International Journal of Gerontology 7 (2013) 167–170

Contents lists available at SciVerse ScienceDirect

International Journal of Gerontology

journal homepage: www.ijge-online.com

Original Article

Risk of Hip Fracture in Community-dwelling and Institutionalized Osteoporotic Patients: A 3-year Study☆

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ARTICLE INFO

Article history:
Received 14 March 2012
Received in revised form
14 August 2012
Accepted 15 October 2012
Available online 17 December 2012

Keywords:
bone mineral density,
fracture,
nursing home,
osteoporosis,
vitamin D

SUMMARY

Background and aims: It has been previously suggested that the incidence of hip fracture is higher among people living in nursing homes than among community-dwelling people. However, it is not clear whether this is a consequence of nursing home residency or of the greater age of the residents. We have examined the relationship between the place of residence and hip fracture incidence, in a prospective 3-year study.

Methods: Women from nine countries included in this study were part of the placebo group of a randomized controlled trial having assessed the long-term effect of a new antiosteoporotic drug. All women were osteoporotic and received placebo and vitamin D during the 3 years of follow-up. All the institutionalized (nursing home, medical house) women ($n = 217$) were included in this *post hoc* analysis and three noninstitutionalized age- and country-matched controls were included ($n = 651$).

Results: The mean (and standard deviation) age of the patients was 80.4 (5.6) years in the institutionalized women and 80.2 (5.8) years in the noninstitutionalized women ($p = 0.87$). After 3 years of follow-up, 37 fractures occurred: 12 (5.5%) in institutionalized women and 25 (3.8%) in noninstitutionalized women. The difference between the two groups was not statistically significant ($p = 0.29$). After controlling for age, body mass index, femoral neck bone mineral density and prevalent nonvertebral fracture, the residence status of the patient (institutionalized vs. noninstitutionalized) was not significantly associated with hip fracture incidence ($p = 0.63$).

Conclusion: We suggest that living in an institutionalized place is not an independent risk factor for hip fracture for osteoporotic women receiving calcium and vitamin D.

1. Introduction

Hip fractures are a burden to both society and the individual, mainly because of their high frequency and their related dramatic consequences. As a matter of fact, the most important consequences of a hip fracture are the ensuing high mortality rate and the decrease in functional abilities[1]. The latter implies reduced mobility, loss of independence, and a lower prospect of returning to the most elementary activities of daily living[2]. The increased mortality risk may persist for several years thereafter, highlighting the need for actions to reduce this risk. Patients experiencing a hip fracture after low-impact trauma are at considerable risk for subsequent osteoporotic fractures and premature death[3]. The cost of a hip fracture is also very high[4,5]. For example, it has been shown, in a 1-year prospective study, that the costs to treat a hip-fracture patient are about three times higher than those to care for a patient with no fracture[5].

Nursing home residents are at high risk of hip fracture and the consequences of this fracture could be more dramatic than for community-dwelling older adults[6–8]. In a Spanish study, 1 year after a hip fracture, mortality was observed to be independently associated with an institutionalized disposition at discharge [relative risk (RR) = 2.92; 95% confidence interval (CI) 1.02–8.38], meaning that the risk of death of a patient living in an institution is almost three times higher than for a patient living in the community[2]. It is also suggested that the characteristics of patients hospitalized for hip fracture according to whether they lived in institutional or community residences seems to be different[9]. According to a prospective cohort study, institutionalized patients were more often male and widowed, had more dementia and visual deficits, and presented higher levels of both total and psychoactive

☆ All contributing authors declare no conflicts of interest.

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1873-9598/$ – see front matter
http://dx.doi.org/10.1016/j.ijge.2012.11.015

drug consumption[9]. Another study, performed in the USA, showed that patients with a hip fracture, resident in long-term care facilities, have higher rates of dementia, arrhythmia, delirium and anxiolytic use than patients from the community[10]. Before hospitalization they were also less ambulant than community patients. Postsurgery ambulatory status declined in both groups. However, a major decline in ambulatory status occurred more often in long-term care facility patients.

It has been previously suggested that the incidence of a hip fracture is higher among people living in nursing homes than among community-dwelling people[11–14]. However, it is not clear whether this is a consequence of nursing home residency or of the greater age of the residents. Moreover, being a resident in a nursing home implies several health conditions, such as frailty, chronic health conditions, and declining cognitive status[15,16]. To date, few studies have examined the risk of hip fracture by residential status while controlling by potential confounding factors, such as age. We have examined the relationship between the place of residence and hip fracture incidence, by comparing new fractures in institutionalized and noninstitutionalized women of the same age.

