Calcif Tissue Int (1993) 52:425–433

Calcified
Tissue
International

Life-Style and Different Fracture Prevalence: A Cross-Sectional Comparative Population-Based Study

Brynjólfur Jónsson, Per Gärdsell, Olof Johnell, Ingemar Sernbo, and Bo Gullberg

Departments of Orthopaedics and Community Health Sciences, Malmö General Hospital. University of Lund, S-214 01 Malmö, Sweden

Received September 2, 1992, and in revised form November 9, 1992

Summary. In order to explain the higher prevalence of fractures in urban compared with rural areas, 782 residents in the city of Malmö, Sweden and 486 inhabitants from the nearby rural municipality of Sjöbo were invited to participate in an sex- and age-matched cross-sectional study on life-style differences; 73 and 80% respectively responded. Responders answered a questionnaire on medical and social background and were interviewed on past and present physical activity. The men and women of the rural area were found to be significantly more active physically at work and during spare time. Housing was larger in the rural area. For women, these differences are decreasing in the younger age groups. Bone mass was found to be correlated to heavier work load for men. Other life-style variable such as dairy calcium intake, coffee drinking, estrogen medication, and morbidity, could not explain this difference. Higher prevalence of fractures in the city could therefore be explained by physically less active life-style.

A higher incidence of hip fractures has been reported in urban residents as compared with rural populations in Scandinavia [1–5]. A higher prevalence of all fractures, including fragility fractures, has been observed in inhabitants of the city of Malmö compared with those in the nearby rural community of Sjöbo [6]. Differences in bone mass between residents of these two communities may be the explanation [7]. The purpose of this study was to compare life-style variables, including physical activity, between a city and a rural area in order to further explain the difference in fracture prevalence.

Material and Methods

The study was carried out as a cross-sectional, population-based comparison between residents of the city of Malmö and the municipality of Sjöbo, and was completed in 1 year. Malmö, located in the South of Sweden has 236,000 residents, and is the third largest city in the country; it is a center of industry and trade.

Sjöbo is a municipality 50 km east of the city—a typical agricultural community with 15,000 residents. Differences in demographic characteristics between these communities have been previously described [7].

Probands were selected at random from the population records of men and women in Sjöbo born in 1908, 1918, 1928, 1938, and women born in 1948. In Malmö, controls of the same sex and age were selected from the city files. The size of the urban group was deliberately made larger because of a forthcoming intervention study.

The recruitment was identical for both populations. A letter with information on the purpose and the methods of the study was followed by a telephone call. After the probands had agreed to participate, they answered a questionnaire about their social and medical background. Thereafter, they were interviewed about previous and present physical activities at work and during their spare time, size of household, and means of transportation. All interviews were done by two of the authors.

The life-span of each proband was divided into four life periods in order to facilitate comparison between the age groups and to detect changes in workload, household work, means of transport, and spare-time physical activities in a lifetime. The first period spanned age 15–30 years, when the individuals were selecting professions and settling down. The second was age 30–45 years, when the probands were assumed to be at the peak of their employment and physical capacity as well as their bone mass. The third was age 45–65 years, when working capacity can be expected to be dwindling and include the years of and after menopause for women. The fourth and last period was the official retirement age of 65 years.

Profession

Main professions past and present was classed as follows by the interviewer (examples given in the brackets): (1) sitting service work (office); (2) sitting manual work (sewing); (3) intellectual work (teacher); (4) standing manual work (nursing, cleaning, light industry); (5) farming and heavy manual work (farmers, carpenters); (6) retired; (7) housewife.

in the results, groups 1–3 are joined to represent "service work"; groups 4 and 5 represent "labor work"; and groups 6 and 7 represent "retired."

Work Load

The probands estimated their work load for each of the four life periods by selecting one of the following three groups as the most appropriate for each period: (1) light—office clerks and other sedentary jobs; (2) medium—more mobile professions such as nursing and cleaning; (3) heavy—farming, carpentry, and construction works.

Spare-Time Physical Activity

Spare-time activities were classified into (1) sedentary spare time; (2) light jogging or lighter gardening once or twice a week; (3) regular training or heavier gardening 3–4 hours a week; (4) regular athletic training and competitive sports [8].

Transports and Household

The primary means of transportation for each life period were di-

Offprint requests to: B. Jónsson

vided into three groups: (1) own a car, (2) bus or train, (3) bicycling or walking.

