

# Who is at Risk of Receiving Inadequate Care for Osteoporosis Following Fragility Fractures? A Retrospective Study

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**ABSTRACT:** **Background:** Osteoporosis is considered the most common bone disease in humans and the most common cause of fractures.

**Objectives:** To identify possible risk factors associated with a low level of care for osteoporosis in patients presenting acutely with the major types of fragility fractures, as well as in patients who remain undertreated following their discharge.

**Methods:** We conducted a retrospective questionnaire-based cohort study. We searched our databases for patients admitted acutely with proximal humerus, distal forearm, thoraco-lumbar spine, and proximal femur fractures. A questionnaire was used to evaluate osteoporotic care including a referral to DEXA and any associated prescribed medication.

**Results:** The study group included 114 patients or their caregivers. The osteoporosis care rate rose from 56.1% (n=64) before admission to 71% (n=81) at follow-up. Significant risk factors associated with a decreased care rate prior to admission were the presence of fewer than three comorbidities and a combination of male gender and young age. Continued neglect at follow-up was associated with the opposite risk factors, such as older age, multiple comorbidities, and polypharmacy. An additional finding was that treated patients had a significantly increased likelihood of presenting with vertebral fractures.

**Conclusions:** While the association of osteoporosis with the elderly may decrease screening rates among younger and healthier patients, fragility fractures may be viewed as “end-stage” bone disease, rendering osteoporotic care inefficient.

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**KEY WORDS:** fragility fractures, osteoporosis, bisphosphonates, calcium, vitamin D, dual energy X-ray absorptiometry (DEXA)

Osteoporosis, defined as a bone mineral density of 2.5 standard deviations or more below the young normal mean, is considered to be the most common bone disease in humans and the most common cause of fractures [1]. Commonly, the first sign of decreased BMD is the occurrence of fragility frac-

BMD = bone mineral density

tures, often defined as low energy injuries affecting the older population and usually located at areas rich in trabecular bone, such as the proximal humerus, distal forearm, thoraco-lumbar spine, and hip [2]. According to the National Osteoporosis Foundation's Clinician's Guide to Prevention and Treatment of Osteoporosis published in 2008 [3], because fractures are considered the only early sign of osteoporosis, many patients are diagnosed relatively late in the disease course and therefore do not receive proper treatment.

The goal of the present study was to identify possible risk factors associated with a low level of care for osteoporosis in patients presenting acutely with the major types of fragility fractures, as well as in patients who remain undertreated following their discharge.

## PATIENTS AND METHODS

The protocol of this study was reviewed and approved by our medical center's Ethics (Helsinki) Committee. We retrospectively searched our center's computerized database, identifying patients admitted to our department over a 5 month period with acute fragility fractures related to a low energy mechanism and involving one or more of the following anatomic locations: the proximal humerus, the distal forearm, the proximal femur, and the thoraco-lumbar spine. Exclusion criteria were age under 50 and a history or a radiographic appearance suggestive of either a high energy injury or any pathology suspected to be other than osteoporosis-related (e.g., malignancy, infection, etc.).

After retrieving the data, the patients themselves or a primary caregiver were contacted by phone, informed consent was given, and a questionnaire was used to assess personal history as well as osteoporosis evaluation and treatment before and after admission.

Specific osteoporosis-related medication types that were evaluated included calcium and/or vitamin D supplementation, bisphosphonates, hormone replacement therapy, calcitonin and parathyroid hormone. In addition, the patients were asked whether they had been referred for a dual energy X-ray absorptiometry scan before and after admission. Positive

**Figure 1.** Questionnaire used in the survey

Patient: \_\_\_\_\_  
 Age: \_\_\_\_\_  
 Gender: F/M  
 Fracture location: prox. hum/dis. radius/hip/vertebra  
 Treatment: conservative/surgery  
 Medications: \_\_\_\_\_  
 Past surgical history: \_\_\_\_\_  
 Past fragility fractures: yes/no/. Specify \_\_\_\_\_  
 Osteoporosis medication: \_\_\_\_\_

	Before admission	At follow-up
Vitamin D and/or calcium		
Bisphosphonates		
Hormone replacement therapy		
Referral to DEXA		
Other		

“osteoporosis care” was defined as either being treated with one of the aforementioned medications or having been referred for or evaluated with a DEXA scan. The questionnaire used is presented in Figure 1.

