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Medical costs of osteoporosis in the Iranian elderly patients

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Abstract

Background: In the coming years and near future, Iran will experience a main demographic transition resulting in an aging phenomenon and increased number of people over 65 years. Aging leads to increased medical expenditures associated with chronic diseases such as osteoporosis. This study aimed to investigate the patient-specific hospitalization costs of osteoporosis treatment in elderly patients.

Methods: A retrospective cost analysis of hospitalization arising from osteoporosis conducted on all the elderly patients (adults aged 65 years and above) in a teaching hospital in Tehran through examining hospital admissions during 2017. The elderly patients consisted of 295 with a length of stay ≥ 24 hours. Cost analysis was performed using a bottom-up micro-costing approach and payer perspective (patient and insurer); and the result was statistically significant ($p \leq 0.05$). Nonparametric tests, including Mann–Whitney and Kruskal–Wallis tests, were used to investigate the relationship between affecting variables. Hospital training was considered as a control variable. The data were analyzed using SPSS 11 software

Results: The mean age of the patients was 71.3 years; of the patients, 79% were female and 21% male. The overall crude prevalence of osteoporosis was 80% among people ≥ 65 years and 85% among patients who experienced relevant surgeries. The average cost of hospitalization was $3794.13. Also, 3 main areas of hospital costs were identified: consumables (57.70%), hoteling (17.24%), and surgical services (15.76%). The prevalence of osteoporosis was 4 times higher in women compared with men. Moreover, there were significant differences between the variables affecting hospital costs, such as gender, length of stay, diagnosis, intensive care unit services, and surgery ($p<0.05$).

Conclusion: Age-associated diseases such as osteoporosis increase the health care costs. The dominant cost drivers in this study were the consumables, hoteling, and surgical services, respectively. Policymakers and health care planners should consider such variables as gender, previous surgeries in the patients' records, length of stay, and intensive care unit services as driving factors and determinants of hospital costs for older seniors with osteoporosis.

Keywords: Osteoporosis, Elderly, Hospital costs, Fractures

Conflicts of Interest: None declared
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Introduction

Low fertility rates and noticeable increases in life expectancy have led to an increase in the number of people aged 65 or older and it is projected to accelerate in future (1). Aging is known to be one of the major risk factors for many chronic diseases, such as osteoporosis (2) characterized by an age-related decrease in the bone mass and structural deterioration of bone tissue, although variables like genetic factors, lifestyle, and diet are considered as

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↑What is "already known" in this topic:
Osteoporosis-related fractures may reach epidemic proportions in many regions of the world, especially in developing countries and lead to considerable medical costs.

→What this article adds:
This study indicated that medical costs of osteoporosis depend on gender, age, length of stay at the hospital, surgery, and ICU care services. The dominant medical cost drivers in this study were consumables, hoteling, and surgical services.

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risk factors as well. Adults aged 75 years and over are at the risk of fractures which are the main clinical consequences of osteoporosis (3, 4). Based on some research evidence, most of women who do not receive adequate osteoporosis management, especially those are not appropriately diagnosed and treated for probable osteoporosis, sustain fragility fractures (5-7).

Osteoporosis accounts for more than 8.9 million fractures per year worldwide, which mostly occur every 3 seconds (8). Moreover, it is estimated that 200 million women are affected by osteoporosis in the world (9). According to Kanis et al, 1 in 3 women and 1 in 5 men may suffer from osteoporotic fractures after the age of 50 (10). Overall, 61% of osteoporotic fractures occur in women, and female to male ratio is 1.6 (8). The lifetime risk of hip, wrist, and vertebral fractures requiring clinical attention is about 40%, which is equivalent to the risk of cardiovascular disease (11). By 2050, The global incidence of the hip fractures in men and women, compared with 1990 (12), is projected to increase to 310% and 240%, respectively.