2. Materials and methods

Women included in this study were part of the placebo group of a large randomized controlled trial having assessed the long-term effect of a new antiosteoporotic drug[17]. The design and methodology of this study have been previously described in detail. Briefly, ambulatory postmenopausal women were recruited at 75 centers in 11 European countries and Australia in a prospective, randomized, double-blind, placebo-controlled 3-year trial to assess the efficacy of strontium ranelate 2 g/day on nonvertebral fracture incidence in the treatment of postmenopausal osteoporosis. Women were eligible for the study if they had a femoral neck bone mineral density (BMD) of 0.600 g/cm^2 (corresponding to a T-score < -2.5), aged 74 years or older or between 70 and 74 years with at least one additional risk factor for fracture. Exclusion criteria were diseases interfering with bone metabolism or use of antiosteoporotic treatments. After receiving information from the investigator (full explanation of the nature, purpose, and duration of the study and that the patient would be free to withdraw from the study at any time, without affecting the standard of care received), and being able to ask questions regarding all aspects of the study, all participants gave written informed consent before enrollment. All women received calcium and vitamin D during the 3 years of follow-up. The study was approved by the institutional review boards.

For this particular study, all institutionalized osteoporotic women from nine countries (Australia, Belgium, France, Germany, Hungary, Italy, Poland, Spain and the UK) were included. For each of the 217 institutionalized (nursing home, medical house) women included in this study, three noninstitutionalized age and country-matched controls were included ($n = 651$).

During the study, cervical and trochanteric hip fractures were reported by study investigators based on written documentation provided and documented in the source document (radiograph, radiological report, copy of the hospitalization/emergency department report). Only documented hip fractures were taken into account in the statistical analysis.

Standing height was measured with a Harpenden stadiometer and weight with a scale, according to a standardized procedure. Bone mineral density at the femoral neck was measured by dual-energy X-ray absorptiometry (Hologic, Marlborough, MA, United States). All the scans were analyzed centrally and a quality-control program was conducted throughout the study. Health-related quality of life was assessed with the SF-36 questionnaire. The SF-36 measures quality of life using 36 items grouped into eight domains: physical functioning, role − physical, bodily pain, general health, vitality, social functioning, role − emotional, and mental health. From these eight domains, two summary scores can be calculated: the physical and the mental component summary index.

Table 1
Baseline characteristics of the study population.

Variables	Institutionalized group ($n = 217$)	Noninstitutionalized group ($n = 651$)	p
Age (y)	80.2 (5.6)	80.4 (5.6)	0.86
Body mass index (kg/m^2)	26.1 (5.0)	25.0 (3.7)	0.0009
Femoral neck bone mineral density T-score	−3.46 (0.73)	−3.29 (0.61)	0.0006
Number of patients with one or more nonvertebral fracture	20 (9.2%)	131 (17.5%)	0.0002
SF-36 physical health summary	40.7 (12.3)	39.1 (9.7)	0.28
SF-36 mental health summary	51.2 (12.2)	48.7 (10.5)	0.13

Results are expressed as mean (SD) or n (%), when appropriate.

Normality of variables has been confirmed by Kolmogorov–Smirnov tests. Student t tests or nonparametric tests were used to compare baseline characteristics of the institutionalized and noninstitutionalized groups. The Chi-square test was used to compare the incidence of fracture in the institutionalized and noninstitutionalized groups. Logistic regression analysis was performed to assess the association of place of residence with the hip fracture incidence after adjustment for age, body mass index, femoral neck BMD and presence of nonvertebral fracture. All the data were analyzed using STATISTICA (version10.1; StatSoft Inc., Tulsa, OK, Unites States). All p values <0.05 were regarded as significant.

3. Results

Baseline characteristics of the study population are reported in Table 1. As expected, no significant differences were observed between the institutionalized and the noninstitutionalized groups in respect of age. However, significant differences were observed for body mass index, femoral neck BMD and number of women with prevalent nonvertebral fracture. The summary scores of the mental health and the physical health were not significantly lower among the institutionalized women than among the noninstitutionalized women.

After 3 years of follow-up, 37 fractures occurred: 12 (5.5%) in institutionalized women and 25 (3.8%) in noninstitutionalized women. The difference between the two groups was not statistically significant ($p = 0.29$).

After controlling for age, body mass index, femoral neck BMD and prevalent nonvertebral fracture, the residence status of the patient (institutionalized vs. noninstitutionalized) was not significantly associated with hip fracture incidence ($p = 0.63$) (Table 2). The only factor that was statistically associated with a future hip fracture was

Table 2
Results of the logistic regression analysis assessing factors associated with fracture incidence.

Variables	Estimate (standard error)	Odds ratio (95% confidence interval)	p
Intercept	−9.9		
Age	0.06 (0.03)	1.06 (0.99–1.13)	0.07
Body mass index	−0.01 (0.04)	0.99 (0.90–1.07)	0.75
Femoral neck bone mineral density	−0.71 (0.24)	0.002 (0.00002–0.13)	0.004
Presence of nonvertebral fracture (yes–no)	0.75 (0.41)	0.47 (0.21–1.06)	0.07
Institutionalized (yes–no)	0.17 (0.37)	1.19 (0.57–2.5)	0.63

the femoral neck BMD ($p = 0.004$) meaning that a low BMD was significantly associated with an increased risk of hip fracture.

