The impact of selected demographic variables and disease on the causes and circumstances of femoral neck fracture

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ABSTRACT

Introduction: Proximal femoral fractures are the major cause of hospitalization due to an injury among advanced age patients.
Purpose: To analyse causes of femoral neck fractures.
Materials and methods: The research material included medical documentation of 203 patients with femoral neck fractures. A research method employed in this study was an analysis of the documentation. A statistical analysis was performed using the chi-square test for independence.
Results: The majority of women and men sustained an injury at home or on the way (62.5% and 46.2% respectively). Patients who had an injury at work were largely men. Most injuries were related to a disease. It has been observed that women considerably more often than men mentioned slipping as the cause of an injury (21.3% and 6.9% respectively). Men, on the other hand, more often than women incurred injuries as a result of falls (19.4% and 9. 5% respectively). The structure of an injury was similar irrespective of whether patients were diagnosed as having such diseases as diabetes, cataract and osteoporosis or not.
Conclusions: There is a relationship between gender and the circumstances of an injury. Women more often sustain an injury at home, and men – at work. The circumstances and causes of injuries are not significantly related to diseases such as diabetes, cataract and osteoporosis.
Key words: Falls, osteoporosis, femoral neck fractures

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Received: 11.08.2014
Accepted: 23.10.2014
Progress in Health Sciences
Vol. 4(2) 2014 pp 45-51

INTRODUCTION

Proximal femoral fractures are a growing medical and socio-economic problem. The number of femoral neck fractures is increasing along with the lengthening average lifespan [1]. Femoral neck fractures negatively affect many aspects of patients' life activity, and pose a serious threat to their lives. This applies particularly to osteoporotic femoral neck fractures, which are often the cause of various complications. Therefore, prophylaxis whose aim is to prevent fractures is so important. Examples of preventive actions are adequate lighting, mounting brackets and handrails, avoid slippery floors, sliding pathways and also rugs [2-6].

Femoral neck fractures are mostly observed in advanced age patients with osteoporosis. They are caused by slight injuries sustained during falls; hence the prophylaxis is mainly focused on the prevention, early detection, and treatment for osteoporosis, as well as the avoidance of falls. A diagnosis of osteoporosis as a current pathological bone state should be distinguished from the prognosis of fractures in the further life of the patient. The five-year, ten-year and lifelong risks are determined [6].

One of the most common reasons for hospitalisation and declining self-reliance of the elderly are injuries and fractures resulting from falls. Therefore, it seems reasonable to introduce fall prevention programmes in this age group. One should not forget that such programmes must be adjusted to the needs, standard of living, expectations and environment of the patient [7- 9].

The National Institute for Clinical Excellence, UK recommends that every patient who visits a family doctor or a specialist should be routinely asked about falls during the previous year. All patients reporting at least one fall should be examined in respect of the ability to walk and keep their balance, which can be done by means of recommended clinical tests. It is suggested that a patient should be examined using the same test each time in order to monitor the efficiency of the therapy and compare the examination results [10].

Fall prevention should involve, above all, the provision of adequate environmental conditions adapted to the needs of the elderly [10,11]. Such solutions should correspond to the causes and circumstances of femoral neck fractures.

The purpose of this study is to analyse causes and circumstances of femoral neck fractures in patients hospitalized in the Clinic of Orthopaedics and Traumatology, the Independent Public Clinical Hospital No. 1 (SPSK 1) in Szczecin. The specific objectives of the study was to demonstrate whether there is a relationship between gender, place of residence, presence of selected comorbidities (diabetes, cataracts, osteoporosis, hypertension) and the circumstances and causes of fractures of the femoral neck.

MATERIALS AND METHODS

The research material included medical documentation of patients hospitalized in the Clinic of Orthopaedics and Traumatology, the Independent Public Clinical Hospital No. 1 (SPSK 1) in Szczecin. An analysis of the causes of femoral neck fractures was performed in 203 patients hospitalized between 2007 and 2009.

In the study group, 5.9% had less than 50 years. In the age group between 51-64 years were 13.3% of patients and a group of people between 65 and 80 years were 39.9% of the respondents. The percentage of people with more than 80 years was 40.9%. Most people treated in the department of orthopedics came from cities (83.7%). Residents of the village were 16.3% of the patients. In the study group, 23.2% of people had diabetes, cataracts 20.20%, 15.76% had osteoporosis, and 64.5% of patients had hypertension.

