Journal of Clinical Densitometry, vol. 7, no. 4, 368–375, 2004

1094-6950/04/7:368–375/$25.00

Original Article

Hip Fractures in Lebanese Patients

Determinants and Prognosis

Haitham Hreybe,[1] Mariana Salamoun,[1] Mohamad Badra,[2] Nadim Afeiche,[2] Omar Baddoura,[2] Suhayl Boulos,[2] Rachid Haidar,[2] Suhayl Lakkis,[2] Ramzi Musharrafieh,[2] Afif Nsouli,[2] Assa'd Taha,[2] Ahmad Tayim,[2] and Ghada El-Hajj Fuleihan*[*,1]

[1]Calcium Metabolism and Osteoporosis Program, Department of Internal Medicine and [2]Department of Orthopedics, American University of Beirut Medical Center, Beirut, Lebanon.

Abstract

Hip fractures are the most costly of osteoporotic fractures, but little is known about their epidemiology in the Middle East. Hip fracture patients and controls with osteoarthritis admitted to our institution from 1992 to 2002 were studied. Information on gender, age, type of fracture, comorbid conditions, and medications use was obtained. The mean age for hip fracture patients (n = 274) was 72.1(8.5) yr, and for controls (n = 112), it was 71.1(4.4) yr, two-thirds of fractures occurred in women. Fractures were 59% intertrochanteric, 34% femoral neck, and 7% subtrochanteric, with no gender differences. Hip fracture patients were more likely to have had a prior fracture and to suffer from neurological, gastrointestinal, or renal comorbidities, as compared to controls. Less than 10% of hip fracture patients received any therapy for osteoporosis, either on admission or discharge. In a subset of patients with follow-up, the mortality rate was 47% in subjects with hip fracture, and most deaths occurred within the first year postoperatively. Gender but not fracture type affected mortality. Lebanese patients with hip fractures are younger, more likely to sustain intertrochanteric fractures, and experience higher mortality than Western counterparts. Few subjects received osteoporosis therapy. This study carries important public health implications on the management of hip fracture in subjects from Lebanon and, possibly, the Middle East.

Key Words: Care gap; gender; hip fracture; Middle East; mortality.

Introduction

Because of the demographic explosion and the aging population, chronic noncommunicable diseases, including osteoporosis, are accounting for an increasing proportion of all causes mortality and morbidity *(1)*. Although the leading cause of death worldwide and in the Middle East is cardiovascular diseases, osteoporotic fractures are and will continue to increasingly incur a significant human and economic cost on society, in general, and in the Middle East, in particular *(1)*. Indeed, the annual incidence of osteoporotic fractures in the United States is 10 times that of breast cancer and at least 3 times that of myocardial infarction *(1)*. Although all fractures carry a high morbidity, the most costly of all is, undoubtedly, the hip fracture. It is estimated that 18–33% of hip fracture subjects will die within the first year and 50% of patients lose functional dependence *(2–8)*.

Received March 03/04/04; Revised 06/23/04; Accepted 06/24/04.
* Address correspondence to Ghada El-Hajj Fuleihan, MD, MPH, Calcium Metabolism and Osteoporosis Program, American University of Beirut Medical Center, Bliss Street, Beirut, Lebanon. E-mail: gf01@aub.edu.lb

Osteoporotic fractures cost more than $10 billion to the US economy yearly, thus exceeding the Medicare budget.

There are wide geographic variations in hip fracture incidence worldwide, and data from the Middle East on this type of fracture are scarce *(1)*. Based on a survey conducted a few years ago in Lebanon, it was estimated that the annual number of osteoporotic hip fractures would be 1500 per year *(9)*. The projected corresponding annual costs for surgical care only amounts to a substantial proportion of the overall annual budget of the national budget for hospitalization. To date, very little is known about the epidemiology of hip fractures in the region and what the most significant risk factors are. Therefore, the relevance of guidelines generated in Western countries, based on bone mineral density (BMD) and risk factors in Western Caucasians, to subjects in the region is unclear. This knowledge gap constitutes a major stumbling block in the management of individuals at risk for fractures, in the implementation of public health preventive measures, as well as in the allocation of health resources, both at regional and national levels. In this study, we aimed to investigate the epidemiology of hip fractures in patients admitted to our institution between 1992 and 2002. Specifically, we evaluated the following:

1. Clinical risk factors for hip fractures such as age, gender, comorbid conditions, previous fractures, and intake of medications
2. The morbidity and mortality rates after-hip fractures in Lebanese patients