Patients not evaluated for osteoporosis before admission and patients who failed to initiate therapy after discharge were compared with treated patients, and statistic analysis was aimed at searching for significant risk factors associated with a decreased level of care before and after hospitalization in these two groups of interest. The variables analyzed included gender, age, polypharmacy (more than three medications taken regularly), multiple comorbidities (more than three), treatment (conservative vs. surgical), and location of the fracture. In a case of more than two simultaneous fractures the primary fracture was defined as the one necessitating acute surgical care or causing the greatest amount of subjective functional limitation. Due to the limitations of group size, fracture types were sorted into those involving the upper extremity (proximal humerus and distal forearm), fractures of the proximal femur, and fractures of the thoraco-lumbar spine.

Simple chi-square tests were used to assess the variables independently, and univariate analysis of variance was used to evaluate a possible interaction between gender and age.

**RESULTS**

During the first 5 months of 2008, 170 patients were admitted to our department after being diagnosed with acute fragility fractures. At an average follow-up period of 18 months, 114 patients (73 females, 41 males, mean age 74.5) or their primary caregiver (72 patients answered the questions themselves, 42 questionnaires were answered by the caregivers)

**Table 1.** Demographic and clinical characteristics of the study group

<b>Gender</b>	
Female	73 (64%)
Male	41 (36%)
Total	114
<b>Age (yr)</b>	
50–60	7 (6.1%)
60–70	18 (15.8%)
70–80	49 (43%)
< 80	40 (35.1%)
Total	114
<b>Diagnosis</b>	
Proximal femur	80 (70.2%)
Thoraco-lumbar spine	17 (14.9%)
Distal forearm	8 (7%)
Proximal humerus	6 (5.2%)
Total*	111
<b>Multiple comorbidities</b>	
3	47 (41.2%)
≤ 3	58 (50.9%)
Total**	105
<b>Polypharmacy</b>	
3	23 (20.2%)
≤ 3	68 (59.6%)
Total**	91
<b>Treatment</b>	
Surgery	83 (72.8%)
Conservative	31 (27.2%)
Total	114

\*Three patients were omitted due to concurrent fractures

\*\*Insufficient data

were available and fully cooperative during the phone survey and fulfilled the inclusion criteria of the study.

The most common primary location involved was the proximal femur (n=83, 72.8%), followed by the thoraco-lumbar spine (n=17, 14.9%) and the upper limb (n=14, 12.3%). Three patients were diagnosed with simultaneous proximal femur and proximal humerus fractures and were therefore omitted from the statistical analysis. Eighty-four patients (73.8%) were treated surgically and the remainder conservatively, either due to the nature of the injury (e.g., stable vertebral body compression fractures, minimally displaced distal radius, and proximal humerus fractures) or as a result of the patient’s poor general health, rendering an operative treatment life-threatening. The overall mortality rate was 22.1% (n=22) and did not differ significantly between the group treated operatively (21.4%, n=15) and the group treated conservatively (21.6%, n=7). Patients’ demographic and clinical characteristics are summarized in Table 1.

The proportion of patients receiving at least one additional intervention following hospitalization was 31.6% (n=32), of whom 20.7% had medical treatment added, 6.9% were referred for a DEXA scan alone, and the remaining 4.9% had both added. As a result, the rate of osteoporosis care (i.e.,

DEXA = dual energy X-ray absorptiometry

**Table 2.** Risk factors for inadequate treatment prior to admission

	No. of non-treated patients	No. of treated patients	P value
<b>Gender</b>			
Male	21 (52.2%)	20 (48.8%)	0.246
Female	29 (39.7%)	44 (60.3%)	
Total	50	64	
Age (yr, average)	74.2	76.6	0.218
<b>Diagnosis</b>			
Proximal femur	38 (47.5%)	42 (52.5%)	0.046
Upper limb	8 (57.1%)	6 (42.9%)	
Thoraco-lumbar spine	3 (17.6%)	14 (82.4%)	
Total*	49	62	
<b>Multiple comorbidities</b>			
3	27 (57.4%)	20 (42.6%)	0.05
≤ 3	17 (29.3%)	41 (70.7%)	
Total**	44	61	
<b>Polypharmacy</b>			
3	14 (60.9%)	9 (39.1%)	0.088
≤ 3	26 (38.2%)	42 (61.8%)	
Total**	40	51	

\*Patients omitted due to concurrent fractures

\*\*Insufficient data

patients receiving at least one medication or having been referred for a DEXA scan) increased from 56.1% (n=64) prior to admission to 71% (n=81) at follow-up. Of 15 patients who suffered a fragility fracture prior to admission, 7 were evaluated after discharge.

