Osteoporos Int (2011) 22:647–653
DOI 10.1007/s00198-010-1287-1

ORIGINAL ARTICLE

Socioeconomic and living conditions are determinants of hip fracture incidence and age occurrence among community-dwelling elderly

E. Guilley · F. Herrmann · C.-H. Rapin · P. Hoffmeyer · R. Rizzoli · T. Chevalley

Received: 7 January 2010 / Accepted: 20 April 2010 / Published online: 18 May 2010

Abstract
Summary In this prospective, 10-year study in community-dwelling elderly aged 50 years and over, hip fracture incidence and accordingly age at hip fracture were inversely associated with the area-level income, independently of the geographical area. Age at hip fracture also depended of marital status but in a gender-specific way.
Purpose The purpose of this study is to investigate the impact of socioeconomic and living conditions on hip fracture incidence and age occurrence among community-dwelling elderly.
Method Between January 1991 and December 2000, 2,454 hip fractures were recorded in community-dwelling adults aged 50 years and over in the Geneva University Hospital, State of Geneva, Switzerland. Median annual household income by postal code of residence (referred to as area-level income) based on the 1990 Census was used as a measure of socioeconomic condition and was stratified into tertiles (<53,170; 53,170–58,678; and ≥58,678 CHF). Hip fracture incidence and age occurrence were calculated according to area-level income categories and adjusted for confounding factors among community-dwelling elderly.
Results Independently of the geographical area (urban versus rural), community-dwelling persons residing in areas with the medium income category presented a lower hip fracture incidence [OR 0.91 (0.82–0.99), p=0.049] compared to those from the lowest income category. Those in the highest income category had a hip fracture at a significant older age [+1.58 (0.55–2.61) year, p=0.003] as compared to those in the lowest income category. Age at hip fracture also depended on marital status but in a gender-specific way, with married women fracturing earlier.
Conclusions These results indicate that incidence and age occurrence of hip fracture are influenced by area-level income and living conditions among community-dwelling elderly. Prevention programs may be encouraged in priority in communities with low income.

Keywords Age occurrence · Area-level income · Hip fracture · Incidence · Marital status · Urban–rural area

This work is dedicated to Charles-Henri Rapin's memory.

E. Guilley · C.-H. Rapin
Centre for Interdisciplinary Gerontology, University of Geneva,
Geneva, Switzerland

F. Herrmann · R. Rizzoli · T. Chevalley
Service of Bone Diseases,
Department of Rehabilitation and Geriatrics,
University Hospitals of Geneva,
Geneva, Switzerland

P. Hoffmeyer
Service of Orthopaedic Surgery, Department of Surgery,
University Hospitals of Geneva,
Geneva, Switzerland

T. Chevalley (✉)
Division of Bone Diseases,
Department of Rehabilitation and Geriatrics,
Geneva University Hospitals and Faculty of Medicine,
Rue Gabrielle-Perret-Gentil 4,
1211 Geneva 14, Switzerland
e-mail: thierry.chevalley@hcuge.ch

Introduction

Osteoporosis and hip fractures cause a huge burden to older patients, and their caregivers and represent one of the most important causes of physical disability, social dependence, and death among the elderly [1, 2]. It is therefore highly

