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Economic Burden of Osteoporotic Fracture of the Elderly in South Korea: A National Survey

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ABSTRACT

Background: Osteoporotic fractures (OFs) in the elderly are common worldwide, and the predicted number of the aging population is increasing the burden of OF on health care systems. **Objectives:** To estimate the economic burden of OF in people older than 65 years in South Korea from a societal perspective. **Methods:** National Health Insurance claim databases were used to analyze health care utilization and medical costs of OF in the Korean population (49 million). We identified medical claims records with a diagnosis of OF and estimated the costs from 2007 to 2011. **Results:** From 2007 to 2011, there were 244,798 patients with at least one medical insurance claim related to OF. Most patients had a single fracture (80%), whereas 20% of all patients had two or more. For fracture sites, vertebral fracture accounted for 75.6% of all fractures, followed by hip and wrist fractures. The societal cost of OF increased annually, from US $88.8 million in 2007 to US $149.3 million in 2011. Among the entire cost, the direct medical cost was US $134.9 million in 2011, which includes the cost of treatment (US $91.2 million) and long-term care (US $48.1 million). The direct nonmedical cost was US $9.9 million in 2011. Costs associated with morbidity and mortality of OF were excluded. **Conclusions:** The economic burden associated with OF in elderly is expected to rise with the predicted increase in life expectancy and the number of elderly in South Korea. Therefore, effective management of the disease is necessary to reduce the growth in the economic burden of OF.

Keywords: economic burden, osteoporosis, osteoporotic fracture.

Introduction

The incidence of osteoporotic fracture (OF) is increasing worldwide in aging populations, and the economic burden of OF on health care systems is continuously increasing as well. According to the National Health Insurance (NHI) database, a total of 244,000 cases of fractures occurred in Korea, 186,000 of which occurred in females. The societal costs associated with OF reached roughly US $105 million in South Korea [1]. Moreover, in cases involving hip fractures, the mortality rate was approximately 16% and 28% within 1 to 2 years, respectively [1]. Because the aging index in Korea is estimated to increase up to 213.8% by 2030, the prevalence of OF and its associated costs are also expected to increase markedly. Moreover, the economic and caregiving burdens for families are expected to increase, because the elderly living with OF have a higher risk of multiple fractures, which can result in immobility or difficulties in activity of daily living (ADL) [2–4]. Therefore, the aim of this study was to investigate, from a societal perspective and using the population-based database, the economic burden of OF in people older than 65 years in South Korea.

Methods

Study Design

In this retrospective observational study, we used data drawn from the NHI claims database and the Long-term Care Insurance (LCI) claims database to estimate the medical cost associated with OF. For the nonmedical cost, we used the Korea National Health and Nutrition Examination Survey database. Approval from the Institutional Review Board and Ethics Committee was not required for this study.

Individuals living in Korea receive health care through the NHI program and the Medical Aid Program. Therefore, the NHI claims database included medical claims for the entire population in Korea (approximately 51 million people). This large, longitudinal database provided data on integrated enrollment, treatment costs, payments made by the NHI, the number of outpatient visits, the number of days per hospital stay, and prescriptions, which can be classified into age, sex, medical care institution, and disease.

Conflicts of interest: The authors have indicated that there are no conflicts of interest with regard to the content of this article.

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The LCI program is available for those elderly who meet certain eligibility criteria, including physical limitations, mental capacity, nursing needs, and rehabilitation services. The LCI claims database provided a listing of elderly enrollees, including the number of their hospital visits, and the cost of nursing care and home care services.

