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Evaluation of Hip Fracture Risk Factors in Older Adults in the Lebanese Population

Wafa Bawab (PhD)[a*], Mohamad Saad (MSc)[a], Nour Hajjar (MSc)[a], Samar Rachidi (PhD)[a], Amal Al Hajje (PhD)[a], Sanaa Awada (PhD)[a], Pascale Salameh (PhD)[a]

[a] Laboratory of Epidemiological and Clinical Research, Lebanese University, Beirut, Lebanon

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**** Correspondence***
Wafa Bawab (PhD)
Tel: *+961 5 463365*
E-mail1: *w.bawab@hotmail.com*
E-mail2: *wbawab@ul.edu.lb*

ABSTRACT

Background: Hip fractures are serious fall injuries that often result in long-term functional impairment and increased mortality. As the population ages, the number of hip fractures is likely to increase worldwide. The main objective of this pilot study was to evaluate the risk factors of hip fracture among the older adults in the Lebanese population.

Methods: This pilot epidemiological, prospective, and case-control study was performed in 6 hospitals in Great Beirut and South Lebanon. Subjects who met the inclusion criteria filled out a questionnaire consisting on the socio- demographic characteristics, health status, drugs intake and cigarette smoking.

Results: Overall, 195 subjects were recruited, with 65 cases of hip fracture and 130 controls all aged over 50 yr. Females represented around two third of the studied population. The logistic regression, using adjusted odds ratio (OR_a), showed a significant relationship between hip fracture and chronic diseases (OR_a=3.02; 95% CI: 1.63, 6.66), antihypertensive drugs intake (OR_a=2.72; 95% CI: 1.56, 6.42), fall (OR_a=2.79; 95% CI: 1.82, 7.06) previous fracture (OR_a=3.80; 95% CI: 1.57, 9.23) and family history of fracture (OR_a=4.82; 95% CI: 2.29, 10.86). Besides, smoking increased the risk of hip fracture (OR_a=2.55; 95% CI: 1.96, 5.80). Having a bow was associated with the highest risk for hip fracture (OR_a=5.18; 95% CI: 2.30, 12.24).

Conclusions: Elderly people in Lebanon are exposed to many risk factors contributing to hip fracture. Our finding has implication in geriatric health improvement by preventing hip fracture in the Lebanese population.

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Introduction

Hip fractures are sever fall injuries that usually lead to long-term functional impairment, nursing home admission and increased mortality[1,2]. The risks of hip fracture are mainly related either to a decreased bone mass density (BMD) or an increased risk of falls[2]. The majority of hip fractures (90%) occur in people aged 50 yr and older. This is partly due to reduction in the bone mineral density as people become older, but age can also be an independent risk factor since older adults with normal BMD are more likely to suffer from a fracture than younger people[3]. Low BMI is also incriminated in the increase of the incidence of fracture, while a high BMI seems to have a protective effect [4]. Besides, osteoporosis is an important fracture risk factor. It is estimated that an osteoporotic fracture occurs every 3 seconds in the world. At the age 50 years, one in three women and one in five men have already suffered from a fracture. Moreover, about 50% of people with osteoporotic fractures will suffer from fracture reoccurrence [5,6].

In addition, fractures are often caused by falls; the factors that increase the risk of falls thus constitute themselves risk factors of fractures. Risk factors of falls in the elderly include, in addition to intrinsic aging, general weakness, a balance problem, a history of falls, joint problems such as arthritis, cardiovascular problems including a history of stroke, orthostatic hypotension, a neurological disorder such as Parkinson's and Alzheimer's disease, reduced visual acuity, due not only to physiological aging, but also to certain diseases prevalent after age 65 including; cataracts, macular degeneration and glaucoma, vitamin D deficiency, low mobility and gait disorder[7] as well as family history of falls[8] and the incidence of previous fall[8], rheumatoid arthritis[9] renal insufficiency[10], chronic liver disease[11] in addition to asthma and chronic obstructive pulmonary disease[12].

It is also well known that some drug consumptions induce fracture. These drugs are associated either with a significant increased risk of falls or BMD reduction; such as some sedatives, antiepileptic (AE), neuroleptics, antidepressants, anti-arrhythmic, diuretics, anti-hypertensives[2], anti diabetics[13], glucocorticoids[14].

Caffeine decreases discreetly gastrointestinal absorption of calcium and increases its urinary excretion and is harmful to bone. Caffeine is found in coffee, tea, cola drinks and energy drinks[15]. Excessive consumption of caffeine (>four cups

of coffee/day) may be associated with a greater loss of bone mass that increases the risk of osteoporotic fractures[16].