important to identify populations at risk for osteoporosis and hip fracture. Socioeconomic conditions have been long ago a factor used to identify gradients in health and have been used for public health policy and disease intervention or prevention. There is evidence that morbidity and mortality are associated with the individuals' socioeconomic position as defined by occupation, education, or income [3–6]. A number of area-level analyses were also performed and showed that characteristics of the social environment (e.g., area-level income) may also impact health [7]. However, there has been only limited data regarding individual socioeconomic conditions [8–10] and in particular area-level socioeconomic conditions as a risk factor of hip fracture, and they tend to produce inconsistent conclusions [11]. While an increased risk of hip fracture was found in areas of lower socioeconomic conditions [12–15], other studies suggested that area-level socioeconomic conditions were not significantly related to the risk of hip fracture [16, 17] particularly in the oldest old population [13]. Two reasons may explain these inconsistent results. First, the inclusion of institutionalized elderly may bias the relationship between area-level socioeconomic indicators and risk of hip fracture in oldest old populations. Nursing homes, where the risk of hip fracture is much greater because of higher prevalence of physical and mental impairments [18, 19], may be located in rich or poor areas. Furthermore, because of place restrictions in nursing homes, some of the oldest persons (30% in Geneva between 1995 and 2000) [20] had to leave the districts where they had lived for a long time when they moved to a nursing home. As a consequence, areas in which those institutionalized elderly currently live may not be well representative, in terms of socioeconomic conditions, of the areas where they had lived for years. Thus, analyses linking area-level socioeconomic conditions with the risk of hip fractures may be better performed on community-dwelling elderly only. Second, confounding factors of area-level socioeconomic conditions, such as the geographical area (rural versus urban), should also be taken into account. Rural areas were indeed shown to be associated with a lower risk of hip fracture [21, 22], and this was not explained by a higher prevalence of nursing homes in urban area [23]. Being married or living with someone have also a well-known protective effect on the risk of hip fracture [8–10, 14, 24–28] and should be considered as a potential confounder of area-level socioeconomic conditions such as household income.

Finally, additional research is needed on the temporal profile of risk factors for hip fracture. Only one study investigated determinants of time to hip fracture [29] but did not consider socioeconomic conditions such as area-level income. Hence, whether age occurrence of hip fracture depends of the area-level income is unknown.

In this study based on community-dwelling men and women over the age of 50 years across a 10-year (1991–2000) period in Geneva (Switzerland), we aimed at testing two hypotheses: (1) hip fracture incidence is lower with higher area-level income and (2) hip fractures occur at an increasing age with increasing area-level income, independently of the geographical area and marital status.

Methods

Participants

During the study period, the State of Geneva (Switzerland) had a population of about 400,000 people, of whom 30% were aged 50 years or older [23]. Nearly all persons with a hip fracture occurring in the State of Geneva are hospitalized in the Geneva University Hospital (93.4%) [2]. We utilized the database of the Geneva University Hospital to identify patients aged 50 and older discharged with a diagnosis of a hip fracture (ICD-10 code: S72.0–S72.2) between January 1991 and December 2000. Patients living outside the State of Geneva, patients with pathological fractures, and resubmissions (i.e., same hip concerned as in the first case) were excluded from the database [23, 30, 31]. Those who died during the hospitalization period were included in the database and calculation.

The database included the patient's date of birth, his/her date of hospitalization, gender, address, postal code area, and marital status at the time of the fracture. Marital status was used as a proxy of cohabitation status. Both variables are closely related in very old age. In Geneva, among the 80 years old and over community-dwelling population, 94.8% of the unmarried lived alone and 98.9% of the married lived together [32]. We determined whether the patient's postal address corresponded to an institution or to a private home by using an address-based register of all nursing homes in the State of Geneva. Persons residing in public or private nursing homes and in assisted living apartments were excluded (1,661 cases of hip fracture excluded) because the relationship between area-level socioeconomic indicators and the risk of hip fracture may be biased among these populations. On this ground, 2,454 hip fractures recorded in 2,321 hospitalized adults aged 50 and older residing in their private home at the time of the fracture were selected. Patients were characterized by their age, gender, marital status, and by their residential postal code on admission. Each postal code was in turn characterized by a geographical area (urban areas defined by areas with more than 15 inhabitants per square hectare versus rural) [23] and by the median household income recorded in the 1990 Census. Each case with contentious residential address was manually investigated; this resulted in no exclusion.

Analysis

Hip fracture incidence (number of hip fractures per 100,000 person-years of risk) was computed over the 10-year period as a function of gender, 5-year age groups (from 50 years to 85+ years), urban/rural area, and tertiles of median income categories (less than 53,170 CHF; 53,170–58,678 CHF; 58,678 CHF and over). The tertiles, with equal numbers of hip fracture cases, presented no difference in women/men ratios. The year-specific population at risk for community-dwelling people was calculated by subtracting the year-specific population at risk in nursing home residents (not negligible particularly in the oldest old population), provided by the General Direction of Social Services, State of Geneva, from the total year-specific census population, supplied by the local State Statistical Office. Using the year-specific population at risk in nursing homes allowed taking into account the change in admission routines to nursing homes during the studied decade observed in many countries, included Switzerland [33]. The total year-specific census population was stratified by gender, age groups, urban/rural area, and area-level income categories while the year-specific population at risk in nursing home residents from 1991 to 2000 was only available by gender and age groups. To stratify the latter statistics also by urban/rural area and area-level income categories, we applied the (gender, age groups, urban/rural area, area-level income categories) stratification of nursing homes population available in 2006, provided by the local State Statistical Office. The consequence of applying nursing homes stratification from 2006 to nursing homes data in the period 1991–2000 is probably minor because the geographical distribution of the nursing homes hardly changed between 2001 and 2006 with only a 2% reduction in beds.