In the study documentation, in 4 of person's cases the cause of fracture was missing, and in 18 cases circumstances of fracture were missing. For this reason, the data on the cicumstances of fractures relate to 185 people. In contrast, data on causes of fractures relate to 199 people. The research method of choice was an analysis of the documentation on hand.

A statistical analysis was performed using the chi-square independence test, which verifies a null hypothesis about the independence of qualitative variables. An alternative hypothesis, on the other hand, presumed the presence of a statistically significant relationship between the selected factors and the circumstances and causes of injuries. The results are presented in tabular terms of Pearson Chi-square and Maximum likelihood estimate. These measures determined by other rules, and that assuming similar values confirm the results. Furthermore, the table shows the number of degrees of freedom (df), and the probability of test (level p) corresponding to the calculated statistics. The significance level was set at α=0.05.

RESULTS

Considering the entire study group, the most common circumstances of the injury is sequentially at home (56.8% of respondents), on the way (34.6% of respondents), at work (6.0% of the respondents) and in hospital (2.7%). The most common cause was illness (eg., post-stroke paresis, psychomotor hyperactivity, idiopathic fracture,

muscle strength or weakness; 25.6% of respondents), balance disorder (18.1% of respondents), slips (16.1% of respondents) fall (13.1% of respondents), fainting/syncope (9.6% of respondents), stumble (9.0% of the respondents) and traffic accidents (8.5% of respondents).

The relationship between gender and the circumstances and causes of an injury

At the first stage of the study, the authors checked whether there was a relationship between patients' gender and the place of an injury. Based on the information collected, it was observed that the majority of women sustained an injury at home (62.5%), and every third patient on the way (32.5%). These circumstances of injuries were also most common among men (46.2% and 38.5% respectively) (Tab. 1).

Table 1. The relationship between selected demographic variables, disease and the circumstances of an injury.

		On the way		At home		At work		In hospital	
		No	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Gander	Women	39	32.5	75	62.5	3	2.5	3	2.5
	Men	25	38.5	30	46.2	8	12.3	2	3.0
Domicile	Urban areas	50	32.1	96	61.5	5	3.2	5	3.2
	Rural areas	14	48.3	9	31.0	6	62.7	0	0
Diabetes	No	50	35.7	79	56.4	8	5.7	3	2.1
	Yes	14	31.1	26	57.8	3	6.7	2	4.4
Cataract	No	53	36.1	80	54.4	11	7.5	3	2.0
	Yes	11	29.0	25	65.8	0	0	2	5.3
Osteoporosis	No	56	35.0	89	55.6	10	6.3	5	3.1
	Yes	8	32,0	16	64,0	1	4,0	0	0
Hypertension	No	28	45.2	25	40.3	7	11.3	2	3.2
	Yes	36	29.3	80	65.0	4	3.3	3	2.4

What drew the authors' attention, however, was the fact that patients of the orthopaedic ward who had an injury at work were mostly men (8 out of 11 subjects). It was found that there was a statistically significant relationship between the gender of the orthopaedic ward patients and the circumstances of an injury ($p<0.05$) (Tab. 2). Women sustained injuries at home considerably more often than men. The latter, on the other hand, more often suffered from injuries at work.

Similarly, the authors performed an analysis of the relationship between gender and the cause of an injury. The results are shown in table 3. In most cases women and men sustained injuries as a result of a disease (e.g., post-stroke paresis, psychomotor hyperactivity, idiopathic fracture, or muscle strength weakness). The proportion in this group was 24.4% women, and 27.8% were men. Furthermore, women considerably more often than men mentioned slipping as the cause of an injury (21.3% and 6.9% respectively). On the other hand, men more often than women had injuries due to falls (19.4% and 9.5% respectively) (Tab. 3). There was a statistically significant relationship between patients' gender and the cause of an injury ($p<0.05$) (Tab. 2), which confirmed previous observations that women's fractures are more often a consequence of slipping, and men's – a result of falls. Falls usually happened at work i.e., the place where injuries were more often sustained by men.

Table 2. The impact of selected demographic variables and disease on the causes and circumstances of femoral neck fracture.