Other life style related factors are excessive alcohol consumption and tobacco smoking. It has been shown that high consumption of alcohol is a fracture risk[17,18]. Fractures are generally four times more common in alcoholic patients. The fracture risk can be explained not only by low bone mass often seen in alcoholic patients but also by accidents and falls favored by excessive alcohol consumption, independently of BMD values[18]. Moreover, since tobacco exposes to a lower BMD, it increases the risk of fracture. Indeed, in postmenopausal women and men, smokers have significantly a lower bone density than non-smokers[19]. Physical inactivity, which can lead to muscle weakness and atrophy, is also associated with an increased risk of hip fracture[2].

In Lebanon, assuming unchanged healthcare parameters, an increasing incidence of hip fracture in people over 50 years of age are expected[20]. All the studies on hip fracture conducted in Lebanon dealt with its epidemiology[20,21]. However, there is lack of data concerning the risk factors leading to hip fracture. Thus, the objective of the present pilot epidemiological study was to evaluate the risk factors for hip fracture among older adults in the Lebanese population.

Methods

Study design and population

This was a pilot epidemiological prospective case-control multicenter study, conducted in Great Beirut and South Lebanon, between March 2013 and June 2013.Cases of hip fracture as well as controls were recruited from 3 hospitals in Beirut (Al Zahraa, Al Makassed and Al Sahel) and 3 hospitals in south Lebanon (Jabal Amel, Lebanese Italian and Hiram).The total number of subjects examined was 195 with 65 cases and 130 controls (case /control ratio = 1/2). Cases with hip fracture diagnosis and controls were found in the surgical departments of the participating hospitals. Controls were matched to cases by gender, age (>40) and region of residence. In addition to the authorization of hospital authorities, oral or written consent was obtained from all participants, according to their education level.

Data Collection

An anonymous questionnaire prepared in Arabic language and filled through an interview with patients and controls enrolled in the study; additionally, some information was taken from the patients' medical charts. The questionnaire was composed of 42 main questions including: general information about the participants (age, sex, height, weight, etc…), BMI was calculated by dividing the weight in kilograms by height in squared meter; followed by health and medical status, history and previous falls, smoking habit, physical activity (3 or more times a week), and alcohol and caffeine intake (>4 cups daily). A pre-survey was conducted among a small sample in the different hospitals to test the understanding and acceptability issues of the questionnaire. Following this pre-survey, some questions were reworded.

Statistical Analysis

Data were entered and analyzed using the statistical software SPSS (Statistical Package for Social Sciences), version 21. A *P*-value <0.05 was considered significant. The chi-square test was used to compare qualitative variables. Student's *t*-tests were used with quantitative variables. Moreover, a logistic regression, using a forward stepwise method, was applied taking hip fracture as the dependent variable and several independent variables into account. The adjusted odds ratios were calculated with their 95% confidence interval.

Results

Study population characteristics

Overall, 190 patients were included, among which 65 [20 (31%) males and 45 (69%) females] had hip fracture and 130 (40 males and 90 females) were controls. The ratio cases versus controls were 1/2. Females with hip fracture were 2.2 times higher than males. The mean age was higher in females 74.4 ±10.5 for cases and 74.7 ±12.2 for controls than in males 65.1±13.2 and 65.4 ±11.8, respectively (Table 1). Concerning BMI, we found no difference in the mean of BMI between cases 27.4 ±4.55 and controls 27.2 ±4.25. Most participants lived with their families in both cases (90.7%) and controls (97.7%). Regarding the profession most participants were non-workers with 44 cases (67.7%) and 76 controls (58.4%). Approximately, the distribution was equal between the two areas of residence with 47.7% from South Lebanon and 52.3% from Great Beirut (Table 1).

Table 1: Characteristics of the study population by cases (n=65) and controls (n=130)

Characteristics	Cases		Controls	
	Number	Percent	Number	Percent
Gender				
Males	20	30.8	40	30.7
Females	45	69.2	90	69.3
Living				
Alone	4	6.2	3	2.3
Family	59	90.7	127	97.7
Other	2	3.1	0	0.0
Profession				
Worker	20	30.8	20	15.4
Non-Worker	44	67.7	76	58.4
Retired	1	1.5	34	26.2
Area of residence				
Great Beirut	34	52.3	68	52.3
South	31	47.7	62	47.7
Hospitals				
Al-Zahraa	11	16.9	22	16.9
Al-Sahel	13	20.0	26	20.0
Makassed	10	15.3	20	15.3
JabalAmel	18	27.7	36	27.7
Lebanese Italian	9	13.9	18	13.9
Hiram	4	6.2	8	6.2
	Mean	**SD**	**Mean**	**SD**
Males age (yr)	65.1	13.2	65.4	11.8
Females age (yr)	74.4	10.5	74.7	12.2
Body mass index (kg/m^2)	27.4	4.3	27.2	4.3

