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Risk factors for contralateral hip fractures following femoral neck fractures in elderly: analysis of the Hungarian nationwide health insurance database

İleri yaşlılarda femur boyun kırıklarını takiben kontralateral kalça kırıkları için risk faktörleri: Macaristan ulusal sağlık sigortası veri tabanının incelenmesi

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ABSTRACT

Objectives: This study aims to investigate the significance of demographic and clinical factors on incidence of second (contralateral) hip fracture in elderly Hungarian population using the nationwide health insurance database in Hungary.

Patients and methods: The study included a total of 3,783 patients (917 males, 2,866 females) treated for primary monotraumatic femoral neck fractures caused by low-energy trauma in the year 2000. Cox regression and Kaplan-Meier survival analyses, and log-rank test were performed to evaluate the following prognostic factors: age, gender, place of living, type of primary fracture and surgical intervention, hospital providing treatment for primary fracture, and comorbidities.

Results: A total of 312 patients (8.2%) suffered second hip fractures. The univariate Cox regression analysis showed a significantly higher risk for second hip fracture in patients having advanced age (p=0.001), female gender (p=0.022), living in capital (p=0.024), and having arthroplasty (p=0.001). Advanced age (p≤0.001) and having arthroplasty (p=0.004) were significant risk factors for second hip fractures according to multivariate analysis. Log-rank test showed significantly longer survival in females (p<0.001) than in males and in patients with arthroplasty (p=0.013) compared with those having osteosynthesis.

Conclusion: Identification of high-risk groups for second hip fractures is needed to establish effective prevention strategies. Our study demonstrates that the risk of suffering from second hip fractures is higher in females, elderly population, those living in the capital, and patients having undergone arthroplasty.

Keywords: Elderly population; femoral neck fracture; incidence; risk factors; second hip fracture.

ÖZ

Amaç: Bu çalışmada demografik ve klinik etkenlerin ileri yaşlı Macar nüfusunda ikinci (kontralateral) kalça kırığı insidansı üzerindeki önemi Macaristan'daki ulusal sağlık sigortası veri tabanı kullanılarak araştırıldı.

Hastalar ve yöntemler: Çalışmaya 2000 yılında düşük enerjili travma nedeniyle primer monotravmatik femur boyun kırıkları için tedavi edilen toplam 3.783 hasta (917 erkek, 2.866 kadın) dahil edildi. Aşağıdaki prognostik etkenleri değerlendirmek için Cox regresyon ve Kaplan-Meier sağkalım analizleri ve log sıra testi uygulandı: Yaş, cinsiyet, yaşanan yer, primer kırık tipi ve cerrahi girişim, primer kırık için tedavi veren hastane ve eşlik eden hastalıklar.

Bulgular: Toplam 312 hastada (%8.2) ikinci kalça kırığı vardı. Tek değişkenli Cox regresyon analizi ikinci kalça kırığı için daha yaşlı (p=0.001), kadın cinsiyetli (p=0.022), başkentte yaşayan (p=0.024) ve artroplastisi olan (p=0.001) hastalarda anlamlı derecede daha yüksek risk gösterdi. Çok değişkenli analize göre, daha yaş (p≤0.001) ve artroplastili olmak (p=0.004) ikinci kalça kırıkları için anlamlı risk faktörleri idi. Log sıra testi erkeklere göre kadınlarda (p<0.001) ve osteosentezli olanlara göre artroplastili hastalarda (p=0.013) anlamlı derecede daha uzun sağkalım olduğunu gösterdi.

Sonuç: Etkili korunma stratejileri oluşturmak için yüksek riskli grupların tanımlanması gereklidir. Çalışmamız ikinci kalça kırığına maruz kalma riskinin kadınlarda, ileri yaşlı nüfusta, başkentte yaşayanlarda ve artroplasti geçiren hastalarda daha yüksek olduğunu göstermektedir.

Anahtar sözcükler: Yaşlı nüfus; femur boyun kırığı; insidans; risk faktörleri; ikinci kalça kırığı.

