Marked Secular Increase in the Incidence Rates of Osteoporotic Hip Fractures in Women and Men in Southern Israel

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Abstract

Background: For the last 35 years, our medical center has been the only referral center and provider of emergency medical services for a well-defined geographic area in southern Israel.

Objectives: To evaluate trends in the incidence of hip fractures in this population.

Methods: The study was based on two surveys done approximately 20 years apart. It included women and men 50 years and older with radiographic evidence of a new hip fracture caused by low impact trauma. Only fractures that resulted from low or moderate trauma were considered for the current study. Incidence rates were calculated based on population data obtained from the official Central Bureau of Statistics.

Results: There was an overall twofold increase in the incidence rate of hip fractures. However, this increase occurred almost exclusively in the over-75 year old age groups (2.5-fold increase, both in women and men). The mean (and median) age of patients with hip fractures increased significantly over the study period, corresponding to the increase in longevity between the two periods.

Conclusions: There was a marked secular increase in the incidence of proximal hip fractures in both genders, primarily because of an increase in the fracture rate in the very old. The increase in median age of fracture patients suggests that the observed increase in fracture rate can be attributed mainly to aging of the population rather than to deterioration in bone quality over the generations.

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Osteoporosis is characterized by decreased bone mass and distortion of the skeletal micro-architecture, resulting in increased risk for fractures. While it is more common among postmenopausal women, there is increasing awareness that elderly men may also be affected. Ethnicity has an important role in determining the risk for osteoporotic fractures [1]. Published data indicate a secular increase, stabilization or decrease in the incidence rate of hip fractures [2], but the underlying causes for those trends are not completely understood.

Only limited data are currently available on the epidemiology of osteoporotic fractures in Israel [3], with no data regarding longitudinal trends in the incidence of osteoporotic fractures. Such data are of particular importance, given the current availability of potent pharmacologic and non-pharmacologic measures that could potentially change the natural trends in morbidity from osteoporosis. Two surveys carried out in our area in the late 1970s and late 1990s provided the opportunity to assess secular trends in the incidence of osteoporotic hip fractures in southern Israel.

Subjects and Methods

Our institution is a 950-bed teaching hospital with approximately 160,000 non-pediatric visits to the emergency room annually, approximately 30,000 of which are to the orthopedic section. The hospital serves the population in a defined geographic area in the southern part of the country; it has been the only secondary, tertiary and emergency referral center for this area since the early 1960s. The majority of the population (approximately 80%) is concentrated in one major city and four smaller satellite towns, and the remainder lives in small rural communities.

The study included women and men aged 50 years and older with radiographic evidence of a new fracture resulting from mild to moderate trauma. The 50 year cutoff for women was chosen because it corresponds with the average onset of menopause, while the 50 year cutoff for men was set arbitrarily. A fracture due to mild or moderate trauma was defined as such if it resulted from a fall from a standing position or from less than 1 meter (e.g., a fall from a chair).

The late 1970s survey data were derived from an MD thesis by one of the authors of the current study (D.A.) [4]. The original data included all hip fracture cases seen in our hospital during the years 1975 through 1980, irrespective of cause; however, the fractures were classified as resulting from severe or mild trauma and only the latter were included in the current study. For the late-1970s survey, all proximal hip fractures were identified and cross-matched using records of the admission office, admission logs of the orthopedic surgery department, emergency room charts, operating room logs, and careful review of each individual patient's chart. For the late-1990s survey, screening and review of all emergency room charts allowed identification of every patient with hip fracture resulting from mild or moderate trauma who was treated at our institution during the corresponding periods of January and February 1998 through 2001. Screening of the hospital's computerized database, using the ICD-9 index code 820 (femoral neck) and careful review of each individual patient's chart, enabled us to identify all patients with osteoporotic hip fractures treated at our hospital during the respective period with a new fracture [5]. Since, previously, no seasonal variations in the incidence rates of hip fractures were observed [4], the 2 month samples taken each year for 4 years could be considered a representative of the year-round rate of fractures.

