INCIDENCE AND TIME TREND OF HIP FRACTURES IN ROMANIA: A NATIONWIDE STUDY FROM 2008 TO 2018

D. Grigorie^{1,2,*}, A. Sucaliuc¹, M. Ciutan³, C. Vladescu³

¹“C.I. Parhon” National Institute of Endocrinology, ²“Carol Davila” University of Medicine and Pharmacy, ³National School of Public Health Management and Professional Development, Bucharest, Romania

Abstract

Background. Hip fractures are a major issue of public health as they are responsible for high morbidity, excess mortality and costs. There are differences in Europe and worldwide in the incidence rates of hip fractures and time trends, in the context of the population aging. Ten years ago, we characterized the incidence of hip fracture in Romania using data from the national hospital discharge register.

Objective. This is the first Romanian study to assess the hip fracture incidence rates over a period of 11 years, between 2008 and 2018.

Subjects and Methods. This analysis is a nationwide retrospective study on hospitals reporting primary DRG data on hip fracture, using a rigorous definition with both diagnostic and surgical procedure codes. The population aged 40+ was stratified in 5-year intervals and both the crude incidence rates and the adjusted incidence rates of hip fracture using standardization on age for the 2018 reference population were calculated in women and men.

Results. From 2008 to 2018, the number of hip fractures rose by 53 % in women (from 7513 to 11512) and 22.4 % in men (from 4266 to 5220). Meanwhile, the Romanian population over 40 years increased by 12.5% in women and 14.2% in men. The crude incidence rate rose by 36.2% in women and 7.2% in men and the age-standardized incidence rates by 27.4% in women and 6% in men. These increases are mostly based on 85+ age populations' changes.

Conclusions. In Romania, the hip fractures incidence continues to grow throughout an 11-year-period, especially in women, representing an increasing burden for our society.

Key words: Hip fracture Incidence, Trend analysis, Hip fracture epidemiology.

INTRODUCTION

Osteoporosis is a bone fragility disorder resulting in increased risk of fractures which are its main clinical significance. Fragility fractures can involve

almost every bone, but hip fractures are considered the barometer of osteoporosis in a country, as they result in the highest morbidity, mortality, disability and costs. Hip, vertebral body, humerus and distal radius fractures are called major osteoporotic fractures and their risk is calculated with the FRAX algorithm; Romania has its own model since 2011 (1). The burden of osteoporosis can be estimated by the incidence of consequent fractures, of hip and others, by the consequent disabilities, or in terms of the population at a high risk of future fractures (2). As almost all hip fractures cases come to medical attention and require hospitalization, hip fracture epidemiology is more known than that of other fractures associated with osteoporosis. As a consequence, hip fractures are considered a useful surrogate for determining the international burden of osteoporosis (3). Although they account for less than 15-20% of all osteoporotic fractures, they account for the majority of fracture-related health care expenditure and mortality in men and women over the age of 50 years (3). In Romania, hip fractures are responsible for half of the direct cost for all fractures (4).

There is a substantial variation in hip fracture incidence between countries in Europe and around the world; a seven-fold difference has been found in Europe, with the highest incidence rate in Scandinavia and the lowest in southern countries (2-4). Recent publications observed changes in the secular trends, many of them reporting decreases or leveling-off; reports on increasing rates are a few (5, 6).

Fragility fractures, and especially hip fractures, occur most often in the elderly population. As the population of the world ages, there is concern that the incidence of hip and major osteoporotic fractures will also increase, leading to excess mortality and costs.

Ten years ago, we characterized the incidence of hip fracture in Romania using data from the national hospital discharge register (1). Even though Romania is

*Correspondence to: Daniel Grigorie MD, PhD, Associate Professor of Endocrinology, “Carol Davila” University of Medicine and Pharmacy, “C.I. Parhon” National Institute of Endocrinology, 34-38 Aviatorilor Blvd, Bucharest, 011863, Romania. E-mail: danielgrigorie58@gmail.com

at a moderate risk of fracture, the burden is significant in that 1 of 14 Romanian women can expect to sustain a hip fracture in their lifetime (1,7).

Despite being understood as a public health issue both at national and global levels, osteoporosis is largely under-diagnosed and under-treated. In our country, the reimbursement of the osteoporosis medication is still exclusively based on BMD by DXA and the FRAX Romanian model (available since 2011) is not used in primary care or guidelines. Romania has one of the highest treatment gaps (86%) in Europe, which means that the majority of individuals at high risk of fracture are untreated (7).