Effect of History, Heredity and Health status on hip fracture

Genetic predisposition such as family history of fracture and osteoporosis were significantly associated with hip fracture (*P*<0.001). In addition, 24 (37%) of cases versus 14 (10.8%) of the controls had a family history of fracture. Similarly, 14 (21.5%) of the cases versus 7 (5.4%) of the controls had a family history of osteoporosis. Cases 12 (18%) versus controls 11 (8.5%) were osteoporotic (*P*=0.041). Previous fracture was significantly associated with hip fracture (*P*<0.001), since 30 of the cases (46.2%) versus 21 of the

controls (16.2%) have had previous fracture. Falls were significantly associated with hip fracture (P<0.001) by comparing cases 27 (41.5%) and controls 16 (12.3%). Moreover, 20 (30.8%) of the cases had a bow and 24 (36.9%) had vertebral pain versus respectively 5 (3.8%) and 17 (13.1%) of controls (P<0.001) (Table 2).

Table 2: Association between history, heredity and diseases with hip fracture

	Hip Fracture (n=65)		Controls (n=130)		
Characteristics	**Number**	**Percent**	**Number**	**Percent**	***P* value**
Family history of Fracture	24	36.9	14	10.8	0.001
Family history of Osteoporosis	14	21.5	7	5.4	0.001
Osteoporosis	12	18.4	11	8.5	0.041
Previous fracture	30	46.2	21	16.2	0.001
Falls	27	41.5	16	12.3	0.001
Bow	20	30.8	5	3.8	0.001
Vertebral Pain	24	36.9	17	13.1	0.001
Chronic disease	45	69.2	43	33.1	0.001
Heart diseases	30	46.2	32	24.6	0.002
Diabetes	13	20.1	10	7.6	0.012
Endocrine Diseases	4	6.1	1	0.8	0.025
Chronic Liver Disease	3	4.6	0	0.0	0.110
Asthma	6	9.2	4	3.1	0.087
Rheumatoid Arthritis	7	10.7	17	13.1	0.644
Kidney Failure	4	6.1	6	4.6	0.734

There was astatistically significant association between hip fracture and chronic diseases in general, where cases 45 (69%) versus controls 43 (33%) had chronic diseases (P<0.001) (Table 2). Moreover, we could observe a statistically significant association between hip fracture and heart diseases (P=0.002), where cases represent 30 (46%) and controls 32 (25%), then 13 (20%) of cases versus 10 (8%) of controls suffered from diabetes with (P=0.012). In addition, a significant association of endocrine diseases with hip fracture was found (P=0.025). Only 3 (2%) cases but no controls had chronic liver disease (P=0.110). Asthma tended to be significantly associated with hip fracture (P=0.087), where 6 (9%) of cases versus 4 (3%) of controls suffered from asthma. We observed no statistically significant association between hip fracture and rheumatoid arthritis and kidney Failure (P=0.644 and P=0.734, respectively).

Association of coffee, drugs and supplements intake with hip fracture

Table 3 shows that 37 (72%) of hip fracture subjects, and 55 (42%) of controls drank coffee (>4 cups daily). X^2 test showed a statistically significant association between hip fracture and coffee drinking (P=0.012). Hip fracture subjects (23.1%) and (4.6%) of controls took 2 corticosteroid injections before minimum 6 months of fracture date (P<0.001). Similarly, 27 (41.5%) of cases and 22 (16.9%) of controls took antihypertensive drugs (P=0.016). A significant association was also found with anti-depressants, where 5 cases (7.7%) and only one of the controls took anti-depressants (P=0.016). Diabetic drugs were used by 12 (18.5%) of cases and 10 (7.7%) of controls (P=0.025). No statistically significant association was shown with the intake of anti-epileptic drugs, stomach or bone protection drugs, such as vitamin D, and calcitonin (P=0.057); only calcium showed a significant association (P=0.042) (Table 3).