Descriptive statistics and calculations of the level of sig-

nificance between groups by Student's *t*-test were done with the JMP-IN statistical program (SAS Institute, Cary, NC, USA). Population data were obtained from the official Central Bureau of Statistics. Ninety-five percent confidence intervals for incidence rates were calculated according to Haenszel et al. [6].

Results

Table 1 presents characteristics of the patients in the late-1970s and late-1990s surveys. The late-1970s survey group comprised 275 patients and the late-1990s group 169. The mean ages of the men and women did not differ during each of the two periods. However, the mean (and median) age of both women and men in the late survey period was significantly higher than that in the earlier survey period.

Figures 1 and 2 present the age-specific incidence rates of proximal hip fractures in each of the survey periods. The overall incidence rate of hip fractures in women aged 50 years and older out of 100,000 was 191 in the late 1970s (95% CI 166–220) and 408 in the late 1990s (95% CI 334–482). The rate in men aged 50+ was 105 in the late 1970s (95% CI 85–130) and 196 in the late 1990s (95% CI 145–258). The change in incidence rate of hip fractures in both genders occurred mainly in the 75+ age group. In this group the incidence of hip fractures increased in women from 757 in the late 1970s (95% CI 702–816) to 1,900 in the late 1990s (95% CI 1,537–2,356) and in men from 412 in the late 1970s (95% CI 371–453) to 1,053 in the late 1990s (95% CI 710–1,505).

Discussion

Since the late 1970s, the absolute number of osteoporotic hip fractures in our area increased fivefold, from 47 to 253 patients per year, which is partly accounted for by an approximately 2.5-fold increase in the size of the population at risk (age over 50 years) [Table 1]. However, the current study reveals a marked age- and gender-specific increase in the incidence rate of hip fractures, which accounts for most of the remaining increase.

In women over 50 years old a 1.5-fold increase in the incidence rate of hip fracture was observed between the late 1970s and the late 1990s, due mainly to an increase in the fracture incidence in those over age 75, among whom a 2.5-fold increase in the incidence of proximal hip fractures was observed, while no significant difference in fracture incidence rate was observed in the younger age groups. A similar trend was also observed in men. The overall incidence of osteoporotic hip fractures in men aged 50+ increased twofold, and in the 75+ age group the fracture incidence rate increased 2.5-fold, while no change in the fracture incidence rates was observed in the younger age groups. In both men and women the mean (and median) age of fracture was higher in the more recent survey.

The present study has several limitations. The study was retrospective and there may be some minor differences in the definition of osteoporotic vs. traumatic fracture. The latter data

CI = confidence interval

Table 1. Patient characteristics in the study periods

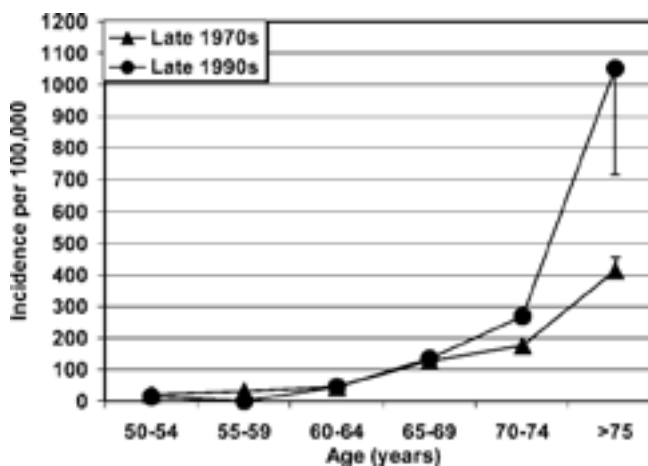|	Late 1970s	Late 1990s
Women	183 (66.6%)	121 (71.6%)
Mean age (yrs ± SD)	72.8 ± 9*	79.7 ± 9*
Median age (yrs)	72.3	80.0
Population at risk (age >50)	16,000	45,100
Longevity (yrs) ***	76	81
Men	92 (33.4%)	48 (28.4)
Mean age (yrs ± SD)	73.1 ± 10.4 **	77.1 ± 8 **
Median age (yrs)	71.6	76.5
Population at risk (age >50)	14,660	36,700
Longevity (yrs) ***	72	77