Housing during each of the life periods were classified into four groups: (1) flat, (2) flat plus a summer home, (3) one-family house with its own yard, (4) one-family house with its own yard plus a summer home.

Cumulative Physical Activity

In order to calculate the sum of previous physical activities and to facilitate statistical analysis for each of the activities—work load, spare-time activities, means of transportations and housing—the physical activity among the probands was accumulated for each of the four life periods. In the resulting cumulative score, the numerical value from the questionnaire of the interview as presented above on work load, housing, transportation, and spare-time activities for each proband were added and the resulting number represents the total score. Within one life period an individual could obtain a score of 1–3 for workload, 1–3 for transportations, and 1–4 each for housing and spare-time activities. The lifetime score increased with advancing age, so that any proband aged 80 could, during a lifetime, have obtained a maximum score of 12 for work and transportation each, and 16 for each housing and spare-time activity.

Fractures

Fractures in Malmö were registered from the files at the Department of Diagnostic Radiology at our hospital where all films have been saved since the beginning of the century. Also, files in the Department of Orthopaedics were checked. Malmö General Hospital is the only hospital in the city where fractures are treated. For the Sjöbo population the files of Ystad Hospital where Sjöbo residents have their fractures treated were examined. In case of fractures treated primarily elsewhere or fractures not admitted to the hospital, the patient records at the local primary care unit were examined. Fractures of the distal end of the radius, the proximal end of the humerus, the hip, the vertebrae, and rami of the pelvis and tibial condyles have been associated with bone fragility and were grouped together and classified as fragility fractures [9].

Other Life-Style Variables

From the questionnaire, information was gathered on the following: oestrogen medications and or oral contraceptives, presently and in the past; number of pregnancies and child births and the number of children raised; coffee consumption; smoking habits classified into nonsmokers, nonsmokers since at least 5 years, smoking less than 10 cigarettes/day, more than 10 cigarettes daily.

The average weekly consumption of alcohol in grams from beer, wines, and liquors was estimated from the questionnaire [10].

Present and past (at 20 years of age) consumption of milk, which represents the probands main source of dietary calcium, was divided into three classes:more than 3 liters/week (over 500 mg calcium daily), 1–3 liters/week (between 500 and 170 mg calcium daily), and less than 1 liter/week (less than 170 mg calcium daily).

Diseases such as epilepsy, rheumatic diseases, diabetes mellitus, thyroid diseases, heart diseases, lung diseases, neurological diseases including stroke, peptic ulcers including ulcer surgery, and corticosteroid medication were recorded.

The probands were asked if they had visited a physician or been admitted to a hospital during the 6-month period preceding participation in the study, or if they had been treated with bedrest exceeding 4 weeks earlier in life.

Information on mortality rates in the two communities was gathered from the Central Bureau of Statistics (SCB) in Örebro Sweden. Pain from shoulder, back, hip, or knee was assessed and classified if it occurred daily, weekly, or monthly.

Weight, height and age at menarche and menopause for the two groups have already been published [7].

For urbans, a subgroup of probands was selected that had been raised in the city and were still living there—lifelong urban residents (LUR), and similarly from the rural group a subgroup of those that had been raised and were still living in the country—lifelong rural residents (LRR).

Table 1. Number of probands participating and percentage of acceptance of all invited in both urban (Malmö) and rural (Sjöbo) populations

	Malmö			Sjöbo	
Age (years)	Sex	N	%	N	%
40	F	71	76	51	93
50	F	63	77	46	90
	M	40	73	39	76
60	F	60	72	46	85
	M	53	83	40	87
70	F	85	71	53	85
	M	91	81	52	85
80	F	49	51	35	66
	M	58	77	29	67
Total	F	328	69	231	81
	M	242	79	160	80

Bone Mineral Content

Bone mineral content (BMC) of both forearms was measured by single-photon absorbtiometry (SPA) using the method described by Nauclér et al. [11]; the method employs a ^{241}Am radiation source. Transverse scans were done of the radius and ulna 1 cm (mainly cancellous bone) and 6 cm (mostly cortical bone) proximal to the tip of the styloid process of the ulna on both forearms. The BMC was calculated and expressed as the average thickness of bone mineral in the pathway of the beam (mg/cm^2) for BMC 1 cm and BMC 6 cm, respectively. Results are presented as the combined mean values for both arms. Bone mass was compared between probands with activity score for work, means of transportations, housing, and spare-time activities above and below the median values.

