OSTEOPOROTIC HIP FRACTURE INCIDENCE RATES IN THE MAIN URBAN AREA OF ROMANIA

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Abstract

Context. Estimation of osteoporotic hip fracture incidence and Romanian FRAX model were based on nationally reported hospital ICD 10 coding admissions of all hip fractures (without a validation process).

Objective. We aimed to calculate, based on individual hospital charts analysis, the incidence of osteoporotic hip fracture in the main urban area of Romania and compare it with data reported to the National Institute of Public Health (NIPH).

Design. We retrospectively analyzed the charts of all patients (>40 years old) admitted for hip fracture in a 12-month period in hospitals with an Orthopedic Department in Bucharest and surrounding Ilfov County (11.8% of Romania population).

Subjects and Methods. All ICD 10 fracture and event/fall codes were validated against the charts. We calculated the age and sex adjusted incidence of osteoporotic hip fracture and used the national reported hip fracture data base for comparison.

Results. There were 2203 hip fractures of which 1997 (90.65%) were fragility fractures. The crude incidence of low-energy hip fractures was 171/100,000 (225/100,000 in women, 103/100,000 in men). The incidence rose with age to a maximum rate of 1902/100,000 in women >85 years. The NIPH-reported incidence of hip fracture was 181/100,000 for the region of interest and 176/100,000 at the national level.

Conclusion. The incidence of osteoporotic hip fracture was lower than the incidence based on hip fractures reported codes in the national database, but the incidence of fragility fractures calculated by our group was higher than the incidence reported in previous national studies. Nationwide studies are warranted.

Keywords: osteoporotic hip fracture, incidence, FRAX, Romania.

INTRODUCTION

The incidence rate of hip fracture is characterized by a widely marked variation with a greater than 10-fold difference between various countries (1). Apparent differences in incidence between countries can be explained by the non-standardized methods of data gathering and the disparate methods of reporting between countries (2).

FRAX models (3) based on country specific incidence rates were developed to overcome the heterogeneity of fracture probability between regions. FRAX models are developed both from national registries (4) and projected estimates from regional based studies (5).

The FRAX model for Romania was developed in 2013 (6). For that study, the osteoporotic hip fracture incidence was estimated based on the hospital reports of hip fracture codes to the National School of Statistics (NSS) (6). The NSS and the National Institute of Public Health (NIPH) receive anonymous data from all the hospitals in the country in the form of a primary ICD 10 diagnostic code. The main shortcoming of that study (6), in addition to the absence of a validation process in the data reporting system, is the inclusion of neoplasia and prosthesis-associated admissions in the calculation of incidence of osteoporotic fractures.

A regional based study on hip fracture in the Western part of Romania was published in 2014 (7). However, data was gathered from one Emergency trauma center with no exclusion of patients not residing in the area of study.

Recently, a nationwide study calculated the incidence and time trends of hip fracture in Romania based on hospital reported DRG codes and included only surgically treated fractures (8).

A nationwide specific registry of low-energy hip fractures based on the World Health Organization

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(WHO) definition of fragility fracture: “caused by injury that would be insufficient to fracture normal bone” (9) or high energy hip fracture with associated clinical osteoporosis assessment with bone mass densitometry (BMD) is not available in our country and the heterogeneity of the informatic system in the Health Care Sector makes it infeasible. Although all public hospitals are required to report all admissions, currently, there are no implemented controlling measures for the reported data. The main limitations of incidence studies are represented by selection biases, double counting and errors of reporting and coding of the fractures, errors estimated to be around +/-10% (1, 10).

Although new data emerged to support the inclusion of high-trauma fractures in clinical assessment for underlying osteoporosis and also epidemiological studies (11), the majority of hip fractures incidences are based on low-trauma hip fractures (12,13).

The aim of our study was to calculate, based on individual hospital charts analysis, the age and sex adjusted incidence of osteoporotic hip fracture (defined by fracture secondary to a low-energy trauma) in the area of Bucharest and surrounding Ilfov county and to compare our data with the data reported to the National Institute of Public Health.