Materials and Methods

Design and Subject Selection

A retrospective study was based on review of medical records at the American University of Beirut Medical Center, a tertiary university-based referral center. The study group of interest was all hip fracture subjects admitted to the center from 1992 to 2002, with an age >50 yr in an attempt to capture presumed osteoporotic hip fractures. The International Classification of Diseases (ICD) codes used to identify hip fractures were as follows: 820.32, subtrochanteric open; 820.22, subtrochanteric closed; 820.21, intertrochanteric closed; 820.31, intertrochanteric open; 820.09, femoral neck closed; 820.19, femoral neck open. In order to select patients receiving care from the same group of providers (i.e., orthopedic surgeon), the control group included patients admitted with osteoarthritis (OA) admitted to the hospital center during the same period for total hip replacement (THR), excluding THR for patients with hip fractures. Controls with an age <68 yr were excluded, in order for the study patients with hip fractures and the controls to have a similar mean age. Indeed, it was very important to eliminate the age difference because of one of the main objectives of this study was to investigate mortality and morbidity after hip fracture compared with controls. The number of patients admitted with hip fractures and of controls fulfilling the above criteria during that period was 274 and 112, respectively. Information provided as baseline data was available on all subjects and controls as described earlier. The study was approved by the Institutional Review Board at the American University of Beirut.

Survey Data

Lifestyle Factors and Clinical Profile

The following relevant clinical information that is routinely captured in the standard format of our center's medical records were gathered for all subjects and controls: date of birth, gender, smoking status and alcohol consumption (both documented as yes/no), history of previous peripheral fractures, presence or absence of comorbid conditions (endocrine, neurologic, renal, cardiovascular, pulmonary, gastrointestinal, and hematologic), and length of hospital stay (in days). This information was captured from multiple sources in the standardized forms of the medical records at our center and was available on all subjects and controls. The forms included physician's admission form, nurse's admission form, review of system form, and problem list and discharge diagnosis form. Also gathered was information on intake of any of the following medications on admission: thyroid hormone, anxiolytics, sleeping pills, corticosteroids, and medications for osteoporosis prevention and treatment, including calcium, vitamin D, hormone replacement therapy, selective estrogen receptor modulators, bisphosphonates, and calcitonin. The same information was obtained regarding osteoporosis medications on discharge. Information on medication intake was gathered from multiple sources in the standardized medical record forms: physician's form medication section, nurse's admission form medication section, admission medication orders, discharge form, and discharge medications form. The telephone number of the patient and name of treating physician were noted to facilitate the contact with the patient/family regarding morbidity and vital status postfracture, as assessed through telephone contact.

Hip Fracture Characteristics

The following information concerning hip fracture was collected: age at fracture, type of fracture as detailed in the radiographic, operative, as well as discharge diagnosis records, whether this was first or second hip fracture (ipsilateral vs contralateral), the type of intervention (nailing vs THR vs hemiarthroplasty), and the year of fracture.

Follow-Up Information on Mortality and Morbidity

Patients, controls, or their next of kin in case of death were contacted by telephone during the period December 2002 to February 2003 to obtain information regarding morbidity and mortality. They were questioned on the following morbidities postadmission for hip fracture or THR: pneumonia, deep-vein thrombosis, pulmonary embolus, decubitus ulcers, and sepsis. Vital status was captured from patients or next of kin in case of death as dead/alive within 1-yr posthospitalization for hip fracture or THR, or beyond 1 yr.

Statistical Analyses

Simple Statistics

A comparison between the main continuous variables such as age, between the various subgroups (fracture and THR non-hip-fracture controls, male vs female hip fractures, various subtypes of hip fractures) was conducted using a two-tailed Student's *t*-test. Chi-square analyses were conducted between

Table 1
Clinical Characteristics of Hip Fracture Patients and Controls

	Hip fracture	Controls	p^a
Number	274	112	
Age (yr)	72.1 (8.5)[b]	71.1 (4.4)	NS
Trochanteric fracture	73.0 (8.0)		NS
Cervical fracture	72.0 (9.0)		
	n (%)	*n* (%)	
Gender (M/F)	75 (28%)/164 (62%)	37 (33%)/75 (67%)	NS
Smoking	106 (38%)	49 (43%)	NS
Alcohol consumption	38 (13.8%)	16 (13.1%)	NS
Neurological conditions	36 (13%)	5 (4%)	0.012
Renal conditions	15 (5.8%)	1 (0.9%)	0.04
Gastrointestinal conditions	16 (5.9%)	1 (0.9%)	0.03
History of previous fracture	31 (11%)	2 (2%)	<0.0001
Length of hospital stay (d)	9.2 (7.0)	9.2 (4.0)	NS

[a] *p*-Value or *t*-test or χ^2.
[b] For continuous variables, numbers are expressed as mean ± SD.
Note: NS: values are statistically insignificant, $p > 0.05$.

subgroups to compare prevalence of ordinal variables: smoking, alcohol abuse, medications intake, comorbid conditions, type of fractures, type of intervention, and intake of meds on admission or discharge.