Patient Identification

The study population included patients with OF who were 65 years and older, and who were discharged from hospitals during the study years of 2007 to 2011. For the sake of extracting the data related to OF, we first extracted the data related to osteoporosis, and then identified the fracture events among patients with osteoporosis. To avoid omission within the study population, patients with osteoporosis were determined by two methods. We used data from medical claims with the *International Classification of Diseases, 10th Revision* (*ICD-10*) codes for osteoporosis and data from prescriptions for osteoporosis medications. Therefore, as the first step, we extracted the patients' information using *ICD-10* codes M80 (osteoporosis with pathological fracture), M81 (osteoporosis without pathological fracture), and M82 (osteoporosis in diseases classified as others). In the second step, among the patients who were excluded from the first step, the patients who were prescribed osteoporosis medications (bisphosphonate, in combination with bisphosphonate and vitamin D, selective estrogen-receptor modulators, vitamin K_2, calcitonin, ipriflavone, and calcium carbonate) were extracted. Last, we identified the fracture events of the patients with osteoporosis using the *ICD-10* code. The codes for fractures included those for vertebral fracture (M48.4, M48.5, S22.0, S22.1, and S32.0), clavicle (S42.0), upper arm (S42.2 and S42.3), wrist (S52.5 and S52.6), hip (S72.0 and S72.1), and ankle (S82.3, S82.5, and S82.6) (Fig. 1).

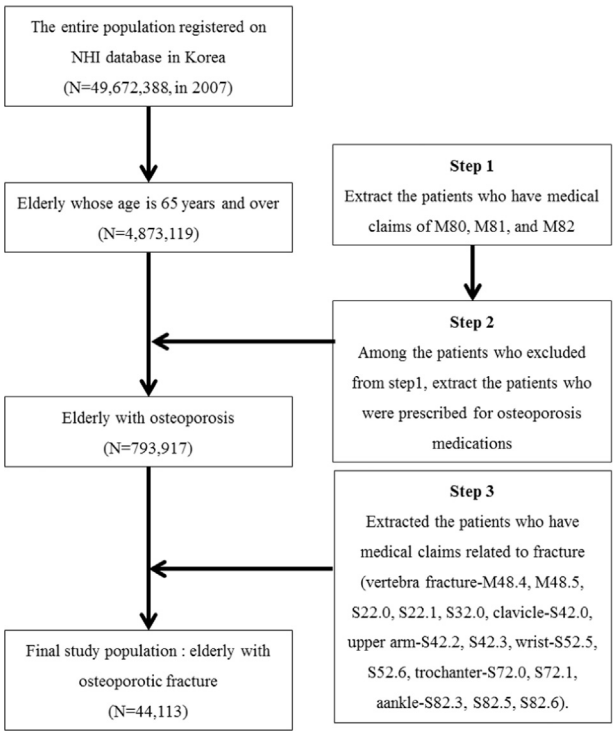

Fig. 1 – Process of extracting OF data from NHI database.

Cost

The analysis used a cost-of-illness framework and included direct medical costs, direct nonmedical costs, and indirect costs such as productivity loss resulting from morbidity and mortality due to OF [5,6]. The societal cost, including direct costs and indirect costs, was estimated by using a macrocosting method. The direct cost (incurred as a result of treating OF) included direct medical costs such as those for hospitalization, outpatient care, and long-term care service and direct nonmedical costs such as those for transportation and caregivers. The associated costs are the typical OF-related expenditures for patients with OF in this study. We used the NHI and LCI databases for estimating the NHI payment and the costs for long-term care service, as well as a national survey report to determine out-of-pocket payments [7].

The OF-related NHI payment information was obtained by summing up each patient's payments, as extracted from the NHI database using the three steps outlined in Figure 1. In addition, we used the results of a previous survey to calculate out-of-pocket payments for patients with OF [7]. This survey was conducted by the NHI, using a stratified random sampling of medical institutions, and reported on the out-of-pocket payments according to the type of medical institution involved, medical specialties, and diseases.

The LCI payments summed up the typical expenditures of each patient with OF, which were extracted from the LCI database [8]. Because the LCI started in Korea in 2008, we used the period between 2008 and 2011 to estimate the average expenditure for long-term care services. Therefore, the total medical cost included NHI payments for hospitalization and outpatient care, NHI-related out-of-pocket expenditures, and LCI payments:

$$\text{Medical cost} = \sum_i \sum_j (\text{InNHI}_{ij} + \text{OutNHI}_{ij}) + \text{OOP} + \text{LCI} \quad (1)$$

where InNHI_{ij} is the NHI payment for hospitalization, OutNHI_{ij} is the NHI payment for outpatient care, OOP is the out-of-pocket payment, LCI is the LCI payment, $i = 0, 1, \ldots, n$ (age), and $j = 1$ or 2 (sex).