MATERIAL AND METHODS

This retrospective hospital-based study was carried out in the city of Bucharest and the surrounding Ilfov County. With a population of 2,301,255 people, this region comprises 11.8% of total country population. We analyzed all hip fractures admitted between September 1st, 2017 and August 31st, 2018 in the Orthopedic Departments of 11 out of 16 hospitals (13 public) that admitted 98.3 % of the Romanian patients for hip fracture in the area of interest. The study received the approval of the hospitals' Ethics Committees.

We retrieved from each hospital database all patients above 40 years of age (with regard to the lower age limit in the FRAX model) with hip fracture: ICD 10 codes S72.0 (femoral neck), S72.1 (trochanter), S72.2 (subtrochanter) as primary or secondary diagnosis. The ICD 10 codes were verified with the descriptive diagnostic present in the chart.

One reviewer (R.D.) examined all patients individual chart and selected all osteoporotic hip fractures defined by fall from a standing height or less and also, high-energy hip fracture (secondary to vehicle crashes, falls from height and aggression related).

The final selection was based on the anamnestic description of the event documented in the chart. We chose this approach based on inconsistencies found between the event/fall code and the additional information found in the chart, the latter being entirely in the responsibility of the attending physician (all osteosynthesis/prosthesis complications were registered as new hip fractures). The following data were recorded: age (>40), sex, residence, treatment management (surgically or conservatively), description of event/admission reason. Specific data about ethnicity was not available.

We excluded femoral metastasis, reinterventions, periprosthetic fractures, pseudarthrosis, readmissions of any cause and inaccurate code reporting. Only the first registration per patient was recorded. Transfers between hospitals were also recorded to minimize errors of double counting. Also, we excluded all patients not residing in the area of interest.

We also retrieved all hip fractures reported to the National Institute of Public Health (NIPH) using the same selection criteria (admitted between September 1st, 2017 - August 31st, 2018 in the area of interest, age above 40 years old and ICD 10 codes S72.0, S72.1, S72.2). NIPH is the main national aggregator of medical data collected from every hospital in the country but reports only the primary diagnosis. A single admission per patient was counted.

For the reference population, we used the government predictions of the stable population (divided age into 5-year intervals (40-45, ...80-84, and 85 and above)) publicly available at the National Institute of Statistics online database, for the 2018 year, in the area selected. Crude incidence rates (cases per 100,000) of hip fractures were calculated for both sexes and regions, low and high-energy hip fractures.

Statistical analyses were conducted using MedCalc Software v19.4.0 (Ostend, Belgium).

RESULTS

The total number of patients admitted for a hip fracture in a 12-month period, with DRG 10 codes S72.0-2, was 2203 with residence in the selected area, 1897 (86.10%) in Bucharest and 306 (13.90%) in Ilfov County. NIPH reported a total of 2119 hip fractures, with a difference between the total number of fractures extracted from the hospital archives and the reported number of 3.81% (n=84).

Of the 2203 hip fractures, 206 (9.35%) were not considered fragility fractures (169 from Bucharest and

37 from Ilfov County): 49 (23.79%) were secondary to vehicle crashes, 57 (27.67%) were fractures produced after falls from higher level and aggression related, 54 (26.21%) were admission for osteosynthesis material complications, periprosthetic fractures or prosthesis decementation, 19 (9.22%) were metastatic bone fractures and 27 (13.11%) comprised errors of diagnostic coding, and readmissions for check-up.

The median age in excluded patients was 69 ± 13.6 years, (65 years in patients with vehicle crashes related injuries, 70 years in patients with falls from a higher level). The percentage of non-low-energy hip fractures decreased from 54.17% in the (40-44) age group to a minimum of 4.12% in the (>85) age group. Non-fragility hip fractures were found more often in men (14.96%) compared to women (7.15%).

