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Original Article

The Incidence of Hip Fractures in Independent and Institutionalized Elderly People

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Abstract. The incidence density of hip fractures in the population of Amsterdam, aged 70 years and over, was studied according to the type of residence. In 1989, 655 patients were admitted to nine hospitals within Amsterdam for a hip fracture. Postal codes were used to classify the residence of the population and the hip fracture cases as independent, home for the elderly or nursing home. Stepwise logistic regression was used for data analysis. The risk of hip fracture increased with age and was 1.7 times higher for women than for men. In the age group 70–74 years the relative risk (RR) was 7.6 for those in homes for the elderly and 5.8 for those in nursing homes, when compared with the independent elderly. This RR was approximately 1 for those in homes for the elderly aged 85 years and over. However, in nursing homes the RR was still 2.8 in the age group 95+. We concluded that, despite protective measures against falls, the institutionalized elderly are at greater risk of hip fracture than the independent elderly of the same age and sex. This higher risk is especially apparent in the 'younger' age groups.

Keywords: Elderly people; Hip fractures; Osteoporosis; Residence

Introduction

Hip fractures constitute an important health problem with considerable morbidity and mortality. In The Netherlands the number of hospital admissions for hip fracture was over 10 000 in 1987 [1]. The incidence of hip fractures increases exponentially after the fifth decade of life. The age-specific incidence is about twice as high in women as in men [2]. In the USA, white women aged 80 years still have a 14% risk of suffering a hip fracture during the rest of their lives, whereas for men this risk is 7.1% [3]. The total incidence of hip fractures is expected to increase in future years due to the aging of the population. Moreover, the age-specific incidence appears to be increasing in some European countries and in the USA [4–7]. Studies show that 15%–35% of patients die within the first year after a hip fracture, while another quarter will remain disabled. Only about half of the patients will be able to walk, with or without a mechanical aid, 1 year after surgical treatment [2,8,9].

There is some evidence that the incidence of hip fractures may be different in the various types of residence for elderly people, although most studies did not allow for differences in sex and age distribution. A consecutive series of 125 patients with hip fracture admitted to a hospital in Amsterdam suggested that the risk of hip fractures was doubled in homes for the elderly compared with elderly people living independently, while the risk was about 7 times higher for residents of nursing homes [10]. Rudman et al. [11] found a higher incidence of hip fractures for men in nursing homes compared with age-matched population data. Hui et al. [12] found a higher risk of hip fractures for women in a retirement home when compared with independent women with the same bone mass but different age.

Housing accommodation for the elderly in The Netherlands can be divided into the following four categories of increasing dependence and care: independent housing (75% of the elderly over 65 years), service flats and service accommodation for the elderly

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(15.5%), homes for the elderly (7%) and nursing homes (2.5%) [13]. Although the last three categories offer special protection (e.g. grip bars, adequate illumination and the absence of loose carpets) against falls and thus fractures, the populations involved are likely to differ substantially with regard to the prevalence of risk factors for osteoporosis and falls. Osteoporosis will be more prevalent in institutionalized elderly due to chronic diseases such as rheumatoid arthritis, parkinsonism and diabetes that are associated with decreased mobility and activity, vitamin D deficiency and more frequent use of corticosteroids [14]. The incidence of falls will be higher due to the higher prevalence of previous stroke, cognitive impairment, poor sight and balance, and the use of medicines which cause drowsiness or postural hypotension [14,15]. These factors may overshadow the benefits of the specific provisions against falls in the institutions.

We are currently conducting a large double-masked clinical trial on the effect of vitamin D supplementation on the incidence of hip fractures among elderly people [16]. In this study, large differences in the incidence of hip fractures among the different types of residence is apparent. As these rates may differ from those in the population, we collected data on hip fractures with regard to the type of residence during 1 year for all the inhabitants of Amsterdam. Here the age- and sex-specific incidence rates of hip fractures in nursing homes, homes for the elderly and service flats/accommodation are compared with those of the elderly living independently.

Methods

The population consisted of the inhabitants of Amsterdam who were aged 70 years and older. All nine hospitals admitting hip fracture patients from the Amsterdam population were approached to provide data on all patients who (1) had been admitted in 1989 and diagnosed as hip fracture patients and (2) were residents of Amsterdam. Data were collected on discharge code, age, sex and the postal code of the home address at the time of the fracture. A stable dynamic population was assumed, which allowed the data on housing, age and sex in the total population to be assessed at one point in time. As it was not possible to obtain this information during 1989, the data were collected on 1 November 1990. The population register of the Amsterdam municipality provided the number of inhabitants aged 70 years and older, by sex and 5-year age group, for each postal code.