* $P < 0.0001$

** $P = 0.0186$; the mean age difference between genders was not significant in the two study periods.

*** Official data from the Central Bureau of Statistics pertain to the entire Israeli population [25].
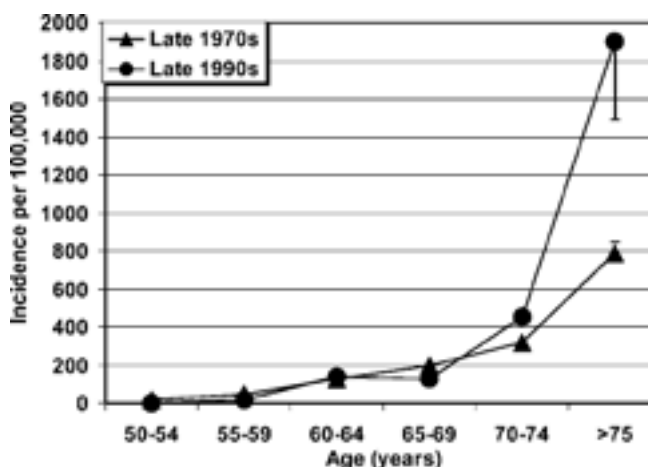
Figure 1. Graph shows the changes in age-specific incidence rate of osteoporotic proximal hip fractures in women in southern Israel in the late 1970s and late 1990s; error bar 95% CI.

Figure 2. Graph shows the changes in age-specific incidence rate of osteoporotic proximal hip fractures in men in southern Israel in the late 1970s and late 1990s; error bar 95% CI.

were combined from 2 month samples during 4 consecutive years; however, the fracture rate was consistent throughout this survey period, suggesting that the annual samples were representative of the true fracture incidence rate. Data regarding trends in general health status of the population, which could help explain the mechanism(s) of the observed increase in the incidence of hip fractures, was limited to longevity alone, and data on trend of bone mineral density in our population were not available. A major limitation was our inability to obtain a breakdown of the composition of the population 75 years and older, which could enhance our understanding of the observed results. On the other hand, the study has the great advantage of being derived from a well-defined geographic area, a defined population served by a single trauma center, and excellent access to the data sources, including patients' medical records that provided effective control over data and largely precluded missing or duplicate reports.

Published data on secular trends in the incidence of hip fractures are variable, depending on time and location. Secular increases in the incidence of osteoporotic fractures were previously observed [2,7]. Kannus et al. [8] reported a particularly marked, 2.7-fold increase in the incidence of hip fractures in Finland between 1970 and 1997 in a nationwide survey of the population aged 50 years and older. As in the present study, the increase in fracture rate was limited to those aged 75+, and the increase in hip fracture incidence in men was somewhat greater than in women. Others reported slower increase rates, leveling off or stabilization of the rate [9–12]. Of particular interest is the observation by Melton and co-workers [2] in a survey from Rochester, Minnesota, covering the period 1928 to 1977, of a continuous rise in the age-adjusted fracture rates for men, leveling off in women since the mid-1950s.