The nonmedical cost included transportation expenditures involved with visiting medical institutions and caregiver expenditures during hospitalization. The total transportation cost was estimated by multiplying the number of hospital visits by average per-visit transportation cost. We extracted the number of a patient's hospital visits from the NHI database, and estimated the transportation cost by using the average transportation costs reported in a previous study and adjusted by the transportation price index because patients used various vehicles [9,10]. We excluded the transportation cost of caregivers because no information on the number of caregiver visits was available. As a result, the transportation cost may be significantly underestimated.

In terms of caregiver costs, we included informal care provided by relatives, as well as formal care. According to the National Elderly Survey in 2008, among the elderly hospitalized with ADL, 74.9% were being cared for by relatives, whereas 8.8% received informal care services [11]. We estimated the total caregiving cost and applied its percentage to this survey. First, we calculated the cost of formal caregiving, together with its average percentage (8.8%), and the average caregiver cost. We quoted the average caregiver cost according to the Korea National Health and Nutrition Examination Survey and adjusted by service price index [9,10]. Second, for the cost of informal caregiving, we calculated the loss of the caregiver's productivity by multiplying the number of days the patient spent in the hospital by the labor market participation rate, the employment rate, and the average daily earnings for each age and sex [10]. We applied the characteristics of the caregivers (sex and age), as reported in the National Elderly Survey in 2011 [11]. After estimating the

productivity loss of all caregivers, we finally calculated the informal caregiving cost, applying the percentage of informal care to our survey.

$$\text{Nonmedical cost} = \sum_i \sum_j \{(\text{InO}_{ij} + \text{OutO}_{ij}) \times M\} + \sum_i \sum_j \left\{(\text{InN}_{ij} \times \text{IR} \times I) + \left(\text{InN}_{ij} \times \text{FR} \times p_{ij} \times e_{ij} \times y_{ij}\right)\right\} \quad (2)$$

where InO_{ij} is the number of hospitalization visits, OutO_{ij} is the number of outpatient visits, M is the transportation cost (based on round-trip transport), InN_{ij} is the length of hospitalization, IR is the utilization rate of formal caregiving service, I is the caregiver cost per day, FR is the utilization rate of caregiving by relatives, p_{ij} is the labor force participation rate, e_{ij} is the employment rate, y_{ij} is the average daily earning, $i = 0, 1, \ldots, n$ (age), and $j = 1$ or 2 (sex).

The indirect cost included lost wages and lost future income due to morbidity and mortality. Some of the elderly patients with OF, however, did have an income; in those cases, we excluded the costs related to lost wages and lost future income for the relatives who were caregivers, because of insufficient data on the characteristics of this study population.

Results

The number of patients with OF increased during the period 2007 to 2010, and then decreased in 2011. Among the elderly patients with OF, approximately 88% were women. A total of 80% of these patients had a single fracture, whereas approximately 20% had two or more fractures. Of the fracture sites, vertebral fracture accounted for 76.3%, followed by hip fractures (9.9%) and wrist fractures (7.5%), as presented in Table 1. The total hospital visits and the total inpatient days increased steadily until 2008, and then began to show a declining trend. The number of inpatient days per visit gradually decreased from 18.7 days in 2007 to 17.0 days in 2011, as indicated in Table 2.

The average treatment cost per capita, due to OF, decreased slightly from US $1521 in 2007 to US $1490 in 2011. The treatment cost per capita, for male patients, was higher than that for female patients, whereas the cost for patients older than 75 years was higher than the cost for patients aged between 65 and 74 years. With regard to treatment types, the average treatment cost per capita for hospitalization decreased from US $2761 in 2007 to US $2560 in 2011, whereas the cost for outpatient care increased from US $391 in 2007 to US $405 in 2011. Of the fracture sites, hip fractures had the highest treatment cost per capita: US $3731 in 2008, which was more than two times the treatment cost for vertebral fractures, as indicated in Table 3.