In The Netherlands the postal code used for mail delivery consists of four digits and two characters. Each individual code uniquely identifies between 1 and 25 neighbouring home addresses. Large buildings and institutions have their own postal codes. We collected the postal codes of all the service flats/accommodation, homes for the elderly and nursing homes in Amsterdam from the 'Address Book of Institutions and Service Flats for Elderly People'. The postal codes were subsequently checked by contacting the institutions and service flats. This enabled us to transform each postal code of the hip fracture cases and the study population into one of four housing categories of increasing care and dependence: (1) independent housing, (2) service flats/accommodation, (3) homes for the elderly and (4) nursing homes.

Independent housing is usually not adapted to the specific needs of the elderly, and the provisions for additional care are limited. Residents of service flats/accommodation for elderly people, which are usually built near a home for the elderly, are largely independent. This type of housing is especially adapted for the elderly. The apartments are either on one floor or served by a lift, and usually meals and other services, such as cleaning, can be provided in case of illness. In homes for the elderly the residents have private rooms but meals, cleaning and some nursing are always provided. Elderly people with severe impairments of mental or physical functions, necessitating permanent supervision and care, form the population of nursing homes [13].

The data were analysed by stepwise multiple logistic regression, resulting in a single model. The initial model contained sex, age group and residence. For these variables male sex, the age group 70–74 years and independent housing were chosen as reference categories. To test for modification, the product terms 'age by sex', 'age by residence' and 'sex by residence' were entered stepwise into the model. A product term remained in the model if this resulted in a significant improvement of the chi-squared statistic. All reported p values are two-sided.

Results

At 1 November 1990, 73 655 people over 70 years of age were registered as inhabitants of Amsterdam: 24 944 men and 48 711 women (Fig. 1A). The number of hip fracture admissions to Amsterdam hospitals during 1989 was 665. Postal codes were missing for 16 patients and these were excluded from the analysis, resulting in a total of 649 patients: 118 men and 531 women (Fig. 1B; mean age 82.7 and 84.2 years respectively). As shown in Fig. 2A, most elderly people lived independently up to the age of 85–89 years. In the age groups 90–94 and 95+ most elderly people lived in institutions, predominantly in homes for the elderly. The distribution of the hip fracture patients according to the type of residence is presented in Fig. 2B. As the service-flat/accommodation group was small and the incidence densities were no different from those of the elderly living independently, these categories were combined in the analysis.

The initial logistic regression model describing hip fracture risk contained age, sex and housing accommodation. The interaction term 'residence by age' was included in the final model ($p<0.001$). The p values for

