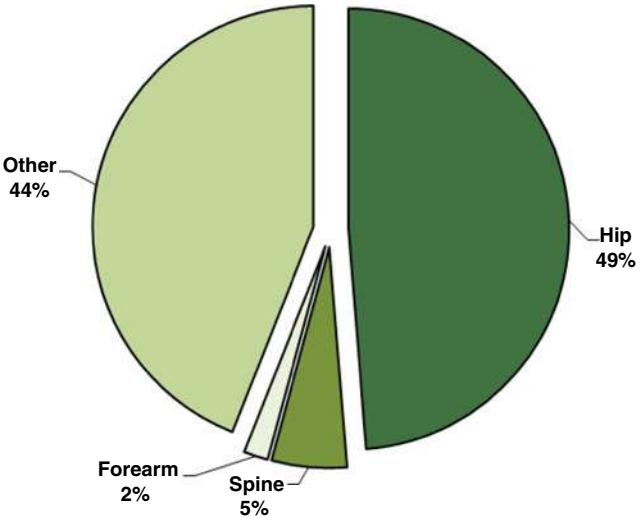

Fig. 1 Share (%) of fracture cost by fracture site in Bulgaria. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
	Women		
Incident hip fractures	316	563	879
Incident vertebral fractures	667	469	1,136
Incident forearm fractures	121	46	167
Incident other fractures	550	487	1,037
Prior hip fractures	930	1,946	2,876
Prior vertebral fractures	551	550	1,101
Total	3,135	4,062	7,197
	Men		
Incident hip fractures	288	227	515
Incident vertebral fractures	712	239	951
Incident forearm fractures	48	7	54
Incident other fractures	932	282	1,214
Prior hip fractures	874	857	1,732
Prior vertebral fractures	430	219	649
Total	3,284	1,831	5,115
	Men and Women		
Incident hip fractures	604	790	1,394
Incident vertebral fractures	1,379	708	2,087
Incident forearm fractures	168	53	221
Incident other fractures	1,482	769	2,251
Prior hip fractures	1,805	2,803	4,608
Prior vertebral fractures	981	769	1,751
Total	6,419	5,893	12,312

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

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.

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

	Population			
	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
		All		
50–59	1,048,000	996,155	968,000	991,000
60–69	910,000	953,000	910,000	873,000
70–79	633,000	597,000	663,000	700,000
80–89	267,000	278,000	264,000	263,000
90+	18,000	29,000	35,000	39,000
	2,876,000			2,866,000

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
				Women				
50–74	1,298	1,355	1,997	2,043	3,423	3,392	4,594	4,651
75+	2,559	2,933	1,562	1,753	1,491	1,652	4,553	5,230
All	3,857	4,288	3,558	3,795	4,914	5,044	9,147	9,881
				Men				
50–74	1,139	1,159	2,075	2,072	1,380	1,348	7,822	7,743
75+	922	918	730	733	198	199	2,454	2,445
All	2,061	2,078	2,805	2,806	1,579	1,548	10,277	10,187
				Women and Men				
50–74	2,437	2,514	4,072	4,115	4,803	4,740	12,416	12,393
75+	3,481	3,852	2,291	2,486	1,689	1,852	7,007	7,675
All	5,918	6,365	6,363	6,601	6,493	6,592	19,424	20,069

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 Bulgaria

	2010	2015	2020	2025
		Women		
50–74	10	10	11	10
75+	14	15	15	16
All	25	25	26	27
		Men		
50–74	11	11	12	11
75+	7	6	6	7
All	18	18	18	18
		Women and Men		
50–74	21	22	22	22
75+	21	21	21	23
All	42	43	44	45

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 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	24	23	24
All	67	66	66	67
		Women and Men		
50–74	83	83	84	84
75+	78	78	79	83
All	160	161	164	168

(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

	Incident fractures		Prior fractures		All fractures	
	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

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.

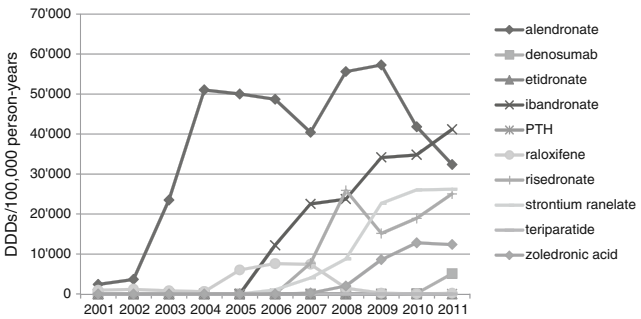

Fig. 2 Treatment uptake in Bulgaria (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	2	92	90	98
Women	13	240	227	95

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 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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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.

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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

		Fracture at the		
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

Table 4 Estimated number of incident fractures in Cyprus, 2010

Age (years)	hip	Fracture at the vertebra	forearm	other	All fractures
		Women			
50–74	178	275	579	753	1,786
75+	316	171	208	654	1,349
Total	494	446	786	1,408	3,135
		Men			
50–74	115	199	129	759	1,202
75+	167	127	36	463	793
Total	282	326	165	1,222	1,995
		Men and Women			
50–74	294	474	708	1,513	2,988
75+	483	298	243	1,117	2,142
Total	777	772	951	2,630	5,130

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	
50–54	0.0	0.0
55–59	0.2	0.6
60–64	0.7	1.5
65–69	1.4	2.4
70–74	2.7	4.3
75–79	4.8	6.3
80–84	7.8	7.9
85+	13.7	10.2
	Men	
50–54	0.0	0.1
55–59	0.2	0.5
60–64	0.5	0.9
65–69	0.8	1.4
70–74	1.4	2.1
75–79	2.5	3.0
80–84	4.4	4.0
85+	8.0	6.0

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

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 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 hip	Fracture at the vertebra	"other"
	Women		
50–74	2	3	0
75+	11	4	4
Total	13	8	4
	Men		
50–74	3	5	1
75+	11	6	3
Total	14	11	4
	Men and Women		
50–74	5	8	1
75+	22	10	7
Total	27	19	8

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

	Annual drug cost (€)
Alendronate	327
Risedronate	508
Etidronate	-
Ibandronate	489
Zoledronic acid	481
Raloxifene	1,037
Strontium ranelate	655
Parathyroid hormone	-
Teriparatide	7,179

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 QALYs 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 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
Women					
50–74	3,540,884	878,017	524,142	5,846,114	10,789,157
75+	7,293,878	501,030	187,921	5,017,685	13,000,515
All	10,834,762	1,379,048	712,063	10,863,799	23,789,672
Men					
50–74	2,272,964	611,810	116,786	5,742,298	8,743,857
75+	3,627,001	350,429	32,421	3,573,787	7,583,638
All	5,899,965	962,239	149,206	9,316,085	16,327,495
Women and Men					
50–74	5,813,848	1,489,828	640,927	11,588,411	19,533,014
75+	10,920,880	851,460	220,342	8,591,472	20,584,153
All	16,734,727	2,341,287	861,269	20,179,883	40,117,167

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).

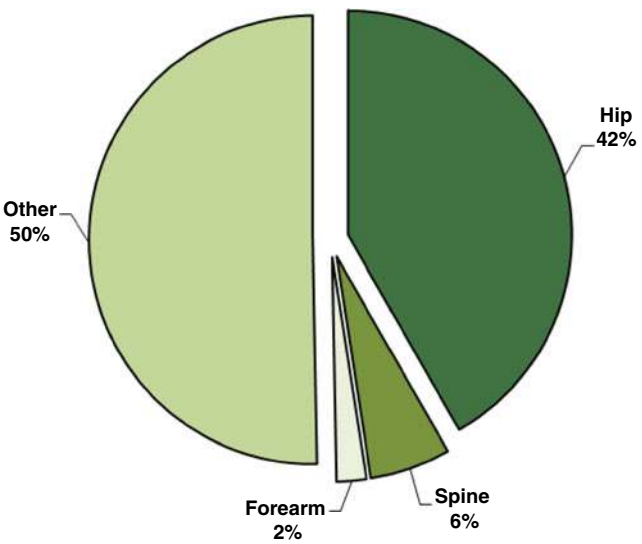

Fig. 1 Share (%) of fracture cost by fracture site in Cyprus. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
Women			
Incident hip fractures	43	68	111
Incident vertebral fractures	91	50	141
Incident forearm fractures	20	6	27
Incident other fractures	90	69	159
Prior hip fractures	161	324	485
Prior vertebral fractures	105	115	220
Total	511	632	1,143
Men			
Incident hip fractures	28	40	68
Incident vertebral fractures	66	41	106
Incident forearm fractures	4	1	6
Incident other fractures	90	53	143
Prior hip fractures	92	140	232
Prior vertebral fractures	58	47	105
Total	338	322	660
Men and Women			
Incident hip fractures	71	108	179
Incident vertebral fractures	157	91	247
Incident forearm fractures	25	8	32
Incident other fractures	180	122	302
Prior hip fractures	253	464	717
Prior vertebral fractures	163	162	325
Total	848	955	1,803

The total number of fractures was estimated to rise from 5,000 in 2010 to 8,000 in 2025 (Table 15), corresponding to an increase of 50 %. Hip, clinical spine, forearm and other fractures increased by 400, 400, 400 and 1,300 respectively. The increase in the

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

	1 × GDP/capita	2 × GDP/capita	3 × GDP/capita
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

Table 14 Population projections in Cyprus by age and sex [11]

	Population			
	2010	2015	2020	2025
	Women			
50–59	65,000	71,000	73,000	77,000
60–69	49,000	56,000	63,000	68,000
70–79	30,000	36,000	42,000	49,000
80–89	15,000	17,000	20,000	23,000
90+	2,000	2,000	4,000	4,000
	Men			
50–59	66,000	72,000	75,000	80,000
60–69	45,000	54,000	62,000	68,000
70–79	27,000	31,000	36,000	43,000
80–89	11,000	12,000	14,000	16,000
90+	1,000	1,000	1,000	2,000
	All			
50–59	131,000	143,000	148,000	157,000
60–69	94,000	110,000	125,000	136,000
70–79	57,000	67,000	78,000	92,000
80–89	26,000	29,000	34,000	39,000
90+	3,000	3,000	5,000	6,000
	311,000			430,000

number of fractures ranged from 44 % to 57 %, depending on fracture site. The increase was estimated to be particularly marked in men (49 %) compared to women (51 %).

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	178	257	275	386	579	791	753	1,051
75+	316	527	171	283	208	339	654	1,090
All	494	784	446	669	786	1,130	1,408	2,141
	Men							
50–74	115	170	199	288	129	184	759	1,088
75+	167	263	127	202	36	57	463	729
All	282	433	326	490	165	241	1,222	1,817
	Women and Men							
50–74	294	426	474	674	708	975	1,513	2,139
75+	483	790	298	485	243	396	1,117	1,819
All	777	1,217	772	1,159	951	1,371	2,630	3,958

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 Cyprus

	2010	2015	2020	2025
	Women			
50–74	18	21	23	25
75+	16	18	22	25
All	34	39	45	50
	Men			
50–74	10	11	13	14
75+	8	9	10	12
All	18	20	23	26
	Women and Men			
50–74	28	32	35	39
75+	24	27	32	37
All	52	59	67	76

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 rise 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.

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

	Incident fractures		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	2025
	Women					
50–74	244	342	266	288	511	630
75+	193	320	439	472	632	792
All	438	662	705	760	1,143	1,422
	Men					
50–74	188	271	150	186	338	458
75+	135	213	187	242	322	454
All	323	484	337	428	660	912
	Women and Men					
50–74	433	613	416	474	848	1,087
75+	328	533	626	714	955	1,247
All	761	1,146	1,042	1,188	1,803	2,334

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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Epidemiology and Economic Burden of Osteoporosis in the Czech Republic

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 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, tibia, 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

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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

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	Fracture at the 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

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

Age (years)	hip	Fracture at the vertebra	forearm	other	All 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	17,519	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

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

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 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	Fracture at the vertebra	"other"
		Women	
50–74	37	58	5
75+	231	101	85
Total	268	159	90
		Men	
50–74	70	129	16
75+	163	92	48
Total	233	221	63
		Men and Women	
50–74	107	186	21
75+	394	193	132
Total	501	380	154

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

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 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	183,604,435
		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
		Women and Men		
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

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

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.

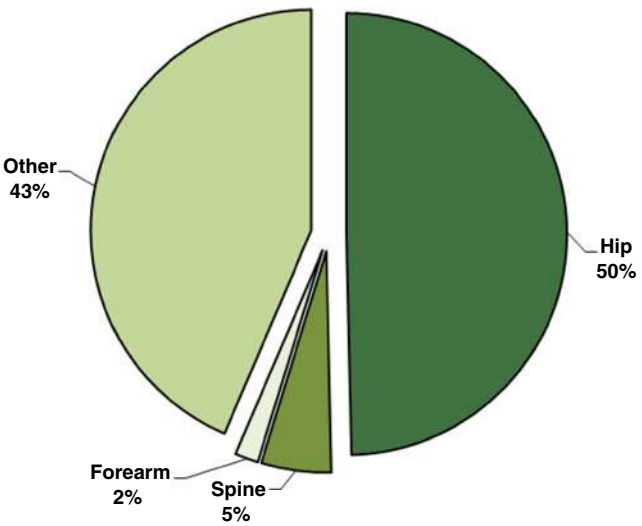

Fig. 1 Share (%) of fracture cost by fracture site in the Czech Republic. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
Women			
Incident hip fractures	443	1,393	1,836
Incident vertebral fractures	953	1,038	1,991
Incident forearm fractures	198	116	313
Incident other fractures	871	1,305	2,176
Prior hip fractures	1,444	4,341	5,784
Prior vertebral fractures	903	1,320	2,223
Total	4,812	9,513	14,324
Men			
Incident hip fractures	410	514	924
Incident vertebral fractures	1,019	519	1,538
Incident forearm fractures	73	15	88
Incident other fractures	1,390	666	2,056
Prior hip fractures	1,357	1,378	2,735
Prior vertebral fractures	742	422	1,164
Total	4,991	3,514	8,505
Men and Women			
Incident hip fractures	853	1,907	2,760
Incident vertebral fractures	1,972	1,557	3,529
Incident forearm fractures	271	130	401
Incident other fractures	2,262	1,971	4,232
Prior hip fractures	2,801	5,719	8,520
Prior vertebral fractures	1,645	1,742	3,387
Total	9,803	13,026	22,829

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 13 Value of lost QALYs (€) in men and women in the Czech Republic in 2010

	1 × GDP/capita	2 × GDP/capita	3 × 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

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			
50–59	1,514,000	1,324,000	1,313,000	1,463,000
60–69	1,235,000	1,421,000	1,378,000	1,215,000
70–79	682,000	740,000	990,000	1,147,000
80–89	344,000	369,000	356,000	413,000
90+	27,000	52,000	66,000	77,000
	3,802,000			4,315,000

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.

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

	2010	2015	2020	2025
	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

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 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		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	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 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.

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

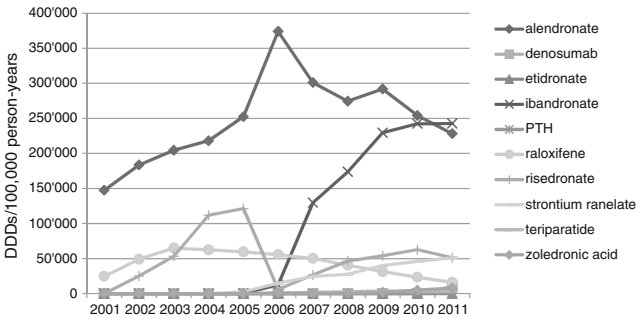

Fig. 2 Treatment uptake in the Czech Republic (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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 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, tibia, fibula, clavicle, scapula, sternum and other femoral fractures) in 2010. The economic burden of incident and previous fragility 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

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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 at 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

Epidemiology of fracture in Denmark

Data on hip fracture incidence are available for Denmark [5], based on admission statistics from the Danish National Board of Health. These rates also included repeat admissions which overestimate somewhat the hip fracture incidence. Given that country specific incidence of the vertebral, forearm and, "other" fractures were not available, these were imputed using the methods described in Chapter 3 of the main report. Briefly, it was assumed for each age and sex that the ratio of the incidence of non-hip fracture to hip fractures in Sweden would be comparable to the ratio of vertebral fracture incidence to hip fracture incidence in Denmark. 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 386.0 and 853.0 respectively.

The number of incident fractures in 2010 was estimated at 66,000 (Table 4). Incident hip, clinical spine, forearm and "other" fractures were estimated at 12,000, 10,000, 10,000 and 34,000 respectively. 63 % 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.

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

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

Age (years)	hip	Fracture at the vertebral	forearm	other
		Women		
50–54	27	70	172	178
55–59	74	206	569	652
60–64	142	251	535	546
65–69	274	398	665	935
70–74	561	792	1,009	1,592
75–79	1,087	1,057	1,060	2,287
80–84	1,983	1,247	1,242	3,373
85+	3,701	1,741	1,580	6,217
		Men		
50–54	58	148	53	257
55–59	81	141	123	753
60–64	125	298	235	1,227
65–69	201	316	302	1,296
70–74	315	480	201	1,617
75–79	592	682	168	1,581
80–84	1,189	826	230	3,161
85+	2,242	1,505	411	6,492

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 2.48 % 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.