The incidence of hip fracture was studied by a generalized linear model with binomial link function according to gender, age groups, urban/rural area, and area-level income categories. The longitudinal design of the data (i.e., two fractures in the same person for 6.5% women and 3.6% men) has not been taken into account in the analysis. However, the longitudinal design has probably minor impact on the results since complementary analyses based on first fractures only gave similar results and other complementary analyses showed that the risk of second hip fracture was not significantly different according to the local income categories. The age of hip fractured patients was examined by analysis of variance according to gender, urban/rural area, area-level income categories, and marital status (married versus other statuses—single, widowed, and divorced). Marital status could not be included in the model of hip fracture incidence because the population profile by gender, age groups, urban/rural area, area-level income categories, and marital status was not available among community-dwelling elderly (this profile was available for the total population only). Statistical analyses were computed using the ANOVA and BLOGIT commands of the STATA release 7 statistical software (StataCorp, College Station, TX, USA).

Results

Over the 10-year period (1991–2000), 2,454 hip fractures (1,825 in women and 629 in men) were recorded in 1,714 women and 607 men aged 50 years and over, living in the community. There was a tendency to increased crude and standardized incidences of hip fracture in community-dwelling elderly living in communities with lower area-level income category, and for those living in urban areas (the same tendency was observed in men and women; Table 1). Hip fracture occurred at an increased age for these populations living in communities with higher income category or living in rural areas (similar results in men and women). Being married, compared to other marital statuses, was associated to a higher mean age at hip fracture in men while it was associated to a lower mean age at hip fracture in women (Table 1).

Hip fracture incidence

Community-dwelling persons residing in communities with the highest income category (58,678 CHF and over) or in communities with a medium income category (53,170–58,678 CHF) had significant lower risk of hip fracture (OR=0.88, p=0.009; OR=0.89, p=0.016, respectively) compared to inhabitants of areas with the lower income category. When the significant effect of the urban/rural area was taken into account, this effect of the area-level income on hip fracture incidence remained in women (OR=0.86, p=0.007) and in the total population (OR=0.91, p=0.049) for communities with a medium income category compared to those with the lowest income category (Table 2). Elderly living in rural area had lower risk of hip fracture, regardless of the income category.

Age at hip fracture

Community-dwelling patients residing in communities with the highest income category had a hip fracture at a significant older age than those living in areas with the lowest income category (difference in age at hip fracture = 1.60; p=0.002; model 1, Table 3). This effect remained when urban/rural area (hip fractured patients in rural areas being older by 1.74 years; p=0.006) and marital status (married patients being younger by 3.35 years; p<0.001)

Table 1 Number of hip fractures, mean age at hip fracture, crude and standardized incidence of hip fracture per 100,000 person-years by area-level income, urban/rural area, marital status, and gender in community-dwelling elderly aged 50 and over (n=2,454 fractures)

		All (n=2,454)				Men (n=629)				Women (n=1,825)			
		n	Mean age (SD)	Crude inc.	St. inc.	n	Mean age (SD)	Crude inc.	St. inc.	n	Mean age (SD)	Crude inc.	St. inc.
Area-level income	Less than 53,170 CHF	801	79.0 (10.6)	223	223	197	75.3 (12.2)	124	124	604	80.3 (9.7)	303	303
	53,170–58,678 CHF	834	79.1 (10.8)	193	198	232	75.6 (11.5)	121	126	602	80.5 (10.2)	251	256
	58,678 CHF and over	819	80.6 (9.7)	181	198	200	78.9 (11.2)	99	103	619	81.2 (9.0)	248	278
Geographical area	Urban	2,136	79.4 (10.5)	212	212	541	76.1 (11.9)	123	123	1595	80.5 (9.8)	282	282
	Rural	318	81.3 (9.1)	135	171	88	79.2 (10.2)	78	90	230	82.2 (8.6)	187	245
Marital status	Married	903	77.6 (9.9)	[a]	[a]	390	77.9 (10.6)	[a]	[a]	513	77.4 (9.3)	[a]	[a]
	Other	1,551	80.8 (10.5)	[a]	[a]	239	74.4 (13.1)	[a]	[a]	1,312	81.9 (9.5)	[a]	[a]

