Epidemiology of hip fractures in Lebanon: A nationwide survey

G. Maalouf, F. Bachour, S. Hlais, N.M. Maalouf, P. Yazbeck, Y. Yaghi, K. Yaghi, R. El Hage, M. Issa

Musculoskeletal Department, Bellevue University Medical Center, Faculty of Medicine, Saint-Joseph University, Mansourieh, Lebanon
Family Medicine Department, American University of Beirut (AUB), Saint-Joseph University (USJ), Beirut, Lebanon
Department of Internal Medicine, Center for Mineral Metabolism and Clinical Research, University of Texas, Southwestern Medical Center, Dallas, Texas, USA
Orthopaedic Department, Hammoud Hospital, Saida, Lebanon
Department of physical education, Balamand University, Lebanon

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Introduction: Hip fractures are a reliable indicator of osteoporosis. Despite their importance, few studies have assessed their epidemiology in Lebanon and the Middle East.
Hypotheses: Hip fracture incidence rates in Lebanon approximate those of Northern countries, and show the same characteristics, particularly the exponential increase with age, higher incidence in women, and a recent trend of rate leveling in women but not in men.
Materials and methods: A national database of hip fracture cases admitted to hospitals in Lebanon in 2007 was created. Crude and age-adjusted incidence rates were calculated at 5-year intervals for individuals over age 50. These rates were also standardized to the 2000 United States population, and compared to those of other countries. Projected incidence rates in Lebanon in 2020 and 2050 were also calculated.
Results: A total of 1199 patients were included in the study. The crude annual incidence rate in individuals over 50 was 147 per 100,000 individuals, 132 per 100,000 males and 160 per 100,000 females, with a female-to-male ratio of 1.2. The age-standardized annual incidence rates (per 100,000) were 180 in males and 256 in females. Assuming unchanged healthcare parameters, the projected crude incidence rates for people over 50 are expected to reach 174 and 284 per 100,000 in 2020 and 2050 respectively.

* Corresponding author. Tel.: +961 3 832 119; fax: +961 1 691 728.
E-mail address: majed_i@yahoo.com (M. Issa).

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Conclusion: Lebanese hip fracture rates are lower than Northern countries, but show many similar characteristics such as an exponential increase with age, a higher incidence in women, and clues of a leveling of rates in women but not in men. Numbers are expected to increase substantially in the coming decades. 
Level of evidence: Level IV. Epidemiological study.
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Introduction

Hip fractures are the most important among fragility fractures in terms of morbidity, mortality and healthcare cost [1–3]. They are considered a close indicator of osteoporosis in a population, since nearly all cases are admitted to hospitals and can be assessed for having an osteoporotic fracture or not, unlike wrist fractures for example, who may benefit from definitive treatment in the clinic or emergency setting, and be discharged and lost of sight from there [4]. The annual incidence of hip fractures is projected to reach 6.26 million worldwide by 2050, more than five times that of 1990 [4]. Some report seven expect 7.3–21.3 million fractures in the year 2050, with more than 70% of the increase occurring in Asia, Latin America, the Middle East and Africa [5]. This is largely due to the considerable increase in lifespan in developing countries, and therefore in the proportion of elderly individuals. The incidence of hip fractures varies considerably between regions, and according to age and gender [5]. Few reports have studied the epidemiology of hip fractures in the Middle East and Mediterranean basin regions, which are characterized by similar meteorological conditions and social and dietary habits. Furthermore, recent data have described widespread high prevalence of vitamin D deficiency in the sunny Middle East region in general, and more specifically in Lebanon, even in people with good sun exposure and good physical activity, suggesting this deficiency may be multifactorial [6,7]. This further highlights the need to focus on the problem of fragility fractures in this region, particularly hip fractures.

The present study is a nationwide retrospective epidemiological assessment of the incidence and demographic characteristics of hip fractures in Lebanon.

Our two main objectives were to compare the Lebanese numbers to those of different countries worldwide, and to characterize their recent temporal evolution.

We hypothesize that:

- hip fracture incidence rates in Lebanon, one of the more developed countries in the Middle East region, approximate those of Northern countries, with a higher incidence in elderly female patients;
- a certain leveling of rates can be seen in women but not in men, in concordance with developed countries’ data.

Methods

Lebanon is a 10,452 km² country located at the eastern bank of the Mediterranean Sea, with a population estimated to more than four million (last official count of 3,869,000 in 2006), the vast majority of whom are Caucasian. Most of the Lebanese population follows a typical Mediterranean diet. In 2008, the Lebanese Ministry of Health issued a decree requiring all hospitals in the country to complete a form for each patient admitted for hip fracture during the year 2007. Data collected included patient name, age, gender, contact coordinates, admission and discharge dates, and surgery code. The official representatives of the ministry of health in each hospital were asked to fill the forms themselves. Given that all hip fractures — except in rare situations — need to be operated upon, the number of surgeries done was verified with the registries of the hardware provider companies. The numbers were congruent after verifying the names of patients and hospitals.