Logistic Regression

A logistic regression model, stepwise as well as all enter model, was used to further evaluate the relative impact of the significant predictors, as determined by chi-square or *t*-test on hip fracture risk and on mortality after-hip fracture. These predictors included age, gender, history of previous fractures, intake of calcium on admission, and presence of comorbid conditions. The latter was expressed as prevalence of individual significant comorbid conditions on univariate analyses, or as the total number of comorbid conditions.

The analyses were performed using SPSS software version 10.0 (SPSS, Chicago, IL). Numbers were expressed as means ± SD, significance was at $p < 0.05$; *p*-values were unadjusted for multiple testing.

Results

Clinical Characteristics of Patients and Predictors of Fractures

The clinical characteristics of the hip fracture patients and controls are shown in Table 1. The mean age for hip fracture patients was 72.1(8.5) yr (range: 50–84 yr) and was 71.1(4.4) yr (range: 65–83 yr) for controls. The mean age was not different by type of hip fracture, with a high proportion being women (62%). Whereas the majority (i.e., 89%) of all hip fracture patients had no history of a previous fracture, the remainder reported a previous fracture prior to current admission at the following sites: 69% had a fracture in the contralateral hip, 16% had an arm fracture, 4% had a leg fracture, 2% had a fracture of the pelvis, and 2% had a fracture of the ipsilateral hip. Hip fracture patients were more likely to have sustained a previous peripheral fracture compared with controls (Table 1).

Because of the design of the control group selection, there was no significant difference in the mean age of patients with hip fractures and controls. There was also no significant difference between patients and controls in gender distribution, smoking, alcohol consumption, or length of hospital stay (Table 1). There was no difference between patients and controls in the intake of medication known to cause bone loss or increase fracture risk including intake of thyroid hormone, anxiolytics, and sleeping pills. However, hip fracture subjects were more likely to suffer from comorbid conditions: 13% of hip fracture subjects suffered from neurological disorders, 5.8% from renal disorders, and 5.9% from gastrointestinal conditions, compared with 4%, 0.9%, and 0.9% in the control group for the same conditions, respectively. Similar analyses conducted by gender subgroups revealed that the higher prevalence of neurological and renal disorders among hip fracture patients compared with controls was mostly the result of the high prevalence of these disorders in male but not female hip fracture subjects. Indeed, 19 out of 110 (17%) of male hip fracture subjects had neurological problems as compared to 1 out of 37 (2.7%) of controls, and 11 out of 110 (11%) male hip fracture subjects had renal disorder as compared with 0 out of 37 controls, $p < 0.03$ and <0.05, respectively. Information regarding the intake

Table 2
Intake of Medication for Osteoporosis Upon Admission and Discharge

	Cases [*n* (%)]	Controls [*n* (%)]	p^a
On Admission			
Calcium supplementation	14 (5%)	18 (16%)	<0.0001
Vitamin D supplementation	7 (3%)	5 (4.5%)	NS
Bisphosphonates	3 (1.1%)	4 (3.6%)	NS
Calcitonin	1 (0.4%)	0 (0%)	NS
Hormone replacement therapy	0 (0%)	0 (0%)	NS
Raloxifene	1 (0.4%)	0 (0%)	NS
On Discharge			
Calcium supplementation	20 (7.3%)	18 (16%)	0.009
Vitamin D supplementation	10 (3.6%)	5 (4.5%)	NS
Bisphosphonates	3 (1.1%)	4 (3.6%)	NS
Calcitonin	0 (0%)	0 (0%)	NS
Hormone replacement therapy	1 (0.4%)	0 (0%)	NS
Raloxifene	1 (0.4%)	0 (0%)	NS

[a] *p*-Value or *t*-test or χ^2.
Note: NS: values are statistically insignificant, $p > 0.05$.