[a] Population at risk in community-dwelling elderly not available; area-level income corresponded to the median household incomes of the patient's postal code area at the time of the fracture. Hip fracture incidence is standardized to the community-dwelling population residing in areas with the lowest income category (first three lines) to the population residing in urban areas (fourth to fifth line)

were taken into account: for men and women gathered, patients were 1.5 years older (difference in age = 1.58; p= 0.003; model 3; Table 3) in communities with the highest income category compared to those living in the lowest income category. Of interest is the differentiated effect of marital status on age at hip fracture according to gender: married hip fractured men were three years older (p=0.002) than hip fractured men with other marital statuses while married hip fractured women were more than four years younger (p<0.001) compared to their female counterparts with other marital statuses (cf. model 3; Table 3).

Discussion

This study aimed at testing two hypotheses: (1) hip fracture incidence is lower and (2) hip fractures occur at an increasing age with increasing area-level income. Independently of the geographical area (urban versus rural), results indicated that community-dwelling persons residing in areas with the medium income category presented a significantly—albeit borderline—lower hip fracture incidence compared to those from the lowest income category. This effect was more pronounced among the community-dwelling women. It may indicate that individual or household income which area-level income is a proxy or characteristics of the social environment impact the risk of hip fracture. At the individual level, lower income was found to be associated with increased risk of hip fracture in Swedish women aged over 50 years [8]. Two other more recent studies confirmed the inverse association between individual income and risk of hip fracture [9, 27]. Our results are in accordance with works based on area-level socioeconomic indicators in the United States, United Kingdom, and Scandinavia which found an increased risk of hip fracture in areas of lower socioeconomic condition [12–15]. One possible pathway is the risk of unhealthy lifestyles in deprived areas. Unhealthy behaviors (poor diet, cigarette smoking, physical inactivity during leisure time, and alcohol consumption—other than moderate) during the life span are indeed more prevalent in lower socioeconomic status groups [34–36] and they are associated with higher risk of hip fracture [37] and with higher rates of injuries caused by falls [38]. Another explanation could be the lower propensity of low socioeconomic status groups to undergo bone density testing before fracture [39]. An additional theory could be a higher exposure to environmental health risks, such as less adequate build environment or a lower likelihood of treatment [40].

In our article, community-dwelling persons residing in areas with the highest income category presented a lower hip fracture incidence compared to those from the lowest income category. Our results did not confirm those by

Table 2 Odd ratios for incidence of hip fracture (95% CI; *p* value) according to area-level income and urban/rural area, by gender, among community-dwelling hip fractured patients, aged 50 and older (*n*=2,454 fractures)

		All (*n*=2,454)		Men (*n*=629)		Women (*n*=1,825)	
Model 1	53,170–58,678 CHF	0.89 (0.80, 0.98)	0.016	1.02 (0.84, 1.23)	0.855	0.84 (0.75, 0.94)	0.003
	58,678 CHF and over	0.88 (0.80, 0.97)	0.009	0.83 (0.68, 1.01)	0.057	0.91 (0.81, 1.02)	0.092
Model 2	53,170–58,678 CHF	0.91 (0.82, 0.99)	0.049	1.05 (0.86, 1.27)	0.639	0.86 (0.76, 0.96)	0.007
	58,678 CHF and over	0.93 (0.84, 1.03)	0.144	0.89 (0.73, 1.09)	0.268	0.94 (0.84, 1.06)	0.319
	Rural	0.80 (0.70, 0.90)	<.001	0.74 (0.59, 0.93)	0.012	0.85 (0.74, 0.99)	0.034

Each age-adjusted model analyzes the incidence of hip fracture according to area-level income (reference category: less than 53,170 CHF), initially introduced alone (model 1), then with the control of urban/rural area (reference category: urban; model 2)

Brennan et al. [41] who found that individuals from both ends of the socioeconomic spectrum had lower bone mineral density and thus may be at increased risk of fracture compared with individuals from intermediate socioeconomic status. Those findings led the latter authors to speculate that osteoporosis may also be a disease of the affluent.