Table 4 Estimated number of incident fractures in Denmark, 2010

Age (years)	hip	Fracture at the vertebra	forearm	other	All fractures
		Women			
50–74	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			
50–74	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			
50–74	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

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–54	0.1	0.2
55–59	0.3	0.8
60–64	0.8	1.6
65–69	1.5	2.6
70–74	2.8	4.5
75–79	5.1	6.8
80–84	9.2	9.2
85+	20.0	16.0
	Men	
50–54	0.1	0.3
55–59	0.4	0.8
60–64	0.8	1.5
65–69	1.3	2.3
70–74	2.0	2.9
75–79	3.3	3.9
80–84	5.8	5.1
85+	12.6	10.4

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–74	7,593	14,167
75+	26,370	24,754
Total	33,963	38,921
	Men	
50–74	6,489	11,028
75+	9,294	8,624
Total	15,783	19,652
	Men and Women	
50–74	14,082	25,195
75+	35,664	33,378
Total	49,746	58,573

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

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 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 vertebra	"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

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

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

Cost of osteoporosis in Denmark 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 € 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 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	61,833,686	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

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		
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
			Men		
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
			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

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

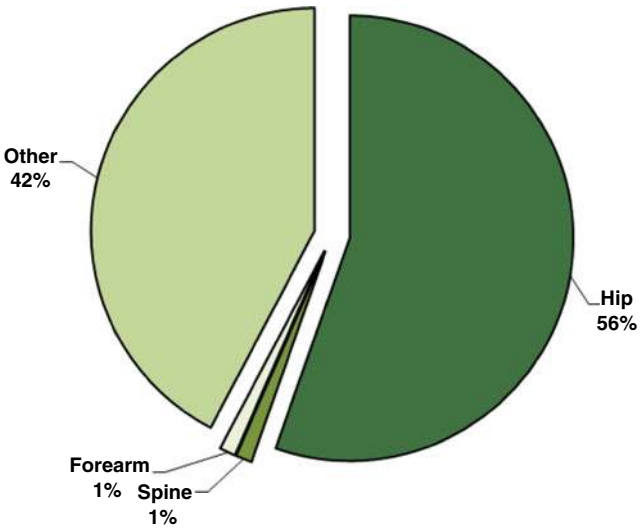

Fig. 1 Share (%) of fracture cost by fracture site in Denmark. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
Women			
Incident hip fractures	450	1,373	1,823
Incident vertebral fractures	940	965	1,905
Incident forearm fractures	179	97	276
Incident other fractures	813	1,244	2,057
Prior hip fractures	1,191	3,527	4,717
Prior vertebral fractures	792	1,189	1,981
Total	4,364	8,395	12,758
Men			
Incident hip fractures	322	538	860
Incident vertebral fractures	776	540	1,315
Incident forearm fractures	53	15	68
Incident other fractures	1,025	709	1,734
Prior hip fractures	1,014	1,372	2,386
Prior vertebral fractures	612	453	1,066
Total	3,803	3,627	7,430
Men and Women			
Incident hip fractures	772	1,911	2,683
Incident vertebral fractures	1,716	1,504	3,220
Incident forearm fractures	232	112	344
Incident other fractures	1,838	1,953	3,791
Prior hip fractures	2,204	4,899	7,103
Prior vertebral fractures	1,405	1,643	3,047
Total	8,166	12,022	20,188

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 %).

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

	1 × GDP/capita	2 × GDP/capita	3 × GDP/capita
Incident hip fractures	113,232,433	226,464,867	339,697,300
Incident vertebral fractures	135,875,793	271,751,585	407,627,378
Incident forearm fractures	14,518,357	29,036,714	43,555,071
Incident other fractures	159,969,903	319,939,806	479,909,708
Prior hip fractures	299,757,795	599,515,589	899,273,384
Prior vertebral fractures	128,584,668	257,169,335	385,754,003
Total	851,938,948	1,703,877,896	2,555,816,844

Table 14 Population projections in Denmark by age and sex [12]

	Population			
	2010	2015	2020	2025
Women				
50–59	355,000	375,000	395,000	389,000
60–69	346,000	350,000	336,000	356,000
70–79	205,000	245,000	294,000	300,000
80–89	119,000	117,000	129,000	159,000
90+	28,000	31,000	33,000	35,000
Men				
50–59	357,000	377,837	399,000	389,000
60–69	337,000	341,000	325,000	347,000
70–79	175,000	216,000	263,000	268,000
80–89	72,000	76,000	89,000	115,000
90+	9,000	11,000	13,000	15,000
All				
50–59	712,000	752,837	794,000	778,000
60–69	683,000	691,000	661,000	703,000
70–79	380,000	461,000	557,000	568,000
80–89	191,000	193,000	218,000	274,000
90+	37,000	42,000	46,000	50,000
	2,003,000			2,373,000

The cost of osteoporosis (excluding value of QALYs lost) was estimated to rise from € 1055 million in 2010 to € 1344 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).

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	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

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 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 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

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

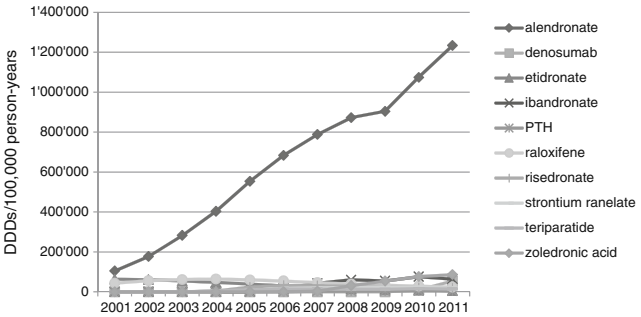

Fig. 2 Treatment uptake in Denmark (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	13	26	13	50
Women	87	190	103	54

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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

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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).

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

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Estonia by age using female-derived reference ranges at the femoral neck, 2010 [3]

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

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

Age (years)	Fracture at the 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

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 4 Estimated number of incident fractures in Estonia, 2010

Age (years)	Fracture at the hip	vertebra	forearm	other	All fractures
		Women			
50–74	263	401	676	920	2,260
75+	966	542	510	1,707	3,725
Total	1,229	942	1,186	2,628	5,986
		Men			
50–74	160	279	175	1,040	1,654
75+	224	172	47	606	1,049
Total	384	451	222	1,646	2,703
		Men and Women			
50–74	423	680	851	1,960	3,915
75+	1,190	713	557	2,314	4,774
Total	1,613	1,393	1,409	4,274	8,689

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
	Men	
50–54	0.1	0.1
55–59	0.2	0.4
60–64	0.5	0.7
65–69	0.8	1.0
70–74	1.1	1.2
75–79	2.0	2.0
80–84	3.3	2.7
85+	7.4	5.2

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	
50–74	1,165	2,101
75+	4,559	3,677
Total	5,725	5,779
	Men	
50–74	703	930
75+	922	777
Total	1,625	1,707
	Men and Women	
50–74	1,869	3,032
75+	5,481	4,454
Total	7,350	7,486

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

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 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	171
Risedronate	143
Etidronate	-
Ibandronate	283
Zoledronic acid	202
Raloxifene	-
Strontium ranelate	446
Parathyroid hormone	-
Teriparatide	-

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

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		
50–74	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).

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

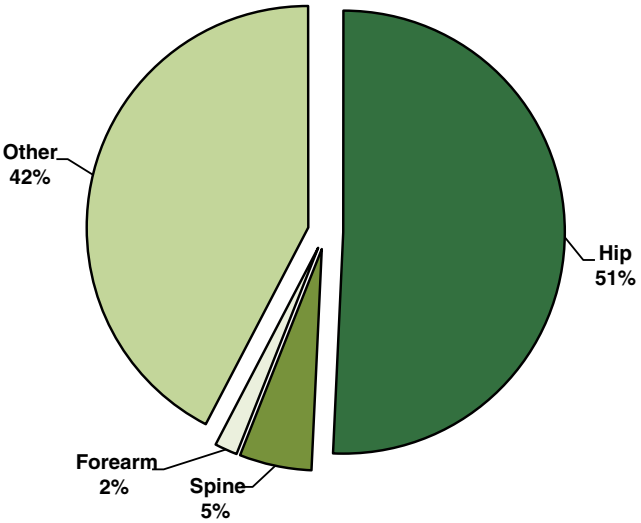

Fig. 1 Share (%) of fracture cost by fracture site in Estonia. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
Women			
Incident hip fractures	64	206	269
Incident vertebral fractures	133	158	291
Incident forearm fractures	24	16	39
Incident other fractures	110	179	289
Prior hip fractures	182	619	801
Prior vertebral fractures	117	180	297
Total	630	1,357	1,987
Men			
Incident hip fractures	40	55	95
Incident vertebral fractures	96	56	152
Incident forearm fractures	6	2	8
Incident other fractures	124	69	193
Prior hip fractures	110	137	247
Prior vertebral fractures	52	41	93
Total	428	359	787
Men and Women			
Incident hip fractures	104	261	364
Incident vertebral fractures	229	214	443
Incident forearm fractures	30	17	47
Incident other fractures	234	249	482
Prior hip fractures	292	756	1,048
Prior vertebral fractures	169	221	390
Total	1,058	1,717	2,774

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

	1 × GDP/capita	2 × GDP/capita	3 × GDP/capita
Incident hip fractures	3,899,777	7,799,554	11,699,331
Incident vertebral fractures	4,735,018	9,470,037	14,205,055
Incident forearm fractures	503,032	1,006,063	1,509,095
Incident other fractures	5,159,726	10,319,452	15,479,178
Prior hip fractures	11,216,129	22,432,259	33,648,388
Prior vertebral fractures	4,170,935	8,341,869	12,512,804
Total	29,684,617	59,369,234	89,053,851

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 %.

Table 14 Population projections in Estonia by age and sex [11]

	Population			
	2010	2015	2020	2025
		Women		
50–59	99,000	97,000	91,000	88,000
60–69	81,000	88,000	93,000	90,000
70–79	74,000	71,000	68,000	76,000
80–89	38,000	41,000	44,000	42,000
90+	5,000	7,000	10,000	11,000
		Men		
50–59	81,000	80,769	77,000	79,000
60–69	55,000	61,000	66,000	66,000
70–79	38,000	37,000	37,000	41,000
80–89	13,000	15,000	16,000	16,000
90+	1,000	1,000	2,000	2,000
		All		
50–59	180,000	177,769	168,000	167,000
60–69	136,000	149,000	159,000	156,000
70–79	112,000	108,000	105,000	117,000
80–89	51,000	56,000	60,000	58,000
90+	6,000	8,000	12,000	13,000
	485,000			511,000

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
				Women				
50–74	263	275	401	412	676	682	920	939
75+	966	1,241	542	658	510	600	1,707	2,196
All	1,229	1,516	942	1,070	1,186	1,282	2,628	3,135
				Men				
50–74	160	174	279	304	175	193	1,040	1,130
75+	224	300	172	229	47	62	606	825
All	384	474	451	532	222	255	1,646	1,955
				Women and Men				
50–74	423	450	680	716	851	875	1,960	2,069
75+	1,190	1,541	713	886	557	663	2,314	3,021
All	1,613	1,991	1,393	1,602	1,409	1,537	4,274	5,090

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

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 Estonia

	2010	2015	2020	2025
		Women		
50–74	6	6	6	6
75+	15	17	18	19
All	21	23	24	25
		Men		
50–74	5	5	5	5
75+	4	5	5	5
All	9	9	10	10
		Women and Men		
50–74	11	11	11	11
75+	19	21	23	24
All	30	32	34	35

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

	Incident fractures		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	2025
Women						
50–74	330	339	300	310	630	648
75+	559	695	798	943	1,357	1,638
All	889	1,033	1,098	1,253	1,987	2,286
Men						
50–74	266	289	162	172	428	462
75+	181	243	178	213	359	456
All	447	532	340	385	787	917
Women and Men						
50–74	596	628	462	482	1,058	1,110
75+	740	938	976	1,156	1,717	2,094
All	1,336	1,566	1,438	1,638	2,774	3,204

million in 2010 to € 104 million in 2025. 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).

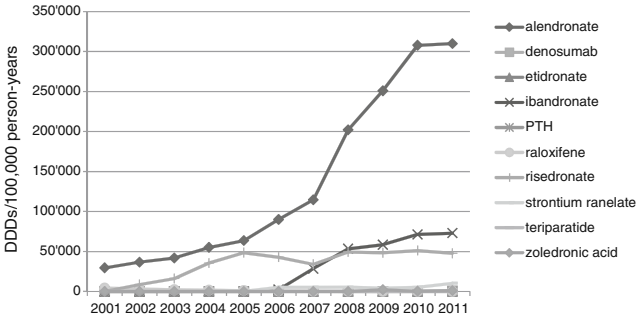

Fig. 2 Treatment uptake in Estonia (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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.

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 Estonia assuming the uptake of treatment remains unchanged

	2010	2015	2020	2025
Women				
50–74	20	19	20	20
75+	44	48	51	54
All	64	67	70	74
Men				
50–74	14	14	14	15
75+	12	13	14	15
All	26	27	28	30
Women and Men				
50–74	33	33	34	35
75+	56	61	64	69
All	89	94	99	104

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.

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	1	14	13	93
Women	7	48	41	86

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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

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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).

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

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

Age (years)	Women	Men
50–54	11,844	4,700
55–59	18,720	6,685
60–64	29,458	11,484
65–69	28,684	9,546
70–74	33,759	7,800
75–79	39,750	7,725
80+	81,184	13,114
50+	243,399	61,054

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

Age (years)	Fracture at the 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

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.

Table 4 Estimated number of incident fractures in Finland, 2010

Age (years)	Fracture at the hip	vertebra	forearm	other	All fractures
		Women			
50–74	869	1,350	2,469	3,253	7,940
75+	3,615	1,920	1,866	6,566	13,966
Total	4,484	3,269	4,334	9,818	21,907
		Men			
50–74	796	1,421	937	5,355	8,509
75+	1,268	964	265	3,494	5,992
Total	2,064	2,385	1,202	8,849	14,500
		Men and Women			
50–74	1,665	2,770	3,406	8,608	16,449
75+	4,883	2,884	2,131	10,060	19,958
Total	6,548	5,654	5,537	18,667	36,407

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	0.1
55–59	0.2	0.5
60–64	0.4	0.9
65–69	0.7	1.4
70–74	1.5	2.5
75–79	3.1	4.0
80–84	5.9	5.7
85+	13.2	9.0
	Men	
50–54	0.1	0.2
55–59	0.3	0.5
60–64	0.6	0.9
65–69	0.9	1.4
70–74	1.4	1.9
75–79	2.4	2.7
80–84	4.2	3.7
85+	8.9	6.3

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 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	
50–74	3,984	7,981
75+	19,376	16,690
Total	23,360	24,671
	Men	
50–74	4,384	6,757
75+	6,438	5,764
Total	10,821	12,521
	Men and Women	
50–74	8,368	14,738
75+	25,814	22,454
Total	34,181	37,192

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 vertebra	"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

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.