of calcium, vitamin D, or medications for osteoporosis either on admission or discharge revealed that the proportion of hip fracture subjects taking any of those was very low, less than 8%, and was significantly lower for calcium tablet intake in hip fracture subjects compared to controls both on admission and discharge (Table 2). In 1995, densitometry became available in Lebanon and awareness about osteoporosis increased. There was an increase in the proportion of hip fracture patients receiving calcium supplementation on admission between the period before 1995 and the period after 1995, increasing from 2.1% to 8.7%, $p = 0.013$. Similarly, there was an increase in the proportion of hip fracture patients receiving calcium supplementation on discharge between the period before 1995 and the period after 1995, increasing from 3.4% to 11.4%, $p = 0.07$.

Type of Fracture and Surgery Performed

Fifty-nine percent of all hip fractures were diagnosed as intertrochanteric, whereas 34% occurred at the femoral neck and 7% were subtrochanteric. Most patients with hip fractures (i.e., 75%) underwent internal fixation for their fracture, 20% underwent hemiarthroplasty, and 5% had a THR. Similar analysis by gender subgroups revealed no significant difference among males and females in term of type of fracture and type of surgery performed.

Multivariate Analyses for Correlates of Hip Fracture Risk

The following correlates of hip fractures were entered in the multivariate model to determine predictors of fracture risk: age, gender, history of previous fracture, presence of neurological disease, renal disease, gastrointestinal disease, and calcium supplementation on admission. Both logistic regression models, using the stepwise and all enter mode, and the two models using either method to express presence of comorbid conditions, revealed almost identical results. The results of the all enter model using the presence of individual comorbid conditions are presented herein. There was a significant impact of presence of neurological disease on hip fracture risk (odds ratio [OR] = 2.88 [1.06, 7.75]), even after adjusting for age, gender, history of previous fracture, intake of calcium, and presence of other comorbidities (Table 3). Patients who took calcium supplementation on admission were less likely to sustain a hip fracture (OR = 0.28 [0.12, 0.61]) after adjusting for the same covariates (Table 3).

Follow-Up on Mortality and Morbidity in the Study Group

The average time between admissions to the hospital with hip fracture in the patients and for THR for the controls and follow-up information obtained by telephone call was 5.2(2.5) yr. We were able to contact one-third of our original study group: 70 out of 274 hip fracture patients and 33 our of 112 control subjects. Part of our inability to contact the patients was because of the change in the telephone directory listing over the years. There were no significant differences in the baseline clinical characteristics, both for hip fractures and controls, between those who were originally captured by medical record review and those who had a telephone follow-up including gender (63 females and 40 males had follow-up data), age, number of comorbid conditions, or prevalence of cardiac, liver, gastrointestinal (GI), pulmonary, renal, or endocrinologic conditions. In the hip fracture group, the age of those who had follow-up data was 73(8) yr, whereas the age of those without follow-up data was 72(7) yr. In the control group, the age of subjects who had

Table 3
Logistic Regression Model With Model Estimates for Hip Fracture Risk and Risk of Mortality After Hip Fractures Using Significant Predictors on Univariate Analyses

Variable	OR	[CI]	AOR	[CI]	R^{2b}
Risk estimates for hip fracture					
On admission calcium	0.281	[0.14, 0.59]	0.28[a]	[0.12, 0.61]	0.04
Neurological disease	3.23	[1.23, 8.5]	2.88[a]	[1.06, 7.75]	0.07
Risk estimates for mortality in the study group					
Gender	0.25	[0.11, 0.59]	0.26[c]	[0.10, 0.68]	0.13
Age	1.09	[1.02, 1.16]	1.09[c]	[1.02, 1.12]	0.21
Hip fracture	4.01	[1.47, 10.92]	3.31[c]	[1.09, 10.02]	0.28

[a] AOR: Adjusted odds ratio for gender, neurological disease, age, on admission calcium, gastrointestinal disease, renal disease and history of fracture.
[b] Cumulative R^2 in each row shown as additional significant variables are added to the model.
[c] AOR: Adjusted odds ratio for gender, neurological disease, age, gastrointestinal disease, renal disease, history of fracture, and hip fracture.

follow-up data was 72(5) yr, whereas the age of subjects without follow-up data was 71(4) yr.