Using the Lebanese population figures given by the US Bureau of Census website [8], the crude, age, and gender-specific annual incidence rates of hip fracture were calculated for patients over 50 years of age in 5-year intervals (age 50–54, 55–59, etc.) and expressed as fractures per 100,000 inhabitants per year. These crude incidence rates were computed as the number of new cases of hip fractures in the year 2007 in each age category for one gender divided by the count of the Lebanese subpopulation of the same age category and gender (for example males 50–54 years old, etc.). As differences in crude incidence rates of hip fractures among populations may be due to the different age distribution in the distinct populations, we used the direct age adjustment (or age standardization) method to account for possible differences in age distribution among populations. Direct age-adjustment was applied to the set of incidence rates; the age-specific rate for each age group in the study population was multiplied by the appropriate weight in the standard population (the weights being the proportion of people in the same age group in the standard population). The directly age-adjusted or age-standardized rate is the sum of these products; conceptually, it is the estimated incidence rate of hip fractures in Lebanon in the year 2007 if the Lebanese population at that time had the same age distribution of the standard population (chosen here as the 2000 United States population).

Based on these age-adjusted rates, the ratios of hip fracture rates in men versus women above the age of 50 were calculated. To enable comparisons with other populations, incidence rates were standardized to the 2000 United States population, also using the numbers from the US bureau of census website (www.census.gov). The direct standardization enabled us to perform comparisons to corresponding figures in the literature.

Assuming unchanged prevention and healthcare parameters, projected incidence rates for the years 2020 and 2050 were calculated from estimates of the population...
distribution of Lebanon in those years [8], using the expected direct method of standardization.

Data was analyzed using Microsoft Excel and the statistical software SPSS 16.0.

Results

There are 145 hospitals in Lebanon, 124 of which are private. The direct response rate among hospitals was 90% (131/145 hospitals), varying from 81.8% in the Bekaa district to 100% in the South Lebanon district. However, taking into consideration that requests were sent even to hospitals that do not deal with orthopedic cases (e.g., eye-specialized hospitals, hospitals under construction at the time of study...), the actual response rate reached 97%. The total number of recorded hip fracture cases in the Lebanese population above age 50 in 2007 was 1199. Only 11% of patients were treated in public hospitals. The length of stay was missing in 271 files. The median length of stay in the remaining cases was 6 days with an interquartile range of 4–8 days, for any type of arthroplasty or open reduction with internal fixation (ORIF) procedure. The median age of patients with hip fracture was 76 years, with an interquartile range of 69–82 years, and a mean age of 75 years (standard deviation = 10.1 years). Fig. 1 shows the number distribution among men and women over 50 years, in 5-year intervals.

Of the total of 1199 hip fractures, 503 occurred in men and 696 in women. The crude annual incidence rate of hip fractures in patients over 50 years was 132 in males and 160 in females, with a female-to-male ratio of 1.2. The age and gender-specific rates are presented in Fig. 2.

Using the 2000 US population as reference, the age-standardized annual incidence rates of hip fractures for individuals over age 50 were 180 in males and 256 in females per 100,000 persons (Table 1). Furthermore, the expected crude incidence in 2020 and in 2050 of hip fractures in the Lebanese population among different age categories is shown in Table 1. The crude incidence rate of hip fractures among the 50 years and above age category is expected to nearly double between 2007 and 2050, assuming that the current standards of prevention and treatment do not change.

Fig. 3A and B shows the reported incidence rates of hip fractures, standardized to the 2000 US population, for several countries, compared to our results [9–17].

Discussion

In contrast to many regions such as Europe, North America and Eastern Asia, only few reports have evaluated the epidemiology of hip fractures in the Middle East. This study is based on hip fractures reported exhaustively by

![Figure 1](image1.png) Number distribution in 5-year intervals for individuals above 50 years.

![Figure 2](image2.png) Age and gender specific incidence rates of hip fractures per 100,000 persons.
almost all Lebanese hospitals, and is an additional tool for understanding the worldwide geographical variation in the incidence of hip fractures. The importance of this subject comes from its considerable projected socioeconomic burden in the upcoming two decades [8]. In fact, many countries have provided the World Health Organization (WHO) with statistical basis for the establishment of the country-specific 10-year fracture risk assessment engine FRAX (www.shef.ac.uk/frax). This engine helps in adjusting the osteoporotic prevention and treatment programs in each country.

The main findings of our study were that hip fracture incidence rates in Lebanon are consistent with patterns described in most populations, where there is an exponential increase with age for both sexes. As expected, over half of the total number of hip fractures in both genders occurs in the age group 75 years or older [2].

According to a recently published study by Sibai et al., age-adjusted incidence rates in Lebanon were lower than in Northern Europe and the USA, but comparable to those in Southern Europe [9]. However, this report was based only on patients covered by the Lebanese Ministry of Health (MOH), which constitutes at best 50% of the population, with the remainder benefiting from other third party coverage (such as private insurance, social security services, etc.). Therefore, a potential flaw of Sibai's work is selection bias.