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

	Annual drug cost (€)
Alendronate	40
Risedronate	40
Etidronate	1,072
Ibandronate	456
Zoledronic acid	394
Raloxifene	488
Strontium ranelate	527
Parathyroid hormone	5,593
Teriparatide	5,933

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
		Women and Men		
50–74	107,728,706	18,594,654	6,298,860	132,622,220
75+	161,038,539	85,593,356	3,617,932	250,249,826
All	268,767,245	104,188,010	9,916,792	382,872,047

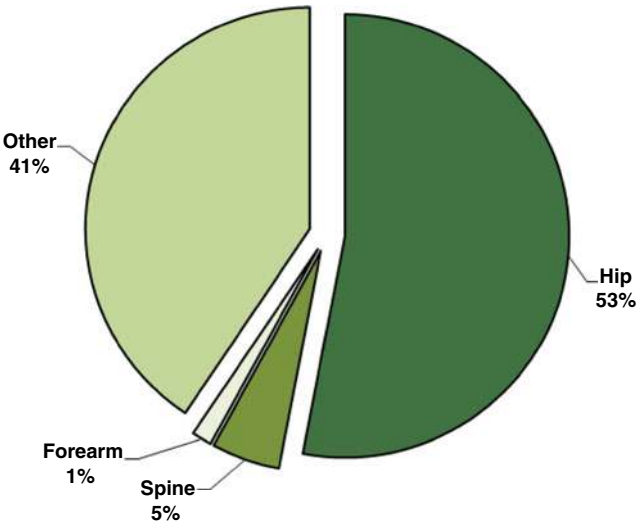

Fig. 1 Share (%) of fracture cost by fracture site in Finland. Note that costs for fracture prevention therapy and monitoring are not included

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 12,300 (Table 12). 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 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	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
			Men		
50–74	22,185,219	4,668,850	919,781	42,387,731	70,161,581
75+	40,472,390	2,884,668	260,507	28,711,048	72,328,612
All	62,657,610	7,553,518	1,180,288	71,098,778	142,490,193
			Women and Men		
50–74	43,877,558	9,299,226	3,343,272	69,803,304	126,323,360
75+	153,776,084	9,115,255	2,091,872	81,648,684	246,631,894
All	197,653,642	18,414,481	5,435,144	151,451,988	372,955,255

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	2,605	3,230
Prior vertebral fractures	447	809	1,256
Total	2,203	5,459	7,661
	Men		
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		
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

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

	1 × GDP/capita	2 × GDP/capita	3 × GDP/capita
Incident hip fractures	49,153,821	98,307,641	147,461,462
Incident vertebral fractures	59,720,352	119,440,704	179,161,056
Incident forearm fractures	6,212,943	12,425,886	18,638,829
Incident other fractures	70,640,403	141,280,807	211,921,210
Prior hip fractures	163,554,941	327,109,882	490,664,823
Prior vertebral fractures	65,017,379	130,034,757	195,052,136
Total	414,299,839	828,599,677	1,242,899,516

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]

	Population			
	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
	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			
50–59	762,000	741,866	714,000	651,000
60–69	675,000	757,000	711,000	697,000
70–79	402,000	445,000	578,000	650,000
80–89	219,000	235,000	252,000	285,000
90+	32,000	44,000	57,000	66,000
	2,090,000			2,349,000

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	869	1,052	1,350	1,555	2,469	2,655	3,253	3,661
75+	3,615	5,044	1,920	2,697	1,866	2,590	6,566	9,232
All	4,484	6,096	3,269	4,252	4,334	5,244	9,818	12,893
	Men							
50–74	796	934	1,421	1,588	937	976	5,355	5,836
75+	1,268	2,374	964	1,833	265	503	3,494	6,567
All	2,064	3,307	2,385	3,420	1,202	1,478	8,849	12,403
	Women and Men							
50–74	1,665	1,986	2,770	3,142	3,406	3,630	8,608	9,497
75+	4,883	7,418	2,884	4,530	2,131	3,092	10,060	15,799
All	6,548	9,403	5,654	7,672	5,537	6,722	18,667	25,296

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

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 Finland

	2010	2015	2020	2025
	Women			
50–74	62	68	76	72
75+	178	190	205	234
All	239	259	281	306
	Men			
50–74	71	79	85	82
75+	73	84	99	125
All	144	163	184	207
	Women and Men			
50–74	133	147	161	154
75+	250	274	304	360
All	383	422	465	514

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
			Women and Men			
50–74	2,466	2,769	2,132	2,324	4,598	5,093
75+	3,061	4,767	4,671	5,901	7,732	10,668
All	5,528	7,536	6,803	8,224	12,330	15,761

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 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
		Women and Men		
50–74	442	473	505	497
75+	770	836	920	1,076
All	1,211	1,308	1,425	1,573

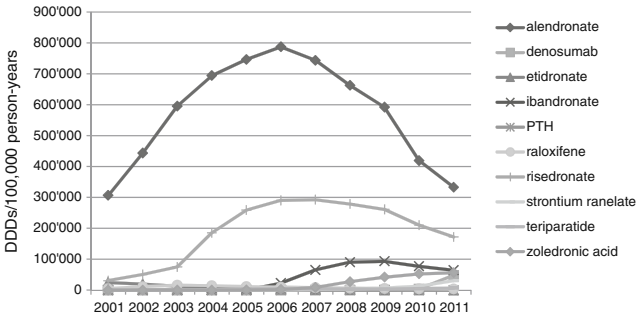

Fig. 2 Treatment uptake in Finland (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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).

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

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

estimates were compared to the numberof 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.

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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

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

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

Age (years)	Fracture at the hip	vertebra	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
	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 at the vertebra	forearm	other	All fractures
		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 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 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

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

Age (years)	Hip	Clinical vertebral	"Other" fracture
		Women	
50–54	654	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

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 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
		Men and Women	
50–74	256	442	49
75+	1,841	813	832
Total	2,098	1,256	880

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

	Annual drug cost (€)
Alendronate	209
Risedronate	380
Etidrontate	99
Ibandronate	327
Zoledronic acid	410
Raloxifene	365
Strontium ranelate	579
Parathyroid hormone	-
Teriparatide	4,829

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

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	2,888,671,058
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

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

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

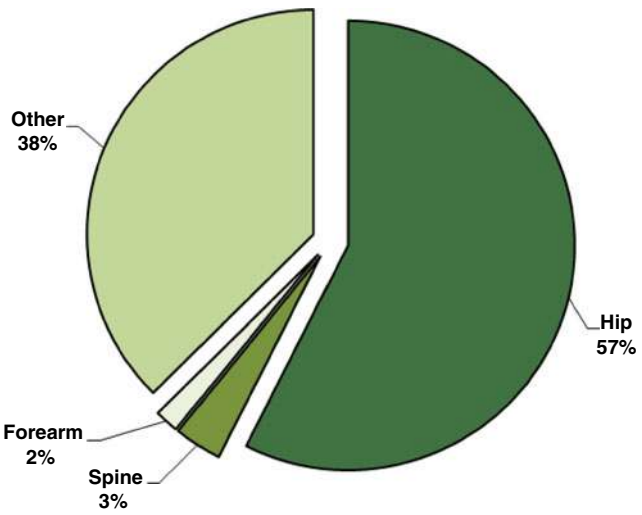

Fig. 1 Share (%) of fracture cost by fracture site in France. Note that costs for fracture prevention therapy and monitoring are not included

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.

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

	1 × GDP/ capita	2 × GDP/ capita	3 × GDP/ capita
Incident hip fractures	478,803,425	957,606,851	1,436,410,276
Incident vertebral fractures	510,715,979	1,021,431,958	1,532,147,937
Incident forearm fractures	55,054,072	110,108,144	165,162,216
Incident other fractures	630,485,223	1,260,970,447	1,891,455,670
Prior hip fractures	1,814,820,821	3,629,641,642	5,444,462,463
Prior vertebral fractures	664,773,990	1,329,547,980	1,994,321,969
Total	4,154,653,510	8,309,307,021	12,463,960,531

Table 14 Population projections in France by age and sex [11]

	Population			
	2010	2015	2020	2025
	Women			
50–59	4,222,000	4,310,000	4,332,000	4,272,000
60–69	3,330,000	3,976,000	4,068,000	4,165,000
70–79	2,578,000	2,483,000	3,049,000	3,645,000
80–89	1,877,000	1,916,000	1,872,000	1,837,000
90+	351,000	527,000	654,000	716,000
	Men			
50–59	4,006,000	4,079,119	4,151,000	4,164,000
60–69	3,122,000	3,657,000	3,681,000	3,780,000
70–79	2,015,000	2,048,000	2,585,000	3,047,000
80–89	1,034,000	1,125,000	1,173,000	1,230,000
90+	110,000	188,000	238,000	278,000
	All			
50–59	8,228,000	8,389,119	8,483,000	8,436,000
60–69	6,452,000	7,633,000	7,749,000	7,945,000
70–79	4,593,000	4,531,000	5,634,000	6,692,000
80–89	2,911,000	3,041,000	3,045,000	3,067,000
90+	461,000	715,000	892,000	994,000
	22,645,000			27,134,000

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

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	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
				Women and Men				
50–74	13,057	17,053	21,687	27,204	29,602	35,724	66,063	81,329
75+	60,573	81,096	33,938	45,599	26,498	33,323	125,355	170,130
All	73,630	98,149	55,625	72,802	56,100	69,047	191,418	251,459

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 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

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
		Women		
50–74	1,961	2,088	2,306	2,383
75+	7,348	7,868	8,187	8,692
All	9,309	9,956	10,493	11,075
		Men		
50–74	1,457	1,544	1,683	1,757
75+	2,396	2,619	2,863	3,287
All	3,853	4,163	4,546	5,044
		Women and Men		
50–74	3,418	3,632	3,989	4,140
75+	9,744	10,487	11,050	11,979
All	13,162	14,120	15,039	16,119

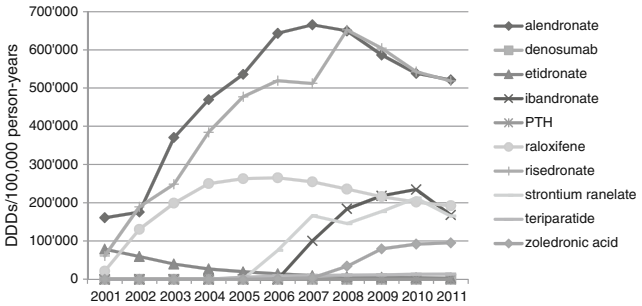

Fig. 2 Treatment uptake in France (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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

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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

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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).

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

Age (years)	Women	Men	All
50–59	5,799,000	5,813,000	11,612,000
60–69	4,641,000	4,405,000	9,046,000
70–79	4,485,000	3,677,000	8,162,000
80–89	2,455,000	1,247,000	3,702,000
90+	384,000	104,000	488,000
50+	17,764,000	15,246,000	33,010,000

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,

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Germany by age using female-derived reference ranges at the femoral neck, 2010 [3]

Age (years)	Women	Men
50–54	192,528	78,050
55–59	263,328	94,185
60–64	335,621	131,950
65–69	463,388	157,620
70–74	754,137	181,428
75–79	668,250	139,153
80+	1,340,008	224,266
50+	4,017,260	1,006,652

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

Age (years)	Fracture at the hip	vertebra	forearm	other
		Women		
50–54	19	48	118	121
55–59	56	156	430	493
60–64	113	200	427	436
65–69	215	314	523	736
70–74	392	553	705	1,112
75–79	685	666	668	1,442
80–84	1,158	728	725	1,968
85+	2,090	983	892	3,511
		Men		
50–54	26	66	24	114
55–59	84	146	128	782
60–64	63	150	118	615
65–69	122	192	184	787
70–74	223	341	143	1,149
75–79	338	389	96	901
80–84	741	514	144	1,969
85+	1,100	739	202	3,186

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,

Table 4 Estimated number of incident fractures in Germany, 2010

Age (years)	Fracture at the hip	vertebra	forearm	other	All fractures
		Women			
50–74	24,384	36,569	62,941	85,975	209,868
75+	71,288	37,767	36,171	129,296	274,522
Total	95,672	74,336	99,112	215,271	484,390
		Men			
50–74	14,906	24,693	15,325	94,879	149,803
75+	19,272	14,598	4,017	52,692	90,579
Total	34,178	39,291	19,342	147,572	240,383
		Men and Women			
50–74	39,290	61,262	78,266	180,854	359,672
75+	90,559	52,365	40,188	181,988	365,101
Total	129,849	113,627	118,454	362,843	724,773

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–54	0.0	0.1
55–59	0.3	0.7
60–64	0.6	1.4
65–69	1.4	2.5
70–74	2.5	3.8
75–79	4.2	5.5
80–84	6.9	7.1
85+	14.0	10.2
	Men	
50–54	0.1	0.2
55–59	0.4	0.7
60–64	0.7	1.1
65–69	1.0	1.5
70–74	1.4	2.1
75–79	2.2	2.7
80–84	3.8	3.4
85+	7.8	5.6

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–74	121,296	215,084
75+	368,240	340,515
Total	489,535	555,599
	Men	
50–74	80,379	126,339
75+	99,885	93,592
Total	180,264	219,930
	Men and Women	
50–74	201,675	341,423
75+	468,125	434,107
Total	669,799	775,529

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

2,965 and 1,527 deaths respectively. Overall, approximately 57 % of deaths occurred in women.

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 [11]

	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	1,317,750,147
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

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

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

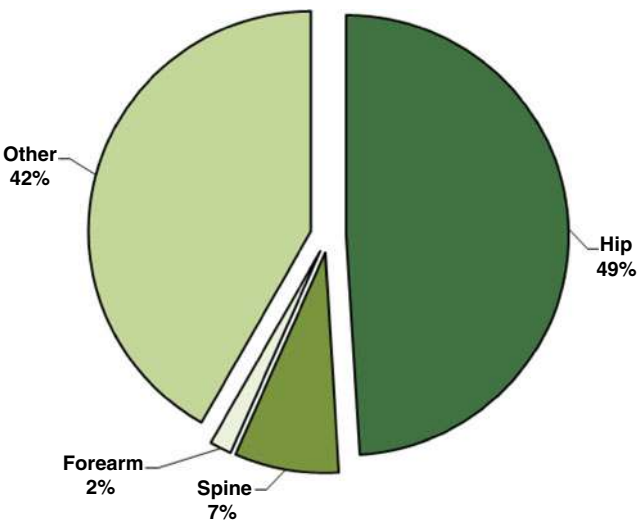

Fig. 1 Share (%) of fracture cost by fracture site in Germany. Note that costs for fracture prevention therapy and monitoring are not included

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

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

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 %).

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

Table 14 Population projections in Germany by age and sex [12]

	Population			
	2010	2015	2020	2025
	Women			
50–59	5,799,000	6,488,000	6,766,000	5,769,000
60–69	4,641,000	4,947,000	5,547,000	6,236,000
70–79	4,485,000	4,602,000	4,117,000	4,437,000
80–89	2,455,000	2,439,000	3,008,000	3,050,000
90+	384,000	543,000	637,000	691,000
	Men			
50–59	5,813,000	6,632,086	6,957,000	5,872,000
60–69	4,405,000	4,698,000	5,335,000	6,146,000
70–79	3,677,000	3,844,000	3,534,000	3,851,000
80–89	1,247,000	1,504,000	2,048,000	2,132,000
90+	104,000	167,000	258,000	327,000
	All			
50–59	11,612,000	13,120,086	13,723,000	11,641,000
60–69	9,046,000	9,645,000	10,882,000	12,382,000
70–79	8,162,000	8,446,000	7,651,000	8,288,000
80–89	3,702,000	3,943,000	5,056,000	5,182,000
90+	488,000	710,000	895,000	1,018,000
	33,010,000			38,511,000

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	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
				Women and Men				
50–74	39,290	43,227	61,262	68,024	78,266	88,939	180,854	205,092
75+	90,559	129,508	52,365	73,653	40,188	52,755	181,988	266,540
All	129,849	172,735	113,627	141,677	118,454	141,694	362,843	471,632

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 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
		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

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	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	54,029	60,498	50,437	53,203	104,467	113,701
75+	55,792	79,812	86,069	103,249	141,861	183,060
All	109,821	140,310	136,506	156,452	246,327	296,762

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 Germany assuming the uptake of treatment remains unchanged

	2010	2015	2020	2025
		Women		
50–74	5,802	5,648	5,895	6,209
75+	10,474	11,465	12,153	12,909
All	16,276	17,113	18,048	19,117
		Men		
50–74	4,207	4,188	4,461	4,738
75+	3,452	4,072	4,733	5,390
All	7,659	8,260	9,194	10,128
		Women and Men		
50–74	10,009	9,836	10,356	10,946
75+	13,926	15,537	16,886	18,299
All	23,935	25,373	27,242	29,245

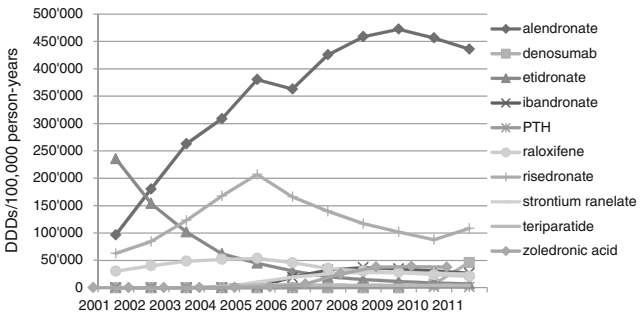

Fig. 2 Treatment uptake in Germany (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	109	540	431	80
Women	730	3,231	2,501	77

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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/).

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

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 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 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

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 hip	vertebra	forearm	other	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
		Men and Women			
50–74	4,404	6,887	9,559	20,395	41,246
75+	10,279	6,422	5,018	22,554	44,273
Total	14,683	13,309	14,577	42,949	85,518

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	6.3
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
	Men and Women	
50–74	24,325	40,796
75+	63,088	60,963
Total	87,413	101,760

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

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 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 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 pharamceuticals in Greece, 2010 [13]

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

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 adjusted) 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

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		
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
			Men		
50–74	26,076,779	6,758,503	1,216,407	63,523,373	97,575,062
75+	58,263,114	5,674,285	522,848	57,536,757	121,997,003
All	84,339,893	12,432,788	1,739,255	121,060,130	219,572,065
			Women and Men		
50–74	74,446,037	18,245,011	7,330,066	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

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.

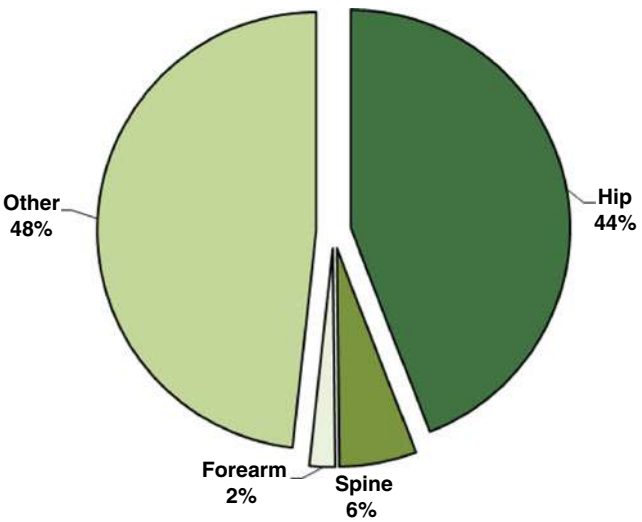

Fig. 1 Share (%) of fracture cost by fracture site in Greece. Note that costs for fracture prevention therapy and monitoring are not included

The number of quality adjusted life years (QALYs) lost due to osteoporosis in 2010 was estimated at 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

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

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,

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]

	Population			
	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	535,000	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
	4,236,000			5,066,000

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).