In the present paper we assess the incidence and the trend of hip fracture rates of the Romanian population above the age of 40, stratified by age and sex, in an 11-year period.

SUBJECTS AND METHODS

This analysis is a nationwide retrospective study on hospitals reporting primary DRG data on hip fracture at the patient level, in the period 2008-2018.

Data from the National DRG Database are reported monthly to the National School of Public Health, Management and Professional Development (8). Data were extracted from over 40 million discharges from the Romanian National DRG Database which includes all discharges from hospitals (public and private) in contractual relationship with the National Health Insurance House in Romania. From 2005 to 2007 the used coding system was HCFA 18, with ICD 9 (9); starting from mid 2007 the Australian version AR DRG v5.0 was introduced using ICD-10; from 2010 is in use the Romanian version ROviDRG, based on Australian version and also using ICD-10 classification; this fact made the data compatible for analysis and comparison for the entire interval (10).

For this study, cases were defined as patients aged 40+ years, who were hospitalized for a hip fracture (HF) as primary diagnosis (International Classification of Diseases ICD10 code S72.0 – fracture of femoral neck, S72.1 – pertrochanteric fracture, S72.2 – subtrochanteric fracture, S72.9 – unspecified site of femoral fracture); specifically, we included only fractures with surgical interventions (hip specific

surgical procedures code). The selected hospitalizations represented 81% of all hospitalizations with hip fractures encoded as primary diagnosis.

Patients were classified by gender, residence and age. We calculated both the crude incidence rates of hip fracture and the adjusted incidence rates using direct standardization on age for the 2018 reference population.

From 2008 to 2018, cases were studied from the age of 40 years since this is the lower age limit used in FRAX. Incidence rates were calculated as the number of men and women in 5-year age intervals with hip fracture divided by the age- and sex-specific population for each year from 2008 to 2018.

For the reference population, we used 40+years Romanian population extracted from the National Institute for Statistics, Tempo online database that is publicly available [<http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>, accessed Feb. 1, 2020].

The SPSS 20.0 software was used for statistical analysis (Pearson and Spearman correlations, comparison by t-test and chi-square).

RESULTS

A total of 194,369 patients with HF as primary diagnosis were discharged from the Romanian hospitals in the last 11 years (2008-2018); about 81% of these, respectively 157,906 patients had hip fracture (primary diagnosis) and surgical procedure, meaning about 14,355 patients with HF per year, and the number was double in women vs. men. For simplicity, in this paper we use the term HF for such cases.

Demographic characteristics of patients with HF

More than 2/3 (67%) of all 157,906 patients with HF were women, with a mean age of 78 ± 9.2 years, among which 71% were 75 years and over. The proportion of men was 33%, with a mean age of 71.4 ± 12.3 years; more than 54% were 74 years and below, while the rest of 46% were 75 years and over.

By residence (51% urban and 49% rural – Table 1) there is no significant difference in comparison to the general population and the proportion of cases within the urban and rural groups does not differ

Table 1. Demographic characteristics of patients with HF

	Age Mean (SD)	Women HF number	%	Age Mean (SD)	Men HF number	%
Rural	77.8 (8.6)	51612	48.8%	71.7 (12.1)	25803	49.5%
Urban	78.2 (9.7)	54207	51.2%	71.1 (12.6)	26284	50.5%

significantly by age group and gender (chi test; $p < 0.05$).

Hip fracture trend analysis

The number of patients with HF increased steadily by about 4% per year, so that the total increase was about 41.5% (from 11,779 in 2008 to 16,732 patients in 2018).

There was an increasing trend in all three indicators studied: number of patients, crude rate of hip fracture and standardized rate of hip fracture with surgical procedure (Fig. 1), both in women (black lines) and in men (grey lines).

Hip fracture trend analysis in women

There was a global increase of 53.2% in the number of HF in women (Fig. 1, Table 2), from 7,513 (in 2008) to 11,512 (in 2018). The number of HF almost tripled for the female population aged 85 years and over, from 1,265 (in 2008) to 3,424 (in 2018). The corresponding population had the largest increase in size (79.8%) during the 11 years of observation. The whole female population (aged 40 years and over) slightly increased, from 5,479,659 in 2008 to 6,162,484 in 2018 (cumulative variation = 12.5%) - Table 2.