The total number of osteoporotic fractures was 1997 (73.3% women). Mean age was 80 ± 11 years, 81 ± 10 years in women and 75 ± 13 years in men. Only 81.12% of the fractures were surgically treated. Total (hospital and NIPH based) and fragility hip fractures (hospital based) can be found in Table 1.

The crude incidence of osteoporotic hip fractures in Bucharest-Ilfov area, in those >40 years of age, was 171/100,000 (225/100,000 in women and 103/100,000 in men). The modified incidence after adding the high-energy hip fracture was 180/100,000 (233/100,000 in women and 113/100,000 in men). The NIPH registries based crude incidence of hip fractures in the Bucharest-Ilfov area was 181/100,000 (231/100,000 in women and 119/100,000 in men) and divided by region, 192/100,000

in Bucharest and 136/100,000 in Ilfov County. The crude incidence of hip fractures in Romania based on NIPH registries was 176/100,000. The calculated age, sex and residence adjusted crude incidences of the osteoporotic fractures are shown in Table 2. Incidence of fragility hip fracture by ICD 10 code can be found in Supplementary Table 1.

The calculated age and sex crude incidences after adding high-energy related injuries (all hip fractures) are shown in Table 3. Incidence of all hip fractures with high-energy injuries divided by type (secondary to vehicle crashes and fall from height plus aggression related) is shown in Supplementary Table 2.

DISCUSSION

Our study calculated the incidence of osteoporotic fracture defined by low-energy fracture after analyzing all patients' charts admitted for hip fracture in the main urban area of Romania. Also, we compared our findings with the incidence of hospitals ICD 10 based reported hip fracture data from NIPH, the medical aggregator that provided data for the development of the FRAX model for Romania. A second analysis was made including also high-energy hip fractures. We selected the Bucharest – Ilfov region for the very low probability of treatment request outside the area of residence and the probability of a very low rate of non-hospitalized hip fracture.

For the development of the FRAX model in France (13), the authors created an algorithm of

Table 1. Total and osteoporotic hip fractures in the selected area

Age group	Total				Bucharest				Ilfov County			
	NIPH reported hip fractures	Hospital database hip fractures	Fragility fractures *	Surgically treated osteoporotic hip fractures **	NIPH reported hip fractures	Hospital database hip fractures	Fragility fractures*	Surgically treated osteoporotic hip fractures**	NIPH reported hip fractures	Hospital database hip fractures	Fragility fractures*	Surgically treated osteoporotic hip fractures**
40-44	18	14	6 (42.86%)	6 (100%)	14	11	5 (45.45%)	5 (100%)	4	3	1 (33.33%)	1 (100%)
45-49	32	40	22 (55%)	20 (90.91%)	22	31	19 (61.30%)	17 (89.47%)	10	9	3 (33.33%)	3 (100%)
50-54	45	42	26 (61.90%)	17 (65.38%)	35	34	19 (55.88%)	10 (52.63%)	10	8	7 (87.50%)	7 (100%)
55-59	54	62	46 (74.19%)	40 (86.96%)	42	46	32 (69.56%)	28 (87.50%)	12	16	14 (87.50%)	12 (85.71%)
60-64	122	138	113 (81.88%)	92 (81.14%)	100	114	94 (82.45%)	77 (81.91%)	22	24	19 (79.16%)	15 (78.95%)
65-69	152	164	145 (88.41%)	118 (81.38%)	126	141	123 (87.23%)	102 (82.92%)	26	24	22 (91.66%)	16 (72.72%)
70-74	189	203	179 (88.17%)	140 (78.21%)	167	173	155 (89.60%)	121 (78.06%)	22	29	24 (82.75%)	19 (79.16%)
75-79	320	349	324 (92.83%)	276 (85.18%)	265	292	272 (93.15%)	234 (86.02%)	55	57	52 (91.22%)	42 (80.77%)
80-84	414	441	417 (94.56%)	343 (82.25%)	349	376	357 (94.95%)	295 (82.63%)	65	65	60 (92.30%)	48 (80%)
>85	773	750	719 (95.87%)	567 (78.86%)	694	679	652 (96.02%)	514 (78.83%)	79	71	67 (94.36%)	55 (82.09%)
Total	2119	2203	1997 (90.65%)	1619 (81.07%)	1814	1897	1728 (91.09%)	1403 (81.19%)	305	306	269 (87.90%)	218 (81.04%)

NIPH – National Institute of Public Health. *Percentages of fragility fractures from hospital database. **Percentages of surgically treated from fragility fractures.