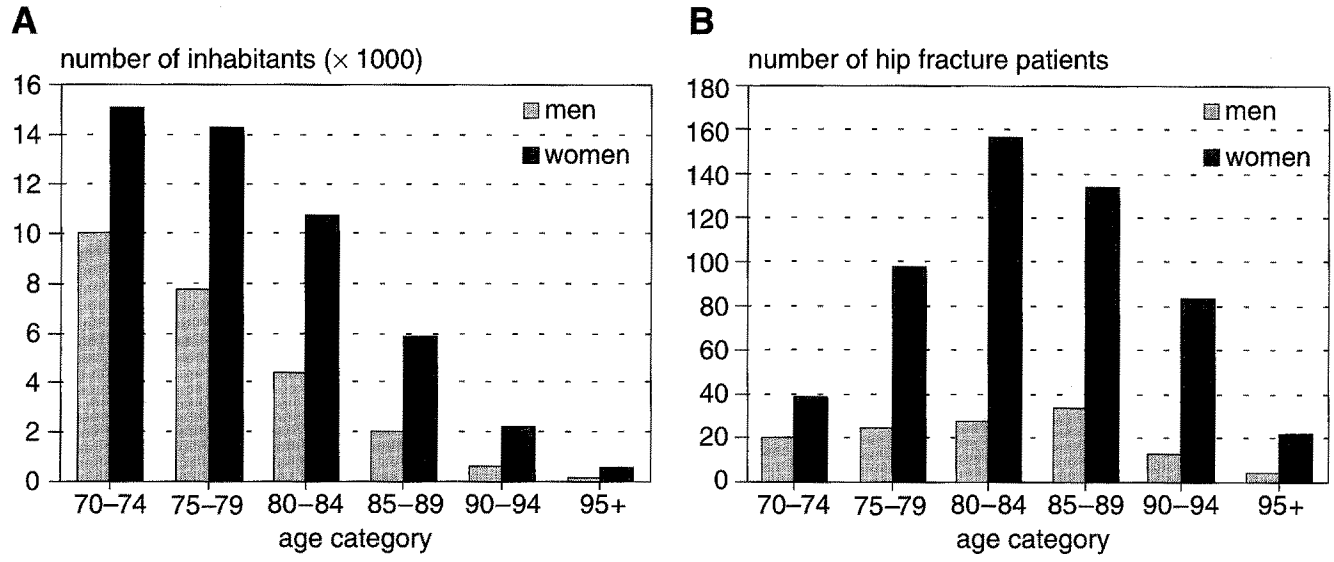

Fig. 1A,B. The number of inhabitants of Amsterdam (n=73 655) (**A**) and the number of hip fracture patients in 1989 (n=649) (**B**) according to age and sex.

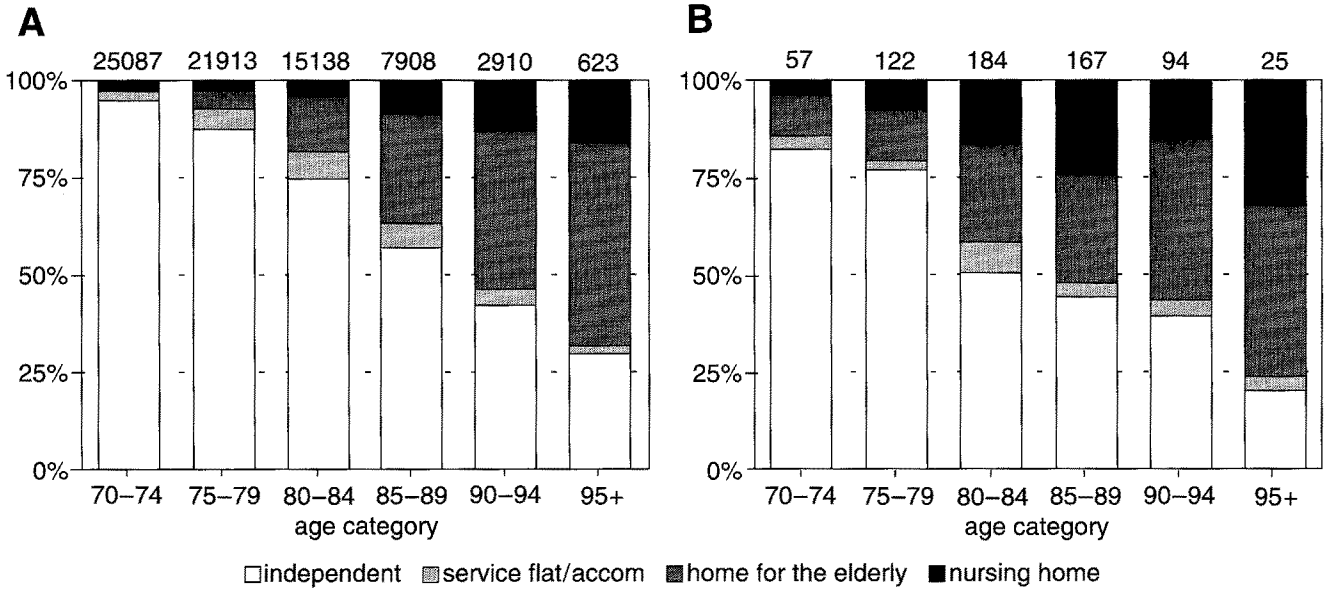

Fig. 2A,B. Distribution (%) of the inhabitants of Amsterdam (**A**) and the hip fracture patients in 1989 (**B**) according to residence and age. (The absolute totals per age group are indicated at the top.)

the terms 'sex by age' and 'sex by residence' were larger than 0.05 and therefore these terms were not included. Therefore, relative risk (RR) of hip fracture according to the housing categories was modified by age, but not by sex. Women had a 1.7 times higher risk of hip fracture then men, independent of age (95% confidence interval 1.4–2.1). Table 1 shows the observed incidence density (ID) in women by age and housing accommodation, and the RR of hip fracture from the logistic model when compared with independent elderly in the age group 70–74 years. As the risk associated with housing accommodation is not modified by sex, these data apply to women as well as men. Among the independent elderly the risk of hip fracture nearly doubled with every 5-year interval, illustrating the exponential increase of the risk with age. This increase was less apparent in the other housing categories. For the age groups 75–79 to 95+, the RR of hip fracture was highest for the nursing home category, followed by the home for the elderly category. The RRs and the 95% confidence intervals for hip fractures in the homes for the elderly and the nursing homes when compared with those for independent elderly people in the same age group are shown in Table 2. For the age group 70–74 years the incidence density was 7.6 times higher in homes for the elderly, and 5.8 times higher in nursing homes, compared with independent housing. The RR of hip fracture decreased with age for residents of homes for the elderly and beyond the age group 80–84 years the risk of hip fracture was no longer statistically signifi-