		Chi-square independence test	**P value**	**Maximum likelihood estimate**	**P value**	**df**
Gender and	the circumstances of an injury	9.25378	p=0.0097	8.91778	p=0.0115	2
	the cause of an injury	15.2533	p=0.0183	16.2058	p=0.0127	6
Domicilum and	the circumstances of an injury	18.0122	p=0.0001	15.1166	p=0.0005	2
	the cause of an injury	16.7795	p=0.0101	21.0764	p=0.0017	6
Diabetes	the circumstances of an injury	0.256047	p=0.8798	0.25650	p=0.8796	2
	the cause of an injury	10.23011	p=0.1153	10.2426	p=0.1148	6

Cataract	the circumstances of an injury	4.01878	p=0.1340	6.1488	p=0.0462	2
	the cause of an injury	5.83417	p=0.4420	5.3995	p=0.4936	6
Osteoporosis	the circumstances of an injury	0.474771	p=0.7886	0.4987	p=0.7792	2
Hypertension	the circumstances of an injury	11.95617	p=0.0025	11.740	p=0.0028	2
	the cause of an injury	18.3050	p=0.0055	17.748	p=0.0069	6

Table 3. The relationship between selected demographic variables, disease and causes of an injury.

	Stumbling		**Slipping**		**Fall**		**Equilibrium disorders**		**Collapse / Fainting**		**Disease**		**Traffic accident**	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Gander														
Women	15	11.8	27	21.3	12	9.5	21	16.5	13	10.2	31	24.4	8	6.3
Men	3	4.2	5	6.9	14	19.4	15	20.8	6	8.3	20	27.8	9	12.5
Domicile														
Urban areas	18	10.8	26	15.6	18	10.8	30	18.0	19	11.4	45	27.0	11	6.6
Rural areas	0	0	6	18.8	8	24.8	6	18.8	0	0	6	18.8	6	18.8
Diabetes														
No	10	6.6	22	14.5	22	14.5	29	19.1	17	11.2	37	24.3	15	9.9
Yes	8	17.0	10	21.3	4	8.5	7	14.9	2	4.3	14	29.8	2	4.3
Cataract														
No	11	7.0	26	16.5	19	12.0	30	19.0	16	10.1	41	26.0	15	9.5
Yes	7	17.1	6	14.6	7	17.1	6	14.6	3	7.3	10	24.4	2	4.9
Osteoporosis														
No	15	9.0	27	16.2	24	14.4	32	19.2	17	10.2	37	22.2	15	9.0
Yes	3	9.4	5	15.6	2	6.3	4	12.5	2	6.3	14	43.8	2	6.3
Hypertension														
No	4	5.9	8	11.8	11	16.2	11	16.2	4	5.9	17	25.0	13	19.1
Yes	14	10.7	24	18.3	15	11.5	25	19.1	15	11.5	34	26.1	4	3.1

The relationship between domicile and the circumstances and the cause of an injury

A half of residents of rural areas sustained injuries on the way (48.3%). Most patients from urban areas (61.5%) had an injury at home (Tab. 1). The relationship between domicile and the circumstances of an injury was statistically significant ($p<0.05$).

Fractures being a consequence of a disease for 27.0% of the inhabitants of the city, in the case of the rural population this percentage was 18.8%. The most common cause of an injury among residents of rural areas was falls (24.8%). Such a cause of fracture was mentioned by 10.78% residents of urban areas. Residents of rural areas did not sustain injuries as a result of stumbling, collapse, or fainting at all. More of them suffered from an injury caused by traffic accidents, than it were observed among patients from urban areas (18.8% and 6.6% respectively) (Tab. 2). The results of the chi-square test confirm that there is a statistically significant relationship between domicile and the cause of an injury ($p<0.05$) (Tab. 3). Thus, it can be said that residents of rural areas considerably more often fell down than patients from urban areas. In the latter

group, on the other hand, fractures were more often caused by a disease.

The relationship between the cause and circumstances of an injury and co-existing diseases

Diabetes

Over a half of patients, both with and without diabetes, experienced an injury at home (57.8% and 56.4%). About one-third of patients in both groups sustained a fracture on the way (31.1% and 35.7%) (Tab.1). The structure of an injury sustained in specific circumstances was similar irrespective of whether patients had been diagnosed as diabetic or not ($p>0.05$).