Osteoporosis leads to major public health problems and economic consequences; for example, in Europe, the disability due to osteoporosis is greater than the impairment induced by cancers except for lung cancer. These disabilities are comparable or greater than those of chronic non communicable diseases, such as rheumatoid arthritis, asthma, and high blood pressure (8). Osteoporosis-related fractures may reach epidemic proportions in many regions of the world, especially in underdeveloped countries (13, 14). Diagnosis of osteoporosis in women over 45 years leads to longer hospitalization than many other diseases, including diabetes, myocardial infarction, and breast cancer (15). Indeed, osteoporosis accounts for a great share of health care costs and, due to its importance, the medical costs of osteoporosis have been estimated in various studies (16-20). In Europe, the direct costs of fractures in men and women was estimated to be about €36 billion in 2006. The direct costs for 2010 were estimated to be €29 billion in the 5 largest EU countries and €38.7 billion in the 27 EU countries (21).

Currently, the aging population consists of 10% of the population of Iran and it is projected to reach 30% by 2050 (22). Osteoporosis at the femoral neck has affected an estimated 18.9% of Iranian women and its prevalence in the spinal area was about 18.9% in 2000-2008 (23). Also, the incidence rate of the hip fractures was about 50000 in 2010 and is expected to reach 62 000 in 2020 in Iran (24). Health care budget in Iran is mainly focused on treatment, so the role of the prevention is neglected. Chronic diseases such as osteoporosis increase the costs and put an economic burden on the health sector. This study aimed to determine the hospital medical cost of osteoporosis treatment using bottom-up cost analysis approach to identify the most important cost drivers and factors contributing to cost structures.

Methods

This retrospective-descriptive study was conducted during 2017 on elderly patients (n=295), with a length of stay (LOS) ≥ 24 hours in a 160-bed teaching hospital affiliated to Iran University of Medical Sciences, which was a referral center in musculoskeletal disorders. We estimated costs of all elderlies whose LOS was ≥ 24 hours in the hospital; thus, there was no need for sampling in this study. The costs analysis was performed using a bottom-up approach and all hospital medical costs paid by the patients and insurers were considered. The patients are insured; therefore, the funding is mainly provided by health insurances and, to a smaller extent, through direct payments. Patients who were readmitted to the hospital were considered as separate admissions, and those who had an accident were excluded from the study. The collected data included the demographic information of the patients, LOS, diagnosis of the diseases, and a meticulous estimation of all expenses from resources available to patients during hospitalization obtained from hospital Health Information System (HIS). Hospital records were based on ICD-10.

Data were described by mean ± standard deviation and reported by percentage. Because the sample size was 295, the Shapiro-Wilk criterion was used. Total costs were taken as the dependent variable and demographic information, LOS, costs of treatment, nursing, medicines, consumables, and surgeries were the independent variables. The result was statistically significant $p \leq 0.05$. Mann-Whitney test was run to determine the differences between gender and costs, and Kruskal–Wallis test was used as a median test to assess the differences in direct hospitalization costs between age groups. The data were analyzed using SPSS 11 software.

All costs converted into US dollars ($US) using average exchange rate based on the rate of Central Bank of Iran (US$1 = 34 460 Rials in 2017) (25).

Results

This study was conducted in 2017 on 295 elderly, with a length of stay ≥ 24 hours. The mean age of the participants was 71.3 years (±5.18 SD). Osteoporosis admissions during the study period accounted for 3637 bed-days, and the total and mean hospitalization costs for the elderly were $1 107 973.46 and $3 794.43, respectively. The dominant cost drivers in this study were the consumables, hoteling, and surgical services (Table 1).