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.

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	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

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 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

	Incident fractures		Prior fractures		All fractures	
	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	8,489	8,699	12,778	14,173
All	7,937	9,749	12,558	12,769	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

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

	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

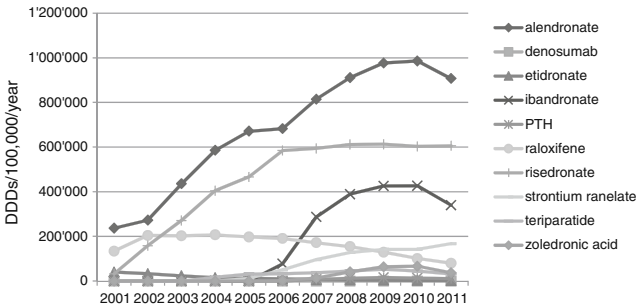

Fig. 2 Treatment uptake in Greece (defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	50	40	−10	−25
Women	333	482	149	31

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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

Table 2 Estimated number of women and men with osteoporosis (defined as a T-score ≤−2.5 SD) in Hungary by age using female-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

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 hip	vertebra	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

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 4 Estimated number of incident fractures in Hungary, 2010

Age (years)	Fracture at the hip	vertebra	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
		Men and Women			
50–74	3,391	5,580	26,224	17,699	52,893
75+	10,011	5,788	12,963	20,800	49,563
Total	13,401	11,368	39,188	38,499	102,456

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
	Men and Women	
50–74	15,622	25,658
75+	41,602	34,936
Total	57,225	60,594

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

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 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	1,387,868	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

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+	42,182,382	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

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.

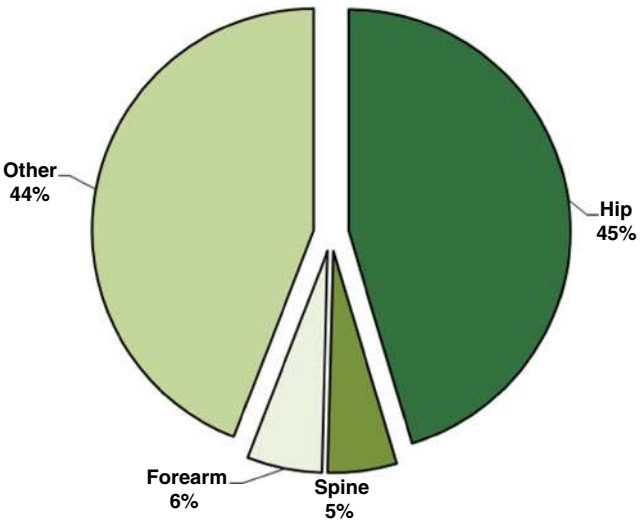

Fig. 1 Share (%) of fracture cost (%) by fracture site in Hungary. Note that costs for fracture prevention therapy and monitoring are not included

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+
Women			
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
Men			
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
Men and Women			
Incident hip fractures	840	2,193	3,034
Incident vertebral fractures	1,891	1,735	3,626
Incident forearm fractures	921	402	1,324
Incident other fractures	2,113	2,234	4,347
Prior hip fractures	2,445	5,734	8,179
Prior vertebral fractures	1,431	1,726	3,157
Total	9,642	14,025	23,667

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	240,475,567
Prior vertebral fractures	30,940,008	61,880,016	92,820,023
Total	231,932,378	463,864,756	695,797,134

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			
50–59	1,433,000	1,235,047	1,209,000	1,368,000
60–69	1,114,000	1,238,000	1,249,000	1,088,000
70–79	744,000	772,000	836,000	947,000
80–89	352,000	360,000	364,000	394,000
90+	40,000	59,000	69,000	75,000
	3,683,000			3,872,000

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 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

	2010	2015	2020	2025
	Women			
50–74	54	55	56	57
75+	86	91	96	103
All	140	146	153	160
	Men			
50–74	31	32	33	34
75+	27	28	30	32
All	58	60	62	66
	Women and Men			
50–74	84	87	89	91
75+	113	119	126	135
All	197	206	215	226

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	1,996	2,183	3,088	3,257	19,242	19,278	7,719	8,019
75+	7,708	9,819	4,056	5,022	10,590	12,532	14,365	18,243
All	9,704	12,001	7,144	8,279	29,832	31,811	22,084	26,262
	Men							
50–74	1,394	1,550	2,492	2,685	6,982	7,230	9,980	10,436
75+	2,303	2,791	1,732	2,114	2,374	2,848	6,435	7,810
All	3,698	4,340	4,224	4,799	9,356	10,078	16,415	18,247
	Women and Men							
50–74	3,391	3,732	5,580	5,941	26,224	26,508	17,699	18,455
75+	10,011	12,610	5,788	7,136	12,963	15,381	20,800	26,054
All	13,401	16,342	11,368	13,078	39,188	41,889	38,499	44,509

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

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 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

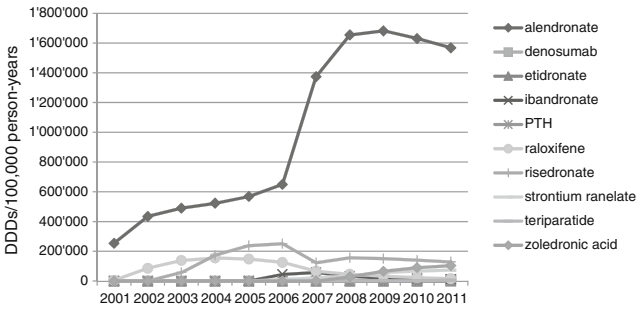

Fig. 2 Treatment uptake in Hungary (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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

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	60	24	41
Women	238	332	94	28

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. 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 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.

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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)

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

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

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	Fracture at the 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	9,940
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

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

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.

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

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 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
		Women and Men		
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

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

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 QALYs 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.

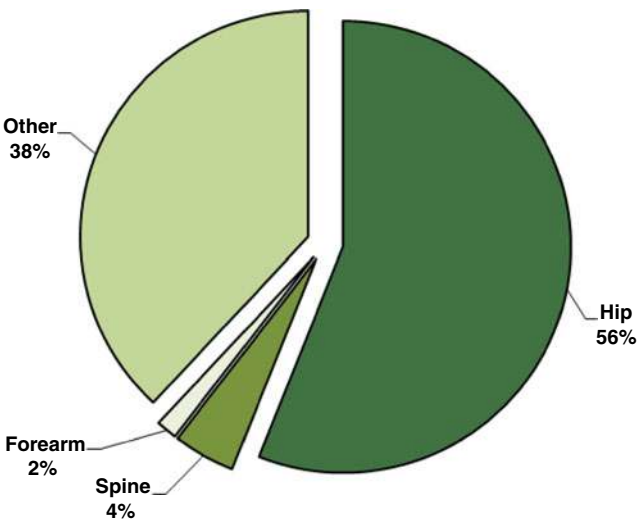

Fig. 1 Share (%) of fracture cost by fracture site in Ireland. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
		Women	
Incident hip fractures	122	373	494
Incident vertebral fractures	254	261	514
Incident forearm fractures	54	30	84
Incident other fractures	241	364	605
Prior hip fractures	396	1,389	1,785
Prior vertebral fractures	256	429	685
Total	1,322	2,845	4,167
		Men	
Incident hip fractures	78	137	215
Incident vertebral fractures	186	138	325
Incident forearm fractures	12	4	16
Incident other fractures	248	182	430
Prior hip fractures	255	404	659
Prior vertebral fractures	146	139	286
Total	927	1,004	1,931
		Men and Women	
Incident hip fractures	200	510	709
Incident vertebral fractures	440	399	839
Incident forearm fractures	66	34	100
Incident other fractures	489	546	1,035
Prior hip fractures	651	1,793	2,444
Prior vertebral fractures	402	568	970
Total	2,248	3,849	6,097

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

	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

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.

Table 14 Population projections in Ireland by age and sex [12]

	Population			
	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
	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			
50–59	509,000	555,963	605,000	662,000
60–69	381,000	440,000	482,000	530,000
70–79	230,000	266,000	325,000	378,000
80–89	108,000	122,000	139,000	164,000
90+	18,000	22,000	29,000	33,000
	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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	504	748	766	1,113	1,526	2,169	2,014	2,911
75+	1,790	2,756	911	1,404	993	1,516	3,515	5,415
All	2,294	3,504	1,677	2,518	2,519	3,686	5,530	8,326
	Men							
50–74	320	465	562	802	361	499	2,091	2,951
75+	571	1,009	434	768	121	214	1,604	2,840
All	892	1,474	996	1,569	482	713	3,695	5,791
	Women and Men							
50–74	824	1,213	1,328	1,915	1,887	2,668	4,105	5,862
75+	2,361	3,765	1,345	2,172	1,114	1,730	5,120	8,255
All	3,186	4,978	2,673	4,087	3,000	4,398	9,225	14,116

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 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

	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

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

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 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

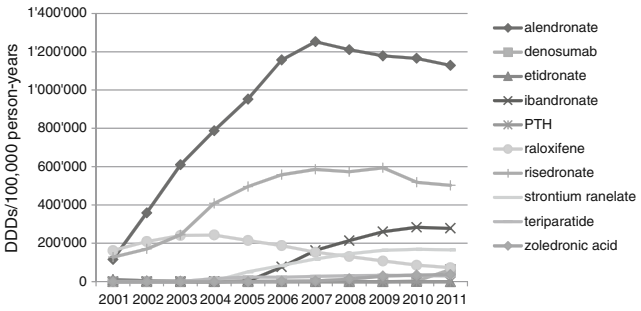

Fig. 2 Treatment uptake in Ireland (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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 1.57 % 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 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	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

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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

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

Age (years)	Women	Men
50–54	128,709	49,800
55–59	180,960	63,245
60–64	274,703	105,386
65–69	338,148	110,260
70–74	463,419	109,356
75–79	552,375	110,828
80+	1,104,480	200,362
50+	3,042,794	749,237

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

Age (years)	Fracture at the 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

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.

Table 4 Estimated number of incident fractures in Italy, 2010

Age (years)	Fracture at the hip	vertebra	forearm	other	All fractures
Women					
50–74	12,298	18,582	32,856	44,355	108,091
75+	55,297	29,339	28,667	100,888	214,191
Total	67,595	47,921	61,523	145,243	322,282
Men					
50–74	6,345	11,053	6,721	40,133	64,252
75+	16,598	12,488	3,435	46,345	78,866
Total	22,944	23,540	10,156	86,478	143,118
Men and Women					
50–74	18,644	29,635	39,577	84,487	172,343
75+	71,895	41,827	32,102	147,234	293,057
Total	90,539	71,461	71,679	231,721	465,400

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

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 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

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	
50–74	165	247	24
75+	1,342	536	605
Total	1,507	784	628
		Men	
50–74	173	286	37
75+	1,098	589	373
Total	1,271	875	411
		Men and Women	
50–74	339	534	61
75+	2,440	1,125	978
Total	2,778	1,659	1,039

Table 9 One year costs for relevant pharamceuticals in Italy, 2010 [9]

	Annual drug cost (€)
Alendronate	294
Risedronate	474
Etidrontae	97
Ibandronate	524
Zoledronic acid	529
Raloxifene	452
Strontium ranelate	665
Parathyroid hormone	6,528
Teriparatide	7,445

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 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 cost	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
		Women and Men		
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

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

Age	Hip	Spine	Forearm	Other	All
			Women		
50–74	449,974,284	77,941,621	39,326,070	473,247,198	1,040,489,173
75+	2,477,211,002	116,273,519	34,311,877	991,583,005	3,619,379,404
All	2,927,185,287	194,215,140	73,637,947	1,464,830,203	4,659,868,577
			Men		
50–74	272,395,678	44,919,535	8,044,816	401,594,305	726,954,334
75+	777,891,928	45,029,477	4,111,504	457,141,101	1,284,174,011
All	1,050,287,606	89,949,012	12,156,320	858,735,406	2,011,128,345
			Women and Men		
50–74	722,369,963	122,861,156	47,370,886	874,841,503	1,767,443,507
75+	3,255,102,930	161,302,996	38,423,382	1,448,724,106	4,903,553,414
All	3,977,472,893	284,164,152	85,794,268	2,323,565,609	6,670,996,922

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 QALYs 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

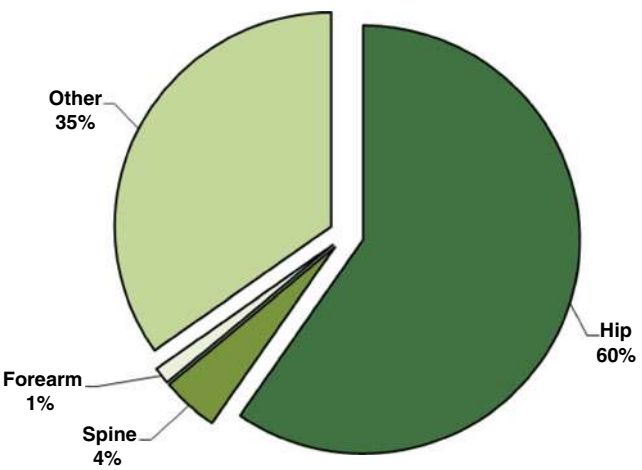

Fig. 1 Share of fracture cost by fracture site in Italy. Note that costs for fracture prevention therapy and monitoring are not included

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

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,

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]

	Population			
	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	4,302,238	4,832,000	5,033,000
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				
50–59	7,727,000	8,659,238	9,600,000	9,886,000
60–69	6,902,000	7,209,000	7,403,000	8,304,000
70–79	5,612,000	5,690,000	6,033,000	6,324,000
80–89	3,089,000	3,320,000	3,601,000	3,700,000
90+	458,000	687,000	851,000	977,000
	23,788,000			29,191,000

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).

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

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	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

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 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
			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

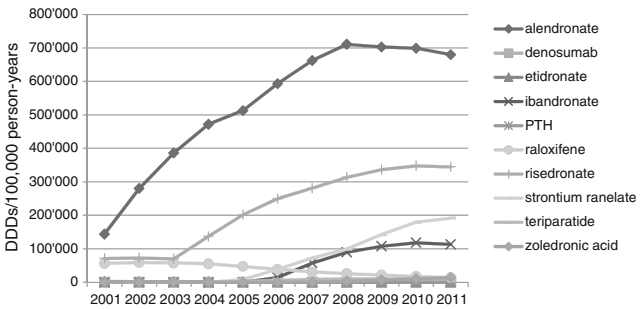

Fig. 2 Treatment uptake in Italy (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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 and before 2010. In the population ≥50 years of age,

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

Age (years)	Women	Men	All
50–54	5,292	1,825	7,117
55–59	7,584	2,205	9,789
60–64	9,581	2,726	12,307
65–69	14,544	3,404	17,948
70–74	19,251	2,886	22,137
75–79	21,000	2,678	23,678
80+	33,984	3,486	37,470
50+	111,236	19,210	130,446

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

Age (years)	Fracture at the 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

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 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)	Fracture at the hip	vertebra	forearm	other	All fractures
		Women			
50–74	442	669	1,134	1,553	3,798
75+	1,580	889	851	2,815	6,135
Total	2,022	1,558	1,985	4,368	9,933
		Men			
50–74	266	460	293	1,731	2,751
75+	347	268	74	933	1,622
Total	613	728	367	2,664	4,372
		Men and Women			
50–74	708	1,130	1,428	3,284	6,549
75+	1,927	1,157	924	3,748	7,756
Total	2,634	2,286	2,352	7,032	14,305

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

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

33 deaths respectively. Overall, approximately 56 % of deaths occurred in women.

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)	Fracture at the hip	Fracture at the vertebra	"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

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 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

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

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.

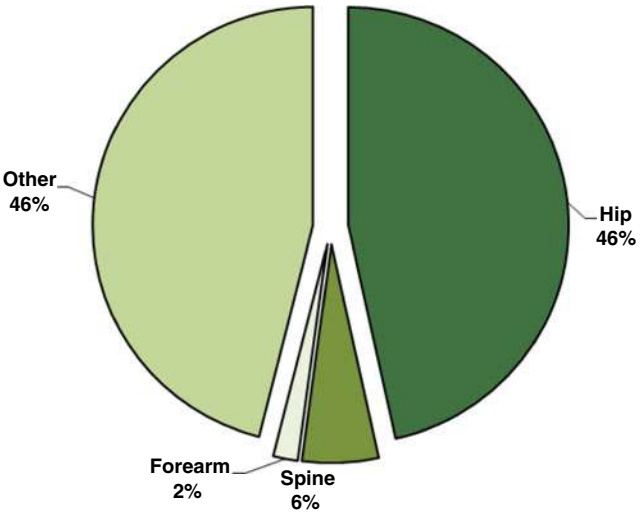

Fig. 1 Share (%) of fracture cost by fracture site in Latvia. Note that costs for fracture prevention therapy and monitoring are not included

Incident fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 27 %, 6 %, 2 % and 66 % respectively.