Our results also indicate that residents from the highest income category had a hip fracture at a significant older age compared to those from the lowest income category. This finding is not entirely due to the socioeconomic gradients in life expectancy [6] because additional analyses showed that differences in age of persons from low versus high income categories are much lower that differences in age of fractured patients from those two distinct areas. Since prevention programs in communities with low income for home and pediatric injuries have already been shown to be effective [42, 43], this result should be useful for policy makers to plan their future prevention programs.

Living in rural areas was not only a protective factor for hip fracture incidence but also for age occurrence, independently of the area-level income. With more exposure to sunlight and more physical activity, the rural lifestyle is supposed to contribute to increased bone strength and decreased risk of hip fracture [21–23] and as suggested by the present study, to a delay in hip fracture occurrence.

Age at hip fracture also depended on marital status but in a gender-specific way. The protective nature of being married on hip fracture incidence is well documented in old age [8–11, 14, 24–28]. It is explained by the social support inherent in the marital relationship and by the fact that a spouse may positively influence lifestyle and health behaviors across the life course. In this study, being married appeared to delay the hip fracture occurrence only among men while being married was associated with earlier hip fracture occurrence among women. One other study on oldest old populations in Switzerland indicated a higher risk of mortality for women living with a spouse [44]. One interpretation of this apparent burden of being married among oldest old women could be found in their caregiver role. Within a couple, the wife is more likely to act as a caregiver. Attending to the impaired can produce a variety of stressors and affect the health of the caregiver [45]. This

Table 3 Differences in age at hip fracture (95% CI; *p* value) according to area-level income, urban/rural area, and marital status, by gender, among community-dwelling hip fractured patients, aged 50 and older (*n*=2,454 fractures)

		All (*n*=2,454)		Men (*n*=629)		Women (*n*=1,825)	
Model 1	53,170–58,678 CHF	0.08 (−0.92, 1.09)	0.872	0.22 (−2.00, 2.43)	0.848	0.25 (−0.84, 1.34)	0.651
	58,678 CHF and over	1.60 (0.59, 2.61)	0.002	3.52 (1.22, 5.81)	0.003	0.97 (−0.11, 2.05)	0.079
Model 2	53,170–58,678 CHF	−0.03 (−1.03, 0.98)	0.958	0.06 (−2.17, 2.28)	0.959	0.15 (−0.94, 1.24)	0.785
	58,678 CHF and over	1.28 (0.23, 2.32)	0.016	3.01 (0.60, 5.42)	0.014	0.68 (−0.43, 1.80)	0.227
	Rural	1.55 (0.29, 2.81)	0.016	1.92 (−0.84, 4.69)	0.172	1.49 (0.12, 2.86)	0.033
Model 3	53,170–58,678 CHF	0.10 (−0.90, 1.09)	0.846	−0.37 (−2.60, 1.85)	0.743	0.10 (−0.97, 1.16)	0.857
	58,678 CHF and over	1.58 (0.55, 2.61)	0.003	2.39 (−0.03, 4.81)	0.053	0.96 (−0.13, 2.05)	0.083
	Rural	1.74 (0.49, 2.98)	0.006	1.74 (−1.00, 4.49)	0.213	1.66 (0.32, 3.00)	0.015
	Married	−3.35 (−4.20, −2.51)	<0.001	3.07 (1.17, 4.96)	0.002	−4.63 (−5.59, −3.67)	0.000

Each model corresponds to an analysis of variance in which age at hip fracture is explained by area-level income (reference category: less than 53,170 CHF), initially introduced alone into the model (model 1), then with the control of urban/rural area (reference category: urban; model 2) and of marital status (reference category: other marital statuses; model 3)

result can also be an artifact due to the underlying population if married community-dwelling women were younger than unmarried community-dwelling women. However, it can be assumed that age difference between the married and unmarried community-dwelling women is quite low. Unmarried women and especially widowed women are generally older than married women but they are also at greater risk to live in nursing homes, especially the oldest old. This household selection may decrease the age difference between the married and unmarried community-dwelling women.