Statistics

Evaluation of number of probands in subgroups was compared by Chi-square test for larger groups and Fischer's exact test for smaller groups of individuals. Statistical analysis of results presented from nonparametrical variables such as the activity scores was performed by Mann-Whitney test. Mean values of BMC and other continuous variables were analyzed by Students-*t* test. Analysis of work load prior to fracture, the fracture risk, and possible confounders was performed by logistic regression model using the SPSS/PC+ software. All tests were two sided. The logistic regression was adjusted for age and differences between urban and rural groups. The multivariate analysis on fracture risk was adjusted for residence in the urban and rural groups.

Results

Of the invited probands, in Malmö, 570/782 (73%) and in Sjöbo, 391/486 (80%) agreed to participate. The participation rate according to age, sex, and residence is shown in Table 1.

Profession

Labor work, as judged by the interviewer, was significantly more common among rural women aged 60 (Fig. 1). For men

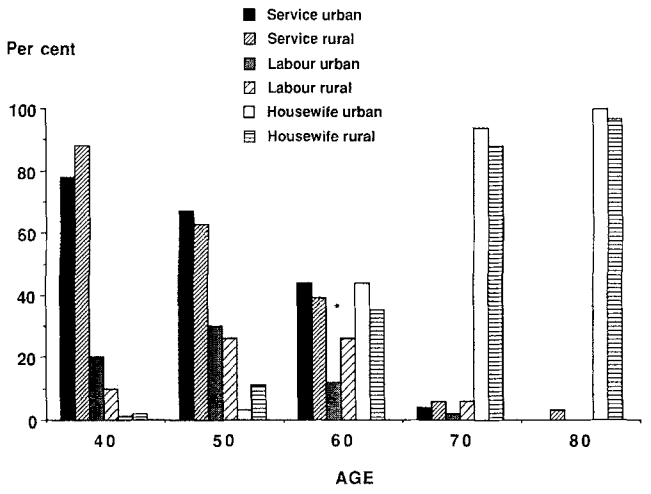

Fig. 1. Present profession for women, both urban and rural, and all age groups. $*P < 0.05$.

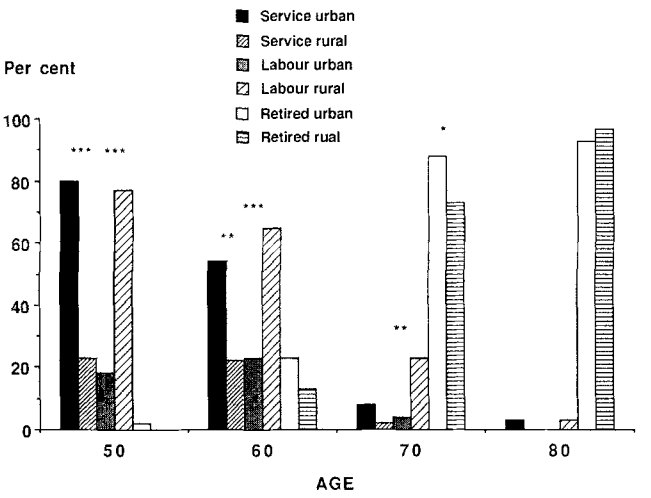

Fig. 2. Present profession for men, both urban and rural, and all age groups. $*P < 0.05$; $**0.01 > P > 0.001$; $***P < 0.001$.

(Fig. 2), the characteristic profession was service in the urban and labor work in the rural groups. Almost one-fourth of the 70-year-old rural men were still active in labor work, 5 years after the official retirement age compared with 4% of the urban men.

Previous and present main profession for women was the same in age groups 40 and 50 years, whereas in the older age groups there was a higher tendency towards labor work and farming as the main previous professions both in the urban and rural groups. Labor work was more common as the previous profession in rural women aged 60 years, 25/46 (54%) as compared with 20/60 (33%) urban women ($P = 0.024$). Among the 70-year-old rural women, there were 28/52 (54%) past labor workers compared with 30/85 (24%) urbans ($P = 0.033$). For 80-year-old rural women, 24/35 (69%) had labor worked as compared with 18/46 (39%) in the urban group ($P = 0.006$).

The tendency to change profession was much less pronounced in men than in women except in the oldest age groups in conjunction with retirement, and even in these age groups the rural group was found to do more labor work.