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

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	387,077	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

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

18 %, depending on fracture site. The increase was estimated to be particularly marked in men (20 %) compared to women (10 %).

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]

	Population			
	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				
50–59	299,000	306,583	291,000	280,000
60–69	232,000	235,000	258,000	267,000
70–79	188,000	189,000	173,000	179,000
80–89	84,000	91,000	95,000	97,000
90+	9,000	12,000	16,000	19,000
	812,000			842,000

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	2025	2010	2025	2010	2025	2010	2025
Women								
50–74	442	439	669	660	1,134	1,113	1,553	1,522
75+	1,580	1,902	889	1,009	851	942	2,815	3,374
All	2,022	2,340	1,558	1,669	1,985	2,054	4,368	4,896
Men								
50–74	266	291	460	511	293	329	1,731	1,908
75+	347	469	268	358	74	98	933	1,303
All	613	761	728	868	367	426	2,664	3,211
Women and Men								
50–74	708	730	1,130	1,171	1,428	1,441	3,284	3,430
75+	1,927	2,371	1,157	1,366	924	1,039	3,748	4,677
All	2,634	3,101	2,286	2,537	2,352	2,481	7,032	8,107

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

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 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

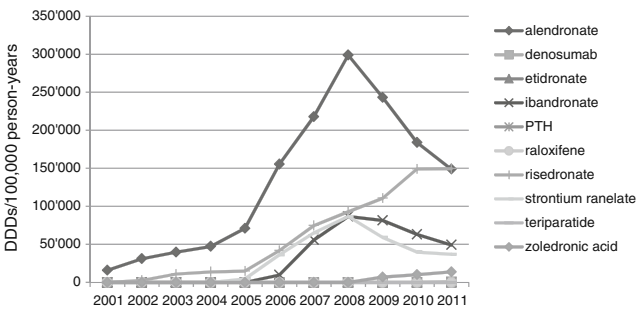

Fig. 2 Treatment uptake in Latvia (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	2	24	22	93
Women	12	80	68	85

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 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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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, tibia, 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. 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

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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 [1]

Age (years)	Women	Men	All
50–59	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

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
50–54	8,190	2,750
55–59	10,176	2,975
60–64	13,728	3,944
65–69	18,786	4,366
70–74	25,668	3,978
75–79	28,875	3,811
80+	42,952	5,312
50+	148,375	27,136

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-

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

		Fracture at the		
Age (years)	hip	vertebra	forearm	other
		Women		
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
		Men		
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

Table 4 Estimated number of incident fractures in Lithuania, 2010

Age (years)	hip	Fracture at the 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

dence (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 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.

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
Men		
50–54	0.1	0.1
55–59	0.3	0.4
60–64	0.5	0.6
65–69	0.7	0.8
70–74	1.0	1.0
75–79	1.4	1.3
80–84	2.3	1.8
85+	5.0	3.0

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.

Cost of osteoporosis in Lithuania 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 € 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

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

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.

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

	Annual drug cost (€)
Alendronate	146
Risedronate	321
Etidronate	-
Ibandronate	402
Zoledronic acid	-
Raloxifene	516
Strontium ranelate	512
Parathyroid hormone	5,428
Teriparatide	5,758

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 8 The number of deaths in men and women in Lithuania 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	11	17	2
75+	55	25	19
Total	66	42	20
		Men	
50–74	22	40	5
75+	27	16	7
Total	49	56	12
		Men and Women	
50–74	33	57	6
75+	81	41	26
Total	114	98	32

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

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

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.

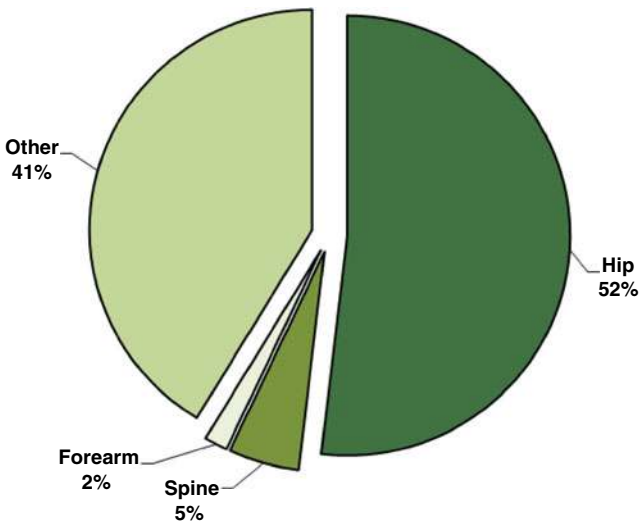

Fig. 1 Share (%) of fracture cost by fracture site in Lithuania. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
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

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).

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

Table 14 Population projections in Lithuania by age and sex [11]

	Population			
	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
	All			
50–59	431,000	472,509	456,000	419,000
60–69	316,000	323,000	368,000	408,000
70–79	257,000	247,000	236,000	245,000
80–89	113,000	124,000	127,000	125,000
90+	10,000	14,000	20,000	23,000
	1,127,000			1,220,000

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.

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

	Hip		Vertebal		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	462	496	719	769	1,264	1,352	1,685	1,799
75+	1,524	1,911	865	1,016	823	938	2,700	3,379
All	1,986	2,407	1,584	1,786	2,087	2,290	4,385	5,178
	Men							
50–74	334	380	595	679	390	464	2,251	2,605
75+	312	356	241	272	66	74	844	982
All	646	737	835	952	456	538	3,095	3,587
	Women and Men							
50–74	797	876	1,314	1,448	1,654	1,816	3,936	4,405
75+	1,836	2,267	1,106	1,289	889	1,012	3,544	4,360
All	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

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

	Incident fractures		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	2025
	Women					
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
	Men					
50–74	574	659	345	379	919	1,038
75+	254	290	293	311	547	601
All	828	949	638	689	1,466	1,639
	Women and Men					
50–74	1,173	1,299	964	1,031	2,137	2,330
75+	1,145	1,367	1,590	1,784	2,735	3,151
All	2,318	2,667	2,554	2,814	4,872	5,481

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 Lithuania assuming the uptake of treatment remains unchanged

	2010	2015	2020	2025
Women				
50–74	31	31	31	33
75+	59	63	66	69
All	89	94	98	102
Men				
50–74	24	24	25	27
75+	15	15	15	16
All	38	39	41	43
Women and Men				
50–74	55	55	57	60
75+	73	78	82	85
All	128	133	138	145

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.

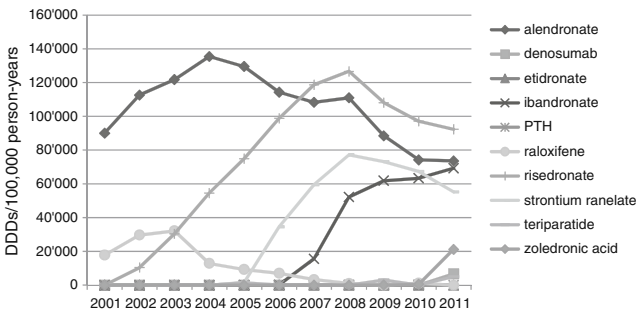

Fig. 2 Treatment uptake in Lithuania (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	2	31	29	95
Women	11	109	98	90

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 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). 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 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, tibia, 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.

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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.

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

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 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]

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

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.

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

	Fracture at the			
Age (years)	hip	vertebra	forearm	other
	Women			
50–54	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
	Men			
50–54	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

Table 4 Estimated number of incident fractures in Luxembourg, 2010

Age (years)	hip	Fracture at the vertebra	forearm	other	All fractures
		Women			
50–74	68	110	223	287	688
75+	272	144	155	521	1,092
Total	340	254	378	808	1,780
		Men			
50–74	54	96	64	363	577
75+	73	55	15	200	344
Total	127	151	79	563	920
		Men and Women			
50–74	122	206	287	650	1,265
75+	346	199	170	721	1,435
Total	467	405	457	1,371	2,700

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.

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–54	0.0	0.2
55–59	0.2	0.7
60–64	0.5	1.2
65–69	1.0	1.7
70–74	1.8	2.7
75–79	3.4	4.3
80–84	6.5	6.1
85+	13.8	9.7
	Men	
50–54	0.1	0.1
55–59	0.3	0.4
60–64	0.6	0.9
65–69	0.9	1.5
70–74	1.3	1.8
75–79	2.1	2.4
80–84	3.7	3.3
85+	7.1	4.9

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–74	359	704
75+	1,418	1,257
Total	1,777	1,960
	Men	
50–74	322	502
75+	347	327
Total	669	829
	Men and Women	
50–74	681	1,206
75+	1,765	1,583
Total	2,446	2,790

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

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

Age (years)	Hip	Clinical vertebral	"Other" fracture
		Women	
50–54	946	1,229	24
55–59	716	881	21
60–64	316	366	10
65–69	1,527	1,674	57
70–74	1,071	1,105	49
75–79	1,826	1,764	115
80–84	2,336	2,067	260
85–89	2,942	2,287	515
90+	2,767	1,560	962
		Men	
50–54	1,671	2,004	26
55–59	1,206	1,371	25
60–64	1,838	1,977	50
65–69	1,774	1,799	64
70–74	3,369	3,208	152
75–79	3,836	3,401	227
80–84	4,634	3,763	389
85–89	7,419	5,422	801
90+	11,898	7,743	1,488

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

	Annual drug cost (€)
Alendronate	109
Risedronate	226
Etidronate	223
Ibandronate	379
Zoledronic acid	355
Raloxifene	446
Strontium ranelate	375
Parathyroid hormone	-
Teriparatide	4,666

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 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

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	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

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.

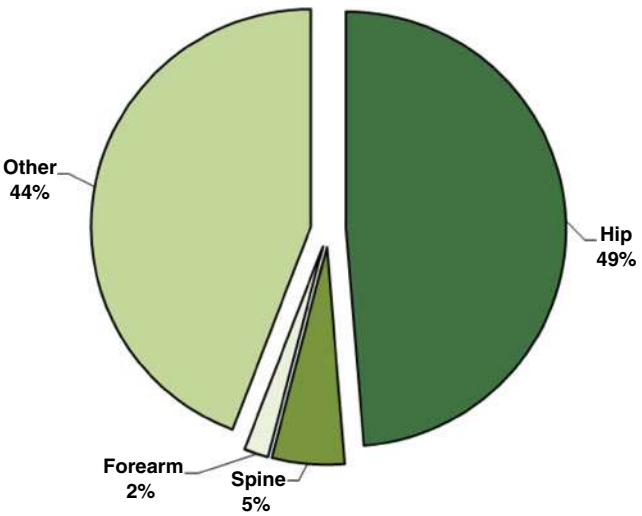

Fig. 1 Share (%) of fracture cost by fracture site in Luxembourg. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
Women			
Incident hip fractures	16	57	74
Incident vertebral fractures	37	42	78
Incident forearm fractures	8	5	13
Incident other fractures	35	54	89
Prior hip fractures	56	193	249
Prior vertebral fractures	40	61	101
Total	191	412	604
Men			
Incident hip fractures	13	18	31
Incident vertebral fractures	32	18	50
Incident forearm fractures	2	1	3
Incident other fractures	43	23	66
Prior hip fractures	50	52	102
Prior vertebral fractures	28	17	45
Total	169	128	296
Men and Women			
Incident hip fractures	30	75	105
Incident vertebral fractures	69	59	128
Incident forearm fractures	10	5	15
Incident other fractures	78	77	155
Prior hip fractures	107	245	351
Prior vertebral fractures	67	79	146
Total	360	540	900

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

	1 × GDP/capita	2 × GDP/capita	3 × GDP/capita
Incident hip fractures	8,583,304	17,166,608	25,749,911
Incident vertebral fractures	10,492,614	20,985,228	31,477,842
Incident forearm fractures	1,260,591	2,521,181	3,781,772
Incident other fractures	12,706,581	25,413,161	38,119,742
Prior hip fractures	28,851,341	57,702,681	86,554,022
Prior vertebral fractures	12,004,972	24,009,944	36,014,916
Total	73,899,402	147,798,804	221,698,206

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
	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			
50–59	65,000	75,001	82,000	83,000
60–69	45,000	52,000	59,000	69,000
70–79	31,000	32,000	36,000	44,000
80–89	16,000	19,000	20,000	20,000
90+	1,000	3,000	4,000	4,000
	158,000			220,000

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).

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

	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
	Women and Men							
50–74	122	177	206	296	287	411	650	930
75+	346	534	199	306	170	229	721	1,151
All	467	711	405	603	457	641	1,371	2,082

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

	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
	Women and Men			
50–74	8	9	11	12
75+	13	16	18	19
All	22	25	28	31

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

	Incident fractures		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	2025
	Women					
50–74	96	139	96	112	191	251
75+	158	215	254	264	412	479
All	254	354	350	376	604	730
	Men					
50–74	90	128	78	97	169	225
75+	59	121	69	93	128	214
All	149	249	147	190	296	439
	Women and Men					
50–74	186	267	174	209	360	476
75+	217	336	324	357	540	693
All	402	603	498	566	900	1,169

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 Luxembourg assuming the uptake of treatment remains unchanged

	2010	2015	2020	2025
		Women		
50–74	36	39	43	48
75+	78	85	89	92
All	114	123	132	140
		Men		
50–74	31	34	38	42
75+	24	32	36	41
All	56	66	74	83
		Women and Men		
50–74	68	72	80	90
75+	102	117	125	132
All	169	190	206	223

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.

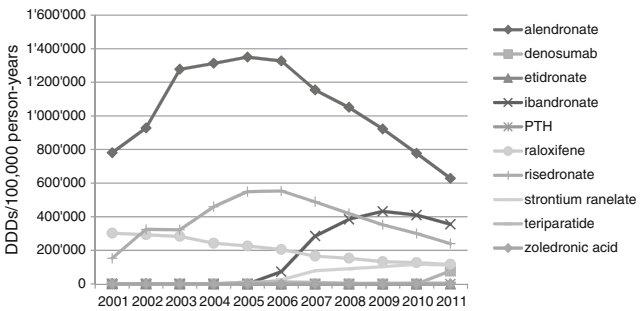

Fig. 2 Treatment uptake in Luxembourg (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	1	1	0	−35
Women	9	16	7	43

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.

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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

		Fracture at the		
Age (years)	hip	vertebra	forearm	other
		Women		
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
		Men		
50–54	29	74	26	127
55–59	28	49	43	263
60–64	54	130	102	534
65–69	111	174	167	714
70–74	215	328	138	1,106
75–79	423	488	120	1,130
80–84	744	517	144	1,979
85+	1,108	744	203	3,210

Table 4 Estimated number of incident fractures in Malta, 2010

Age (years)	hip	Fracture at the 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

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 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	6.1
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

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

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.

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 vertebra	"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

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 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

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
Women and Men					
50–74	2,311,774	473,613	180,764	3,392,064	6,358,215
75+	5,308,508	319,241	81,595	2,829,001	8,538,344
All	7,620,282	792,853	262,358	6,221,065	14,896,559

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 fracture, prior fracture, pharmacological fracture prevention, and value of QALYs lost accounted for 27 %, 10 %, 5 %, 58 % respectively.

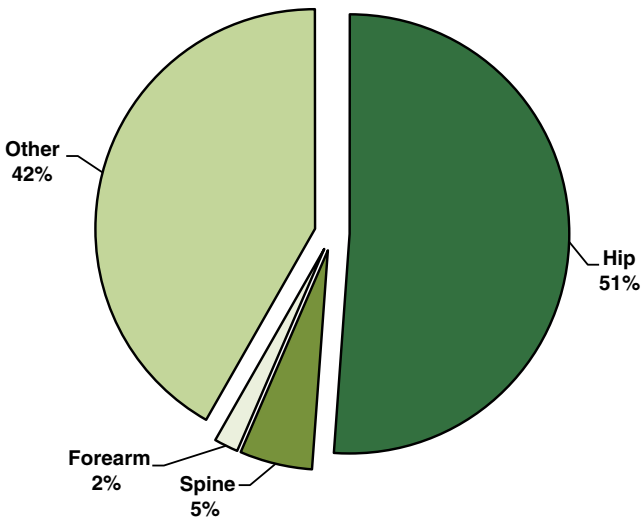

Fig. 1 Share (%) of fracture cost by fracture site in Malta. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
Women			
Incident hip fractures	25	49	74
Incident vertebral fractures	50	38	89
Incident forearm fractures	9	4	14
Incident other fractures	43	45	88
Prior hip fractures	62	152	214
Prior vertebral fractures	40	48	88
Total	230	336	566
Men			
Incident hip fractures	13	16	29
Incident vertebral fractures	31	16	47
Incident forearm fractures	2	0	2
Incident other fractures	39	19	59
Prior hip fractures	37	34	71
Prior vertebral fractures	23	11	34
Total	145	97	242
Men and Women			
Incident hip fractures	38	64	102
Incident vertebral fractures	82	54	136
Incident forearm fractures	11	5	16
Incident other fractures	83	64	147
Prior hip fractures	99	186	285
Prior vertebral fractures	63	59	122
Total	375	433	808

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).