Table 3: Association between coffee, drug and supplement intake and hip fracture

	Hip Fracture(n=65)		Controls (n=130)		
Drug type	**Number**	**Percent**	**Number**	**Percent**	***P* value**
Coffee consumption>4 cups daily	47	72.3	55	42.3	0.012
Corticosteroids	15	23.1	6	4.6	0.074
Antihypertensive Drugs	27	41.5	22	16.9	0.001
Anti-Depressant	5	7.7	1	0.8	0.016
Antidiabetic agents	12	18.5	10	7.7	0.025
Stomach Protection	9	13.8	13	10.1	0.424
Bone Protection	4	6.2	13	10.1	0.369
Calcium	9	13.8	12	9.2	0.042
Vitamin D	7	10.8	19	14.6	0.456
Calcitonin	1	1.5	6	4.6	0.428
Multi-Vitamins	6	9.2	12	9.2	1.000
Anti-Epileptic drugs	2	3.1	3	2.3	1.000

Physical activity and Alcohol consumption effect on hip fracture

We found that only 17% of hip fracture subjects and 28% of controls practice leisure physical activity (P=0.097). Besides, only three subjects with hip fracture and 2 subjects of controls drank alcohol (P=0.336).

Effect of smoking on hip fracture

Most of hip fracture subjects 35 (54%) smoked, while 42 (32%) of the controls smoked (P=0.004). Moreover, we could observe a significant association (P=0.001) between the dependent factor “hip fracture” and the amount of tobacco smoked (>20 cigarette/day), as shown in Table 4.

Table 4: Effect of the amount of cigarette smoked on hip fracture (P=0.001)

	Hip Fracture (n=65)		Controls (n=130)	
Number of cg/day	**Number**	**Percent**	**Number**	**Percent**
<5 cg	4	6.2	8	6.1
5-10 cg	2	3.1	2	1.5
10-15 cg	6	9.2	3	2.3
15-20 cg	8	12.3	6	4.6
>20 cg	15	23.1	23	17.8
Total number of smokers	35	53.8	42	32.3

Logistic regression

The logistic regression, using adjusted odds ratio (OR_a) showed a significant relationship between hip fracture and chronic diseases (OR_a=3.02; 95% CI: 1.63, 6.66), antihypertensive drugs intake (OR_a=2.72; 95% CI: 1.56, 6.42), fall (OR_a=2.79; 95% CI: 1.82, 7.06) previous fracture (OR_a=3.80; 95% CI: 1.57, 9.23) and family history of fracture (OR_a=4.82; 95% CI 2.29, 10.86). Besides, we found that smoking increased the risk of hip fracture (OR_a=2.55; 95% CI: 1.96, 5.8). Having a bow had the highest risk for hip fracture (OR_a=5.18; 95% CI: 2.30, 12.24). This model explained 52% (adjusted R^2 = 0.52) of the older adults hip fracture variability (Table 5).

Table 5: Hip fracture predictors as shown by the multivariate analysis

Independent variables	**Adjusted OR**	**CI 95%**	***P* value**
Chronic Disease	3.02	1.63, 6.66	0.013
Smoker	2.55	1.96, 5.80	0.026
Previous Fracture	3.80	1.57, 9.23	0.003
Fall	2.79	1.82, 7.06	0.029
Bow	5.18	2.30, 12.24	0.008
Family Fracture	4.82	2.29, 10.86	0.001
Antihypertensive Drugs	2.72	1.56, 6.42	0.030

Discussion

In the present work, we have done a pilot prospective study to address the risk factors for hip fractures among older adults in Lebanon. Among cases hospitalized during the period of our study and the hospitals in which the study was done, females account for 69.2% as compared to men 30.8%. This is not surprising since the incidence of bone fractures is found to be two to three folds higher in women as compared to men[22].This may be the result of that women experience a rapid phase of bone loss during the first 5-10 years after menopause, due to the loss of estrogen hormone[23]. In Lebanon, the prevalence of vertebral fractures between age 65 and 85 yr was estimated at 19.9% (15.4% to 25.0%) in women and in 12.0% (7.3% to 18.3%) in men[24].

Low BMI is associated with a significant increase in fracture risk in both men and women, irrespective of BMD and after adjusting for age[4]. But this is not confirmed by our study since the mean BMI was almost equal between cases and controls (cases = 27.4 years; controls = 27.2 years), this show no significant difference (P=0.735). Then by dividing BMI into classes, it also gives no statistically significant results (P=0.323). Baddoura et al. also failed to observe statistical significant association of BMI with vertebral fracture in the Lebanese population[24].

A history of fragility fracture greatly increases the risk of a subsequent fracture. Women with a history of fracture at any site had a risk of fracture greater compared to women without previous fracture[8]. This was highly in concordance with our results demonstrating significant increased risk of hip fracture in subject who has previous fracture (OR_a=3.8; 95% CI: 1.57, 9.23). This also constitutes a risk of vertebral fracture in Lebanon[24].