The OF-related NHI payments were US $294.7 million over 5 years, with this amount being more or less maintained annually. The NHI payments for female patients with OF waxed and waned over 5 years and were approximately five times higher than those for male patients with OF. The NHI payment for patients aged between 65 and 74 years was US $122.4 million over 5 years, representing 41.5% of the total NHI payment. NHI payments for hospitalization accounted for 83.1% of the expenditure, which is approximately five times higher than outpatient care expenditures. In addition, health insurance accounted for 81.3% of the total NHI payments, which is higher than the payments for medical aid. Most of patients preferred to visit large-size hospitals for treatment. The highest NHI payment was on single fractures with 239.0 million over the 5 years, and 18.9% of the total NHI expenditure was on two or more fractures. Of the fracture sites, the largest percentage of the expense involved vertebral fractures (64.1%), followed by hip fractures (38.4%) and other sites (13.7%), as indicated in Table 4.

The total societal costs involved with OF increased approximately 13.9% each year, with an estimated US $88.8 million spent in 2007 and US $160.4 million spent in 2010, which then decreased to US $149.3 million in 2011. Even allowing for an annual average inflation rate of 3.6% over this period, the increase of 10.3% was substantial. Within the societal costs associated with OF, the percentage of medical costs was 92.7% of the total, which was higher than the percentage of nonmedical costs (7.3%). Within the total medical cost, the cost of treatment was US $81 million in 2007, which waxed and waned during the five study years. The cost for long-term care, however, increased approximately 5.7-fold, from 2008 to 2010, and then decreased in

Table 1 – Epidemiology.

Characteristic	2007	2008	2009	2010	2011
Total no. of patients with OF	44,113	47,835	49,791	52,009	51,050
Sex					
Female	39,350	42,457	43,751	45,518	44,622
(% of females)	(89.2)	(88.8)	(87.9)	(87.5)	(87.4)
Age (y)					
65–74	22,112	22,791	23,318	23,728	22,326
>75	22,001	25,044	26,473	28,281	28,724
No. of fractures					
Single fracture	35,538	38,843	40,522	42,191	41,069
Multiple fractures	9,257	9,652	9,969	10,537	10,801
(% of multiple fractures)	(21.0)	(20.2)	(20.0)	(20.3)	(21.2)
Fracture site					
Vertebra	33,942	36,532	38,108	39,561	38,607
(% of vertebra)	(76.9)	(76.4)	(76.5)	(76.1)	(75.6)
Hip	4,673	4,894	4,801	4,983	4,940
Wrist	2,912	3,419	3,651	4,152	4,174
Multiple sites	1,067	1,187	1,268	1,274	1,300
Upper arm	723	816	802	868	788
Ankle	557	685	847	880	934
Clavicle	239	302	314	291	307

OF, osteoporotic fracture.

Table 2 – Medical utilization due to OF from 2007 to 2011.

Medical utilization	2007	2008	2009	2010	2011
Total visits	163,905	188,242	187,215	186,253	184,211
Inpatient	28,386	34,014	34,261	35,574	33,452
Outpatient	135,519	154,228	152,954	150,679	150,759
Total inpatient days	530,698	635,897	605,696	607,774	567,162
Inpatient days per case	18.7	18.7	17.7	17.1	17.0

OF, osteoporotic fracture.

2011. The nonmedical cost was US $47.4 million over 5 years, which was maintained at more or less the same amount annually. Within the total nonmedical cost, the cost of caregiving was US $36.7 million over 5 years, which was higher than the transportation cost (US $10.8 million), as indicated in Table 5. The costs associated with the morbidity and mortality of OF were excluded because of these patient characteristics: age, level of disability, and age at death.

Discussion

This study was based on NHI medical claim data for the entire population of Korea from 2007 to 2011. The database was used to examine OF-related prevalence, health care utilization, and associated expenditures in a real-world setting.

In this study, the number of patients with OF increased continuously from 44,113 in 2007 to 51,050 in 2011. According to the study by Jang et al. [12], the number of patients with osteoporosis in Korea has increased annually by 10%, while the increase in the annual average rate of OF diagnoses did not even reach 4% [12]. Approximately 16% of the patients at age 65 years or above had osteoporosis. In addition, 5.5% of all cases of osteoporosis resulted in fractures. The percentage of women with OF (87.4%–89.2%) made up most of the total patients, which is consistent with results from other studies [13–15]. For women, the risk for bone fracture is higher than for men because bone loss increases dramatically at menopause [16–19]; 83% of the patients with OF had single fractures, whereas 17% had two or more fractures. As the number of fractures increases, the likelihood of the occurrence of more fractures increases, and the mortality due to these fractures increases as well [2–4]. Therefore, patients with two or more fractures need more aggressive treatment to prevent further fractures. Of the fracture sites, vertebral fractures accounted for 76.3%, hip fractures accounted for 9.9%, and wrist fractures accounted for 7.5% of the total. This result appears to be in keeping with the findings of other studies conducted in Korea [11,20]. Several studies conducted in Europe, however, showed different patterns: in these studies, for example, fractures in the hips and wrists were the most common [14,16,18].