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The literature shows that hip fractures are often accompanied by additional or second hip fractures.[1] The incidence of second hip fractures presents an alternating picture. Some found that it is 2.7% at one year and 7.8% at 8.5 years,[2] others present 5 to 10%,[3] while others conclude that the cumulative incidence is 9% after a year and 20% after five years.[4]

Patients with low-energy hip fracture have an increased risk of suffering subsequent contralateral hip fracture. In recent years several papers highlighted the correlation between risk factors and predictors.[5,6]

Several studies report on gender or age specific incidence of second hip fractures, and also on consequent mortality and the length of time until the second fracture. Among the risk factors; the role of accompanying diseases, bone status, body mass index, residence, Singh index, localization of the fracture, physical functioning, and complications are often studied.[2-4,7,8] On the other hand, little is known about the effect of different settlement types (location of residence) and operation techniques of primary fractures as risk factors of second hip fractures.

A remarkable number of studies focus on the patient material of a single hospital or university clinics, a county, or any other geographical unit, seldom that of a nationwide patient material of a country.[2,4]

Therefore, in this study, we aimed to investigate the significance of demographic and clinical factors on incidence of second (contralateral) hip fracture in elderly Hungarian population using the nationwide health insurance database in Hungary.

PATIENTS AND METHODS

Study design and data source

This retrospective observational cohort study based on data of Hungarian National Health Insurance Fund Administration (NHIFA). The study included a total of 3,783 patients (917 males, 2,866 females) treated for primary monotraumatic femoral neck fractures [International Statistical Classification of Diseases and Related Health Problems (ICD) 10th Revision code: S7200] caused by low-energy trauma in the year 2000. Data were validated and complemented with the help of the hospitals that provided the primary surgical treatment; they checked and confirmed the data from the NHIFA and provided additional information on surgical delay and the exact types of fractures. The resulted database is nationwide containing all patients' data. Patients' demographic and clinical characteristics are shown in Table I.

Hungary runs a compulsory health insurance system, NHIFA, with a single payer. This single payer finances all the Hungarian hospitals through an agreement between NHIFA and individual hospitals. The reimbursement method of the Hungarian hospitals is fee for service in out-patient care and diagnosis related groups in the acute inpatient care. The hospitals send a monthly report containing detailed data of their discharged patients to the NHIFA in order to get reimbursement. Therefore, the financing agency has a unique nationwide dataset, covering all the Hungarian hospitals. The tasks of NHIFA include the analysis of the collected data for quality assurance purposes, thus their processing does not require ethical approval.[9]

Patients diagnosed with femoral neck fracture (S7200 ICD) in the year 2000 were selected for the study. A total of 5,404 records were identified from real word data of NHIFA and sent to hospital control. Of these, 461 records were excluded due to non-response; therefore, 4,943 records were sent back by hospitals to NHIFA. A total of 664 records were excluded from the study because of young age (under 60 years). From the remaining 4,279 subjects, a total of 496 records were excluded owing to missing hospital data (38 records), insufficient data (58 records), diagnosis with old fracture, pathologic hip fracture, other diagnosis (259 records), or second admission and polytrauma (148 records).

Second hip fractures were recorded between 01 January 2000 and 31 December 2008. Study base was restricted to the patients with second hip fractures on the contralateral side. The patients have been followed up until a second hip fracture, or death, or the completion of the study.

The patients' data about the following factors were collected: gender, age, place of living (capital, city with a population over 50,000 people, town with a population less than 50,000 people, or village), hospital providing treatment for primary fracture (capital, city and town, county, national institutes and university clinics), type of primary fracture (extracapsular, intracapsular undisplaced, intracapsular displaced), surgical intervention for primary fracture (arthroplasty, osteosynthesis) and ICD groups of accompanying diseases (presence of 0, 1, 2, ≥3 groups).