On follow-up, there was no significant difference between hip fractures and controls in the incidence of deep vein thrombosis, decubitus ulcers, pneumonia, or sepsis. Of the total of 70 hip fracture patients contacted, 47% had died. The mortality rate was 73% in men and 28% in women, $p = 0.0004$. There was no significant difference in mortality rate postfractures by fracture type. Of the total of 33 hip fracture subjects who died, 23 (70%) did so within the first year. Among the controls, we were able to contact 33 out of 112 subjects, and 27 subjects (82%) were still alive at the time of contact. Of the six control patients who died, four did so within the first year. There was a significant difference in mortality between hip fracture patients (47%) and controls (18%), $p = 0.012$.

Multivariate Analyses of Correlates of Mortality After Hip Fracture

The following correlates of mortality were entered in the multivariate model to determine predictors of mortality in the study population: age, gender, presence of hip fracture, history of previous fracture, presence of neurological disease, renal disease, and GI disease. Both logistic regression models, using the stepwise and all enter mode, revealed almost identical results; the results of the all enter model are presented herein. Age, gender, and hip fracture were all significant predictors of mortality, as shown in Table 3. The OR for mortality in women compared to men was 0.26 [0.10, 0.68], and the OR for mortality in hip fracture subjects compared to controls was 3.31 [1.09, 10.02].

Discussion

Our investigation revealed that Lebanese subjects sustain a hip fracture at a relatively young age (mean age = 72.1 yr) and the majority of the fractures (58%) were intertrochanteric, whereas only 34% occurred at the femoral neck. Neurological, renal, and GI diseases, in addition to a history of previous fracture were significant risk factors for hip fracture. Few patients received any therapy to prevent bone loss either on admission or upon discharge, including calcium and vitamin D. The mortality rate was significantly high after hip fracture (47%), with the majority of deaths occurring in men and within the first year after the hip fracture.

The mean age of hip fracture subjects was 2–13 yr younger than reported in previous studies conducted in the United States or Europe, including other Mediterranean countries such as Italy, Spain, Greece, Portugal, and Turkey (Table 4) *(10–16).* Our group has reported in a population-based study that peak bone mass is lower in the Lebanese subjects compared with Western standards *(17).* Presuming a similar rate of age-related bone loss, it is plausible that elderly Lebanese subjects reach fragility thresholds at a younger age than their Western counterparts. Indeed, we have also shown that Lebanese patients sustain their hip fracture at a younger age than Western counterparts, but have similar bone mineral densities *(18).* The higher prevalence of hip fractures in women compared to men in our study is consistent with abundant literature on that topic *(6,7,11,13,19,20).* In two large studies, however, the proportion of hip fractures among men was less than noted in our study *(20,21).* This might be explained by the high prevalence of several known risk factors for hip fractures in our study population, including high prevalence of smoking and hypovitaminosis D in our population *(22,23),* in addition to lifestyle factors such as a low calcium intake and lack of exercise among Lebanese elderly (El-Hajj Fuleihan et al., study in progress).

The overall mortality after hip fracture was 47% at a mean follow-up period of 5.2 ± 2.5 yr, and 70% of deaths occurred

Table 4
Comparison of Mean Age for Hip Fracture Between Current Study Group and Several International Studies

Study	*n*	Mean age (SD) (yr)	Age difference with current study	*p*
This study	274	71.0 (4.0)	—	—
Ekman et al. *(10)*	87	76.0 (5.2)	–5.0	<0.001
Alonzo et al. *(11)*	422	74.9 (7.6)	–3.9	<0.001
MEDOS *(12)*	730	73.9 (10.3)	–2.9	<0.001
EPIDOS *(13)*	154	82.8 (4.6)	–11.8	<0.001
Greenspan et al. *(14)*	72	83.8 (8.0)	–12.8	<0.001
SOF *(15)*	65	76.4 (—)	–5.4	NA
Libanati et al. *(16)*	29	79.0 (8.0)	–2.9	<0.001

Note: NA: Standard deviation for study not provided, therefore *p*-value could not be derived.

within 1 yr of the fracture. This rate exceeds by far those reported in the literature that varied between 13.5% and 37%, with most deaths also occurring within the first year *(6,7,20,24–26).* This rate also exceeds the population-based mortality rate of 6% reported in elderly Lebanese subjects *(27).* Although the mortality rate after hip fracture is high, it has been suggested that only part of it is directly related to the fracture itself *(26,28,29).* Risk factors for the high mortality in our study were age and male gender, in addition to hip fracture. Age and male gender were found to be of great impact on the outcome of hip fractures in several studies *(6,25,28).* Center et al. found an overall mortality of 55% among males as compared to 31% among females *(6).* Another study by Luthje et al. has shown a similar impact of gender on overall mortality: 37% in males and 24% in females *(25).* However, in this study, age appeared also as another risk factor, increasing the rate of mortality after fracture *(25).* Neurological disease and mental status impairment were also found as risk factors by previous studies, perhaps because patients with a low mental status score were more susceptible to fall and had a higher predisposition for complications after fracture *(26).* Fox et al. showed that trochanteric fractures had a poorer prognosis than cervical, mostly because of their association with an older age *(30).* Our study, however, showed no impact of type of fracture on mortality rate, possibly because no age difference was noted between the two fracture subgroups.