The increase in crude incidence rates of hip fractures is usually attributed to the increased longevity and aging of the population. However, other explanations, not fully satisfactory, were occasionally put forward for the observed increase in the age-adjusted incidence rates. Proposed explanations include methodologic problems in data collection, earlier menopause due to increased frequency of oophorectomy (unlikely in view of the concurrent increased incidence in men), increased alcohol intake and cigarette smoking, use of drugs, dietary (calcium and vitamin D intake) and environmental changes, decreased physical labor and physical activity [2,8], and secular adverse changes in hip geometry [13]. In our area, a major demographic change occurred in the early 1990s with the massive immigration from the former USSR republics. However, preliminary data suggest that the fracture rate among former USSR immigrants is not different to that of immigrants, native Israelis or immigrants from other parts of the world (Liel et al., in preparation). Overall, the proportion of the 75 years and older group within the population at risk increased between the two study periods (14.4% vs. 11.5% of the population aged 50+ in the late 1990s and late 1970s, respectively; $P < 0.0001$), explaining, in part, the increase in fracture incidence rates in the overall population, but as previously mentioned we lack details on changes in

the composition of our 75 years and older age group that could shed more light on the increase in fracture incidence within this age group. Given the documented increase in longevity of our population [Table 1], an increase in the proportion of the "old-old" within the 75+ group is very likely. Since the entire population is medically insured and accessibility to medical services unobstructed, changes in accessibility and quality of medical services could not explain the observed increase in the rate of osteoporotic hip fractures (particularly in view of an increasing awareness towards osteoporosis, at least among women).

It has been suggested that deterioration in bone quality might contribute to the secular increase in osteoporotic fractures observed elsewhere [7], but we are not aware of any solid evidence to support this claim. In this regard, we were specifically concerned about a potential "cohort effect" with respect to a significant proportion of our population who were children or young adolescents during World War II and turned 70 and 80 in the late 1990s. A decrease in the population's bone quality could be expected to be associated with a decrease in the mean age of patients with fractures. However, we observed the opposite. This increase in the mean (and median) age at fracture, which corresponded with the increase in longevity and the expected increase in fracture rates attributed to aging alone [14], seems to exclude the possibility of a decrease in bone quality over time with regard to our population.

Falls are by far the main cause of hip fractures [15,16], and increasing age markedly increases the risk of falls [17]. In Israel, 24% in the age group 65 and older reported at least one fall per year, ranging from 20% in the 65–69 year age group, mostly in women, stepping up to 35% in those 80–85 years and older, reaching even higher rates in women [18]. Population aging and subsequent age-related falls probably best explain the increase in the incidence of hip fractures in our population.

Numerous recent studies have reported poor adherence to osteoporosis treatment guidelines [5,19] and problems of adherence with the prescribed treatments [20,21]. The current study, as well as previous studies indicating a secular increase in the incidence of osteoporotic fractures, underlines the importance of taking advantage of currently available effective pharmacologic and non-pharmacologic measures, such as hip protectors and training for avoiding hip impact during falling [22–24] in order to reduce fracture risk in susceptible groups. Continuous monitoring of the incidence rate of hip fractures is imperative to adjust health policies to the morbidity trends and to evaluate the effectiveness of fracture prevention measures on a population scale.

References

1. Ross PD, Santora A, Yates AJ. Epidemiology and consequences of osteoporotic fractures. In: Rosen CJ, Glowacki J, Bilizikian JP, eds. The Aging Skeleton. San Diego: Academic Press, 1999:339–47.
2. Melton LJ 3rd, O'Fallon WM, Riggs BL. Secular trends in the incidence of hip fractures. *Calcif Tissue Int* 1987;41:57–64.
3. Liel Y, Castel H. Low-impact fractures in southern Israel: preliminary observations. *Harefuah* 2004;143:18–21 (Hebrew).
4. Alkalay D. MD thesis: Epidemiology of femoral neck fractures

in the Negev population. Hebrew University-Hadassah Medical School, Jerusalem, 1982.

5. Liel Y, Castel H, Bonneh DY. Impact of subsidizing effective antiosteoporosis drugs on compliance with management guidelines in patients following low-impact fractures. Osteoporos Int 2003;14:490–5.