Work Load

Workload, as estimated by the probands themselves, during the four life periods in women aged 80 years was significantly heavier in the rural women throughout their lives (Fig. 3). These differences in work load between urban and rural women had a tendency to be less in the younger age groups and at age 40 years, only light work load remains as significantly more common in urban women (Fig. 4). In men there was also a significant dominance of heavier work load in the rural group throughout life (Fig. 5) in all age groups.

The differences described above were confirmed when comparing the cumulated work load score for women and men (Table 2).

Spare-Time Activities

More strenous lifetime, spare-time physical activities were noted in rural women aged 80 years (Fig. 6). As for work load difference between urban and rural women, the self-reported, spare-time activities had a tendency towards leveling in the two youngest age groups, particularly at age 40 (Fig. 7). Rural men aged 80 had significantly heavier spare-time physical activities during their lifetime than did their urban counterparts (Fig. 8). However, the significance of this difference disappears for all younger men. Differences in spare-time activities in all groups are presented in Table 2.

Transportation and Housing

Rural residents used cars more often as primary means of transportation than urbans and were less likely to walk or bicycle to work which results in a insignificantly lower total score for women (Table 2). Rural men, however, had significantly lower scores for transportations—total and for the ages 50 and 70 years (Table 2). Rural women lived more often in one-family houses than the urban women; this resulted in a significantly higher score for housing both total and for every age group (Table 2). The same tendency was true for rural men (Table 2). However, many of the urban women had a summer home.

Lifelong Residents

Comparison of activities between lifelong urban and rural residents shows that the differences in activity scores persist in the smaller more homogeneous subgroups, and was even more pronounced for work load and sparetime activities (Table 3).

After excluding lifelong urban and rural residents, the remaining residents in the city or at the countryside had activity scores that rely between the scores of the life-long groups. For both sexes there is a tendency toward lower values of activity scores in the remaining residents in Sjöbo and higher values for the remaining residents in Malmö. However, a statistically significant difference was only observed sporadically, especially for work load for men and housing for women.

Physical Activity in Probands with a Fracture

Comparison of work load and spare time activities prior to

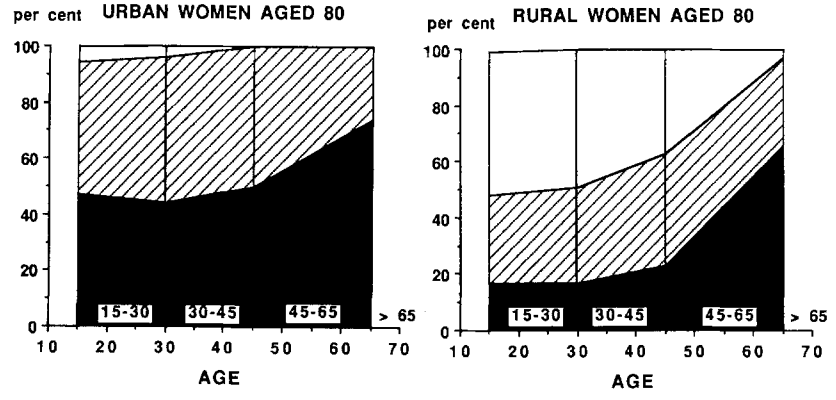

Fig. 3. Lifetime work load for women aged 80 years divided into four life periods. Urban compared with rural. Heavy work load significantly more common for rural women during life periods 15–65 years ($P < 0.001$). Light work significantly more common in urban women during life periods 15–65 years ($0.01 > P > 0.001$). (□) Heavy work load; (▨) medium work load; (■) light work load.

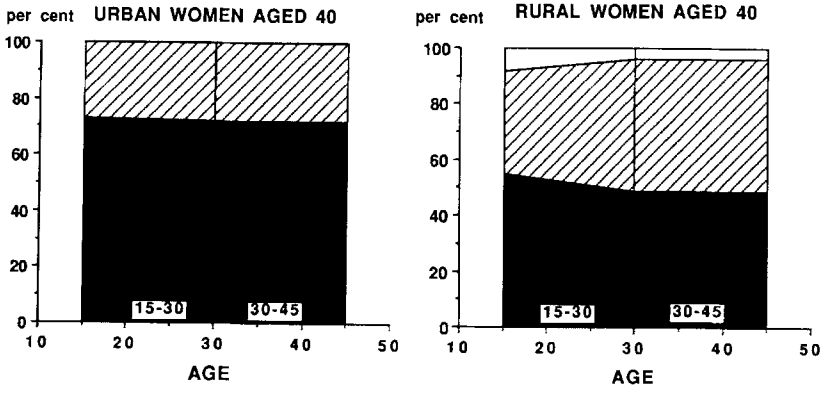

Fig. 4. Lifetime work load for women aged 40 years divided into two life periods. Urban compared with rural. Light work load significantly more common in urban women during life periods 15–30 years and 30–45 years ($P = 0.035$ and 0.01, respectively). (□) Heavy work load; (▨) medium work load; (■) light work load.