Patients with diabetes mentioned slipping as the cause of an injury (21.3%) considerably more often than those without this disease (14.5%). The latter more often sought the causes in equilibrium disorders (19.1%) and collapse or fainting (11.2%) (Tab. 2). The relationship was not statistically significant (Tab. 3).

Cataract

Both patients with cataract and those without it usually sustained an injury at home (54.4% and 65.8% respectively). Nearly every third patient with cataract incurred a fracture on the way (29.0%). Similar circumstances of an injury were mentioned by over one-third of patients without cataract (36.1%). None of the patients who had a fracture in a workplace suffered from cataract (tab. 1.). With the assumed level of significance, it cannot be clearly said whether the relationship between cataract and the circumstances of an injury was statistically significant ($p>0.05$ for the Pearson chi-square and $p<0.05$ for the maximum-likelihood chi-square).

The causes of an injury turned out to be similar irrespective of whether patients had cataract or not. It was also observed that stumbling was a more common cause of fractures among patients with cataract than in the group without this health problem (17.1% and 7.0%) (tab. 2.). The difference, however, was not statistically significant.

Osteoporosis

Irrespective of whether patients suffered from osteoporosis or not, they usually sustained injuries at home (64.0% and 55.6% respectively) and on the way (32.0% and 35.00% respectively). Fractures at work or in hospital were considerably more often observed among patients without osteoporosis (6.3% and 3.1% respectively) (Tab 1.).

The results of the chi-square test did not confirm a statistically significant relationship between osteoporosis and the circumstances of an injury ($p>0.05$). Osteoporotic and non-osteoporotic patients sustained fractures in similar circumstances.

Respondents with osteoporosis more often mentioned falls as the cause of a fracture, than those without this health problem (14.4% and 6.3% respectively). Similar situation was observed in the case of equilibrium disorders (19.2% and 12.5% respectively) and collapse/fainting (10.2% and 6.3%) (Tab. 2).

Since the criteria for the theoretical frequency for specific cells in the contingency table were not met, it was impossible to use the chi-square test to analyse the significance of the correlation between osteoporosis and the cause of an injury among patients of the orthopaedic ward.

Hypertension

Hypertensive patients usually sustained injuries at home (65.0%), which was also very common among people without hypertension (40.3%). The latter, however, more often suffered from injuries on the way (45.2%). Some 29.3% of hypertensive patients sustained fractures in such circumstances. Among healthy patients, 11.3% had work-related injuries, and among ill patients - 3.3% (Tab. 1).

The authors accepted an alternative hypothesis about a significant relationship between hypertension and the circumstances of an injury ($p<0.05$) (Tab. 3). Hypertensive patients considerably more often sustained fractures at home, and healthy patients – on the way.

It should be pointed out, however, that hypertensive patients more often mentioned stumbling (10.7%), slipping (18.3%), and collapse/ fainting (11.5%) as the cause of a fracture. Healthy patients considerably more often sustained injuries as a consequence of traffic accidents (19.1%) and falls (16.2%) (Tab. 2).

With the assumed level of significance, a null hypothesis was rejected in favour of an alternative hypothesis suggesting a statistically significant relationship between hypertension and the cause of an injury ($p<0.05$).

Thus, it can be said that patients with hypertension considerably more often incurred fractures as a result of stumbling, slipping or fainting, while patients with normotension considerably more often had traffic accidents and mentioned falls as the causes of fractures. Such a situation may be associated with a limited activity of people with hypertension.

DISCUSSION

Analysis of the causes and circumstances of femoral neck fracture and the factors affecting them is extremely important for preventing this type of injury. As stated by Biliński et al. [12] and

Czerwiński et al. [13] this problem usually affects people over 65 years of age. Also, in the study the elderly more often than younger experienced injuries. In the study performed on 203 patients, as many as 164 subjects were over 65 years old. Another important variable is the gender of people who sustained fractures. According to Czerwiński et al. [13], Roszkowska et al. [14], and Jędrzejewski [15] the problem of femoral neck fractures is more common among women, which was also demonstrated by the study described in this article (a group of 203 patients included 128 (63.1%) women). Czerwiński et al. [16] noticed that most women (68.3%) fell outside the home, and 31.7% – at home. Similar results were found in the present study, where 62.5% out of women and 46.1% out of men sustained a fall at home. There was also a significant correlation between gender and the place of an injury. Women were proved to sustain injuries at home considerably more often than men (p=0.009), which however, may be related to the fact that women constituted a substantial part of respondents (63.5%). Falls happening at home might have been associated with inappriopriate environmental conditions and the lack of necessary facilities for elderly people.