6. Haenszel W, Loveland D, Sirken MG. Lung cancer mortality as related to residence and smoking histories. J Natl Cancer Inst 1962;28:947–1001.

7. Cummings SR, Melton LJ. Epidemiology and outcomes of osteoporotic fractures. Lancet 2002;359:1761–7.

8. Kannus P, Niemi S, Parkkari J, Palvanen M, Vuori I, Jarvinen M. Hip fractures in Finland between 1970 and 1997 and predictions for the future. Lancet 1999;353:802–5.

9. Bacon WE. Secular trends in hip fracture occurrence and survival: age and sex differences. J Aging Health 1996;8:538–53.

10. Beringer TR, Wilson RA, Swain D, Patterson CC, Beverland D. Proximal femoral fracture in Northern Ireland between 1985-1997–trends and future projections. Ulster Med J 2000;69:112–17.

11. Lofthus CM, Osnes EK, Falch JA, et al. Epidemiology of hip fractures in Oslo, Norway. Bone 2001;29:413–18.

12. Reginster JY, Gillet P, Gosset C. Secular increase in the incidence of hip fractures in Belgium between 1984 and 1996: need for a concerted public health strategy. Bull WHO 2001;79:942–6.

13. O'Neill TW, Grazio S, Spector TD, Silman AJ. Geometric measurements of the proximal femur in UK women: secular increase between the late 1950s and early 1990s. Osteoporos Int 1996;6:136–40.

14. De Laet CE, Van Hout BA, Burger H, Weel AE, Hofman A, Pols HA. Hip fracture prediction in elderly men and women: validation in the Rotterdam study. J Bone Miner Res 1998;13:1587–93.

15. Parkkari J, Kannus P, Palvanen M, et al. Majority of hip fractures occur as a result of a fall and impact on the greater trochanter of the femur: a prospective controlled hip fracture study with 206 consecutive patients. Calcif Tissue Int 1999;65:183–7.

16. Porthouse J, Birks YF, Torgerson DJ, Cockayne S, Puffer S, Watt I. Risk factors for fracture in a UK population: a prospective cohort study. Q J Med 2004;97:569–74.

17. Nevitt MC. Osteoporosis and fragility fractures in the elderly. In: Rosen CJ, Glowacki JG, Bilezikian JP, eds. The Aging Skeleton. San Diego: Academic Press, 1999:349–57.

18. Cwikel J. Falls among elderly people living at home: medical and social factors in a national sample. Isr J Med Sci 1992;28:446–52.

19. Siris ES, Bilezikian JP, Rubin MR, et al. Pins and plaster aren't enough: a call for the evaluation and treatment of patients with osteoporotic fractures. J Clin Endocrinol Metab 2003;88:3482–6.

20. Tosteson AN, Grove MR, Hammond CS, et al. Early discontinuation of treatment for osteoporosis. Am J Med 2003;115:209–16.

21. Clowes JA, Peel NF, Eastell R, et al. The impact of monitoring on adherence and persistence with antiresorptive treatment for postmenopausal osteoporosis: a randomized controlled trial. Early discontinuation of treatment for osteoporosis. J Clin Endocrinol Metab 2004;89:1117–23.

22. Kannus P, Parkkari J, Niemi S, et al. Prevention of hip fracture in elderly people with use of a hip protector. N Engl J Med 2000;343:1506–13.

23. Robinovitch SN, Inkster L, Maurer J, Warnick B. Strategies for avoiding hip impact during sideways falls. J Bone Miner Res 2003;18:1267–73.

24. Haines TP, Bennell KL, Osborne RH, Hill KD. Effectiveness of targeted falls prevention programme in subacute hospital setting: randomised controlled trial. Br Med J 2004;328:676.

25. Central Bureau of Statistics. Life expectancy. Vol. 2003. http://www.cbs.gov.il/lmse.cgi?i=3&ti=4&r=0&f=3&o=0

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