The average OF-related treatment cost, per capita, decreased slightly from US $1520.7 in 2007 to US $1490.1 in 2011. The percentage of out-of-pocket payments account for about 34% of the total treatment cost, with the average payment per capita being roughly US $500. Considering the typically reduced income level (and thus, the spending ability) of the elderly, there is a significant economic burden on these individuals. The average treatment cost for men is higher than that for women, and the cost for patients older than 75 years is higher than for those aged between 65 and 74 years. This result has been attributed to the patients' conditions; the likelihood of comorbidity in men is relatively higher than in women, and aging increases vulnerability to age-associated diseases [21,22]. The treatment cost per capita for hip fractures was the highest (maximum US $3731 in 2008), which was more than two times higher than that for other fracture sites. In the case of hip fractures, most patients will need to be operated, and postoperation complications are expected to be high. Therefore, the treatment cost for hip fracture is high than for other sites for these reasons.

Table 3 – Average treatment cost per capita due to OF from 2007 to 2011.

Cost (US $)	2007	2008	2009	2010	2011
Average treatment cost	1520.7	1582.7	1488.0	1503.1	1490.1
Sex					
Male	1936.8	1981.0	1862.6	1927.5	1988.0
Female	1470.3	1532.2	1436.3	1442.6	1418.4
Age (y)					
65–74	1330.8	1380.0	1305.8	1340.1	1352.6
>75	1711.6	1767.1	1648.5	1639.9	1597.0
Treatment type					
Hospitalization	2760.8	2715.5	2559.9	2531.9	2559.8
Outpatient care	391.3	382.5	370.2	372.6	404.7
Fracture site					
Hip	3539.0	3730.6	3388.1	3249.9	3088.1
Multiple sites	2674.8	3055.3	2803.9	2920.3	2741.5
Upper arm	1816.3	1918.1	1896.8	1844.9	1750.2
Clavicle	1343.0	1431.2	1442.4	1539.9	1491.2
Vertebra	1257.2	1297.4	1244.8	1278.1	1287.6
Ankle	1203.8	1372.6	1236.2	1299.0	1251.5
Wrist	932.0	1020.7	1044.0	1085.4	1086.5

OF, osteoporotic fracture.

Table 4 – NHI payments for OF by groups from 2007 to 2011.

Payment (US $ million)	2007	2008	2009	2010	2011	Total	%
Total NHI payments	54.4	60.1	58.6	61.8	59.9	294.7	100.0
Sex							
Male	7.5	8.5	8.9	9.9	10.1	44.8	15.2
Female	46.9	51.6	49.7	51.9	49.8	250.0	84.8
Age (y)							
65–74	24.0	25.0	24.2	25.3	23.9	122.4	41.5
>75	30.4	35.0	34.4	36.5	36.0	172.3	58.5
Treatment type							
Hospitalization	44.5	50.4	48.9	51.8	49.2	244.8	83.1
Outpatient care	9.8	9.7	9.7	10.0	10.7	49.9	16.9
Insurance type							
Health insurance	42.7	47.7	47.9	51.4	50.0	239.8	81.3
Medical aid	11.6	12.3	10.7	10.4	9.9	55.0	18.7
Medical institution type							
Tertiary hospitals	6.0	5.6	4.5	4.1	4.7	24.9	8.5
General hospitals	21.4	24.4	21.5	23.4	22.4	113.1	38.4
Hospitals	20.8	24.2	26.8	28.5	27.1	127.4	43.2
Clinics	6.1	5.9	5.9	5.8	5.7	29.3	9.9
No. of fractures							
Single fracture	44.4	48.7	47.5	50.1	48.3	239.0	81.1
Multiple fractures	10.0	11.3	11.2	11.7	11.6	55.7	18.9
Fracture site							
Vertebra	34.6	37.6	37.5	40.0	39.1	188.8	64.1
Hip	13.4	14.5	12.9	12.8	12.0	65.6	22.2
Others	6.4	8.0	8.2	9.0	8.7	40.3	13.7

NHI, National Health Insurance; OF, osteoporotic fracture.