Other researchers, such as in the study, investigated or domicile affects the occurrence of tipping over. According to Białoszewski [7] and Cummings [17] residents of urban areas sustained falls more often than those from rural areas, which however was not confirmed by this study. On the contrary, there was a statistically significant correlation showing that residents of rural areas fell considerably more often than their counterparts from urban areas (p=0.010), even though the latter constituted the majority of respondents (170 subjects, 83.7%). Among residents of urban areas, the main cause of the fracture was not a fall, but the disease. There was also a statistically significant correlation between the place of injury and domicile. Residents of rural areas considerably more often incurred fractures on the way, while residents of urban areas – at home (p=0.0001). Fractures noted among residents of rural areas may have been related to architectural barriers as well as a lifestyle which forces people to take very risky actions.

Knowledge of the main causes of femoral neck fracture is very important in the planning of prevention in this area. Czerwiński et al. [13], reported that 50% of falls are caused by slipping or stumbling, 10% – fainting, 10% – vertigo, and 20-30% – other equilibrium disorders. In the study described in this article 16.1% patients suffered from injuries caused by slipping, 9.5% – fainting or collapse, 18.1% – equilibrium disorders.

According to the results of own research and the reports of other authors, prevention of femoral neck fracture should be directed primarily to the elderly. The solutions proposed to avoid falls to at home include non-slip floor mats, proper lighting, toilet safety frames and rails, bathrooms grab bars, and shower seats. It is also important to eliminate loose cables and wires as well as to install shelves so that they do not require excessive reaching (climbing or bending down). The most commonly used things (clothes, household cleaners, food) should be stored on shelves between hip and eye level of an old person. Shoes worn by the elderly ought to have non-slip outer soles. Furthermore, people in bad physical condition should have special orthopaedic appliances such as canes, walkers, rollators etc. It is crucial that elderly people always have hands free; therefore, they should carry backpacks and shoulder bag to cushion potential falls [10,11]. Because the risk factor for fractures is osteoporosis, it is important to recognize the reduced BMD. For the standard place to determine, the diagnosis of osteoporosis and fracture risk was considered to measure BMD of the proximal femur. Measurements in this site are reliable for any age and are now a standard measure for the calculation of the 10-year absolute fracture risk. Another test useful in identifying or exclusion of osteoporosis includes densitometry, which are based on the measurement of X-ray absorption [2,18,19].

In contrast to previous reports, the studies the most common cause of injury (25.63%) was illness (e.g., post-stroke paresis, psychomotor hyperactivity, idiopathic fracture, muscle strength or weakness). Appropriate prevention should go also to the group of people suffering from these diseases.

CONCLUSIONS

1. There is a relationship between patients' gender and the place of an injury. Women more often sustain injuries at home, and men – at work.
2. There is a statistically significant relationship between patients' gender and the cause of an injury, which confirmed previous observations that women's fractures are more often a consequence of slipping, and men's – a result of falls.
3. Residents of rural areas more often incur fractures while walking, and their injuries are a consequence of falls. Fractures sustained by patients from urban areas significantly more often happen at home and are related to a disease.
4. Residents of rural areas more often fell down than patients from urban areas.
5. The circumstances and causes of injuries are not significantly related to such health problems as diabetes, cataract and osteoporosis.
6. Patients with hypertension noticeably more often sustain fractures at home as a result of stumbling, slipping or fainting than people without this health problem.

7. Prevention of femoral neck fracture should be directed mainly to the elderly and to persons suffering from ilness such as post-stroke paresis, psychomotor hyperactivity, idiopathic fracture, muscle strength or weakness and balance disorders. Prevention should involve the provision of adequate environmental conditions to reduce the risk of falling.

Conflicts of interest

The authors declare that there are no conflicts of interest of this paper.

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