Accompanying diseases were classified according to the major groups of ICD 10th Revision [certain infectious and parasitic diseases (A00-B99), malignant neoplasms (C00-97), in situ neoplasms, benign neoplasms and neoplasms of uncertain or unknown

TABLE I

Demographic and clinical features of patients with femoral neck fracture and patients with or without second hip fracture

		Patients without second hip fracture					Patients with second hip fracture						
Prognostic factors	Total patients	n	%	Mean±SD	Median	Min.-Max.	n	%	Mean±SD	Median	Min.-Max.	(Percent of total patients)	Incidence density (1000 person-years)
Patients	3783	3471	100				312	100				8.2	22.36
Age at the time of 1st fracture				77.9±8.5	78	60.0-100.5			80.9±7.4	81.2	62-99.6		
Gender													
Female	2866	2603	75				263	84.3				9.2	23.82
Male	917	868	25				49	15.7				5.3	16.84
Age-group													
60-69 (years)	710	657	18.9				53	17.0				7.5	13.55
70-79 (years)	1586	1438	41.4				148	47.4				9.3	23.53
80-89 (years)	1188	1091	31.4				97	31.1				8.2	29.69
90 (years) ≤-	299	285	8.2				14	4.5				4.7	28.83
Place of living													
Capital	828	744	21.4				84	26.9				10.1	27.46
City	630	572	16.5				58	18.6				9.2	25.17
Town	1050	972	28.0				78	25.0				7.4	20.21
Village	1082	1006	29.0				76	24.4				7.0	19.18
Unknown	193	177	5.1				16	5.1				8.3	20.84
Type of hospital providing treatment for the primary fracture													
Capital	816	744	21.4				72	23.1				8.8	24.26
City	1167	1079	31.1				88	28.2				7.5	20.96
National institutes and university clinics	475	427	12.3				48	15.4				10.1	25.75
County	1325	1221	35.2				104	33.3				7.8	21.14
Type of primary fracture													
Extracapsular	436	410	11.8				26	8.3				6.0	18.63
Intracapsular undisplaced	789	722	20.8				67	21.5				8.5	20.21
Intracapsular displaced	2558	2339	67.4				219	70.2				8.6	23.70
ICD groups of accompanying diseases													
0	342	304	8.8				38	12.2				11.1	21.70
1	1705	1556	44.8				149	47.8				8.7	20.78
2	1155	1061	30.6				94	30.1				8.1	25.81
≥3	581	550	15.8				31	9.9				5.3	22.32
Type of surgical intervention for primary fracture													
Arthroplasty	471	410	11.8				61	19.6				13.0	32.73
Osteosynthesis	3312	3061	88.2				251	80.4				7.6	20.76

SD: Standard deviation; Min.: Minimum; Max.: Maximum; ICD: International Statistical Classification of Diseases and Related Health Problems.

behavior (D00-D48), diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89), endocrine, nutritional and metabolic diseases (E00-E90), mental and behavioral disorders (F00-F99), diseases of the nervous system (G00-G99), diseases of the eye and adnexa (H00-H59), diseases of the ear and mastoid process (H60-H95), diseases of the circulatory system (I00-I99), diseases of the respiratory system (J00-J99), diseases of the digestive system (K00-93), diseases of the skin and subcutaneous tissue (L00-99), diseases of the musculoskeletal system and connective tissue (M00-99), and diseases of the genitourinary system (N00-99)].[10] If a patient had more comorbidities in different major ICD 10th groups, they were separately counted according to the number of different major groups.

Statistical analysis

Patients' demographic and clinical characteristics with and without second hip fracture were described. The correlations between prognostic factors and occurrence of second hip fractures were assessed by univariate and multivariate Cox regression analyses. Patients were censored at the time of the first fracture following the contralateral fracture. Results were expressed as hazard ratios (HR) with the appropriate 95% confidence intervals (CI), and p values less than 0.05 were considered statistically significant. Where a significant difference was found between the occurrence of second hip fracture and one of the investigated risk factor, Kaplan-Meier survival analysis and log-rank test were used to compare survival time of patients groups. Statistical analyses

TABLE II

Univariate and multivariate analyses of prognostic factors for second hip fracture