The alarming low treatment rates in our hip fracture subjects echo similar findings in many Western studies, including the most recent one by Juby et al. In a review of 311 hip fractures, less than 13% of subjects were receiving any therapy including calcium, vitamin D, bisphosphonates, calcitonin, or hormone replacement therapy on admission or discharge compared to less than 8% in our study *(31).* Potential explanations for low treatment rates on admission but more importantly on discharge include relatively low awareness of osteoporosis in the early 1990s, which spans a large proportion of hip fractures charts reviewed (201 out of 274 were admitted before 1998), the fact that hospital care is focused on the surgical management of the acute fracture, the reluctance of some physicians to start antiresoptive therapies immediately after fracture, especially with bisphosphonates, and deferral of medical therapy until after discharge.

Significant comorbid conditions associated with hip fractures in our study include history of previous fractures and several associated medical conditions such as neurological, renal, and GI diseases. A history of previous fragility fracture is a well-established independent predictor of future fractures *(32–39).* It reflects the fragility of bones of the patient and poor mobility and propensity to falls in the case of previous hip fracture. Indeed, hip fracture was the most common type of previous fracture, found in 7.6% of hip fracture patients, a prevalence similar to that found by Juby et al. *(31).*

Suggested mechanisms for associations between neurological and renal disorders with hip fractures include lack of motor coordination and propensity to falls for the former *(20,28)* as well as potentially secondary hyperparathyroidism and high bone turnover for the latter *(40).* We are unaware of any reported associations between GI disorders and hip fractures, although there are clearly association between low BMD and osteoporosis in patients with GI disorders, including malabsorptive conditions or lactose intolerance *(41,42).* However, because of its retrospective nature, our study did not allow the dissection of these possibilities.

The literature is abundant with studies relating smoking, alcohol consumption, and intake of medications such as corticosteroids, thyroid hormones, benzodiazepines, and antidepressants with the risk of hip fracture *(19,34).* These variables, however, were not significant predictors of hip fracture among our study group. This finding can be explained by the high prevalence of smoking in our population, both among hip fractures and control subjects, and the low prevalence of alcohol abuse. Finally, because information on several variables is retrospective through chart review, it might not be reflective of the true prevalence of these variables in our study group.

The majority of hip fracture cases in our study were of the introchanteric type 58% and only 34% occurred in the femoral neck. This is in sharp contrast to findings in several European and American studies in which 48–58% of hip fractures were cervical *(10–12,14,30,43).* The higher prevalence of intertrochanteric fractures in this study could be potentially explained by the lower stature *(44)* and, possibly, shorter hip axis length in the study group *(43).* Michaelsson et al. found that height was a strong risk factor for cervical hip fractures *(44).* Although height measurements were not available in the study group, the mean height in a population-based sample of young Lebanese men and women was 4 cm shorter than American counterparts *(17).* This is anticipated to carry into height differences between Lebanese and American elderly and, therefore, possibly translate into a higher prevalence of intertrochanteric fractures.

Limitations of our study include the fact that the findings are in large part based on a chart review of records of patients admitted to a major tertiary referral center. Although the study was based on chart review, the information selected for the purpose of this study was available routinely on cases and controls as part of the standard medical record forms. The control group (i.e., patients with osteoarthritis) might be at lower risk for all osteoporosis but was chosen for the sake of consistency in the population studied (patients were on the orthopedic service). Furthermore, several of our observations mirror comparable findings in studies conducted worldwide, including risk factors, comorbidities, undertreatment, and care gap. Finally, the primary measures (excluding lifestyle measures) that were obtained from the chart review, such as age, gender, diagnosis of fracture type, comorbid conditions, and medications on admission and discharge, were extracted from multiple sources for validation including the emergency room admission, the admission orders, admission notes, discharge orders, discharge diagnosis, nurses' notes, and ICD codes, by a trained physician who is familiar with the American University of Beirut charting system (personal communication, H. Hreybe, MD). Although the follow-up information was available on a subset, patients were lost to follow-up did not show significant differences in the characteristics with the overall group.