As a consequence, the crude incidence rate of

Figure 1. Trend of number and crude- and age-standardized incidence rates for hip fracture, women versus men, Romania, 2008-2018.

Table 2. 2008 and 2008-2018 % variation in number of hip fractures, population and crude incidences in women and men

	Women				Men			
	2008 HF No	% HF No	% Population	% Incidence	2008 HF No	% HF No	% Population	% Incidence
40-44 yrs	31	-12.9%	27.9%	-31.9%	109	-19.3%	30.8%	-38.3%
45-49 yrs	66	-9.1%	32.0%	-31.2%	190	-3.7%	35.0%	-28.6%
50-54 yrs	149	-23.5%	-15.6%	-9.4%	305	-15.4%	-12.3%	-3.5%
55-59 yrs	249	-13.3%	-8.2%	-5.5%	400	-18.8%	-6.1%	-13.5%
60-64 yrs	353	30.6%	42.9%	-8.6%	366	48.4%	43.8%	3.2%
65-69 yrs	607	39.0%	20.7%	15.2%	530	28.5%	24.2%	3.5%
70-74 yrs	1236	1.8%	-14.4%	18.9%	670	-3.3%	-13.0%	11.2%
75-79 yrs	1756	23.9%	-0.1%	24.1%	720	2.2%	-5.4%	8.1%
80-84 yrs	1801	62.8%	23.7%	31.6%	595	36.5%	18.3%	15.3%
>84 yrs	1265	170.7%	79.8%	50.5%	381	148.3%	91.4%	29.7%
Total	7513	53.2%	12.5%	36.2%	4266	22.4%	14.2%	7.2%

hip fracture in women over 40 globally increased from 1,371 HF (in 2008) to 1,868 HF per 1,000,000 women (in 2018) - Fig. 1.

The cumulative change of the HF incidence showed an increase from 2008 to 2018 (Table 3) for women aged 65 and over (from 15.2% to 50.5%), and in particular in women aged over 84 (50.5%), while the trend was negative for women aged 59 and below.

Meanwhile, the cumulative change in women

population aged 40 and over increased (12.5%), with a particular increase of 79.8% in women over 84 (the highest increase among the age groups); the values in Table 2 illustrate a variation in the demographic characteristics of the female population that is not correlated with the HF incidence variation (Example: increasing in population and decreasing in crude incidence rate for the 60-64 age group or decreasing in population and increasing in crude incidence rate for the 70-74 age group); the

Variation (% in comparison with the value in 2008), women

Figure 2. Cumulative variation of population and crude incidence rates in women (>40 years and >84 years groups), Romania, 2008-2018.

Table 3. Incidence rates of hip fracture in women, Romania, 2008-2018 (crude and standard* rates/1,000,000 women)

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Var(%)	
Crude Incidences	40-44 yrs	44	37	40	36	33	27	34	27	17	21	30	-31.9%
	45-49 yrs	93	59	60	54	82	68	60	63	66	64	64	-31.2%
	50-54 yrs	181	154	170	138	143	171	133	162	167	204	164	-9.4%
	55-59 yrs	333	322	346	320	341	314	333	305	268	294	315	-5.5%
	60-64 yrs	651	636	688	624	628	611	622	620	618	631	595	-8.6%
	65-69 yrs	1080	1245	1283	1216	1193	1397	1223	1249	1179	1275	1243	15.2%
	70-74 yrs	2282	2279	2504	2323	2417	2484	2350	2376	2593	2445	2712	18.9%
	75-79 yrs	4088	4525	4487	4357	4759	4711	4747	4855	4817	4931	5073	24.1%
	80-84 yrs	6732	7058	7133	7280	7949	8038	8370	8243	8964	8450	8858	31.6%
	>84 yrs	9066	9933	10392	10824	11062	11845	12090	12774	12970	13690	13646	50.5%
Total	1371	1456	1523	1508	1612	1675	1696	1737	1789	1818	1868	36.2%	
Age-adjusted incidences *	Total	1466	1555	1608	1587	1672	1728	1728	1761	1809	1827	1868	27.4%

*direct standardization on 2018 as reference. Var(%) = Variation 2008-2018 (%).

difference between the yearly variation in the population over 84 years old has increased much faster compared to the difference recorded in the population aged 40 and over (Table 2); this aspect is also illustrated in Fig. 2.