Over the 5 years of this study, the total NHI payment involving elderly patients diagnosed with OF was approximately US $294.7 million, which did not reach 2% of the total NHI payment for the elderly in Korea. The expense involved in hospitalization accounted for most of the (83.1%) total NHI payments, which is supported by results from other studies [18,23,24]. Considering the type of medical institution involved, NHI payments to specialized hospitals and general hospitals accounted for more than 80% of the total. Within Korea, there are several hospitals specializing in musculoskeletal diseases; thus, most of the elderly patients with OF are treated in these specialized hospitals. For treatment cost per capita according to the fracture site, the cost for hip fractures was highest, at approximately 2.8 times higher than that for vertebral fractures. Nevertheless, the NHI payment for vertebral fractures was the highest (64.1%), as the number of patients with vertebral fractures made up the majority of the total number of patients.

The societal cost involved with OF in elderly was approximately US $130 million, which is slightly higher than that in the results of the study by Kang et al. (2008) [20]. This difference can be attributed to the cost for long-term care services, which started in 2008. For long-term care service, most of the patients with OF received the necessary care in their local communities after receiving treatment for OF-related fractures in medical institutions. Therefore, the cost for long-term care service is expected to continue growing. In this study, the societal cost was found to be lower in comparison with that in studies conducted in other countries [25,26]. This is hardly an actual gap, however, because there are differences in the measurement method for cost and the definition of OF. In this study, the treatment cost of OF formed most of the total societal cost because the indirect cost was excluded from the calculation. The caregiving cost included care provided by the family, as well

Table 5 – Societal costs of OF from 2007 to 2011.

Societal costs (US $ million)	2007	2008	2009	2010	2011	Total	%
Total societal costs	88.8	111.1	137.4	160.4	149.3	647.1	100.0
Growth rate (%)	–	(25.1)	(23.7)	(16.7)	(−6.9)	(13.9)	
Medical costs	81.0	101.0	127.8	150.4	139.4	599.6	92.7
Treatment costs	81.0	91.2	88.6	93.4	91.2	445.3	68.8
NHI payment	54.4	60.1	58.6	61.8	59.9	294.7	45.5
OOP payment	26.7	31.1	30.0	31.6	31.3	150.6	23.3
Long-term care cost	–	9.9	39.2	57.1	48.1	154.3	23.8
Nonmedical costs	7.8	10.1	9.6	10.0	9.9	47.4	7.3
Transportation cost	1.8	2.2	2.1	2.3	2.4	10.8	1.7
Caregiving cost	6.1	7.9	7.5	7.7	7.6	36.7	5.7

Note. All costs are measured at current prices. An annual average inflation rate in terms of consumer price index was 3.6% during 2007–2010.
NHI, National Health Insurance; OF, osteoporotic fracture; OOP, out of pocket.

as formal care. In those elderly patients hospitalized with ADL impairment, 74.9% were cared for by relatives [11]. This type of caregiving involves productivity loss, which changes their economic abilities. In this study, some of the elderly patients had an income; nevertheless, we excluded the indirect costs because of the age of the study population. If these limitations are addressed in a future study, more accurate measurements of the economic burden associated with OF could be obtained.

Conclusions

The results of this study indicate that the economic burden associated with OF in the elderly is expected to rise with the predicted increase in life expectancy and the number of elderly individuals in South Korea. The societal cost of OF does not account for a large proportion of the total societal cost of all diseases in the elderly, but there is a significant economic burden on individuals, considering the income level and the spending ability of elderly patients. In addition, OF can lead to an ADL impairment, and because many elderly individuals do not have any income, obtaining care for those individuals can become a great burden for their family. Therefore, the results of this study suggest that further research should be undertaken to discover ways to reduce the economic burden on elderly patients as well as their families.

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