A significant risk factor found to be associated with a decreased care rate prior to admission was having less than three major comorbidities (only 42.6% of healthier patients were treated compared to 70.7% of patients with more than three comorbidities). When univariate analysis of variance was performed combining age and gender, younger males were also at a significantly higher risk of being neglected compared to older males (mean age 71 among non-treated compared to an average of 80 among treated males,  $P = 0.012$ ). The non-significant risk factors identified included male gender, younger age, and receiving less than three medications regularly. An additional finding was that a significantly larger proportion of patients eventually diagnosed with a vertebral compression fracture were more likely to have been either treated or evaluated prior to admission (82.4%,  $P = 0.046$ ). A summary of the risk factors associated with a decreased care rate before admission is presented in Table 2.

At follow-up, 28.9% of the patients (n=33) still received inadequate care for osteoporosis, whereas 14.9% (n=17) were either referred for a DEXA scan or were prescribed one of the aforementioned drugs. Analysis revealed that continued neglect was associated with older age, multiple comorbidities, polypharmacy, and conservative treatment. No statistical significance, however, was identified. Gender, as well as location

**Table 3.** Risk factors for inadequate treatment at follow-up

	No. of "neglected" patients at follow-up	No. of newly treated patients at follow-up	P value
<b>Gender</b>			
Male	14 (66.7%)	7 (33.3%)	1.0
Female	19 (65.5%)	10 (34.5%)	
Total	33	17	
Age (yr, average)	75.3	71.9	0.386
<b>Diagnosis</b>			
Proximal femur	26 (68.4%)	12 (31.6%)	0.609
Upper limb	4 (50%)	4 (50%)	
Thoraco-lumbar spine	2 (65.3%)	1 (34.7%)	
Total *	32	17	
<b>Multiple comorbidities</b>			
3	18 (66.7%)	9 (33.3%)	0.366
≤ 3	13 (76.5%)	4 (23.5%)	
Total **	31	13	
<b>Polypharmacy</b>			
3	8 (57.1%)	6 (42.9%)	0.173
≤ 3	20 (76.9%)	6 (23.1%)	
Total **	28	12	
<b>Treatment</b>			
Conservative	7 (77.8%)	2 (22.2%)	0.341
Operative	26 (63.4%)	15 (36.6%)	
Total	33	17	

\*One patient was omitted due to concurrent fractures

\*\*Insufficient data

of fractures, had no apparent effect on the treatment rates. A similar combination of age and gender failed to identify any tendency to being neglected. The characteristics of the "neglected" group at follow-up are shown in Table 3.

## DISCUSSION

The most important finding of the current study and in contrast to other reports was that decreased care prior to admission was significantly associated with patients who had fewer comorbidities, and non-significantly with patients receiving fewer medications. This finding is supported by another finding indicating that young age combined with male gender was also significantly associated with decreased care rates. At follow-up, decreased care was associated with the opposite risk factors (i.e., slightly older patients with multiple comorbidities), although not significantly.

Osteoporosis affects nearly 200 million individuals worldwide [4], placing an enormous medical and financial burden on both individuals and health care systems. According to the Third National Health and Nutrition Examination Survey [5], over 10 million people are diagnosed with osteoporosis in the United States and over 33 million have decreased bone density of the hips. The personal and economic burden imposed by osteoporosis-related fractures is overwhelming: more than 1.5

million osteoporosis-related fractures occur annually [6,7], with an estimated cost of \$15 billion each year in the U.S. alone [8]. Reports have repeatedly shown that many patients are not given appropriate information about prevention, that inappropriate tests for the diagnosis of osteoporosis or the establishment of its risk are often performed, and that even after diagnosis, effective therapy is often not prescribed [9,10].

The National Osteoporosis Foundation recommends initiating therapy for osteoporosis in patients with previous hip or vertebral fractures. Several studies that did attempt to assess the adequacy of osteoporosis care following osteoporotic fractures, however, found an overall suboptimal diagnosis and treatment rate ranging from 24% to 45% [9]. Risk factors suggested to be related to decreased levels of osteoporotic care include increasing age [11], male gender [12], wrist fractures [13], cognitive impairment [14], numerous comorbidities [12,15], polypharmacy [16], postoperative delirium, and low socioeconomic status [17].

A possible explanation for the fact that our study identified other risk factors may be that osteoporosis is often viewed as an ailment of the elderly, hence the low awareness among primary physicians regarding the need to routinely screen for osteoporosis in younger and healthier patients.

An additional finding, apparently unrelated to the objective of the current study, may deserve further discussion. Patients diagnosed with vertebral fractures were significantly more likely to be already receiving treatment for osteoporosis. This may raise concern about a potential primary adverse effect of one of the medications prescribed, namely bisphosphonates. This group of drugs has been suggested by recent studies [18-20] to play a substantial role in causing atypical proximal femoral fracture, possibly by interfering with the normal bone modeling process. In the current study, however, only a minority of patients diagnosed with vertebral fractures were treated with bisphosphonates (6 of 17).