Prognostic factors	Univariate analysis			Multivariate analysis		
	Hazard ratio	95% CI	*p*	Hazard ratio	95% CI	*p*
Age	1.59	1.20-2.10	0.001	1.03	1.02-1.05	0.000
Gender						
Female/Male	1.43	1.05-1.94	0.022	1.27	0.93-1.73	0.14
Place of living						
Capital/village	1.43	1.05-1.95	0.024	1.34	0.89-2.01	0.165
Town/village	1.32	0.94-1.85	0.116	1.24	0.88-1.76	0.227
City/village	1.05	0.77-1.44	0.749	1.00	0.86-1.92	0.983
Unknown/village	1.08	0.63-1.86	0.771	1.06	0.59-1.92	0.851
Type of hospital providing treatment for the primary fracture						
Capital/county	0.99	0.75-1.32	0.951	1.09	0.81-1.46	0.587
City/county	1.14	0.85-1.55	0.380	0.99	0.67-1.48	0.972
National institutes and university clinics/county	1.22	0.87-1.71	0.258	1.00	0.69-1.46	0.992
Type of primary fracture						
Extracapsular/intracapsular displaced	0.86	0.65-1.13	0.275	0.97	0.73-1.28	0.818
Intracapsular undisplaced/intracapsular displaced	0.78	0.52-1.17	0.230	0.84	0.56-1.27	0.416
ICD groups of accompanying diseases						
1/0	0.96	0.67-1.37	0.810	0.86	0.60-1.24	0.423
2/0	1.18	0.81-1.72	0.400	1.04	0.71-1.53	0.845
≥3/0	1.00	0.62-1.60	0.999	0.83	0.51-1.34	0.448
Type of surgical intervention for primary fracture						
Arthroplasty/osteosynthesis	1.60	1.20-2.10	0.001	1.56	1.56-2.09	0.004

CI: Confidence Interval; ICD: International Statistical Classification of Diseases and Related Health Problems.

were performed using the IBM SPSS version 19.0 software (IBM Corporation, Armonk, NY, USA).

RESULTS

The majority of patients (1,586) belonged to the 70 to 79 years age group. The incidence of subsequent hip fracture expressed as cases per 1000 person-years was 22.36. According to the endpoints, 312 (8.24%) second hip fractures occurred and 2,689 (71.08%) patients died without second hip fracture. Other 782 (20.68%) survived the study period without second hip fracture. The mean age of patients' with second hip fracture was 80.9 years. The incidence density was the highest (29.69 1000 person-years) in group of patients aged between 80 and 89 years. Majority of patients with subsequent fracture (80.4%) received osteosynthesis as surgical treatment for primary fracture. Significantly lower incidence density was calculated for osteosynthesis (20.76 1000 person-years) compared to arthroplasty (32.73 1000 person-years) (Table I).

The univariate Cox regression analysis showed significant associations between the occurrence of second hip fractures and female gender (female vs. male, HR=1.43, p=0.022, CI: 1.05-1.94), higher age (years, HR: 1.59, p=0.001, CI: 1.20-2.10), living in the capital (capital vs. village, HR: 1.43, p=0.024, CI: 1.05-1.95), and type of surgical intervention (arthroplasty vs. osteosynthesis, HR: 1.60 p=0.001, CI: 1.20-2.10) (Table 2). In multivariate analysis, higher age (years, HR: 1.03, p≤0.001, CI: 1.02-1.05) and type of surgical intervention (arthroplasty vs. osteosynthesis, HR: 1.56, p=0.004, CI: 1.56-2.09) remained significantly associated with second hip fracture (Table II). No differences were observed regarding the number of groups in terms of accompanying diseases, type of primary fracture or hospital providing treatment for primary fracture (Table II).

When patients' survivals were compared based on different surgical interventions, log-rank test showed significantly longer survival (p=0.013) in patients with arthroplasty (mean survival time: 1,659.75 days) compared with those having osteosynthesis (mean survival time: 1,463.46 days) (Table III, Figure 1b). Females had significantly longer survival (p<0.001) (mean survival time: 1,567.89 days) relative to males

TABLE III

Results of survival analysis and prognostic factors of secondary hip fracture evaluated by Kaplan-Meier survival analysis and log-rank test