4. Discussion

In this study, we found that people living in nursing homes were not at increased risk of hip fracture. These results were shown in the unadjusted analysis and confirmed by the analysis adjusted for age, body mass index, BMD and prevalent nonvertebral fracture. These results contrast with what would have been expected from the literature[11,13,14]. In a previous Australian report, it has been shown that the age- and sex-adjusted odds ratio for the association between risk of hip fracture and living in a nursing home (compared with living in the community) was 2.7 (95% CI 1.6–4.6)[12]. Another study from New Zealand, showed that patients living in institutions are twice more likely to experience a hip fracture than those living in private homes (OR = 2.2)[13]. Another US study showed that the standardized age- and sex-adjusted hip fracture rate of nursing home residents (23.0 per 1000 person-years) substantially exceeded that of nonnursing home residents (5.7 per 1000 person-years)[14].

The conflicting results we observed, compared to previous data, could be explained by differences in methodology and by the particularity of this study. An important confounding factor (i.e., age) has been taken into account in this study. However, we acknowledge that other important confounders (i.e., cognitive impairment, physical activity level, arrhythmia, and use of anxiolytics[12]) were not assessed in this study. A further point of interest is that even if institutionalized women have been shown to have a lower level of vitamin D compared to noninstitutionalized women[18], all patients from this study received appropriate doses of calcium and vitamin D, according to baseline status. Consequently, vitamin D status at baseline could not be considered as a potential confounding factor in the present study. Indeed, vitamin D and calcium have been shown to reduce the risk of vertebral and nonvertebral fracture, especially in the very older adult population[19,20]. We acknowledge that the power of our study is probably too low, with only 37 hip fractures observed during the 3 years of follow-up. However, results of the logistic regression analysis do not even show a trend towards a relationship between place of residence and risk of hip fracture. Several epidemiological studies have indicated a wide geographical variability in hip fracture incidence, with the highest values being reported for Scandinavian countries and North America[21]. In the present analysis, because of the nine countries involved in this study, we have matched each control for country of residence. Because of the design of this study (placebo group of a randomized controlled trial), women were carefully followed and no hip fracture could have been missed. In addition, individuals who volunteer to participate in clinical trials are probably more careful about their health than equivalent individuals in the general population. It must also be pointed out that our patients had no major diseases other than osteoporosis. Regarding the cognitive status, frequently altered in nursing home residents, it must be noted that all women included in this had to give a written consent, suggesting that our study population could have less cognitive disorders compared to populations of other epidemiological studies. These elements could partly explain the relatively low incidence of hip fracture in our study. Interestingly, the number of women with prevalent nonvertebral fracture was more important in the noninstitutionalized group. Prevalent fracture being a major risk of future fracture, the observed difference between the two groups in term of prevalent nonvertebral fracture could explain the absence of a relation between place of residence and hip fracture in our study. However, in the logistic regression analysis, the presence of nonvertebral fracture is not significantly associated with hip fracture, even if the p value was borderline significant ($p = 0.07$). Moreover, the logistic regression analysis show an absence of association between place of residence and hip fracture incidence after controlling for nonvertebral fracture prevalence.

Although several studies reported an increase in hip fracture incidence, some recent reports show that hip fracture incidence has reached a plateau or has even declined in some countries. We could hypothesize that this observation is the result of a better preventive pharmacological or nonpharmacological treatment[22–25]. In a prospective 10-year study, performed in Switzerland in elderly patients, aged 60 years and over, there was a 1.3% per year reduction in the standardized incidence of hip fracture in women but not in men[26]. Interestingly, this decrease was mainly because of changes in the standardized incidence of hip fracture in institution-dwelling women. Better management of the very elderly population in institutions could explain their results and those we observed. The improvement of patient safety and fall prevention programs in nursing homes could also partly explain the opposite results of our study (i.e., people living in nursing homes were not at increased risk of hip fracture) compared to results performed in the 1990s[11–14].

In adjusted analysis, the only factor predictive of hip fracture was baseline femoral neck BMD confirming that a low BMD is associated with an increased risk of hip fracture. This result confirms the interest of BMD assessment for the identification of patient at higher risk of fracture[27,28]. However, it should be acknowledged that only approximately one-half of fragility fractures occur in women meeting current criteria for osteoporosis based on BMD[29]. A large number of additional risk factors for fracture have been identified. The use of clinical risk factors in conjunction with BMD and age improves the accuracy of fracture prediction without adverse effects on specificity[30]. An algorithm that integrates the weight of clinical risk factors for fracture risk with or without information on BMD is now available[31]. Unfortunately, we have not been able to assess all these risk factors in this particular study. At last, it should be acknowledged that BMD assessment in institutionalized women is problematic, from a practical point of view. Further research is needed to better assess and manage the risk of fracture of institutionalized individuals.

5. Conclusion

In conclusion, we suggest that living in an institutionalized place is not an independent risk factor for hip fracture for osteoporotic women receiving calcium and vitamin D supplements. Other studies need to be performed to confirm these results.

Acknowledgments

We thank Servier for providing access to their database.

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