Lebanese patients with hip fractures are relatively young, are more likely to have neurological disorders, and seem to suffer excess mortality. Risk factors for mortality in the study group include age, gender, and the presence of hip fracture, independent of other comorbid conditions. Our study sheds light on the epidemiology of hip fractures in Lebanon and has important public health implications regarding the management of osteoporosis and hip fractures in Lebanon and, possibly, the region.

Acknowledgments

The authors thank Ms. Leila Haidar and her staff in the Medical Records Department for their tireless efforts making the patients' records available for chart review. This study was supported by an unrestricted educational grant from Merck, Sharp and Dohme.

References

1. Cooper C, Campion G, Melton LJ. 1992 Hip fractures in the elderly: a worldwide projection. Osteoporos Int 2:285–289.
2. Magaziner J, Simonsick EM, Kashner M, et al. 1989 Survival experience of aged hip fracture patients. Am J Public Health 79:274–278.
3. Ray WA, Griffin MR, Baugh DK. 1990 Mortality following hip fracture before and after the implementation of the prospective payment system. Arch Intern Med 150:2109–2114.
4. Boereboom FTJ, Raymakers JA, Duursma SA. 1992 Mortality and causes of death after hip fractures in the Netherlands. Neth J Med 41:4–10.
5. Jacobsen SJ, Goldberg J, Miles TP, et al. 1992 Race and sex differences in mortality following fracture of the hip. Am J Public Health 82:1147–1150.
6. Center JR, Nguyen TV, Schneider D, et al. 1999 Mortality after all major types of osteoporotic fracture in men and women: an observational study. Lancet 353:878–882.
7. Cooper C, Atkinson EJ, Jacobsen SJ, et al. 1993 Population-based study of survival after osteoporotic fractures. Am J Epidemiol 137:1001–1005.
8. Magaziner J, Lydick E, Hawkes W, et al. 1997 Excess mortality attributable to hip fracture in white women aged 70 years and older. Am J Public Health 87(10):1630–1636.
9. Baddoura R, Okais J, Awada H. 2001 Incidence fracturaire après 50 ans et implications d'osteoporose dans la population Libanaise. Rev Epidemiol Sante Publique 49:27–32.
10. Ekman A, Michaelsson K, Petren-Mallmin M, et al. 2001 DXA of the hip and heel ultrasound but not densitometry of the fingers can discriminate female hip fracture patients from controls: a comparison of four different methods. Osteoporos Int 12:185–191.
11. Alonzo C, Curiel M, Carranza F, et al., Multicenter Project for Osteoporosis. 2000 Femoral bone mineral density, neck shaft angle and mean femoral neck width as predictors of hip fracture in men and women. Osteoporos Int 11:714–720.
12. Kanis J, Johnell O, Gullberg B, et al. 1999 Risk factors for hip fractures in men from southern Europe: the MEDOS study. Osteoporos Int 9:45–54.
13. Schott A, Cormier C, Hans D, et al., for the EPIDOS group. 1998 How hip and whole-body bone mineral density predict hip fracture in elderly women: the EPIDOS prospective study. Osteoporos Int 8:247–254.
14. Greenspan S, Myers E, Maitland L, et al. 1994 Fall severity and bone mineral density as risk factors for hip fracture in ambulatory elderly. JAMA 271(2):128–133.
15. Cummings SR, Black D, Nevitt M, et al. 1993 Bone density at various sites for prediction of hip fractures. Lancet 341:72–75.
16. Libanati C, Schulz E, Shook J, et al. 1992 Hip mineral density in females with a recent hip fracture. J Clin Endocrinol Metab 74:351–356.
17. El-Hajj Fuleihan G, Baddoura R, Awada H, et al. 2002 Low peak bone mineral density in healthy Lebanese subjects. Bone 31:520–528.
18. El Hajj Fuleihan G, Badra M, Tayim A, et al. 2001 A. Lebanese patients with hip fractures are relatively young, but have osteoporosis. J Bone Miner Res 16:S513.
19. Van Staa T, Leufkens H, Cooper C. 2002 Utility of medical and drug history in fracture risk prediction among men and women. Bone 31:508–514.
20. Eastwood E, Magaziner J, Wang J, et al. 2002 Patients with hip fracture: subgroups and their outcome. J Am Geriatr Soc 50: 1240–1249.
21. Karagas M, Lu-Yao G, Barrett J, et al. 1996 Heterogeneity of hip fracture:age, race, sex and geographic patterns of femoral neck and trochanteric fractures among the US elderly. Am J Epidemiol 143:677–682.
22. El-Hajj Fuleihan G, Nabulsi M, Shoucair M, et al. 2001 Hypovitaminosis D in healthy school children. Pediatrics 107:1–7.
23. Gannage-Yared M, Chemali R, Yaacoub N, et al. 2000 Hypovitaminosis D in a sunny country: relation to lifestyle and bone markers. J Bone Miner Res 15:1856–1862.
24. Hannan E, Magaziner J, Wang J, et al. 2001 Mortality and locomotion 6 months after hospitalization for hip fracture: risk factors and risk adjusted hospital outcomes. JAMA 285:2736–2742.
25. Luthje P, Kataja M, Nurmi I, et al. 1995 Four-year survival after hip fractures—an analysis in two Finnish health care regions. Ann Chir Gynaecol. 84:395–401.
26. Meyer H, Tverdal A, Falch J, et al. 2000 Factors associated with mortality after hip fracture. Osteoporos Int 11:228–232.