Table 2. Incidence of osteoporotic hip fracture

Age group	Population	Osteoporotic fractures	Crude incidence per 100,000	95% CI	Incidence rate
Men					
40-44	98794	5	5	2-12	1:91759
45-49	88180	10	11	5-21	1:8818
50-54	64274	13	20	11 – 34.5	1:4944
55-59	57836	24	41	27 – 62	1:2410
60-64	69060	49	71	53 – 94	1:1409
65-69	55886	50	89	66 – 118	1:1118
70-74	31571	60	190	145 - 245	1:526
75-79	22916	88	384	308 - 473	1:260
80-84	16577	76	458	361 - 573	1:218
>85	13433	157	1169	993 - 1366	1:86
Total	518527	532	103	94 - 112	1:975
Women					
40-44	101006	1	1	0.02 – 5.51	1:101006
45-49	94553	12	13	7 - 22	1:7879
50-54	70353	13	18	10 – 32	1:5412
55-59	70753	22	31	19 - 47	1:3216
60-64	89183	64	72	55 – 92	1:1393
65-69	74475	95	128	103 - 156	1:784
70-74	45963	119	259	215 - 310	1:386
75-79	41179	236	573	502 - 651	1:174
80-84	33593	341	1015	910 - 1128	1:99
>85	29547	562	1902	1748 - 2066	1:53
Total	650605	1465	225	214 - 237	1:444
Bucharest					
40-44	155550	5	3	1 – 7.5	1:31110
45-49	141798	19	13	8 - 21	1:7463
50-54	108043	19	18	11 – 27	1:5686
55-59	104937	32	30	21 - 43	1:3279
60-64	131536	94	71	58 – 87	1:1399
65-69	108103	123	114	95 - 136	1:879
70-74	63901	155	243	206 - 284	1:412
75-79	52806	272	515	456 580	1:194
80-84	41870	357	853	766 946	1:117
>85	36330	652	1795	1660 - 1938	1:56
Total	944874	1728	183	174 - 192	1:547
Ilfov County					
40-44	44250	1	2	0.1 – 13	1:44250
45-49	40935	3	7	2 - 22	1:13645
50-54	26584	7	26	11 - 54	1:3798
55-59	23652	14	59	32 - 99	1:1689
60-64	26707	19	71	43 - 111	1:1406
65-69	22258	22	99	62 – 150	1:1012
70-74	13633	24	176	113 - 262	1:568
75-79	11289	52	461	344 - 604	1:217
80-84	8300	60	723	552 - 931	1:138
>85	6650	67	1008	799 - 1309	1:99
Total	224258	269	120	106 - 135	1:834
All fractures					
	1169132	1997	171	163 - 178	1:585
			170*		

*Age adjusted crude incidence.