	Mean survival time (days)	Median survival time (days)	
Prognostic factors	95% (CI)	95% (CI)	*p*
Gender			
Female	1567.89 (1519.94-1615.83)	1310.00 (1205.42-1414.58)	0.000
Male	1240.64 (1160.41-1320.86)	795.00 (672.24-917.76)	
Type of surgical intervention for primary fracture			
Arthroplasty	1659.75 (1542.65-1776.86)	1528.00 (1239.18-1816.82)	0.013
Osteosynthesis	1463.46 (1419.24-1507.68)	1115.00 (1027.11-1202.89)	
Place of living			
Capital	1519.73 (1431.27-1608.19)	1307.00 (1106.30-1507.69)	0.732
Town	1473.25 (1395.45-1551.04)	1118.00 (963.47-1272.52)	
City	1481.80 (1379.24-1584.37)	1113.00 (920.87-1305.12)	
Village	1456.86 (1379.84-1533.88)	1110.00 (975.65-1244.34)	
Unknown	1599.45 (1410.47-1788.42)	1387.00 (948.46-1825.53)	

CI: Confidence interval.

(mean survival time: 1,240.64 days), but there was no significant difference (p=0.732) in survival of patients living in different places (Table III, Figure 1a and c).

DISCUSSION

Increasing number of the elderly population, besides the growing number of unilateral and bilateral hip fractures, impose a great burden both on the individual and the family, as well as on the health care system.[11] To elaborate effective prevention strategies for second hip fractures, the identification of high-risk groups is essential. In our nationwide study, we evaluated the influence of different demographic and clinical factors on the occurrence of contralateral hip fractures in a Hungarian population over 60 years of age.

The female gender is considered as a risk factor for a second hip fracture.[11,12] We found significantly higher risk in females with univariate analysis, but there were no statistical significance seen with multivariate analysis. The results of the survival analysis confirm the fact that females have longer survival, which may explain their higher risk of second hip fracture. The higher risk in females might be attributable to the earlier onset and higher incidence of osteoporosis. Analyzing the risk factors, Lau et al.[13] reported marginal significance (p=0.05) between female gender and contralateral hip fractures.

Age shows a wide variety in the incidence of second hip fractures. In our study, the risk of subsequent hip fracture increased with higher age. Yamanashi et al.[14] demonstrated no significant difference in the incidence of second hip fracture in relation to age in the Japanese elderly. Angthong et al.[8] reported that the risk for sustaining a second hip fracture was greater in patients over 85 years of age. In practical terms, the role of age is considered to be an influential factor.

Considering the role of the place of living as a risk factor, the increase in the risk of fractures is nearly 50% higher in those living in the capital as compared to that of villagers, and the difference was found statistically significant with univariate analysis. There was no significant difference detectable in survival time between those living in the capital as compared to that of villagers. When Chevalley et al.[15] investigated primary hip fractures, they found that in rural areas, the incidence of hip fracture is significantly higher than in urban areas, whether it be home-dwelling or institutional-dwelling. Sanders et al.[16] considered incidence of all fractures, and demonstrated that fracture rates are lower in rural than in urban communities. They explained the difference in the fracture risk between the two populations with different environmental and lifestyle factors that may have a different impact on bone health. Our data also confirm that, in the older rural population, fracture rate is lower compared to patients living in capital, which may be associated with osteoporosis. The effect of living in city or town was not significant.

According our results, neither the type of primary fracture nor the type of institution providing treatment for the primary care was found to be a risk factor from the point of view of second fractures.