Table 1. Observed incidence density (ID) per 100 000 person-years in women by age and housing accommodation, and relative risk (RR) of hip fracture compared with independent men and women aged 70–74, as calculated from the logistic model

Age group (yr)	Independent elderly		Home for the elderly		Nursing home	
	$ID_{observed}$	RR_{model}	$ID_{observed}$	RR_{model}	$ID_{observed}$	RR_{model}
70–74	218	1.0	1544	7.6	1852	5.8
75–79	563	2.3	1768	6.5	3448	12.5
80–84	1005	4.2	2685	10.2	5556	23.5
85–89	1718	7.6	2145	10.0	6355	29.9
90–94	3455	14.5	3685	15.2	3571	19.5
95+	4316	14.7	2952	15.6	10 127	40.4

Table 2. Relative risks (RR) and 95% confidence intervals (CI) for hip fractures in homes for the elderly and nursing homes, compared with independent housing in the same age category (adjusted for sex)

Age group (yr)	Home for the elderly		Nursing home	
	RR	CI	RR	CI
70–74	7.6	3.2–17.7	5.8	1.4–23.8
75–79	2.8	1.7– 4.8	5.4	2.7–10.7
80–84	2.5	1.7– 3.5	5.6	3.7– 8.5
85–89	1.3	0.9– 1.8	3.9	2.7– 5.8
90–94	1.1	0.7– 1.7	1.4	0.7– 2.5
95+	1.1	0.4– 2.9	2.8	1.0– 8.4

cantly higher. In the nursing home category the decrease in RR with age was smaller, the risk remaining statistically significantly different from that of the independent group up to age 85–89 years.

Discussion

In the elderly population of Amsterdam the incidence density of hip fractures during 1 year was studied among the various types of residence for the elderly. The observed incidence density in the independent elderly was slightly less than other investigators have found for the general population [2,6,17,18]. The 1.7 times higher risk for women, which was independent of age, is comparable to the results of other studies in predominantly Caucasian populations [2]. Many authors have found an exponential increase in the incidence of hip fractures with age [4–6]. In our study the incidence nearly doubled every 5 years among independent elderly people and the elderly in nursing homes, but in homes for the elderly this increase was less pronounced.

The incidence of hip fractures in the various types of residence is determined by population differences with regard to risk factors for hip fracture on the one hand, and the protection against falls that is offered by the adapted housing on the other hand. Admission to a nursing home or a home for the elderly at a relatively young age is likely to be associated with considerable impairments in, for example, mobility, activity and cognitive function [14,15], which could account for the high risk of hip fracture for the younger age categories in these institutions. The RR was progressively lower for the higher age groups in the homes for the elderly, being nearly 1 for those aged 85–89 and over. Although this trend was also apparent in the nursing homes, the RR was still 2.8 in the 95+ group, although of borderline statistical significance. Only elderly people requiring additional care will be admitted to homes for the elderly, while the residents who have become too incapacitated will be admitted to a nursing home. Elderly people are able to continue to live independently only if additional care at home (family, neighbours, professional help) is available to a sufficient degree. This supportive care at home may approach the degree of care in the homes for the elderly. This could explain why the independent elderly of 85 years and over are similar to residents of homes for the elderly with regard to hip fracture risk.

Elderly in nursing homes are largely dependent, and require much care. They will have severe impairment of mobility, and poor general health. This explains the high risk of hip fractures in all age groups, as these are risk factors for osteoporosis as well as for falls. Furthermore, psychogeriatric disorders are present in a large proportion of the population of nursing homes, which is known to be another important risk factor for falls [14,15]. In addition, elderly people will often be admitted to a nursing home following a hip fracture. The risk of hip fracture recurrence among these cases is approximately twice the risk of a first fracture [19].

We were able to achieve a relatively complete ascertainment of hip fracture cases. In-hospital deaths are included in the hospital discharge files, and the chance of an inhabitant of Amsterdam with a hip fracture being admitted to a hospital in a nearby town is very small. In 1989 the only hospital within a 10 kilometre range of Amsterdam had admitted only 10 hip fracture patients from Amsterdam. As we were unable to obtain the source-population data in mid-1989, these were collected at 1 November 1990. However, the total number of Amsterdam inhabitants aged 65–79 and 80+ years did not change by more than 3% during this period [20,21], nor were there any changes in the total number of

institutional places available. Using postal codes for determining the housing accommodation proved to be a reliable method: in only 6 of 665 cases in which a nursing home and a home for the elderly had the same address we were unable to establish the residence categories at the time of the fracture. Furthermore, using postal codes provided the opportunity to exclude patients who were not inhabitants of Amsterdam, and, in combination with the patient's date of birth, allowed us to exclude second fractures and readmissions within the study period.