This study has several strengths and originalities. First, to our knowledge, this is the first study on socioeconomic determinants of hip fractures that excluded institutionalized elderly. The inclusion of institutionalized elderly may bias the relationship between area-level socioeconomic indicators and risk of hip fracture in oldest old populations. In Geneva, nursing homes, in which about 40% of the hip fractures occur [2, 31], are more likely to be located in rural areas [23] which correspond to higher income areas. Furthermore, socioeconomic conditions of the areas in which institutionalized elderly currently live are not representative of socioeconomic conditions of the areas where they had lived for years before [20]. Analyses not reported here showed that incidence and age occurrence of hip fracture were not significantly related to area-level income when institutionalized elderly were included. Second, to our knowledge, the relationship between area-level income and age of hip fractured patients has not previously been investigated. It goes further than simply informing that hip fractures occur earlier among persons residing in the lowest income category. It gives an estimation of how much younger are the hip fractured patients living in such areas. A third strength of this study is that virtually all hip fractures that occurred within the State of Geneva were treated in a single hospital assuring a homogeneous record of all cases of hip fractures. Finally, multiple counts of hip fracture cases were minimized here by excluding cases that were admitted for complications of the fracture.

Our findings have some limitations. First, indicators of patient health state or comorbid diseases would have been useful to better interpret the pathway between area-level income and hip fracture incidence or age occurrence. Second, a study limitation is the absence of individual data for income. However, area-level measures of income are useful to identify areas of elevated hip fracture risk and to allow for policy-level interventions in specific areas. Third, data in community-dwelling elderly stratified by marital status were not available. Fourth, persons from higher SES were probably over-represented in the community-dwelling studied population because of their better health and their financial resources to pay for private care allowing them to stay at home. This selection bias may have decreased the hip fracture gradient according to local income in the sense that a higher proportion of hip fractures among persons from lower SES may have occurred in nursing homes.

In conclusion, our results indicate that area-level socioeconomic factors, notably income based on census data, influence hip fracture incidence and age occurrence in community-dwelling elderly. Therefore, prevention programs and direct health interventions could be focused in priority in communities with low income to possibly reduce hip fracture incidence and/or delay its occurrence.

Acknowledgments We thank René Bourdilloud (University Hospital of Geneva) for extracting the data file from the hospital information system and Daniel Baccino (Center for Interdisciplinary Gerontology) for data management. We acknowledge the assistance of Sophie Mouchet, Janine Dubois, and Chiara D'Aiuto from the local State Statistical Office, for providing us with official population data and data on population in nursing homes.

Conflict of interest None

References

1. Keene G, Parker M, Pryor G (1993) Mortality and morbidity after hip fractures. BMJ 307:1248–1250
2. Schürch MA, Rizzoli R, Mermillod B, Vasey H, Michel JP, Bonjour JP (1996) A prospective study on socioeconomic aspects of fracture of the proximal femur. J Bone Miner Res 11:1935–1942
3. Guilley E, Lalive d'Epinay C (2008) Social status and mortality with ADL-disability in later life. J Gerontol B Psychol Sci Soc Sci 63:192–196
4. Kawachi I, Marshall S, Pearce N (1991) Social class inequalities in the decline of coronary heart disease among New Zealand men, 1975–1977 to 1985–1987. Int J Epidemiol 20:393–398
5. Mackenbach JP, Kunst AE, Cavelaars AE, Groenhof F, Geurts JJ (1997) Socioeconomic inequalities in morbidity and mortality in western Europe. The EU working group on socioeconomic inequalities in health. Lancet 349:1655–1659
6. Marmot MG (1984) Inequalities in death—specific explanations of a general pattern? Lancet 1:1003–1006
7. Pickett KE, Pearl M (2001) Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. J Epidemiol Community Health 55:111–122
8. Farahmand BY, Persson P-G, Michaëlsson K, Baron JA, Parker MG, Ljunghall S (2000) Socioeconomic status, marital status and hip fracture risk: a population-based case-control study. Osteoporos Int 11:803–808
9. Vestergaard P, Rejnmark L, Mosekilde L (2006) Socioeconomic aspects of fractures within universal public healthcare: a nationwide case-control study from Denmark. Scand J Public Health 34:371–377
10. Wilson RT, Chase GA, Chrischilles EA, Wallace RB (2006) Hip fracture risk among community-dwelling elderly people in the United States: a prospective study of physical, cognitive, and socioeconomic indicators. Am J Public Health 96:1210–1218
11. Brennan SL, Pasco JA, Urquhart DM, Oldenburg B, Hanna F, Wluka AE (2009) The association between socioeconomic status and osteoporotic fracture in population-based adults: a systematic review. Osteoporos Int 20:1487–1497