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

	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

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			
50–59	62,000	60,096	55,000	51,000
60–69	47,000	59,000	59,000	57,000
70–79	30,000	29,000	39,000	48,000
80–89	12,000	13,000	16,000	17,000
90+	1,000	2,000	2,000	3,000
	152,000			176,000

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 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

	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

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

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	103	135	153	192	269	317	364	449
75+	228	338	130	196	133	199	426	637
All	331	473	283	388	403	515	790	1,085
	Men							
50–74	54	70	95	118	56	67	333	409
75+	64	138	50	109	14	30	170	375
All	117	208	144	227	70	97	503	784
	Women and Men							
50–74	156	205	248	310	326	384	697	858
75+	292	476	180	305	147	229	596	1,011
All	448	681	428	614	473	613	1,293	1,870

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

	Incident fractures		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	2025
	Women					
50–74	128	159	102	112	230	271
75+	136	203	200	235	336	438
All	264	362	302	347	566	709
Men						
50–74	86	107	60	67	145	174
75+	52	113	45	68	97	182
All	137	220	105	136	242	356
	Women and Men					
50–74	213	266	162	179	375	445
75+	188	316	245	304	433	620
All	401	582	407	483	808	1,065

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 Malta assuming the uptake of treatment remains unchanged

	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

to women (25 %). Incident and prior fractures accounted for about 70 % and 33 % of the increase respectively.

The cost of osteoporosis including value of QALYs 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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Epidemiology and Economic Burden of Osteoporosis in the Netherlands

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 Netherlands.

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 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, tibia, 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

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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.

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

Age (years)	Women	Men	All
50–59	1,130,000	1,145,000	2,275,000
60–69	931,000	927,000	1,858,000
70–79	607,000	508,000	1,115,000
80–89	360,000	198,000	558,000
90+	67,000	20,000	87,000
50+	3,095,000	2,798,000	5,893,000

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]

Age (years)	Women	Men
50–54	37,107	14,900
55–59	51,936	19,215
60–64	76,648	31,378
65–69	79,790	28,564
70–74	91,233	22,854
75–79	105,000	22,145
80+	201,544	36,188
50+	643,258	175,244

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

Table 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and "other" fractures in the Netherlands by age

	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 4 Estimated number of incident fractures in the Netherlands, 2010

Age (years)	hip	Fracture at the vertebra	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	14,688
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	34,911
75+	9,892	5,830	4,423	20,890	41,034
Total	13,395	11,624	12,470	38,457	75,946

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.

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

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.

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

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

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 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
Etidrontate	354
Ibandronate	302
Zoledronic acid	377
Raloxifene	325
Strontium ranelate	433
Parathyroid hormone	5,705
Teriparatide	5,811

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 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
All	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
All	133,466,299	128,055,530	3,578,354	265,100,183
		Women and Men		
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
All	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		
50–74	65,689,649	7,407,122	4,117,967	44,688,252	121,902,990
75+	329,294,607	8,080,393	2,474,901	71,312,881	411,162,782
All	394,984,256	15,487,515	6,592,868	116,001,132	533,065,772
			Men		
50–74	50,676,403	5,349,638	1,023,907	48,639,814	105,689,763
75+	112,887,327	3,835,988	351,120	38,757,632	155,832,066
All	163,563,730	9,185,626	1,375,027	87,397,446	261,521,829
			Women and Men		
50–74	116,366,053	12,756,761	5,141,874	93,328,066	227,592,753
75+	442,181,933	11,916,380	2,826,021	110,070,512	566,994,848
All	558,547,986	24,673,141	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

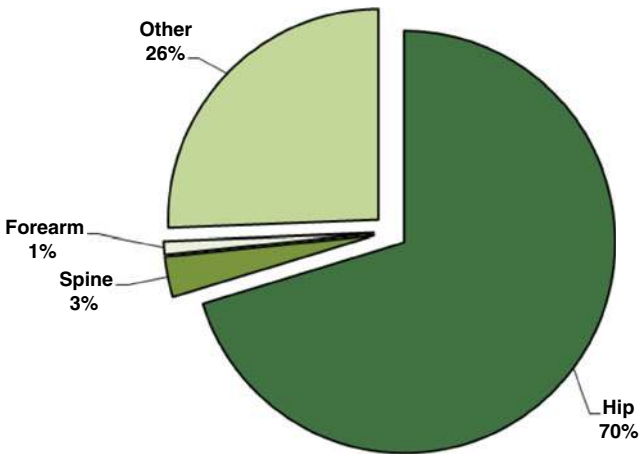

Fig. 1 Share (%) of fracture cost by fracture site in the Netherlands. Note that costs for fracture prevention therapy and monitoring are not included

Table 12 Number of QALYs lost due to fractures during 2010 in men and women in the 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 € 1069 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).

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]

	Population			
	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

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

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		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	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

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 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	2025	2010	2025	2010	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	2,305	2,945	1,959	2,298	4,263	5,244
75+	2,110	3,771	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

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

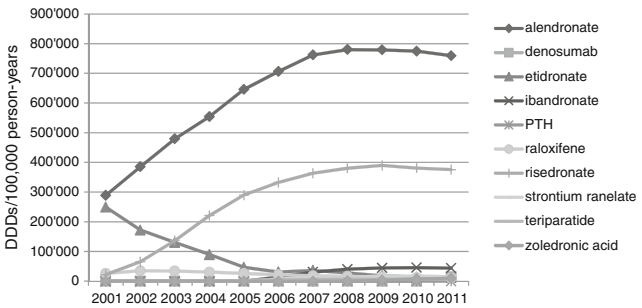

Fig. 2 Treatment uptake in the Netherlands (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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

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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,

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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).

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

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

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.

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].

Age (years)	Women	Men
50–54	98,532	37,075
55–59	148,512	48,615
60–64	166,738	57,420
65–69	155,944	43,290
70–74	228,222	42,588
75–79	279,000	45,526
80+	432,824	64,242
50+	1,509,772	338,756

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

Age (years)	hip	Fracture at the vertebral	forearm	other
		Women		
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
		Men		
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

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 1.04 % 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 4 Estimated number of incident fractures in Poland, 2010

Age (years)	hip	Fracture at the vertebra	forearm	other	All fractures
		Women			
50–74	4,519	7,390	14,078	17,989	43,976
75+	15,145	8,445	8,133	27,134	58,857
Total	19,665	15,835	22,211	45,124	102,833
		Men			
50–74	4,181	7,678	5,215	29,884	46,958
75+	3,799	2,931	803	10,337	17,871
Total	7,981	10,609	6,018	40,221	64,829
		Men and Women			
50–74	8,700	15,068	19,292	47,873	90,935
75+	18,945	11,376	8,936	37,471	76,728
Total	27,645	26,444	28,229	85,345	167,663

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–54	0.0	0.1
55–59	0.2	0.4
60–64	0.4	0.7
65–69	0.7	1.1
70–74	1.3	1.7
75–79	2.3	2.5
80–84	4.3	3.7
85+	9.3	5.9
	Men	
50–54	0.1	0.2
55–59	0.3	0.4
60–64	0.5	0.7
65–69	0.7	1.0
70–74	1.1	1.3
75–79	1.7	1.6
80–84	2.4	1.9
85+	5.4	3.9

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,

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–74	23,598	38,948
75+	75,098	60,809
Total	98,696	99,757
	Men	
50–74	19,934	28,000
75+	20,582	17,106
Total	40,516	45,106
	Men and Women	
50–74	43,532	66,948
75+	95,680	77,915
Total	139,212	144,863

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

vertebral and "other" fractures accounted for 1,083, 941 and 319 deaths respectively. Overall, approximately 49 % of deaths occurred in women.

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)	Fracture at the hip	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 9 One year costs for relevant pharmaceuticals in Poland, 2010 [12].

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

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

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	49,151,782	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

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

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.

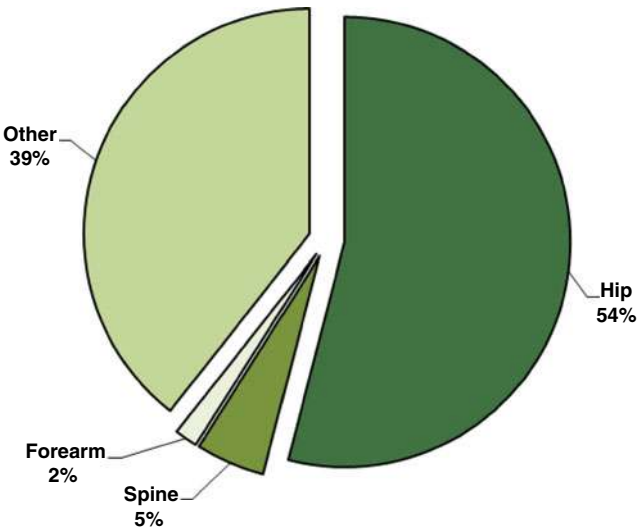

Fig. 1 Share (%) of fracture cost by fracture site in Poland. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
	Women		
Incident hip fractures	1,098	3,228	4,326
Incident vertebral fractures	2,471	2,465	4,937
Incident forearm fractures	500	249	749
Incident other fractures	2,170	2,848	5,018
Prior hip fractures	3,707	10,221	13,928
Prior vertebral fractures	2,186	2,978	5,164
Total	12,132	21,989	34,121
	Men		
Incident hip fractures	1,052	923	1,975
Incident vertebral fractures	2,629	947	3,576
Incident forearm fractures	182	26	208
Incident other fractures	3,567	1,181	4,748
Prior hip fractures	3,123	3,055	6,179
Prior vertebral fractures	1,562	904	2,465
Total	12,114	7,036	19,150
	Men and Women		
Incident hip fractures	2,150	4,151	6,301
Incident vertebral fractures	5,100	3,412	8,512
Incident forearm fractures	681	275	957
Incident other fractures	5,737	4,029	9,766
Prior hip fractures	6,830	13,276	20,106
Prior vertebral fractures	3,748	3,882	7,630
Total	24,246	29,025	53,272

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 %, 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 % (Table 17). 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

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

	1 × GDP/ capita	2 × GDP/ capita	3 × GDP/ capita
Incident hip fractures	58,595,246	117,190,492	175,785,738
Incident vertebral fractures	79,163,832	158,327,665	237,491,497
Incident forearm fractures	8,898,714	17,797,428	26,696,142
Incident other fractures	90,823,231	181,646,461	272,469,692
Prior hip fractures	186,989,696	373,979,391	560,969,087
Prior vertebral fractures	70,955,830	141,911,661	212,867,491
Total	495,426,549	990,853,098	1,486,279,647

Table 14 Population projections in Poland by age and sex [13].

	Population			
	2010	2015	2020	2025
	Women			
50–59	3,111,000	2,762,000	2,311,000	2,352,000
60–69	1,938,000	2,610,000	2,917,000	2,598,000
70–79	1,562,000	1,426,000	1,660,000	2,252,000
80–89	827,000	918,000	925,000	862,000
90+	90,000	143,000	199,000	232,000
	Men			
50–59	2,872,000	2,575,097	2,198,000	2,266,000
60–69	1,575,000	2,142,000	2,414,000	2,188,000
70–79	988,000	898,000	1,101,000	1,518,000
80–89	359,000	420,000	423,000	395,000
90+	28,000	42,000	57,000	68,000
	All			
50–59	5,983,000	5,337,097	4,509,000	4,618,000
60–69	3,513,000	4,752,000	5,331,000	4,786,000
70–79	2,550,000	2,324,000	2,761,000	3,770,000
80–89	1,186,000	1,338,000	1,348,000	1,257,000
90+	118,000	185,000	256,000	300,000
	13,350,000			14,731,000

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	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

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 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	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

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

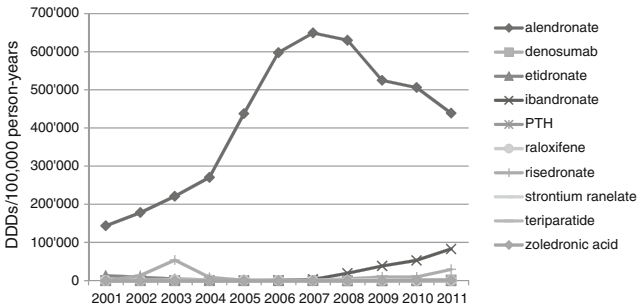

Fig. 2 Treatment uptake in Poland (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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

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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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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Abstract

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

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 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

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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
50–59	720,000	674,000	1,394,000
60–69	612,000	528,000	1,140,000
70–79	516,000	387,000	903,000
80–89	271,000	158,000	429,000
90+	41,000	15,000	56,000
50+	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			
Age (years)	hip	vertebra	forearm	other
	Women			
50–54	9	24	60	61
55–59	24	68	187	214
60–64	47	83	178	182
65–69	98	143	239	336
70–74	239	338	430	679
75–79	516	501	503	1,085
80–84	983	618	615	1,671
85+	1,700	800	726	2,856
	Men			
50–54	7	18	6	31
55–59	19	32	28	173
60–64	32	77	60	315
65–69	61	96	92	394
70–74	128	195	82	658
75–79	226	261	64	604
80–84	424	294	82	1,127
85+	789	530	145	2,284

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 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 hip	vertebra	forearm	other	All fractures
			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+	1,746	1,326	369	4,874	8,315
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

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

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

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.

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

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

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

Age (years)	hip	Fracture at the vertebra	"other"
		Women	
50–74	21	31	3
75+	169	68	76
Total	190	99	79
		Men	
50–74	25	39	5
75+	121	66	40
Total	146	105	45
		Men and Women	
50–74	46	70	9
75+	290	134	116
Total	336	204	124

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 cost	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

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

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

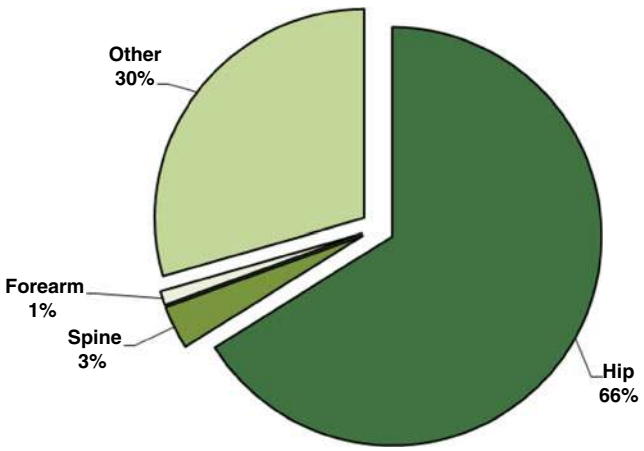

Fig. 1 Share (%) of fracture cost by fracture site in Portugal. Note that costs for fracture prevention therapy and monitoring are not included

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

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

	1 × GDP/ capita	2 × GDP/ capita	3 × GDP/ capita
Incident hip fractures	35,514,395	71,028,791	106,543,186
Incident vertebral fractures	39,339,425	78,678,849	118,018,274
Incident forearm fractures	4,371,340	8,742,680	13,114,020
Incident other fractures	46,884,286	93,768,572	140,652,857
Prior hip fractures	119,387,307	238,774,613	358,161,920
Prior vertebral fractures	44,730,600	89,461,201	134,191,801
Total	290,227,353	580,454,706	870,682,059

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 %).

Table 14 Population projections in Portugal by age and sex [11]

	Population			
	2010	2015	2020	2025
	Women			
50–59	720,000	767,000	793,000	815,000
60–69	612,000	660,000	698,000	745,000
70–79	516,000	517,000	547,000	592,000
80–89	271,000	310,000	329,000	337,000
90+	41,000	54,000	71,000	85,000
	Men			
50–59	674,000	726,228	758,000	791,000
60–69	528,000	582,000	627,000	676,000
70–79	387,000	394,000	425,000	472,000
80–89	158,000	185,000	202,000	210,000
90+	15,000	23,000	29,000	37,000
	All			
50–59	1,394,000	1,493,228	1,551,000	1,606,000
60–69	1,140,000	1,242,000	1,325,000	1,421,000
70–79	903,000	911,000	972,000	1,064,000
80–89	429,000	495,000	531,000	547,000
90+	56,000	77,000	100,000	122,000
	3,922,000			4,760,000

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.

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
				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

Treatment gap

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.

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
		Women		
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

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

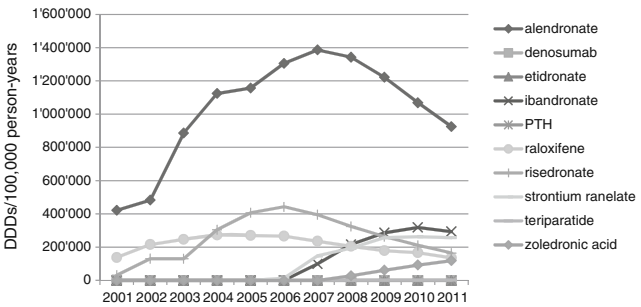

Fig. 2 Treatment uptake in Portugal (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	40	53	13	24
Women	269	425	156	37

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Epidemiology and Economic Burden of Osteoporosis in Romania

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 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, tibia, 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

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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).