In contrast, the present study comes to make a more complete analysis by including the entire Lebanese population (97% of hospitals), regardless of third party coverage, providing a statistically more reliable baseline for calculation of the FRAX. We found age-adjusted rates in women considerably lower than those reported by Sibai [18], possibly because of the aforementioned selection bias.

Our rates were closest to the US rates of 2006 [19], but lower than those of 2005 and most Northern European figures such as Sweden, Norway and Finland [8,20]. The same is observed in the literature in Iran in 2006 [21,22] and in many Eastern Asian countries, where age-standardized rates are 60–70% of the Northern European ones [23]. This could be due to the fact that the Lebanese and the aforementioned populations are "younger" than Northern countries, which have higher life expectancies.

Moreover, our numbers fall within the range of 100–300/100,000 person years reported for Southern European countries, in the MEDOS study of the previous decade [24], indicating a probable influence of common Mediterranean characteristics (climate, food, genetics...). Hence, our first hypothesis could not be confirmed and Lebanese numbers fall at midway between developing and rich countries.

In contrast, a study done in nearby Kuwait by Memon in 1998 found rates higher than other Asian countries and

<table>
<thead>
<tr>
<th>Yearly incidence (per 100,000 person)</th>
<th>Total population</th>
<th>Men</th>
<th>Women</th>
<th>Total population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude rate</td>
<td>Standardized rate</td>
<td>Crude rate</td>
<td>Standardized rate</td>
</tr>
<tr>
<td>Age ≥ 50 yrs</td>
<td>147.3</td>
<td>222.5</td>
<td>132.3</td>
<td>179.7</td>
</tr>
<tr>
<td>Age ≥ 55 yrs</td>
<td>183.5</td>
<td>280.9</td>
<td>161.5</td>
<td>228.7</td>
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<tr>
<td>Age ≥ 60 yrs</td>
<td>232.3</td>
<td>352.4</td>
<td>205.4</td>
<td>295.1</td>
</tr>
<tr>
<td>Age ≥ 65 yrs</td>
<td>306.7</td>
<td>444.8</td>
<td>270.2</td>
<td>380.6</td>
</tr>
<tr>
<td>Age ≥ 70 yrs</td>
<td>425.9</td>
<td>569.7</td>
<td>373.9</td>
<td>499.1</td>
</tr>
</tbody>
</table>


Figure 3  A. Rates (per 100,000) in women over 50 in various countries standardized to the 2000 US population. B. Rates (per 100,000) in men over 50 in various countries standardized to the 2000 US population.
similar to some European and North American ones [25]. In that manner, rates among countries of a certain geographical location are not always homogenous, which suggests that numerous other influential factors need to be investigated.

Interestingly, female predominance in our study is marked only in few age groups. For instance, age and gender-specific hip fracture rates were 20.1 times higher in women 75–79 years old than in women in the 50–54 years age group, and in men, the rates were 12.1 times higher. As for the 65–69 age group, incidence rates were identical between both sexes. Moreover, Fig. 3A and B show that the incidence rates of hip fractures in Lebanon are in the lower half among populations worldwide for women, but among the highest for men.

Although we do not have older numbers in Lebanon for comparison, these findings could nevertheless concur with our second hypothesis assuming a trend break and leveling of the rates in women, but not in men. This has been reported in many developed countries, possibly reflecting successful long-term osteoporosis management and prevention programs over the last two decades, focused almost exclusively on women [8,26–28].

This could delineate the need to acknowledge more the weight of “male osteoporosis”, and adapt our treatment regimens accordingly.

Our study was limited by the non-response of a minor proportion of hospitals in the country.

Furthermore, we could not collect data about the nature of the fall, nor comorbidities, and the data distinguishing intracapsular and intertrochanteric fractures was incomplete, and thus not interpretable. Finally, our incidence projections for 2020 and 2050 assume that the current standards of healthcare remain unchanged, which, while not entirely realistic, still provide an estimate of the magnitude of this medical problem in the future.

Information regarding current and projected incidence of osteoporotic hip fractures is essential for planning and allocating healthcare resources at the population level, and is also key for the efficient use of anti-osteoporotic drugs at the level of individuals. Therefore, it would be most interesting and exploitable to have further periodic studies in Lebanon in order to delineate a potential trend in the evolution of hip fracture epidemiology.

Conclusions

The Lebanese hip fracture incidence rates are lower than those of developed Northern countries, although many common characteristics could be brought up, such as the exponential increase with age, the higher incidence in women, and proofs of a leveling of rates in women but not in men. The numbers of hip fractures in Lebanon are expected to increase greatly in the few coming decades. Fracture risk evaluation policies should be seriously redrawn to anticipate this costly public health problem.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References