12. Bacon WE, Hadden WC (2000) Occurrence of hip fractures and socioeconomic position. J Aging Health 12:193–203
13. Jones S, Johansen A, Brennan J, Butler J, Lyons RA (2004) The effect of socioeconomic deprivation on fracture incidence in the United Kingdom. Osteoporos Int 15:520–524
14. Reimers A, Laflamme L (2007) Hip fractures among the elderly: personal and contextual social factors that matter. J Trauma 62:365–369
15. Zingmond DS, Melton LJ, Silverman SL (2004) Increasing hip fracture incidence in California Hispanics, 1983 to 2000. Osteoporos Int 15:603–610
16. Icks A, Haastert B, Wildner M, Becker C, Rapp K, Dragano N, Meyer G, Rosenbauer J (2009) Hip fractures and area level socioeconomic conditions: a population-based study. BMC Public Health 9:doi:10.1186/1471-2458-1189-1114
17. West J, Hippisley-Cox J, Coupland CAC, Price GM, Groom LM, Kendrick D, Webber E (2004) Do rates of hospital admission for falls and hip fracture in elderly people vary by socio-economic status? Public Health 118:576–581
18. Brennan nee Saunders J, Johansen A, Butler J, Stone M, Richmond P, Jones S, Lyons R (2003) Place of residence and risk of fracture in older people: a population-based study of over 65-year-olds in Cardiff. Osteoporos Int 14:515–519
19. Butler M, Norton R, Lee-Joe, Cheng A, Campbell AJ (1996) The risks of hip fracture in older people from private homes and institutions. Age Ageing 25:381–385
20. Guilley E (2005) La vie en institution. In: Wanner P, Sauvain-Dugerdil C, Guilley E, Hussy C (eds) Ages et Générations; La vie après 50 ans en Suisse; analyse générale du recensement de la population 2000. Office Fédéral de la Statistique, Neuchâtel
21. Larsson S, Eliasson P, Hansson LI (1989) Hip fractures in northern Sweden 1973–1984. A comparison of rural and urban populations. Acta Orthop Scand 60:567–571
22. Sernbo I, Johnell O, Andersson T (1988) Differences in the incidence of hip fracture; comparison of an urban and a rural population in southern Sweden. Acta Orthop Scand 59:382–385
23. Chevalley T, Herrmann F, Delmi M, Stern R, Hoffmeyer P, Rapin C-H, Rizzoli R (2002) Evaluation of the age-adjusted incidence of hip fractures between urban and rural areas: the difference is not related to the prevalence of institutions for the elderly. Osteoporos Int 13:113–118
24. Espino DV, Palmer RF, Miles TP, Mouton CP, Wood RC, Bayne NS, Markides KP (2000) Prevalence, incidence, and risk factors associated with hip fractures in community-dwelling older Mexican Americans: results of the Hispanic EPESE study. Establish population for the epidemiologic study for the elderly. J Am Geriatr Soc 48:1252–1260
25. Hökby A, Reimers A, Laflamme L (2003) Hip fractures among older people: do marital status and type of residence matter? Public Health 117:196–201
26. Korpelainen R, Korpelainen J, Heikkinen J, Väänänen K, Keinänen-Kiukaanniemi S (2006) Lifelong risk factors for osteoporosis and fractures in elderly women with low body mass index—a population-based study. Bone 39:385–391
27. Peel NM, McClure RJ, Hendrikz JK (2007) Psychosocial factors associated with fall-related hip fractures. Age Ageing 36:145–151
28. Wolinsky FD, Fitzgerald JF (1994) The risk of hip fracture among noninstitutionalized older adults. J Gerontol B Psychol Sci Soc Sci 49:165–175