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

Age (years)	Women	Men	All
50–59	1,525,000	1,401,000	2,926,000
60–69	1,124,000	916,000	2,040,000
70–79	991,000	666,000	1,657,000
80–89	408,000	218,000	626,000
90+	29,000	11,000	40,000
50+	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)	Fracture at the hip	vertebra	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			
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	Fracture at the 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	
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
	Men	
50–54	0.1	0.2
55–59	0.3	0.5
60–64	0.6	0.9
65–69	0.9	1.2
70–74	1.3	1.4
75–79	1.7	1.7
80–84	2.3	1.9
85+	4.2	2.8

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	
50–74	14,391	24,862
75+	31,610	27,920
Total	46,001	52,782
	Men	
50–74	14,637	20,325
75+	11,386	9,721
Total	26,023	30,046
	Men and Women	
50–74	29,028	45,187
75+	42,997	37,642
Total	72,024	82,829

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]

	Annual drug cost (€)
Alendronate	53
Risedronate	106
Etidrontate	-
Ibandronate	195
Zoledronic acid	747
Raloxifene	362
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

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	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

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.

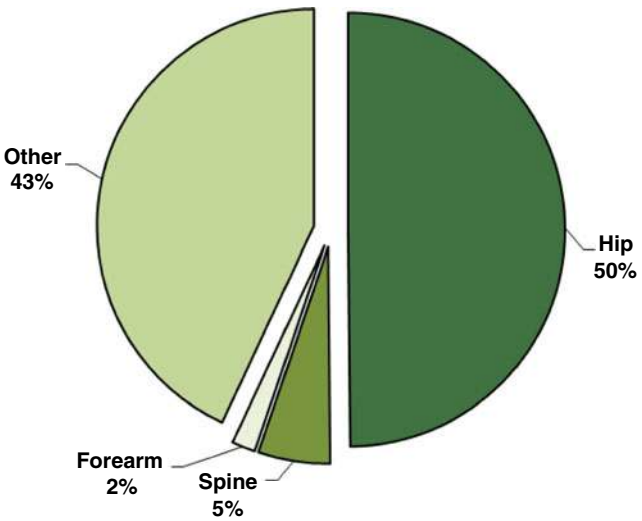

Fig. 1 Share of fracture cost (%) by fracture site in Romania. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
Women			
Incident hip fractures	797	1,337	2,134
Incident vertebral fractures	1,691	1,115	2,806
Incident forearm fractures	310	112	421
Incident other fractures	1,410	1,166	2,576
Prior hip fractures	2,252	4,377	6,629
Prior vertebral fractures	1,389	1,389	2,777
Total	7,848	9,495	17,343
Men			
Incident hip fractures	733	515	1,248
Incident vertebral fractures	1,807	543	2,350
Incident forearm fractures	119	15	134
Incident other fractures	2,373	635	3,008
Prior hip fractures	2,291	1,698	3,989
Prior vertebral fractures	1,133	516	1,649
Total	8,456	3,922	12,378
Men and Women			
Incident hip fractures	1,530	1,852	3,382
Incident vertebral fractures	3,499	1,658	5,157
Incident forearm fractures	429	126	555
Incident other fractures	3,783	1,801	5,584
Prior hip fractures	4,543	6,075	10,618
Prior vertebral fractures	2,522	1,905	4,427
Total	16,305	13,417	29,721

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

	1 × GDP/capita	2 × GDP/capita	3 × GDP/capita
Incident hip fractures	19,276,074	38,552,148	57,828,222
Incident vertebral fractures	29,392,408	58,784,817	88,177,225
Incident forearm fractures	3,164,827	6,329,654	9,494,482
Incident other fractures	31,825,963	63,651,925	95,477,888
Prior hip fractures	60,520,194	121,040,388	181,560,582
Prior vertebral fractures	25,232,311	50,464,622	75,696,933
Total	169,411,777	338,823,554	508,235,331

Table 14 Population projections in Romania by age and sex [9]

	Population			
	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			
50–59	2,926,000	2,577,000	2,777,000	3,211,000
60–69	2,040,000	2,415,000	2,587,000	2,296,000
70–79	1,657,000	1,507,000	1,533,000	1,845,000
80–89	626,000	706,000	766,000	708,000
90+	40,000	70,000	97,000	116,000
	7,289,000			8,176,000

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).

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			
50–74	68	67	73	78
75+	62	67	69	73
All	129	134	142	151

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	3,269	3,792	5,061	5,802	8,787	9,894	11,764	13,495
75+	6,063	7,834	3,708	4,514	3,588	4,264	10,873	14,002
All	9,332	11,625	8,768	10,316	12,375	14,158	22,638	27,498
	Men							
50–74	2,893	3,356	5,249	5,924	3,429	3,884	19,896	22,651
75+	2,082	2,291	1,653	1,818	451	495	5,517	6,132
All	4,975	5,647	6,901	7,742	3,880	4,379	25,413	28,783
	Women and Men							
50–74	6,163	7,148	10,309	11,727	12,216	13,778	31,661	36,147
75+	8,145	10,125	5,360	6,331	4,039	4,759	16,390	20,134
All	14,308	17,273	15,670	18,058	16,255	18,537	48,051	56,281

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

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).

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 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

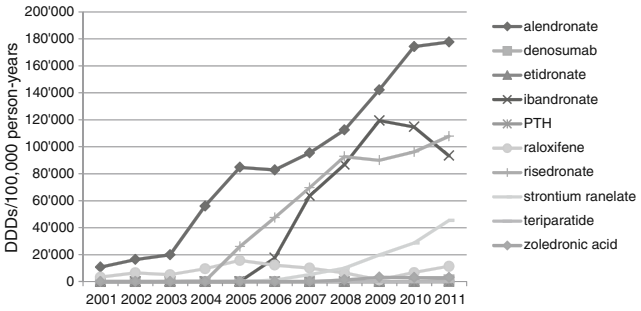

Fig. 2 Treatment uptake in Romania (defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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 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	235	220	94
Women	100	599	499	83

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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

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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).

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

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

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.

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]

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 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and "other" fractures in Slovakia by age

Age (years)	Fracture at the hip	vertebral	forearm	other
		Women		
50–54	36	92	227	234
55–59	67	187	516	591
60–64	113	200	428	437
65–69	142	206	344	483
70–74	342	483	615	971
75–79	760	739	742	1,600
80–84	1,465	921	917	2,491
85+	2,383	1,121	1,017	4,003
		Men		
50–54	89	229	82	395
55–59	124	216	189	1,156
60–64	157	376	296	1,545
65–69	204	321	306	1,314
70–74	312	475	199	1,601
75–79	463	533	131	1,236
80–84	823	571	159	2,187
85+	1,459	980	267	4,225

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.

Table 4 Estimated number of incident fractures in Slovakia, 2010

Age (years)	Fracture at the hip	vertebra	forearm	other	All fractures
		Women			
50–74	1,092	1,792	3,521	4,480	10,885
75+	2,807	1,602	1,626	5,175	11,210
Total	3,899	3,395	5,147	9,655	22,095
		Men			
50–74	1,111	2,057	1,433	8,085	12,685
75+	816	627	173	2,238	3,854
Total	1,927	2,683	1,606	10,322	16,539
		Men and Women			
50–74	2,203	3,849	4,954	12,564	23,570
75+	3,623	2,229	1,799	7,413	15,064
Total	5,826	6,078	6,753	19,977	38,634

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–54	0.1	0.2
55–59	0.3	0.8
60–64	0.7	1.5
65–69	1.1	2.0
70–74	2.0	3.0
75–79	3.9	4.6
80–84	7.1	5.9
85+	14.1	9.0
	Men	
50–54	0.2	0.4
55–59	0.6	1.0
60–64	1.0	1.6
65–69	1.4	2.0
70–74	1.9	2.3
75–79	2.7	2.7
80–84	4.4	3.3
85+	9.1	6.4

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.

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–74	5,132	9,927
75+	13,697	11,336
Total	18,830	21,263
	Men	
50–74	5,259	7,979
75+	3,977	3,245
Total	9,236	11,224
	Men and Women	
50–74	10,392	17,906
75+	17,674	14,582
Total	28,065	32,488

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	Fracture at the 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

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

	Annual drug cost (€)
Alendronate	116
Risedronate	320
Etidrontate	-
Ibandronate	404
Zoledronic acid	480
Raloxifene	509
Strontium ranelate	610
Parathyroid hormone	5,651
Teriparatide	6,414

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

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.

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	Hip	Spine	Forearm	Other	All
			Women		
50–74	7,407,091	1,756,990	1,009,062	10,311,193	20,484,336
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	26,821,101
75+	6,458,636	516,602	49,580	5,414,921	12,439,740
All	13,956,084	2,384,535	460,167	22,460,055	39,260,841
			Women and Men		
50–74	14,904,539	3,624,923	1,419,648	27,356,326	47,305,437
75+	27,908,125	1,973,173	515,468	17,989,229	48,385,995
All	42,812,663	5,598,096	1,935,116	45,345,556	95,691,431

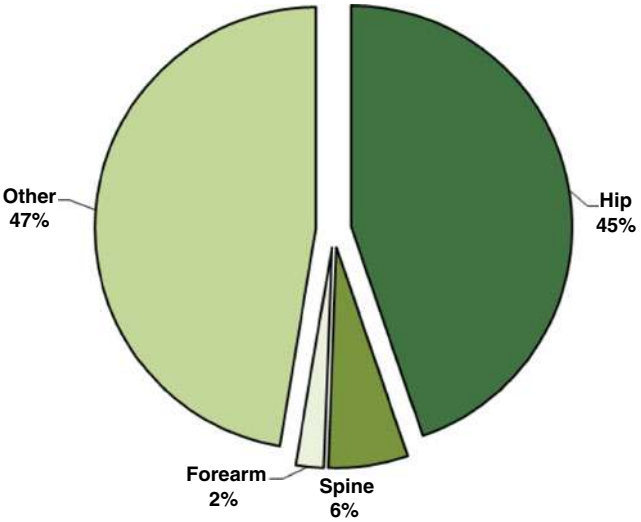

Fig. 1 Share (%) of fracture cost by fracture site in Slovakia. Note that costs for fracture prevention therapy and monitoring are not included

Burden of osteoporosis up to 2025

The population above 50 years of age is expected to increase from 1.7 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 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	2,312
Prior hip fractures	1,633	2,464	4,097
Prior vertebral fractures	1,004	729	1,733
Total	6,172	5,539	11,712

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

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]

	Population			
	2010	2015	2020	2025
Women				
50–59	405,000	388,000	362,000	377,000
60–69	279,000	342,000	379,000	364,000
70–79	187,000	198,000	232,000	289,000
80–89	95,000	98,000	101,000	112,000
90+	9,000	15,000	19,000	22,000
Men				
50–59	379,000	367,369	349,000	371,000
60–69	221,000	282,000	319,000	314,000
70–79	111,000	121,000	149,000	196,000
80–89	41,000	41,000	43,000	49,000
90+	3,000	5,000	5,000	6,000
All				
50–59	784,000	755,369	711,000	748,000
60–69	500,000	624,000	698,000	678,000
70–79	298,000	319,000	381,000	485,000
80–89	136,000	139,000	144,000	161,000
90+	12,000	20,000	24,000	28,000
	1,730,000			2,100,000

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

	Hip		Spine		Forearm		Other	
	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

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

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.

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	898	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
		Women and Men		
50–74	204	220	237	259
75+	186	194	207	232
All	390	414	444	491

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

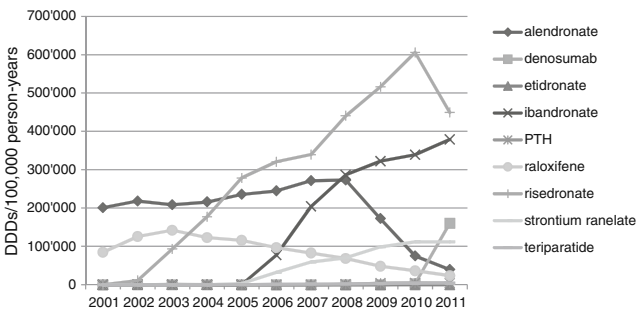

Fig. 2 Treatment uptake in Slovakia (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	11	50	39	78
Women	75	148	73	49

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 value of QALYs lost accounted for 51 %, 3 %, 2 %, and 45 % of the cost, respectively.

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
		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)

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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

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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

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

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 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and "other" fractures in Slovenia by age

		Fracture at the		
Age (years)	hip	vertebra	forearm	other
		Women		
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		
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.

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

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	Fracture at the vertebra	forearm	other	All fractures
		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 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

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

€ 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.

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
Etidronte	-
Ibandronate	104
Zoledronic acid	360
Raloxifene	323
Strontium ranelate	474
Parathyroid hormone	-
Teriparatide	5,193

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 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	229,696	7,969,783
All	12,997,746	3,693,281	866,124	17,557,150
		Women and Men		
50–74	14,160,267	2,597,243	4,396,484	21,153,994
75+	22,068,827	10,190,923	2,616,062	34,875,813
All	36,229,094	12,788,167	7,012,546	56,029,807

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
Women					
50–74	3,195,677	450,107	175,397	3,985,391	7,806,572
75+	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
Men					
50–74	2,825,804	417,419	63,034	5,644,682	8,950,939
75+	4,227,361	221,388	14,648	3,276,691	7,740,088
All	7,053,164	638,807	77,682	8,921,373	16,691,027
Women and Men					
50–74	6,021,480	867,526	238,431	9,630,073	16,757,511
75+	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

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.

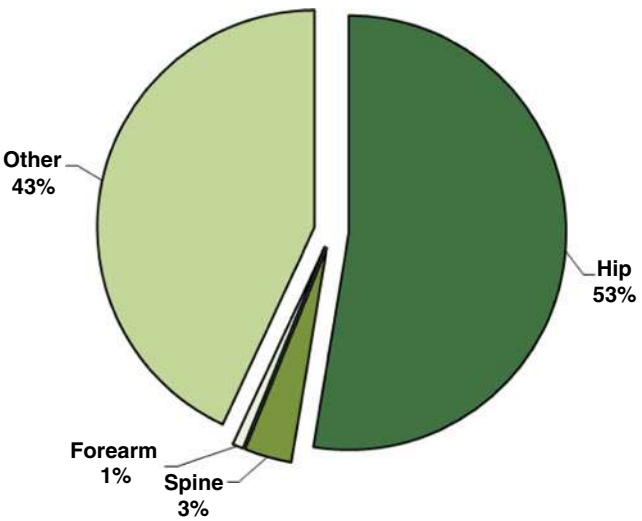

Fig. 1 Share (%) of fracture cost by fracture site in Slovenia. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
Women			
Incident hip fractures	90	350	440
Incident vertebral fractures	191	252	443
Incident forearm fractures	38	27	65
Incident other fractures	172	320	491
Prior hip fractures	287	977	1,264
Prior vertebral fractures	194	322	516
Total	972	2,247	3,220
Men			
Incident hip fractures	77	105	182
Incident vertebral fractures	188	105	294
Incident forearm fractures	14	3	17
Incident other fractures	265	136	401
Prior hip fractures	242	273	515
Prior vertebral fractures	141	89	230
Total	927	711	1,638
Men and Women			
Incident hip fractures	167	454	621
Incident vertebral fractures	380	357	737
Incident forearm fractures	52	30	82
Incident other fractures	437	456	892
Prior hip fractures	528	1,251	1,779
Prior vertebral fractures	336	411	746
Total	1,900	2,958	4,858

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 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	12,743,758	25,487,517	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

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

	Population			
	2010	2015	2020	2025
	Women			
50–59	151,000	153,000	149,000	145,000
60–69	111,000	132,000	144,000	147,000
70–79	94,000	92,000	98,000	117,000
80–89	54,000	59,000	62,000	61,000
90+	6,000	12,000	15,000	18,000
	Men			
50–59	155,000	152,654	150,000	150,000
60–69	102,000	127,000	138,000	138,000
70–79	64,000	67,000	78,000	98,000
80–89	21,000	26,000	31,000	33,000
90+	1,000	2,000	3,000	5,000
	All			
50–59	306,000	305,654	299,000	295,000
60–69	213,000	259,000	282,000	285,000
70–79	158,000	159,000	176,000	215,000
80–89	75,000	85,000	93,000	94,000
90+	7,000	14,000	18,000	23,000
	759,000			912,000

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 %).

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	2025
	Women							
50–74	373	477	578	715	1,090	1,295	1,433	1,745
75+	1,659	2,483	873	1,225	887	1,177	3,069	4,578
All	2,032	2,960	1,451	1,940	1,977	2,473	4,502	6,323
	Men							
50–74	314	410	563	716	392	478	2,235	2,750
75+	434	796	327	603	91	167	1,192	2,228
All	748	1,206	890	1,319	483	645	3,427	4,978
	Women and Men							
50–74	687	887	1,141	1,431	1,482	1,773	3,668	4,495
75+	2,092	3,279	1,200	1,829	978	1,344	4,261	6,806
All	2,780	4,166	2,341	3,260	2,460	3,117	7,929	11,301

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 Slovenia

	2010	2015	2020	2025
	Women			
50–74	12	12	13	14
75+	27	31	33	37
All	38	43	47	51
	Men			
50–74	10	10	12	12
75+	8	10	11	13
All	18	20	23	26
	Women and Men			
50–74	21	23	25	27
75+	35	41	44	50
All	56	63	69	77

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

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

	Incident fractures		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	2025
	Women					
50–74	491	604	481	529	972	1,133
75+	948	1,360	1,299	1,542	2,247	2,902
All	1,439	1,964	1,780	2,071	3,220	4,035
	Men					
50–74	544	682	383	458	927	1,139
75+	349	643	362	509	711	1,151
All	893	1,324	745	966	1,638	2,291
	Women and Men					
50–74	1,036	1,286	864	987	1,900	2,273
75+	1,297	2,003	1,662	2,050	2,958	4,053
All	2,332	3,289	2,526	3,037	4,858	6,325

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 Slovenia assuming the uptake of treatment remains unchanged

	2010	2015	2020	2025
		Women		
50–74	45	47	51	54
75+	105	117	125	137
All	150	165	176	191
		Men		
50–74	42	44	48	52
75+	33	37	43	53
All	74	82	91	105
		Women and Men		
50–74	87	92	99	105
75+	137	155	169	190
All	224	246	267	296

(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.