In term of crude incidence rates and standardized incidence rates data show also an increased trend in both indicators (Table 3 and Fig. 1), more in women than in men. The crude incidence rates of HF based on each year population show a global increase between 2008 and 2018 of 36.2%, representing a yearly increase of 3.3% of incidence rate.

The variation analysis of the HF incidences in the five-year age group populations showed that the values of the cumulative change in the crude incidence rate were negative for women aged 64 and below. The analysis on the HF crude incidence rates shows a direct and strong correlation between the cumulative change in the value of this indicator and the age group (corr. = +0.86, $p < 0.05$), which indicates that the crude incidence rates increased with increasing age.

An increasing trend was also found for standardized incidence rates (11 years of observation) but the variations were slightly different (Fig. 1 and Table 3). Therefore, after adjustment of the crude incidences using direct standardization on age for the 2018 reference population, we found an incidence rates variation of +27.4% (+2.5% per year). Thus, the increase observed after standardization is less accelerated than the increase in crude incidence rates (the slope for the crude rate is steeper) - Fig. 1.

Hip fracture trend analysis in men

There is also a global increase in the number of hip fractures and surgical procedure in men (Fig. 1, Table 2), from 4,266 (in 2008) to 5,220 cases (in 2018). This trend is only slightly increased in comparison with the accelerated trend of incidence in women (mean growth of 85 men per year *versus* mean growth of 385 women with HF per year).

Similar with the pattern in women, the demography of the whole population of men aged 40 years and over shows slightly increased numbers, from 4,701,380 in 2008 to 5,368,774 in 2018 (cumulative variation = 14.2%), with the highest increase in cumulative change recorded for men in the 85 years and over age group (+91.4%) - Table 2.

The analysis of the HF crude incidence rate in men over 40 also highlights a yearly increase of 7.2%, from 907 HF (in 2008) to 972 HF per 1,000,000 men (in 2018) - Fig. 1.

The analysis of the variation in the hip fracture

incidence shows an increase from 2008 to 2018 (Table 4, Fig. 3) for men aged 60 years and over, in particular in men aged over 84 (+ 29.7 %), while for men aged 59 and below the trend was negative (-38.3% to -3.5%). As a consequence, the analysis on the crude incidence rate shows a direct and moderate correlation between the cumulative change in the value of this indicator and the age group (corr. = +0.66, $p < 0.05$), which indicates that the crude incidence rates increased with increasing age.

In term of the demographic trend, the values in Table 2 illustrate a variation in the men population that is not correlated with the variation in HF incidence; the difference between the yearly variation in the population over 85 has increased much faster compared to the difference recorded in the population aged 40 years and over, while the difference in incidence rates increased much less accelerated (Fig. 3).

Both incidence rates, crude and standardized (after direct age-class standardization on 2018 population), showed a very slightly increasing trend (Table 4 and Fig. 1). The HF crude incidence rates based on each year population show a global increase of 7.2% (0.65% annual variation) between 2008 and 2018). Regarding standardized incidence rates, the variations tend to approach each year (Fig. 3); therefore, the values differed slightly after standardization, with a variation of only +6.0% (+0.5% per year). Thus, the slight increase observed after standardization is not significant (chi test, $p < 0.05$); Figure 1 illustrates this trend and highlights an inflection point in 2014, after which the trend was growing obviously, from 892 (in 2014) to 972 HF per 1,000,000 men (in 2018).

DISCUSSION

The analysis of hip fracture epidemiology in Romania in the period 2008-2018 showed a 41.5% increase in the absolute number of hip fractures (from 11,779 in 2008 to 16,732 patients in 2018, 4% per year), an increase much more pronounced than the slight population increase of the 40 years and older age group.

In this context, the crude incidence rates have increased in the past 11 years, with a variation of 36.2 % for women and 7.2% for men (between 2008 and 2018); the levels of crude incidence rates differ between women (linear increasing from 1,371 to 1,868 HF per 1,000,000 women) and men (increasing from 907 to 972 HF per 1,000,000 men, with an inflection point of 892 in 2014), with a female/male ratio of about 2/1.