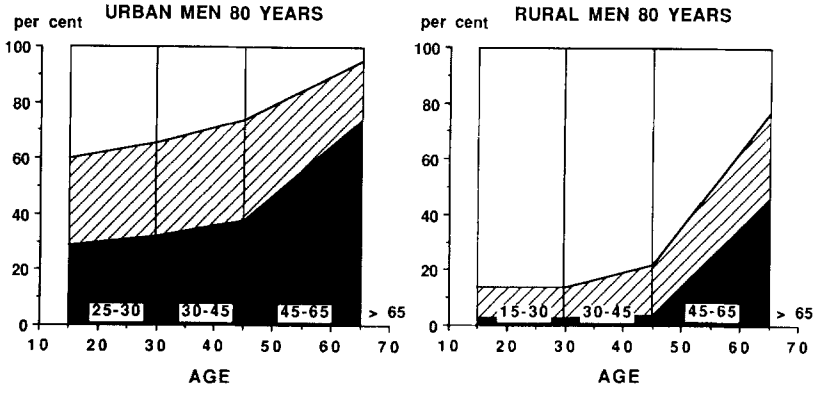

Fig. 5. Lifetime work load for men aged 80 years divided into four life periods. Urban compared with rural. Heavy work load significantly more common in rural men during life periods 15–65 years ($P < 0.001$) and after 65 years ($P = 0.04$). Light work load significantly more common in urban men in all life periods ($0.05 > P > 0.001$). Medium work load significantly more common in urban men during life periods 15–45 years ($P = 0.04$). (□) Heavy work load; (▨) medium work load; (■) light work load.

the first fracture after the age of 40 years was performed using logistic regression analysis with the following variables as confounders: body mass index (BMI); age; coffee, milk, and alcohol consumption; and, for women, estrogen medication.

For all women, a nonsignificant tendency towards a reduced risk of all fracture and fragility fractures was found for high work load and spare-time activities, this difference persisted even after incorporating coffee, milk, estrogen, and alcohol into the equation. For all men, the relative risk of sustaining fractures was reduced with increasing spare-time activities. Moderate work load increased the relative risk of sustaining a fracture whereas heavy work load reduced the relative risk. The same tendency was observed for fragility fractures only. None of these changes were statistically significant. The confounders listed above did not influence our results.

Other Life-Style Variables

There was no difference in the health status between urban and rural probands. However, urban residents had been in contact with a physician more often during the 6-month period preceding the study, 62% of the urban compared with 53% of the rural women ($P = 0.028$). The corresponding figures for men were 60% for urban and 50% for rural ($P = 0.036$). No significant difference was found for men or women for individual age groups.

The mortality rates for the mean population from 1986 to 1990 were similar in the two communities: 13.1/1,000 in Malmö (13.9 for men and 12.3 for women) compared with 13.3/1,000 in Sjöbo (14.2 for men and 12.4 for women).

Age at menarche and menopause in the two communities have already been presented [7]. The mean age at menarche in both urban and rural women was 13.8 years, and for

Table 2. Cumulated scores for activities at work, transports, housing, and during spare time for men and women in the city of Malmö and the rural community of Sjöbo