Supplementary Table 1. Incidence of osteoporotic hip fracture by ICD 10 Code

Age group	Population	Osteoporotic Fractures	Crude incidence per 100,000	95% CI	Incidence rate
S72.0 Femoral Neck					
40-44	199800	1	1	0.01-3	1:199800
45-49	182733	11	6	3-11	1:16612
50-54	134627	13	10	5-17	1:10356
55-59	128589	25	19	13-29	1:5144
60-64	158243	51	32	24-42	1:3103
65-69	130361	85	65	52-81	1:1534
70-74	77534	60	77	59-100	1:1292
75-79	64095	124	193	161-231	1:517
80-84	50170	170	339	290-394	1:296
>85	42980	235	547	479-621	1:183
Total	1169132	785	67	63-72	1:1489
S72.1 Trochanter					
40-44	199800	4	2	0.5-5	1:49950
45-49	182733	8	4	2-9	1:22842
50-54	134627	12	9	5-16	1:11219
55-59	128589	19	15	9-23	1:6768
60-64	158243	58	37	29-47	1:2728
65-69	130361	89	68	55-84	1:1465
70-74	77534	119	153	127-184	1:652
75-79	64095	187	292	251-337	1:343
80-84	50170	232	462	405-526	1:216
>85	42980	454	1056	961-1158	1:95
Total	1169132	1134	97	91-103	1:1031
S72.2 Subtrochanter					
40-44	199800	1	1	0.01-3	1:199800
45-49	182733	3	2	0.3-5	1:60911
50-54	134627	1	1	0.01-4	1:134627
55-59	128589	2	2	0.2-6	1:64294
60-64	158243	4	3	0.7-6	1:39561
65-69	130361	4	3	0.8-8	1:32590
70-74	77534	5	6	2-15	1:15507
75-79	64095	13	20	11-35	1:4930
80-84	50170	15	30	17-49	1:3345
>85	42980	30	70	47-100	1:1433
Total	1169132	78	7	5-8	1:14989

search in the national database in order to exclude the main causes that can interfere with the absolute count (readmissions for osteosynthesis/prosthesis complications and neoplasia) but the etiology of the hip fractures was assumed. There are also countries like Armenia (12) who had hospital charts based approach, similar to our study. In this study (12) the authors excluded the high-energy fractures and the incidence was calculated based on low-energy hip fractures.

As expected, we observed a high exclusion rate in the younger population. Classically, it is expected that vehicle crashes and neoplasia are the main causes of non-fragility fractures mentioned in other studies as possible selection bias but, in our study, they only comprised a third of the total excluded

cases. The regional study carried out in Armenia (12), that described a similar study design, did not specify additional information of the excluded rate, general or age correlated.

We found an osteoporotic hip fracture incidence of 225/100,000 persons in women (maximum of 1902/100,000 in the (>85) age group) and 103/100,000 persons in men (maximum of 1169/100,000 in the (>85) age group).

The incidence of fragility fractures found in women is higher compared to neighboring countries like Moldova (5) and Ukraine (14) but lower than Bulgaria (15) and Hungary (16). All the countries mentioned above reported a higher incidence of hip fracture in men. Our study included more than 11% of

Supplementary Table 2. Incidence of both low-energy and the high-energy hip fracture type mentioned

Age group	Pop (n)	Vehicle related fractures (n)	Modified crude incidence per 100,000	95% CI	Incidence rate	High-energy fractures [#] (n)	Modified crude incidence per 100,000	95% CI	Incidence rate
Men									
40-44	98794	2	7	3-16	1:14113	2	7	3-16	1:14113
45-49	88180	5	17	10-28	1:5879	4	16	9-27	1:6299
50-54	64274	3	25	14-40	1:4017	4	26	14-42	1:3781
55-59	57836	3	47	31-68	1:2142	1	43	28-64	1:2313
60-64	69060	3	75	56-99	1:1328	4	77	57-100	1:1303
65-69	55886	3	95	71-124	1:1054	2	93	69-122	1:1075
70-74	31571	2	196	151-252	1:509	3	200	153-255	1:501
75-79	22916	2	393	316-483	1:255	3	397	320-488	1:252
80-84	16577	2	471	372-587	1:213	2	471	372-587	1:213
>85	13433	1	1176	1000-1375	1:85	5	1206	1027-1408	1:83
Total	518527	26	108	99-117	1:929	30	108	100-118	1:923
Women									
40-44	101006	1	2	0-7	1:50503	0	1	0-6	1:101006
45-49	94553	2	15	8-25	1:6574	2	15	8-25	1:6754
50-54	70353	1	20	11-33	1:5025	2	21	12-35	1:4690
55-59	70753	1	33	21-49	1:3076	0	31	19-47	1:3216
60-64	89183	3	75	58-95	1:1331	2	74	57-94	1:1351
65-69	74475	4	133	108-162	1:752	2	130	106-159	1:768
70-74	45963	2	263	218-315	1:380	3	265	220-317	1:377
75-79	41179	3	580	509-659	1:172	4	583	511-661	1:172
80-84	33593	2	1021	916-1135	1:98	5	1030	924-1144	1:97
>85	29547	4	1916	1761-2080	1:52	7	1926	1771-2091	1:52
Total	650605	23	229	217-241	1:437	27	229	218-241	1:436