We conclude that the elderly in institutions are at greater risk of hip fracture than the independent elderly of the same age, although the risks converge for the very old. This suggests that the special provisions for preventing falls in institutions are not sufficient to protect the residents against hip fractures. The greatly increased risk of hip fractures in the younger institutionalized elderly may be the consequence of a higher prevalence of intrinsic risk factors for osteoporosis and falls among this subgroup. Further studies should be aimed initially at these factors. However, as these often cannot be influenced easily, prospective studies should also include extrinsic environmental factors, such as carpeting and illumination.

References

1. Boereboom FTJ, Groot RRM de, Raymakers JA, et al. The incidence of hip fractures in the Netherlands. Neth J Med 1991;38:51–8.
2. Gallagher JC, Melton LJ, Riggs BL, et al. Epidemiology of fractures of the proximal femur in Rochester, Minnesota. Clin Orthop Rel Res 1980;150:163–71.
3. Cummings SR, Black DM, Rubin SM. Lifetime risks of hip, Colles', or vertebral fracture and coronary heart disease among white postmenopausal women. Arch Intern Med 1989; 149:2445–8.
4. Johnell O, Nilsson B, Obrant K, et al. Age and sex patterns of hip fracture: changes in 30 years. Acta Orthop Scand 1984;55:290–2.
5. Lewis A. Fracture of the neck of the femur: changing incidence. BMJ 1981;283–1217–9.
6. Rodriguez JG, Sattin RW, Waxweiler RJ. Incidence of hip fractures, United States 1970–83. Am J Prev Med 1989;5:173–81.
7. Nagant de Deuxchaisnes C, Devogelaer JP. Increase in the incidence of hip fractures and the ratio of trochanteric to cervical hip fractures in Belgium. Calcif Tissue Int 1988;42:201–3.
8. Miller CW. Survival and ambulation following hip fracture. J Bone Joint Surg Am 1978;60:930–3.
9. Lips P, Obrant K. The pathogenesis and treatment of hip fractures. Osteoporosis Int 1991;1:218–31.
10. Lips P. Metabolic causes and prevention of hip fractures. PhD thesis, Free University, Rodopi Amsterdam, 1982.
11. Rudman IW, Rudman D. High rate of fractures for men in nursing homes. Am J Phys Med Rehab 1989;68:2–5.
12. Hui SI, Slemenda CW, Johnston CC. Baseline measurement of bone mass predicts fracture in white women. Ann Intern Med 1989;11:355–61.
13. Houben PPJ. Huisvesting van ouderen in Nederland in een veranderingsproces. In: Nies HLGR, Kroone ThJM, Baeyens JP, et al., editors. Handboek ouder worden. Deventer: Van Loghum Slaterus, 1989:III.D.3a.:1–26.
14. Molen T van der, Meyboom-de Jong B, Smith RJA. Seniors inside and outside the rest home. (In Dutch: Hoogbejaarden in en buiten het verzorgingshuis.) Huisarts Wet 1991;34:377–84.
15. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among the elderly living in the community. N Engl J Med 1988;319: 1701–7.
16. Lips P, Ooms ME, Schegget RM ter, et al. Prevention of hip fractures in the elderly by vitamin D supplementation. In: Christiansen C, Overgaard K, editors. Osteoporosis 1990. Copenhagen: Osteopress ApS 1990:1086–7.
17. Boereboom FTJ. Hip fractures: a public health problem. PhD thesis, University of Utrecht, 1991.
18. Nydegger V, Rizzoli R, Rapin CH, Vasey H, Bonjour JP. Epidemiology of fractures of the proximal femur in Geneva: incidence, clinical and social aspect. Osteoporosis Int 1991;2: 42–7.
19. Melton III LJ, Ilstrup DM, Beckenbaugh RD, Riggs BL. Hip fracture recurrence. Clin Orthop Rel Res 1982;167:131–8.
20. Anonymous. Age distribution per municipal, 1 January 1989. Mndstat Bevolk (CBS) 1989;11:47–55.
21. Anonymous. Age distribution per municipal, 1 January 1991. Mndstat Bevolk (CBS) 1991;10:27–35.

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