This significant increase in the HF incidence rate in Romanian women in the last decade is rare for an European country, as most published data from western and northern countries observed decreasing or stable trends. In France, decreasing trends were found both in crude incidence rates and especially age-

standardized rates despite the increased global number of HF throughout a 12-year period (11). Recent data from Poland showed an increasing trend in the total number of HF and incidence rates, in both women and men (12, 13). In general, incidence rates decreased in the last 2 decades after a period of significant increase in many Western European countries and Northern America, albeit at different times, whereas rates are still increasing in other parts of the world (14-19). In Denmark and Sweden the standardized incidence rates continue to decline, but at lower rates, the recent data indicating a possible trend reversal (18, 20, 21). An increased hip fractures number and standardized incidence rates were recently confirmed in Korea (22). Hip fracture is an issue mainly affecting the older population and demographic changes in the elderly have translated into a global increase of HF numbers worldwide. In Romania, the increase in the number of HF cases outpaced the increase of the respective populations. Of note is also that the hip fracture incidence trend increases, in both genders, in the population over 65 years old. These results support the value of osteoporosis screening and treatment in women over aged 60 to 65, as has been recently proposed (23).

Although clear explanations for increasing incidence trends are not yet available, some points are of interest. It has been speculated that hip fracture is the expression of the increased urbanization based on the parallel between increased incidence and increased urbanization (6). An increased urbanization has indeed been seen in Romania in the past decade, but the distribution of hip fracture cases between urban and rural populations was equal. A possible explanation is the fact that many people are living in the rural area but are working in cities, where more jobs are available. Another point of interest is the high treatment gap in Romania (more than 80%), which is relevant for the low uptake of medication for the population at risk for fracture (7). Even if Romania has had a FRAX model (<https://www.sheffield.ac.uk/FRAX/?lang=ro>) available since 2011, it is not taken into account for the reimbursement of treatment, which is solely based on bone densitometry. Fragility hip fracture is not a criterion for reimbursement or gratuity in patients older than 70 years of age, as currently recommended (24, 25).

Our study has some limitations related to the optimal use of diagnosis and surgical procedures codification and to the changing structure of the Romanian population (aging, migration). The need of a national registry for hip fractures is urgent as it will improve the quality of administrative data, and

will allow a better characterization of hip fracture consequences like mortality and refracture rates, as well as the identification and prevalence of risk factors. The refracture rate is high, starting just one month after the hip fracture event (26). Excess mortality appears early, is higher in men than in women, and is about 20% in the first year (27).

In conclusion, in this 11 years long nationwide study we observed an increasing trend in all indicators examined: the number of hip fracture cases, the crude incidence and the age-standardized incidence of hip fractures with surgical procedures. This will inform decision makers to calibrate resources for this increased burden of severe osteoporosis and to optimize the quality of elderly care in Romania.

Conflict of interest

The authors declare that they have no conflict of interest.

References

1. Grigorie D, Sucaliuc A, Johansson H, Kanis JA, McCloskey E. Incidence of hip fracture in Romania and the development of a Romanian FRAX model. *Calcif Tissue Int.* 2013; 92(5):429-436.
2. Odén A, McCloskey EV, Kanis JA, Harvey NC, Johansson H. Burden of high fracture probability worldwide: secular increases 2010-2040. *Osteoporos Int.* 2015;26(9):2243-2248.
3. Kanis JA, Odén A, McCloskey EV, Johansson H, Wahl DA, Cooper C. A systematic review of hip fracture incidence and probability of fracture worldwide. *Osteoporos Int.* 2012; 23(9):2239-2256.
4. Hernlund E, Svedbom A, Ivergård M, Compston J, Cooper C, Stenmark J, McCloskey EV, Jönsson B, Kanis JA. Osteoporosis in the European Union: Medical Management, Epidemiology and Economic Burden. A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA). *Arch Osteoporos.* 2013; 8(1-2):136.
5. Rapp K, Büchele G, Dreinhöfer K, Bücking B, Becker C, Benzing P. Epidemiology of hip fractures. *Z Gerontol Geriat.* 2019;52(1):10-16.
6. Ballane G, Cauley JA, Luckey MM, El-Hajj Fuleihan G. Secular trends in hip fractures worldwide: Opposing trends East *versus* West. *J Bone Miner Res.* 2014; 29(8):1745-1755.
7. Kanis JA, Hernlund E, Svedbom A, Ivergård M, Grigorie D. The osteoporosis treatment gap in Romania. *Acta Endocrinologica.* 2013; 9(4):509-514.
8. National DRG Database, National School of Public Health, Management and Professional Development.
9. Vladescu C, Astarastoae V, Scintee SG. A health system focused on citizen's needs. Romania. Financing, organization and drug policy. Solutions (II). *Revista Romana de Bioetica.* 2010; 8(3):106-115.
10. Vladescu C, Astarastoae V. Integrating health services within the health reform policy in Romania. *Revista Romana de Bioetica.* 2012; 10(2):78-90.
11. Garofoli R, Maravic M, Ostertag A, Cohen-Solal M. Secular trends of hip fractures in France: impact of changing characteristics of the background population. *Osteoporos Int.* 2019; 30(2):355-362.