Of the patients, 79% were female (Table 2). In addition, 65-74 year group was the dominant age group, and 80% of the patients suffered from osteoporosis. Patients with spinal stenosis were in the next rank. The prevalence of osteoporosis is as much as 4 times higher in women than in men. Moreover, 85% of the patients had previous surgeries and 81% of them had received intensive care services. Average nursing costs for women were 1.2 times more than the estimated costs for men, and the average cost of rehabilitation services was as much as 2 times higher in women than in men. Furthermore, the average hoteling costs were as much as 1.3 times higher in women than in men. Finally, the total costs for women were 1.14 times more than those for men. The distribution of all costs was skewed. The results of Mann-Whitney test showed significant differences between men and women in total costs,

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Table 1. Cost headings of elderly patients in the hospital in 2017 (US$*)

Cost items	Total cost	Cost per patient	% of the total cost
Nursing	9,954.38	34.21	0.89
Visiting and consulting services	9,858.96	38.66	0.88
Surgical services	176,983.55	702.31	15.76
Lab. services	20,821.32	72.30	1.85
Imaging services	23,155.57	81.25	2.06
Other diagnostic services	6,411.53	26.94	0.57
Rehabilitation services	7,154.92	34.39	0.64
Hoteling	193,634.44	663.13	17.24
Medicine	27,097.98	100.7	2.41
Consumables	647,993.26	2,242.26	57.70

*One US dollar = 34 460 Rials

Table 2. The related costs of osteoporosis for the elderly in 2017 (US$)

Variable	N (%)	Sum	Cost per patient	Mean	P value
Sex					
Male	62 (21)	211,228.34	3,406.91	3,406.91	0.042
Female	233 (79)	896,745.12	3,848.69	3,898.89	
Age					
65 to 74	218 (74)	829,362.68	3,804.41	3,857.50	0.508
75 to 90	77 (26)	278,610.78	3,618.33	3,618.33	
LOS					
First week	61 (20.68)	83,840.39	1,374.43	1,352.26	<0.001
Second week	138 (46.78)	553,144.25	4,008.29	4,127.94	
Third week	77 (26.10)	356,962.86	4,635.88	4,635.88	
One month	10 (3.39)	71,429.41	7,142.94	7,142.94	
Over one month	9 (3.05)	42,596.53	4,732.95	4,732.95	
Disease					
Osteoporosis	237 (80)	923,036.88	3,894.67	3,944.60	0.016
Spinal stenosis	26 (9)	84,276.69	3,241.41	3,241.41	
Others	32 (11)	100,659.89	3,145.62	3,145.62	
ICU services					
Did not receive ICU services	57 (19)	85,989.71	1,508.59	1,508.59	<0.001
Received ICU services	238 (81)	1,021,983.75	4,294.06	4,348.86	
Surgery services					
No surgery	43 (15)	17,784.92	413.60	433.77	<0.001
Surgery	252 (85)	1,090,188.54	4,343.38	4,343.38	

nursing, laboratory, rehabilitation, and hoteling costs ($p<0.05$).

The mean LOS was 12.32 days. The highest average cost of treatment was related to the elderly who stayed in the hospital for 1 month. The average cost of consumables was higher for patients hospitalized for 1 month than the other patients with different lengths of stay. The average cost of diagnostic services was low for patients who were hospitalized for 1 week. In fact, there was a direct relationship between the length of stay and pharmaceutical costs, indicating that patients who were hospitalized for more than 1 month had to spend more on drugs. Hospitalization costs for patients with more than 1 month of hospitalization were 5 times higher than those of the patients who were hospitalized for about 1 week. The average costs of nursing, rehabilitation, and surgery for patients with 1 month of hospitalization were the highest compared with other costs. The results of Kruskal–Wallis test also indicated a significant difference between length of stay and hospital costs ($p<0.05$).