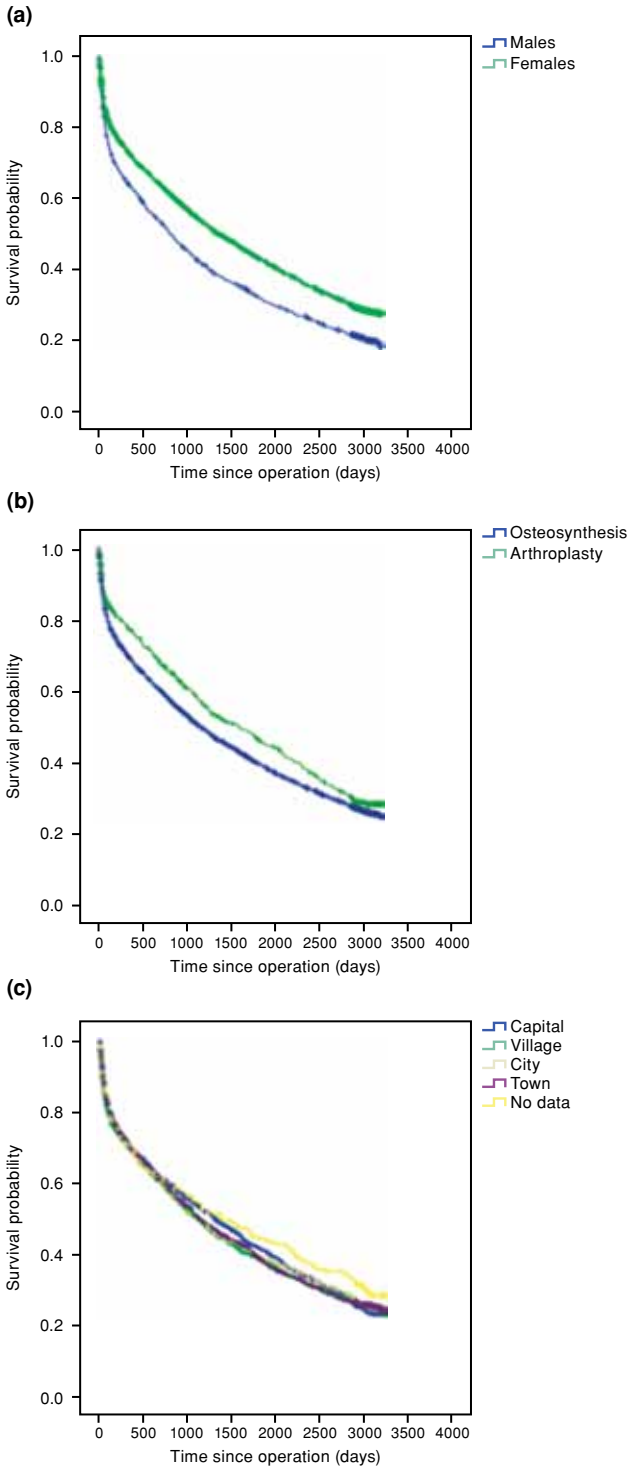

Figure 1. Kaplan Meier survival curves according to gender **(a)**, type of surgical intervention **(b)** and place of living **(c)**.

In the literature, there are few data concerning the effect of the type of surgical intervention for first femoral neck fractures on incidence of second hip fractures.[13] Gao et al.[17] conducted a meta-analysis in which treatment of displaced femoral neck fractures including internal fixation and arthroplasty were investigated in terms of major complications, reoperations, function, pain, and mortality, but not of the occurrence of second hip fractures. According our results, the risk of second hip fractures was 60% higher in patients with hip arthroplasty than in patients undergoing osteosynthesis. The higher risk of second hip fracture in patients with hip arthroplasty could be explained by their longer survival after primary treatment. Patients whose general health status was poor were considered unsuitable for hip replacement, therefore they underwent osteosynthesis. This resulted in a shorter life span for patients with osteosynthesis and a longer life for patients with arthroplasty.

From the aspect of the number of groups in terms of accompanying diseases, there were no associations detected with incidence of contralateral hip fractures, according to the major groups of ICD 10th Revision. In the literature, there are several studies emphasizing the role of comorbid diseases as risk factors of subsequent hip fractures. Higher risk of second fractures was reported among patients with cognitive impairment, lower bone mass, senile dementia, respiratory diseases, and alcoholism.[3,18,19]

This study has several limitations. First, it was not possible to ascertain hip fractures that occurred before 2000. The second limitation was related to the computerized dataset due to the potential bias based on coding practices in national claim database. We tried to reduce this coding bias by controlling the computerized data by the hospital's traumatology and orthopedics departments.

Increased risk of secondary hip fracture was associated with higher age, female gender, living in capital, and having arthroplasty in our nationwide study. Clarifying the role of prognostic factors related to the occurrence of second hip fracture is necessary for the identification of high-risk groups for second hip fracture and elaboration of prevention strategies.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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