12. Wilk R, Skrzypek M, Kowalska M, Kusz D, Koczy B, Zagórski P, Pluskiewicz W. The 13-year observation of hip fracture in Poland-worrying trend and prognosis for the future. *Aging Clin Exp Res.* 2018; 30(1):61-69.
13. Glinkowski W, Narloch J, Krasuski K, Śliwczyński A. The Increase of Osteoporotic Hip Fractures and Associated One-Year Mortality in Poland: 2008-2015. *J Clin Med.* 2019; 8(9):1487.
14. Dimai HP, Svedbom A, Fahrleitner-Pammer A, Pieber T, Resch H, Zwettler E, Chandran M, Borgstrom F. Epidemiology of hip fractures in Austria: evidence for a change in the secular trend. *Osteoporos Int.* 2011; 22(2):685–692.
15. Maravic M, Taupin P, Landais P, Roux C. Change in hip fracture incidence over the last 6 years in France. *Osteoporos Int.* 2011; 22(3):797–801.
16. Brauer CA, Coca-Perraillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. *JAMA.* 2009; 302(14):1573–1579.
17. Leslie WD, O'Donnell S, Jean S, Lagacé C, Walsh P, Bancej C, Morin S, Hanley DA, Papaioannou A, Osteoporosis Surveillance Expert Working Group. Trends in hip fracture rates in Canada. *JAMA.* 2009; 302(8):883–889.
18. Abrahamsen B, Vestergaard P. Declining incidence of hip fractures and the extent of use of anti-osteoporotic therapy in Denmark 1997-2006. *Osteoporos Int.* 2010; 21(3):373–380.
19. Cauley JA, Chalhoub D, Kassem AM, Fuleihan GE-H. Geographic and ethnic disparities in osteoporotic fractures. *Nat Rev Endocrinol.* 2014; 10(6):338–351.
20. Rosengren BE, Björk J, Cooper C, Abrahamsen B. Recent hip fracture trends in Sweden and Denmark with age-period-cohort effects. *Osteoporos Int.* 2017; 28:139–149.
21. Abtahi S, Driessen JHM, Vestergaard P, van den Bergh J, Boonen A, de Vries F, Burden AM. Secular trends in major osteoporotic fractures among 50+ adults in Denmark between 1995 and 2010. *Osteoporos Int.* 2019; 30(11):2217-2222
22. Hong S, Han K. The incidence of hip fracture and mortality rate after hip fracture in Korea: A nationwide population-based cohort study. *Osteoporos Sarcopenia.* 2019; 5(3):102.
23. Crandall CJ, Schousboe JT, Morin SN, Lix LM, Leslie M. Performance of FRAX and FRAX-Based Treatment Thresholds in Women Aged 40 Years and Older: The Manitoba BMD Registry. *J Bone Miner Res.* 2019; 34(8):1419–1427.
24. Eastell R, Rosen CJ, Black DM, Cheung AM, Murad MH, Shoback D. Pharmacological Management of Osteoporosis in Postmenopausal Women: An Endocrine Society Clinical Practice Guideline. *J Clin Endocrinol Metab.* 2019; 104(5):1–28.
25. Conley RB, Kiel DP. Secondary Fracture Prevention: Consensus Clinical Recommendations from a Multistakeholder Coalition. *J Bone Miner Res.* 2020; 35(1):36-52.
26. Ryg J, Rejnmark L, Overgaard S, Brixen K, Vestergaard P. Hip fracture patients at risk of second hip fracture: a nationwide population-based cohort study of 169,145 cases during 1977–2001. *J Bone Miner Res.* 2009; 24(7):1299–1307.
27. Downey C, Kelly M, Quinlan JF. Changing trends in the mortality rate at 1-year post hip fracture – a systematic review. *World J Orthop.* 2019; 10(3):166-175.