In the present study, the patients were divided into 3 groups based on frequency: osteoporosis, spinal stenosis, and other musculoskeletal disorders. The average costs of visits and counseling were higher among patients with spinal stenosis than the other patients in different groups. In addition, the surgical costs of this group were 1.4 times higher than osteoporosis patients, but the average cost of rehabilitation and nursing services for patients with osteoporosis groups was 1.4 times higher than those for patients with spinal stenosis. The average pharmaceutical cost of these patients was as much as 1.6 times higher than the average costs for patients with osteoporosis. Based on the results of the Kruskal–Wallis test, the costs of consumables, imaging, hoteling services, and total costs were significantly different based on disease ($p<0.05$). Compared with the average costs of services for other diseases, the average costs of nursing, medication, and hoteling for patient with previous surgeries in their records were about 4, 3, and 4 times higher, respectively. The average cost of rehabilitation services for patients who had surgery was about 4 times higher than the average costs of the aforementioned services for other patients. Finally, it has been demonstrated that a patient with previous surgeries would increase the cost of admission up to 4 times. The results of Mann-Whitney test demonstrated that nursing costs, visits and counseling, medication, consumables, laboratory, hoteling, and total costs were significantly different for patients with or without previous surgeries ($p<0.05$).

Discussion

This was the first study to estimate the medical costs of osteoporosis in Iran. A retrospective cost analysis of hospitalization arising from osteoporosis was conducted on

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all the elderly patients (adults aged 65 years and above). Based on the results, the costs of osteoporosis depend on gender, age, LOS, surgery, and ICU care services. The dominant cost drivers in this study were consumables (57.70%), hoteling (17.24%), and surgical services (15.76%). According to the results, the average cost of hospitalization for the elderly with osteoporosis was $3794 in 2017.

The results of a study by Phillips et al indicated that the direct cost of osteoporosis treatment in women was $5.2 and the highest share of costs was related to visits and nursing services (3). The results of the study by Norris et al showed that the total direct cost of osteoporosis treatment for women was $5.15 billion in 1992, and hospital and nursing services accounted for the largest share of the total direct costs (26). The variety of the results of studies indicated the diversity of medical processes for the treatment of osteoporosis in some countries; for example, patients take the advantage of nursing services after hospital discharge; however, in Iran, the process of treatment is finished when the patient is discharged from the hospital. Lotters et al (27) demonstrated that osteoporosis-related fractures in older adults substantially increase the health care costs and that aging exacerbates the situation. These findings are consistent with those of the present study. A study on osteoporosis and its related costs in Korea indicated that the average medical cost per patient was about $4410 in 2011, which is considerably higher than the reported results in this study. The difference in sample size and methodology of their study may justify such discrepancy (28). A study by Häussler et al suggests that more than half of the women affected by osteoporosis are more likely to experience at least 1 clinical fracture, which is consistent with the findings of this study. In our study, osteoporosis was more prevalent in women due to systemic differences between men and women. Osteoporosis is a common disease in women during menopause, because estrogen significantly reduces during this period. Total direct cost of osteoporosis of this study was estimated to be €5.4 billion in 2003 (29).

Based on our results, the health care costs in some cases, especially osteoporosis, increased by aging population, which has nothing to do with the time of death. Thus, policymakers should eliminate the factors that lead to the disease, including mineral deficiency (e.g, calcium, protein, and vitamin D), smoking, lack of exercise, or weight loss more than 10%, BMI less than 19, hereditary factors, and alcohol addiction. One way to delay the disease is to provide vitamin D to girls in schools. Lifestyle changes and increased awareness of people in this area will be of significant importance. However, in our study, the indirect costs were excluded from the calculation. We could consider the costs of osteoporosis from social perspective and also the burden of the osteoporosis disease; however, because of the limitation in available data, the costs were calculated in hospital perspective.

The trend analysis can estimate the effects of inflation on hospital costs. Regardless of the restrictions mentioned, because this was the first study about osteoporosis costs in elderly patients in Iran, policymakers can use the results of this study to optimize resource allocation. Moreover, they can reduce costs for the health sector and patients by adopting policies to prevent or delay the disease.

Conclusion

The future costs of osteoporosis in Iran rely on formulating and developing specific policies to prevent or delay this phenomenon in the population. The Ministry of Health should adopt policies to reduce health care costs and improve the quality of life of patients. Future studies are needed to investigate the economic burden of the disease and the cost-effectiveness of interventions.

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Conflict of Interests

The authors declare that they have no competing interests.

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