29. Young Y, Myers AH, Provenzano G (2001) Factors associated with time to first hip fracture. J Aging Health 13:511–526
30. Chevalley T, Guilley E, Herrmann F, Hoffmeyer P, Rapin C-H, Rizzoli R (2007) Incidence of hip fracture over a 10-year period (1991–2000): reversal of a secular trend. Bone 40:1284–1289
31. Guilley E, Chevalley T, Herrmann F, Baccino D, Hoffmeyer P, Rapin CH, Rizzoli R (2008) Reversal of the hip fracture secular trend is related to a decrease in the incidence in institution-dwelling elderly women. Osteoporos Int 19:1741–1747
32. Guilley E, Lalive d'Epinay C (2008) The closing chapters of long lives: results from the 10-year Swilsoo study on the oldest old. Nova Science Publishers, Hauppauge NY
33. Ribbe MW, Ljunggren G, Steel K, Topinková E, Hawes C, Ikegami N, Henrard JC, Jónnson PV (1997) Nursing homes in 10 nations: a comparison between countries and settings. Age Ageing 26:3–12
34. Laaksonen M, Talala K, Martelin T, Rahkonen O, Roos E, Helakorpi S, Laatikainen T, Prattala R (2008) Health behaviours as explanations for educational level differences in cardiovascular and all-cause mortality: a follow-up of 60 000 men and women over 23 years. Eur J Public Health 18:38–43
35. Lee SJ, Sudore RL, Williams BA, Lindquist K, Chen HL, Covinsky KE (2009) Functional limitations, socioeconomic status, and all-cause mortality in moderate alcohol drinkers. J Am Geriatr Soc 57:955–962
36. Markides KS, Black SA (1995) Race, ethnicity, and aging: the impact of inequality. In: Binstock RH, Georges LK (eds) Handbook of aging and the social sciences. Academic, San Diego, pp 153–170
37. Cooper C, Westlake S, Harvey N, Javaid K, Dennison E, Hanson M (2006) Review: developmental origins of osteoporotic fracture. Osteoporos Int 17:337–347
38. Schiller JS, Adams PF, Coriaty Nelson Z (2005) Summary health statistics for the US population: National Health Interview Survey, 2003. Vital Health Stat 10:29
39. Neuner JM, Zhang X, Sparapani R, Laud PW, Nattinger AB (2007) Racial and socioeconomic disparities in bone density testing before and after hip fracture. J Gen Intern Med 22:1239–1245
40. Rapiti E, Fioretta G, Schaffar R, Neyroud-Caspar I, Verkooijen HM, Schmidlin F, Miralbell R, Zanetti R, Bouchardy C (2009) Impact of socioeconomic status on prostate cancer diagnosis, treatment, and prognosis. Cancer. doi:10.1002/cncr.24607
41. Brennan SL, Henry MJ, Wluka AE, Nicholson GC, Kotowicz MA, Williams JW, Pasco JA (2009) BMD in population-based adult women is associated with socioeconomic status. J Bone Miner Res 24:809–815
42. Davidson LL, Durkin MS, Kuhn L, O'Connor P, Barlow B, Heagarty MC (1994) The impact of the safe kids/healthy neighborhoods injury prevention program in Harlem, 1988 through 1991. Am J Public Health 84:580–586
43. Schwarz DF, Grisso JA, Miles C, Holmes JH, Sutton RL (1993) An injury prevention program in an urban African-American community. Am J Public Health 83:675–680
44. Guilley E, Pin S, Spini D, Lalive d'Epinay C, Herrmann F, Michel JP (2005) Association between social relationships and survival of Swiss octogenarians; a five-year prospective, population-based study. Aging Clin Exp Res 17:419–425
45. Wallsten SS (2000) Effects of care giving, gender, and race on the health, mutuality, and social supports of older couples. J Aging Health 12:90–111