27. Sibaii A, Fletcher A, Hills M, et al. 2001 Non communicable disease mortality rates using the verbal autopsy in a cohort of middle aged and older populations in Beirut during war time, 1983–93. J Epidemiol Community Health 55:271–276.
28. Kanis J, Oden A, Johnell O, et al. 2003 The components of excess mortality after hip fracture. Bone 32:468–473.
29. Parker MJ, Anand JK. 1991 What is mortality of hip fractures? Public Health 105:443–446.
30. Fox KM, Magaziner J, Hebel JR, et al. 1999 Intertrochanteric versus femoral neck hip fractures: differential characteristics, treatment, and sequalae. J Gerontol A: Biol Sci Med Sci 54(12):M635–M640.
31. Juby A, De Geus-Wenceslau C. 2002 Evaluation of osteoporosis treatment in seniors after hip fracture. Osteoporos Int 13: 205–210.
32. Ross P, Genant H, Davis J, et al. 1993 Predicting vertebral fracture incidence from prevalent fractures and bone density among non black, osteoporotic women. Osteoporos Int 3:120–126.
33. Kotowicz M, Melton L, Cooper C, et al. 1994 Risk of hip fracture in women with vertebral fracture. J Bone Miner Res 599–605.
34. Cummings SR, Nevitt MC, Browner WS, et al. 1995 Risk factors for hip fractures in white women. N Engl J Med 332:767–773.
35. Torgerson D, Campbell M, Thomas R, et al. 1996 Prediction of perimenopausal fractures by bone mineral density and other risk factors. J Bone Miner Res 11:293–297.
36. Melton L, Atkinson E, Cooper C, et al. 1999 Vertebral fractures predict subsequent fractures. Osteoporos Int 10:214–221.
37. Klotzbuecher C, Ross P, Landsman P, et al. 2000 Patients with prior fractures have an increased risk of future fractures: a summary of the literature and statistical synthesis. J Bone Miner Res 15:721–739.
38. Lindsay R, Silverman S, Cooper C, et al. 2001 Risk of a new vertebral fracture in the year following a fracture. JAMA 285:320–323.
39. Hasserius R, Johnell O, Nilsson B, et al. 2003 Hip fracture patients have more vertebral deformities than subjects in population based studies. Bone 32:180–184.
40. Chapuy M, Pamphile R, Paris E, et al. 2002 Combined calcium and vitamin D3 supplementation in elderly women: confirmation of reversal of secondary hyperparathyroidism and hip fracture risk: the Decalyos II study. Osteoporos Int 13:257–264.
41. Wheadon M, Goulding A, Barbezat G, et al. 1991 Lactose malabsorption and calcium intake as risk factors for osteoporosis in Elderly New Zealand women. NZ Med J 104:417–419.
42. Harma M, Alhava E. 1988 Is Lactose malabsorption a risk factor in fractures of the elderly? Ann Chir Gynaecol 77:180–183.
43. Faulkner K, Mcclung M, Cummings S. 1994 Automated evaluation of hip axis length for predicting hip fracture. J Bone Miner Res 9(7):1065–1070.
44. Michaelsson K, Weiderpass E, Farahmand Y, et al. 1999 Differences in risk factor patterns between cervical and trochanteric fractures. Osteoporos Int 10:487–494.