**STUDY LIMITATIONS**

The relatively small patient group and the retrospective nature of this study are obvious disadvantages, limiting the ability to draw meaningful recommendations regarding osteoporosis care. In addition, the study group comprised those who were admitted for the purpose of future surgical treatment. Consequently, a selection bias may have resulted, leading to the inclusion of patients who might have been less evaluated, treated or compliant, sustaining injuries more suitable for surgical treatment. On the other hand, the selection of in-patients may improve the awareness of medical staff in surgical departments and encourage the development of discharge protocols addressing the need for ambulatory osteoporosis evaluation and treatment. In addition, one has to suspect that not all patients referred for a DEXA will receive the proper treatment or even have their results noticed by the

primary physician. Due to the setting of the current study (a questionnaire-based study aimed at patients only) an attempt to analyze the “true” treatment rate is suboptimal.

Finally, despite the increasing incidence of these injuries in orthopedic trauma, growing evidence suggests that the orthopedic surgeon’s contribution to osteoporotic care remains generally inadequate [9,16,21,22]. Despite the undoubted important role of the orthopedic surgeon as the medical liaison between the treatment of the acute fracture and the ambulatory treatment of osteoporosis, this aspect of contribution to the low care rate was not evaluated in the current study.

Overall, the discrepancy between previously described risk factors for decreased care and those identified by the current study may warrant larger-scale studies to improve future evaluation and treatment rates.

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**References**

1. The United States Department of Health and Human Services. The frequency of bone disease. In: Bone Health and Osteoporosis: A Report of the Surgeon General. Rockville, MD: US Department of Health and Human Services, Offices of the Surgeon General, 2004: 69-70.
2. Court-Brown CM, Aitken SA, Forward D, RV O’toole. The epidemiology of fractures. In: Buchholz RW, Court-Brown CM, Heckman JD, Tornetta P III, eds. Rockwood and Green’s Fractures in Adults. Vol. 2. 7th edn. Philadelphia: Lippincott, Williams and Wilkins, 2010: 53-84.
3. National Osteoporosis Foundation. Available at: [http://www.nof.org/sites/default/files/pdfs/NOF\\_Clinicians\\_Guide2008.pdf](http://www.nof.org/sites/default/files/pdfs/NOF_Clinicians_Guide2008.pdf). Chapter 1 pages 1-3. Accessed July 16, 2012.
4. Lin JT, Lane JM. Osteoporosis: a review. *Clin Orthop Relat Res* 2004; 425: 126-34.
5. Plan and operation of the Third National Health and Nutrition Examination Survey, 1988-94. Series 1: programs and collection procedures. *Vital Health Stat* 1 1994; 32: 1-407.
6. Riggs BL, Melton LJ 3rd. The worldwide problem of osteoporosis: insights afforded by epidemiology. *Bone* 1995; 17 (5 Suppl): 505-11S.
7. Melton LJ 3rd. How many women have osteoporosis now? *J Bone Miner Res* 1995; 10: 175-7.
8. Ray NF, Chan JK, Thamer M, Melton LJ 3rd. Medical expenditures for the treatment of osteoporotic fractures in the United States in 1995: report from the National Osteoporosis Foundation. *J Bone Miner Res* 1997; 12: 24-35.
9. Freedman KB, Kaplan FS, Bilker WB, Strom BL, Lowe RA. Treatment of osteoporosis: are physicians missing an opportunity? *J Bone Joint Surg Am* 2000; 82-A: 1063-70.
10. Gardner MJ, Flik KR, Mooar P, Lane JM. Improvement in the treatment of osteoporosis following hip fracture. *J Bone Joint Surg Am* 2002; 84-A: 1342-8.
11. Petrella RJ, Jones TJ. Do patients receive recommended treatment of osteoporosis following hip fracture in primary care? *BMC Fam Pract* 2006; 7: 31.
12. Elliot-Gibson V, Bogoch ER, Jamal SA, Beaton DE. Practice patterns in the diagnosis and treatment of osteoporosis after a fragility fracture: a systematic review. *Osteoporos Int* 2004; 15: 767-78.
13. Gong HS, Oh WS, Chung MS, Oh JH, Lee YH, Baek GH. Patients with wrist fractures are less likely to be evaluated and managed for osteoporosis. *J Bone Joint Surg Am* 2009; 91: 2376-80.
14. Jones G, Warr S, Francis E, Greenaway T. The effect of a fracture protocol on