Falls also increases the risk of hip fracture (OR_a=2.79; 95% CI: 1.82, 7.06). According to Deandra et al., factors that increase the risk of falls constitute themselves a risk of fracture[7].

We have shown that family history of fracture significantly increased the risk of hip fracture (OR_a=2.72: 95% CI: 2.29, 10.86). In bivariate analysis we also showed an association between family osteoporosis and hip fracture (P<0.001). A parental history of fracture or hip fracture in women confers a risk of future fracture and that the risk is largely independent of BMD[25].

We demonstrated for the first time, that having a bow had the highest risk for hip fracture (OR_a=5.18; 95% CI: 2.3, 12.24). The effect of having a bow on osteoporotic fracture has not been previously investigated. This relation is maybe due to improper posture while standing, which increases the risk of falls.

Coffee consumption does not show any statistically significant results in the multivariate analysis. However, in the bivariate analysis the association was clear and highly significant between hip fracture and excessive coffee drinking (P=0.012). Coffee decreases discreetly gastrointestinal absorption of calcium and increases its urinary excretion. In subjects consuming large amounts of cola (rich in caffeine), there exist a positive association with hip fracture risk. Excessive consumption of coffee (more than four cups of coffee per day) may be associated with a greater loss of BMD significantly and a significant increase in the risk of osteoporotic fractures occurs[16].

Chronic disease incidence increases as people get older and then they start taking drugs to control their diseases. In our study, the bivariate association of chronic diseases with hip fracture shows a significant association. This is confirmed by the logistic regression analysis (OR_a=3.02; 95% CI: 1.63, 6.66). Also, heart disease, diabetes and endocrine diseases have shown significant association with hip fracture in the bivariate analysis, further investigation are needed to confirm these results and to understand the reason of these associations, to have a deeper insight into whether is it because of the drug used in these diseases or of the pathology itself. Anti-hypertensive drugs for example can potentially cause a dizzy spell when blood pressure falls suddenly when standing. The effect occurs over a short time and may lead to falls, and breaking a hip[26]. It was clear in our study that antihypertensive drugs increased the risk of hip fracture (OR_a=2.72; 95% CI: 1.56, 6.42). The bivariate analysis shows also a significant association between the uses of anti-diabetic drugs with the risk of hip fracture. An association between anti-diabetic drugs and the risk of hip and wrist fracture in diabetic women has been shown [13].

Our study showed a significant association between the corticosteroids uses and the risk of hip fracture using bivariate analysis. It is well known that corticosteroids induce secondary osteoporosis because of bone loss and the risk of fracture[14]. Concerning other drugs such as the antiepileptic drugs, we found no significant association with hip fracture. This is in contradiction with other studies showing that antiepileptic drugs increase the risk of hip fracture and falls [27]. Some other factors studied have shown no conclusive results, such as some diseases like; endocrine diseases, chronic liver diseases, asthma, rheumatoid arthritis, kidney failure, and the use of some drugs such as stomach and bone protection drugs and vitamins. This is most probably due to the size of the participants recruited.

Our results showed a highly statistically significant association between smoking and hip fracture (OR_a=2.55; 95% CI: 1.96, 5.8), with a trend towards a dose-effect relationship. In another study and regardless of age, BMI and BMD, current smoking was associated with a significantly increased risk of hip fracture (RR=1.84; 95% CI: 1.52, 2.22). Indeed, the adverse effect of smoking on bone is durable, and even continues after stopping smoking[19]. Excessive alcohol consumption is an important fracture risk[18]. Our results however cannot be conclusive in this field, since only three subjects with hip fracture and 2 of the controls drink alcohol.

This study has several limitations: although we have no means to prove the representativity of the sample, we have no reasons to believe that the sample is biased since we took all cases from all socioeconomic levels in 6 different hospitals of the capital Beirut and the Southern region; however, results may not be extrapolated to other regions of Lebanon such as the North or the Bekaa Plain. Nevertheless, a selection bias is still possible due to refusal of some individuals to participate to the study. Moreover, the small sample size can lead to non-significant results in the estimation of relationships between risk factors for hip fracture. We also note that we tried to insert first degree interaction terms in the model, but they were removed due to non-significance. In addition, the low R2 may be due to a number of unmeasured factors that con-

tribute to hip fracture variability; we suggest further studies that take into account these issues.

Conclusions

Many potential risk factors for hip fractures in the Lebanese population have been identified as contributing to the rising incidence of hip fractures; we suggest public health interventions focusing on encouraging physical activity participation to promote muscle strength among all community-dwelling younger and older adults, regardless of health status.

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Conflict of interest statement

No potential conflicts of interest were disclosed.

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