#fall from height and other high-energy fractures with the exception of vehicle related. n=number.

Table 3. Incidence of all hip fractures

Age group	Pop. (n)	Low energy fractures (n)	High-energy fractures (n)	Modified crude incidence of all hip fractures per 100,000	95% CI	Incidence rate
Men						
40-44	98794	5	4	9	4-17	1:10977
45-49	88180	10	9	22	13-34	1:4641
50-54	64274	13	7	31	19-48	1:3214
55-59	57836	24	4	48	32-70	1:2066
60-64	69060	49	7	81	61-105	1:1233
65-69	55886	50	5	98	74-128	1:1016
70-74	31571	60	5	206	159-262	1:486
75-79	22916	88	5	406	328-497	1:246
80-84	16577	76	4	483	383-601	1:207
>85	13433	157	6	1213	1034-1415	1:82
Total	518527	532	56	113	104-123	1:882
Women						
40-44	101006	1	1	2	0-7	1:50503
45-49	94553	12	4	17	10-27	1:5910
50-54	70353	13	3	23	13-37	1:4397
55-59	70753	22	1	33	21-49	1:3076
60-64	89183	64	5	77	60-98	1:1293
65-69	74475	95	6	136	110-165	1:737
70-74	45963	119	5	270	224-322	1:371
75-79	41179	236	7	590	518-669	1:169
80-84	33593	341	7	1036	930-1151	1:97
>85	29547	562	11	1939	1784-2105	1:52
Total	650605	1465	50	233	221-245	1:429

n=number.

Table 4. Incidence of hip fracture in Romania

Study/ Published and NIPH data	Grigorie, 2013 [6]	Poenaru, 2014 [7]	Grigorie, 2019 [8]	NIPH reported incidence Bucharest- Ilfov	NIPH reported incidence Romania**	Present study	Present study
Study period (year)	2010	2008-2012	2008-2018	Sep 1 st , 2017 - Aug 31 st , 2018	Sep 1 st , 2017 - Aug 31 st , 2018	Sep 1 st , 2017 - Aug 31 st , 2018	Sep 1 st , 2017 - Aug 31 st , 2018
Type	HB*	HB	HB*	HB	HB	HB	HB
Population (n)	Whole country 19,502,161 (2018)	174,685 (Timis county)	Whole country 19,502,161 (2018)	2,301,255	Whole country 19,502,161 (2018)	2,301,255	2,301,255
Age (years)	>40	>55	>40	>40	>40	>40	>40
Incidence rate	171/100,000 in women	252/100,000 in women	187/100,000 in women	231/100,000 in women	224/100,000 in women	225/100,000 in women	233/100,000 in women
	116/100,000 in men	165/100,000 in men	97/100,000 in men	119/100,000 in men	121/100,000 in men	103/100,000 in men	119/100,000 in men
Discussions	- ICD 10 codes records based - newly implemented reporting system	undefined study population	only surgically treated fractures included	all hip fractures	all hip fractures	low-trauma hip fractures	all hip fractures

NIPH=National Institute of Public Health. * although defined by the author as population-based studies, data presented represents hospital reported data based on ICD 10 codes with no available data from primary care sources or estimations of non-hospitalized hip fractures. ** data collected as described in the first study [6].

the country's population, compared with other regional based studies and like Moldova with 5.1% (209,010 population) (5) or Bulgaria with 4.6% (183,294 population) (15). The lower incidence in men in our study could have been explained by the different study methodology that allowed us to exclude the non-osteoporotic fractures, but also, the inclusions of high-energy fractures translated into a smaller incidence in men. These various differences between neighboring countries can indicate the existence of unquantifiable errors but, as stated in other studies, these errors are unlikely to alter the conclusions (17).