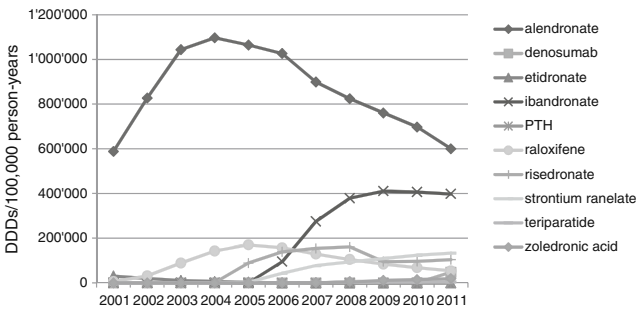

Fig. 2 Treatment uptake in Slovenia (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	5	14	9	63
Women	35	62	27	44

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.

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Epidemiology and Economic Burden of Osteoporosis in Spain

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 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 286,000 in 2025, representing an increase of 82,000 fractures. Hip, clinical vertebral (spine), forearm and other fractures were estimated to increase by 16,700, 11,500, 10,000 and 43,500, respectively. The burden of fractures in Spain in 2025 was estimated to increase by 30 % to € 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.

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

Age (years)	Women	Men	All
50–59	2,859,000	2,774,000	5,633,000
60–69	2,351,000	2,141,000	4,492,000
70–79	1,961,000	1,543,000	3,504,000
80–89	1,234,000	735,000	1,969,000
90+	223,000	84,000	307,000
50+	8,628,000	7,277,000	15,905,000

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)	Fracture at the 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			
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	Fracture at the vertebra	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

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 found, these were imputed as described in Chapter 4 of the main report.

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)	Fracture at the hip	Fracture at the vertebra	"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

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

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	687,245,489	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
		Women and Men		
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

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.

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

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 milllion) (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

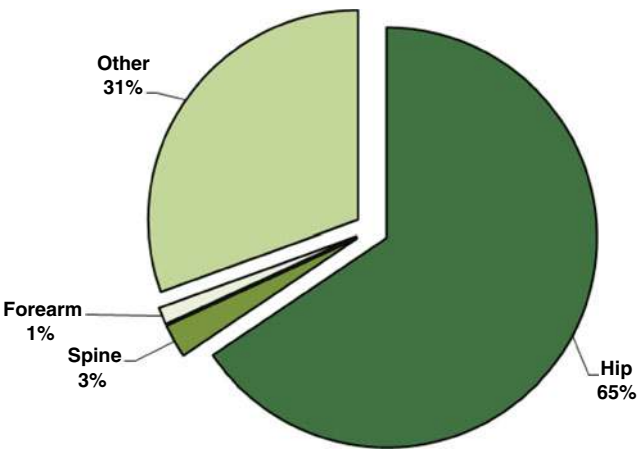

Fig. 1 Share (%) of fracture cost by fracture site in Spain. Note that costs for fracture prevention therapy and monitoring are not included

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	5,491	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

(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
	Men			
50–59	2,774,000	3,212,585	3,632,000	3,987,000
60–69	2,141,000	2,352,000	2,622,000	3,054,000
70–79	1,543,000	1,568,000	1,790,000	1,989,000
80–89	735,000	865,000	889,000	946,000
90+	84,000	125,000	174,000	219,000
	All			
50–59	5,633,000	6,488,585	7,251,000	7,846,000
60–69	4,492,000	4,921,000	5,446,000	6,288,000
70–79	3,504,000	3,513,000	3,968,000	4,376,000
80–89	1,969,000	2,252,000	2,273,000	2,358,000
90+	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

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

	Hip		Spine		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	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

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 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		Prior fractures		All fractures	
	2010	2025	2010	2025	2010	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
		Women and Men		
50–74	1,514	1,621	1,778	1,938
75+	4,599	4,980	5,365	5,853
All	6,113	6,601	7,143	7,791

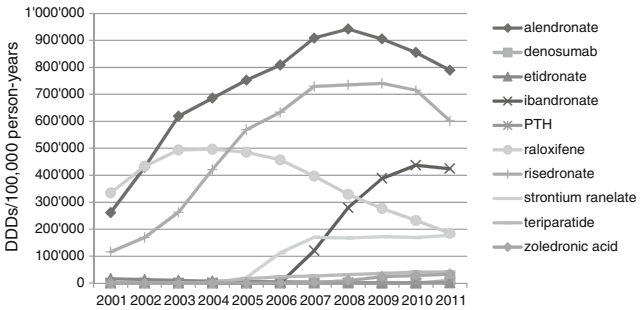

Fig. 2 Treatment uptake in Spain (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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	191	239	48	20
Women	1,277	1,709	432	25

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Epidemiology and Economic Burden of Osteoporosis in Sweden

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 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.

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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).

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

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

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 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and "other" fractures in Sweden by age

Age (years)	Fracture at the 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
	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.

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–54	0.1	0.3
55–59	0.3	1.0
60–64	0.8	1.6
65–69	1.5	2.6
70–74	2.6	4.4
75–79	5.1	6.9
80–84	9.3	9.6
85+	19.1	14.8
	Men	
50–54	0.2	0.4
55–59	0.5	1.0
60–64	0.9	1.5
65–69	1.3	2.0
70–74	2.0	2.8
75–79	3.4	3.9
80–84	6.3	5.4
85+	11.9	9.0

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

For the purpose of this report, the cost of osteoporosis in 2010 (excluding value of QALYs 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.

Table 4 Estimated number of incident fractures in Sweden, 2010

Age (years)	hip	Fracture at the vertebra	forearm	other	All fractures
		Women			
50–74	2,870	4,388	7,799	10,329	25,386
75+	11,819	6,121	5,757	21,321	45,018
Total	14,688	10,509	13,556	31,650	70,403
		Men			
50–74	1,852	3,195	2,070	11,889	19,006
75+	3,740	2,788	767	10,342	17,636
Total	5,592	5,983	2,837	22,231	36,643
		Men and Women			
50–74	4,722	7,582	9,869	22,218	44,392
75+	15,558	8,909	6,524	31,663	62,654
Total	20,280	16,492	16,393	53,881	107,046

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–74	12,784	24,433
75+	53,743	49,996
Total	66,527	74,428
	Men	
50–74	11,741	18,741
75+	20,684	18,178
Total	32,425	36,919
	Men and Women	
50–74	24,525	43,174
75+	74,427	68,174
Total	98,952	111,348

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

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 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 vertebra	"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	27
Risedronate	366
Etidronate	241
Ibandronate	-
Zoledronic acid	443
Raloxifene	358
Strontium ranelate	468
Parathyroid hormone	4,585
Teriparatide	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

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

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.

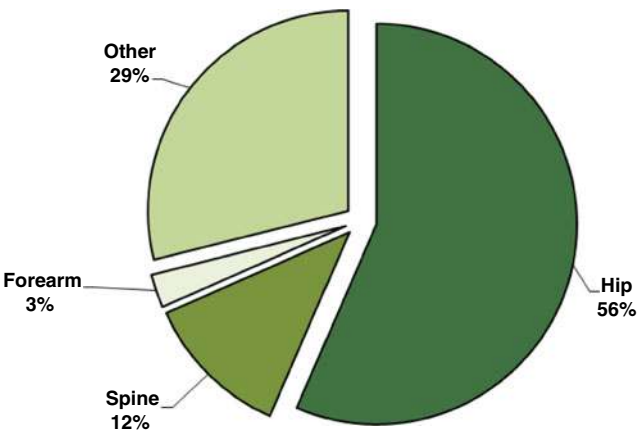

Fig. 1 Share (%) of fracture cost by fracture site in Sweden. Note that costs for fracture prevention therapy and monitoring are not included

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

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

	1 × GDP/ capita	2 × GDP/ capita	3 × GDP/ capita
Incident hip fractures	165,618,254	331,236,508	496,854,762
Incident vertebral fractures	189,937,256	379,874,511	569,811,767
Incident forearm fractures	20,182,331	40,364,663	60,546,994
Incident other fractures	222,513,731	445,027,462	667,541,192
Prior hip fractures	521,113,364	1,042,226,728	1,563,340,092
Prior vertebral fractures	213,567,199	427,134,398	640,701,598
Total	1,332,932,135	2,665,864,269	3,998,796,404

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.

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

	Population			
	2010	2015	2020	2025
	Women			
50–59	571,000	594,000	634,000	639,000
60–69	583,000	584,000	551,000	574,000
70–79	365,000	433,000	520,000	524,000
80–89	253,000	242,000	249,000	306,000
90+	58,000	67,000	72,000	75,000
	Men			
50–59	580,000	605,636	649,000	650,000
60–69	579,000	575,000	543,000	573,000
70–79	317,000	398,000	482,000	483,000
80–89	161,000	162,000	183,000	240,000
90+	22,000	28,000	33,000	37,000
	All			
50–59	1,151,000	1,199,636	1,283,000	1,289,000
60–69	1,162,000	1,159,000	1,094,000	1,147,000
70–79	682,000	831,000	1,002,000	1,007,000
80–89	414,000	404,000	432,000	546,000
90+	80,000	95,000	105,000	112,000
	3,489,000			4,101,000

The cost of osteoporosis including value of QALYs lost was estimated to increase from approximately € 4.2 billion in 2010 to € 5 billion in 2025. The increase was estimated to be particularly marked in men (+29 %) 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 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.

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	21,321	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

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 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	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

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

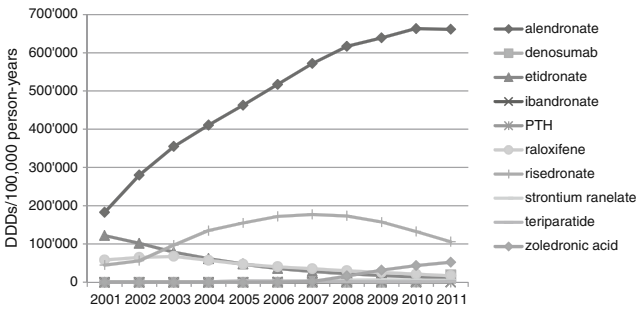

Fig. 2 Treatment uptake in Sweden (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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

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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

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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/).

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

Age (years)	Women	Men	All
50–59	3,844,000	3,740,000	7,584,000
60–69	3,449,000	3,262,000	6,711,000
70–79	2,418,000	2,053,000	4,471,000
80–89	1,486,000	925,000	2,411,000
90+	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

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 3 Incidence per 100,000 person years of hip, clinical vertebral, forearm, and "other" fractures in the UK by age

	Fracture at the			
Age (years)	hip	vertebra	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
	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

Table 4 Estimated number of incident fractures in the UK, 2010

Age (years)	hip	Fracture at the vertebra	forearm	other	All fractures
		Women			
50–74	10,504	16,482	37,567	64,277	128,830
75+	45,632	23,640	21,440	125,656	216,367
Total	56,136	40,121	59,007	189,933	345,197
		Men			
50–74	8,070	14,485	6,672	71,410	100,637
75+	15,037	11,317	3,242	60,443	90,039
Total	23,107	25,803	9,913	131,853	190,676
		Men and Women			
50–74	18,574	30,967	44,238	135,688	229,467
75+	60,669	34,957	24,681	186,099	306,406
Total	79,243	65,924	68,920	321,786	535,873

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.

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–54	0.1	0.2
55–59	0.3	0.7
60–64	0.6	1.2
65–69	1.0	1.7
70–74	1.8	2.6
75–79	3.4	4.0
80–84	6.6	5.8
85+	15.1	10.4
	Men	
50–54	0.1	0.2
55–59	0.3	0.6
60–64	0.6	1.1
65–69	0.9	1.5
70–74	1.4	1.9
75–79	2.2	2.4
80–84	3.7	3.1
85+	8.5	6.2

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])

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

Age (years)	Hip fracture	Vertebral fracture
	Women	
50–74	55,026	98,018
75+	238,068	194,076
Total	293,095	292,093
Men		
50–74	46,259	77,861
75+	79,527	67,545
Total	125,786	145,406
	Men and Women	
50–74	101,286	175,879
75+	317,595	261,621
Total	418,881	437,499

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

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.

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

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 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)	Fracture at the hip	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
		Men and Women	
50–74	438	723	118
75+	2,326	1,073	1,382
Total	2,764	1,795	1,500

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+	666,005,143	250,509,467	3,398,496	919,913,106
All	1,112,140,528	343,862,880	10,344,663	1,466,348,071
		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	3,214,686,120
All	3,232,985,333	1,079,748,509	83,981,188	4,396,715,030

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	3,327314	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+	1,684,739659	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

£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).

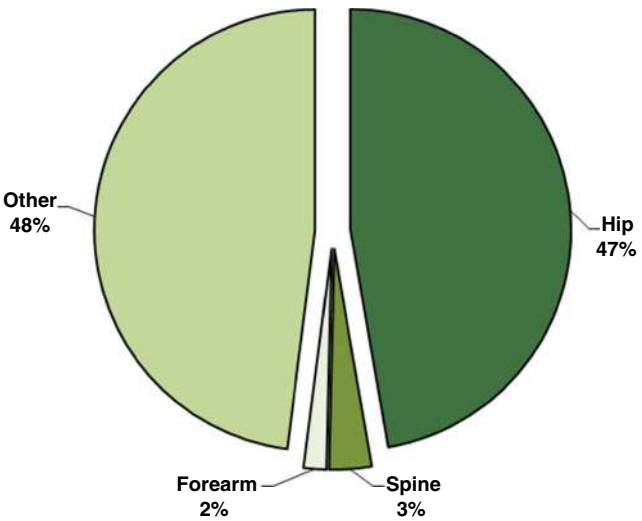

Fig. 1 Share (%) of fracture cost by fracture site in the UK. Note that costs for fracture prevention therapy and monitoring are not included

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

	Age (years)		
	50–74	75+	50+
	Women		
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	12,989	20,691
Prior hip fractures	8,644	31,772	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
	Men and Women		
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	59,367
Prior vertebral fractures	9,822	12,859	22,681
Total	58,249	100,477	158,726

Table 13 Value of lost QALYs (£) in men and women in the UK in 2010

	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

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).

Table 14 Population projections in the UK by age and sex [10]

	Population			
	2010	2015	2020	2025
	Women			
50–59	3,844,000	4,271,000	4,559,000	4,373,000
60–69	3,449,000	3,624,000	3,654,000	4,076,000
70–79	2,418,000	2,595,000	3,016,000	3,184,000
80–89	1,486,000	1,496,000	1,574,000	1,733,000
90+	337,000	391,000	439,000	474,000
	Men			
50–59	3,740,000	4,140,197	4,423,000	4,268,000
60–69	3,262,000	3,423,000	3,450,000	3,842,000
70–79	2,053,000	2,253,000	2,649,000	2,791,000
80–89	925,000	1,014,000	1,125,000	1,271,000
90+	122,000	162,000	198,000	231,000
	All			
50–59	7,584,000	8,411,197	8,982,000	8,641,000
60–69	6,711,000	7,047,000	7,104,000	7,918,000
70–79	4,471,000	4,848,000	5,665,000	5,975,000
80–89	2,411,000	2,510,000	2,699,000	3,004,000
90+	459,000	553,000	637,000	705,000
	21,636,000			26,243,000

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 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

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		Vertebral		Forearm		Other	
	2010	2025	2010	2025	2010	2025	2010	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

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 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	20,351	14,141	15,164	31,183	35,515
75+	29,919	38,057	41,083	45,205	71,003	83,263
All	46,961	58,409	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

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

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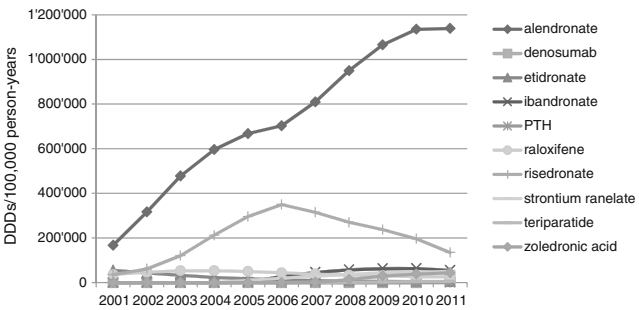

Fig. 2 Treatment uptake in the UK (Defined daily doses [DDDs] per 100,000 persons aged 50 years or above)

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

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