- hospital prescriptions after minimal trauma fractured neck of the femur: a retrospective audit. *Osteoporos Int* 2005; 16: 1277-80.
15. Press Y, Grinshpun Y, Berzak A, Friger M, Clarfield AM. The effect of comorbidity on the rehabilitation process in elderly patients after hip fracture. *Arch Gerontol Geriatr* 2007; 45: 281-94.
  16. Switzer JA, Jaglal S, Bogoch ER. Overcoming barriers to osteoporosis care in vulnerable elderly patients with hip fractures. *J Orthop Trauma* 2009; 23: 454-9.
  17. Unson CG, Fortinsky R, Prestwood K, Reisine S. Osteoporosis medications used by older African-American women: effects of socioeconomic status and psychosocial factors. *J Community Health* 2005; 30: 281-97.
  18. Black DM, Kelly MP, Genant HK, et al. Bisphosphonates and fractures of the subtrochanteric or diaphyseal femur. *N Engl J Med* 2010; 362: 1761-71.
  19. Neviaser AS, Lane JM, Lenart BA, Edobor-Osula F, Lorch DG. Low-energy femoral shaft fractures associated with alendronate use. *J Orthop Trauma* 2008; 22: 346-50.
  20. Odvina CV, Zerwekh JE, Rao DS, Maalouf N, Gottschalk FA, Pak CY. Severely suppressed bone turnover: a potential complication of alendronate therapy. *J Clin Endocrinol Metab* 2005; 90: 1294-301.
  21. Rozental TD, Makhni EC, Day CS, Bouxsein ML. Improving evaluation and treatment for osteoporosis following distal radial fractures. A prospective randomized intervention. *J Bone Joint Surg Am* 2008; 90: 953-61.
  22. Talbot JC, Elener C, Praveen P, Shaw DL. Secondary prevention of osteoporosis: calcium, vitamin D and bisphosphonate prescribing following distal radial fracture. *Injury* 2007; 38: 1236-40.

## Capsule

### Richness of human gut microbiome correlates with metabolic markers

We are facing a global metabolic health crisis provoked by an obesity epidemic. Le Chatelier and co-workers assessed the human gut microbial composition in a population sample of 123 non-obese and 169 obese Danish individuals. The authors found two groups of individuals differing by the number of gut microbial genes and thus gut bacterial richness, and containing known and previously unknown bacterial species at different proportions; individuals with a low bacterial richness (23% of the population) are characterized by more marked overall adiposity, insulin resistance and dyslipidemia and a more pronounced inflammatory phenotype when

compared with individuals having high bacterial richness. The obese individuals among the lower bacterial richness group also gain more weight over time. Only a few bacterial species are sufficient to distinguish between individuals with high and low bacterial richness, and even between lean and obese participants. This classifications based on variation in the gut microbiome identify subsets of individuals in the general white adult population who may be at increased risk of progressing to adiposity-associated co-morbidities.

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Eitan Israeli

## Capsule

### Worldwide research productivity in the field of rheumatology

Bibliometric studies on the quantity and quality of articles published in rheumatology journals are scarce. A study by Tao Cheng and Guoyou Zhang compared scientific production in the field of rheumatology between countries and evaluated the publication trend and citations worldwide. Articles published in 39 rheumatology journals from 1996 to 2010 were screened using the Scopus database. The number of articles, citations, Hirsch indices (h-indices) and international collaborations were determined for countries or regions. Publication activity was adjusted for the top 35 countries categorized by population size and gross domestic product (GDP). A total of 43 808 articles were identified. The time trend of the number of articles showed an increase of 2.95-fold between 1996 and 2010. Western Europe and northern America were the most productive world areas, producing 52.4% and 23.1% of the available literature, respectively. The USA published the most

articles, followed by the UK and Germany. The USA, the UK and the Netherlands had the highest h-indices (169, 137 and 117, respectively) and ranked about the same when total citations were used. However, Ireland had the highest average citations per article (48.33), followed by Denmark (40.19) and the Netherlands (39.86). Positive associations between the total number of publications/citations and population/GDP were observed ( $P < 0.01$ ). Scandinavian countries ranked the highest after adjusting for population and GDP. Israel ranked very high in all scores – third place in the number of publications per billion US \$ GDP, fourth in the number of citations per billion US \$ GDP, sixth in the number of publications per 10 million inhabitants and eleventh in citations per 10 million inhabitants.

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**“It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change”**

Charles Darwin (1809-1882), English naturalist who established the theories of evolution and natural selection