We found an incidence of osteoporotic hip fractures with 6% lower than the NIPH incidence of reported hip fracture data for the same region of interest and with 3% lower than national reported incidence in the same time period. If we consider the osteoporotic hip fracture in women as reference for the risk category, an upgrade from low to moderate risk could be necessary(1). The higher number of hip fractures included in our

analysis (second diagnostics and 3.81% error of reporting) was translated into an erroneous similarity between the incidence of all hip fractures (low and high-energy) found and the NIPH reported incidence by the compensating 4.85% rate of exclusion.

The incidences found in our study are higher than previously reported incidences in nationwide studies (6, 8). A description of studies/reports regarding hip fracture incidence in Romania is found in Table 4. The first mentioned publication, provided the data for the construction of the FRAX model for Romania (6) and used the 2010 admission registry. The explanation of a lower total hip fracture incidence compared to the osteoporotic hip fracture found could reside in the immaturity of data reporting system in 2010 and a continuously improvement in reporting over the years. The possibility of a more correct registration in the developed areas can be considered. In the most recent published study (8), the inclusion of only surgically treated patients represents the main contributor to the

differences in incidence, based on our finding of a very high percentage of conservatively treated fractures. We can expect that this number is even bigger in other parts of the country, considering the decreased availability of medical facilities in less developed areas. These findings could imply that the national reported incidence, although based on all hip fracture data, is underestimated. The lack of a validation process in the data reporting system and the finding of a 3.81% difference between data retrieved from the hospital archives signify that some imprecision in the accuracy of reporting system exists and it should be incorporated in future incidence estimations at the national level.

The main limitation of our study is the examination of only two regions of the country. Although it is recognized that a national study has more statistical power than a regional one, this study's design is not feasible on a larger scale without a specific National Registry of Hip Fracture.

Another limitation could be the high percentage of urban population that can associate a higher number of hip fractures (18). Also, urban areas can associate an increased number of high-energy hip fractures, mostly vehicle crashes related injuries. We found only less than one quarter of excluded fractures to be secondary to vehicle crashes, the rest of 76.21% not being explained by a difference in the urban/rural population and also we found a higher percentage of excluded patients inversely related with the grade of urbanization.

Other limitation is the hospital-based data used with 46% of the population >40 years old in Romania living in a rural area. Based on studies from Armenia, Georgia, Kazakhstan and Kyrgyzstan that recognized a high rate of patients with hip fractures that did not refer to a hospital (12), from 27-75%, other studies also analyzed data from primary care facilities (5). The main explanation for these findings was the lack of medical facilities for surgical management in Eastern Europe. A more accurate approach for the calculation of incidence of hip fracture would imply a combined hospital and primary care data but currently this approach is unfeasible in Romania. No data from primary care registries or estimations of non-hospitalized fractures were included in the previous nationwide population (6, 8). Choosing a highly urbanized area that associates a higher number of medical facilities is the optimal approach to minimize the non-hospitalized fractures.

The strength of our study resides in the selection of the patients that sustained a hip fracture with minimal energy trauma and also the possibility of making a second analysis of high-energy fractures in

terms of age and gender. Simply verifying all charts enable us to exclude all other causes of hip fracture that interfere with the absolute count.

The difference between the incidences of osteoporotic hip fractures and hip fracture data extracted solely based on ICD 10 codes could signify that the probability of hip fracture estimated by FRAX based on this data needs reevaluation.

In conclusion, the incidence of osteoporotic hip fracture was lower than the incidence based on hip fractures reported codes in the national database, but the incidence of fragility fractures calculated by our group was higher than the incidence reported in previous national studies. Nationwide studies are warranted.

Conflict of interest

The authors declare that they have no conflict of interest.

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