Age (years)	40			50			60			70			80		
Residence	Urban	Rural	*P*	Urban	Rural	*P*	Urban	Rural	*P*	Urban	Rural	*P*	Urban	Rural	*P*
Women	n = 71	n = 51		n = 60	n = 44		n = 60	n = 46		n = 82	n = 53		n = 48	n = 35	
Work															
Median	2	3	0.006	3	5	0.06	4	6	0.001	5	7	0.001	7	8	0.001
Range	2–4	2–6		3–6	3–9		3–7	3–9		4–12	4–11		4–9	3–12	
Transports															
Median	4	3	0.07	7	5	0.4	7	7	0.9	10	10	0.4	10	10	0.6
Range	2–6	2–6		3–9	3–9		3–9	5–9		4–10	4–12		8–12	4–12	
Housing															
Median	3	6	0.001	5	9	0.001	5	9	0.001	6	12	0.001	5.5	12	0.001
Range	2–6	2–6		3–9	3–10		3–9	3–10		4–12	4–12		4–10	6–12	
Spare time															
Median	4	4	0.26	6	6	0.009	6	6	0.2	8	9	0.001	8	8	0.001
Range	2–6	2–6		3–9	3–9		3–9	3–9		4–12	4–12		4–12	7–12	
Men				n = 39	n = 39		n = 53	n = 40		n = 89	n = 51		n = 58	n = 28	
Work															
Median				5	8	0.001	6	7	0.03	7	9.5	0.002	7	10	0.001
Range				3–9	3–9		3–9	3–9		4–12	4–12		4–12	4–12	
Transports															
Median				5	3	0.01	5	5	0.4	8	8	0.02	10	8	0.8
Range				3–9	3–9		3–9	3–9		4–12	4–12		4–12	4–12	
Housing															
Median				5	9	0.001	5	9	0.001	7	12	0.001	6	12	0.001
Range				2–10	3–10		3–11	3–10		4–13	4–14		4–12	4–12	
Spare time															
Median				7	9	0.08	7	8	0.08	10	10	0.16	8	11	0.001
Range				3–10	3–12		3–12	5–10		3–13	6–14		4–13	4–13	

Statistical significance *P* after Mann-Whitney analysis

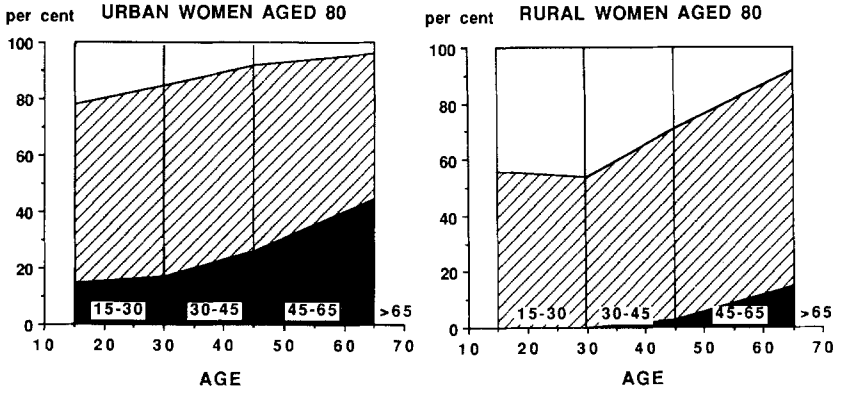

Fig. 6. Spare-time activities during the lifetime of women aged 80 years divided into four life periods. Urban compared with rural. Sedentary spare time significantly more common for urban women in all life periods ($0.05 > P > 0.001$). Regular activities significantly more common for rural women during life periods 15–65 years ($0.05 > P > 0.001$) and moderate activities significantly more common in rural women after 65 years ($P = 0.02$). (□) regular activities; (□) moderate activities; (■) sedentary spare time.

menopause, 48.7 and 48.5 years, respectively. No significant differences were found in the individual age groups.

The number of pregnancies was significantly higher in Sjöbo for nearly all age groups: rural women had on average of 2.4 pregnancies (median 2, range 0–12) whereas the urban women had 1.65 (median 2, range 0–9), $P < 0.001$.

Age-adjusted logistic regression analysis did not reveal any significant difference between the urban and rural groups in their past or present use of estrogens in women, or past and present milk and coffee consumption in either sex.

Age-adjusted logistic regression analysis did not reveal any significant difference between the urban and rural groups in their past or present use of estrogens in women, or past and present milk and coffee consumption in either sex.

Rural residents had significantly higher age adjusted BMI and less consumption of alcohol $P < 0.001$.

Locomotor Discomfort

There was no significant difference between urban and rural groups concerning hip and shoulder pain. Urban women (34/49) aged 80 years (69%) had experienced back pain during the preceding year compared with 14/35 (40%) of rural women ($P = 0.007$).

Knee pain was experienced at least once monthly by 24/84 (29%) of urban women aged 70 years, compared with 3/52 (6%) of rural women ($P = 0.003$). In the same age group 43 (51%), urban and 36 (69%) rural women ($P = 0.038$) had never had knee pain. In men aged 50 years, 8/40 (20%) urban and 1/39 (3%) rural complained of daily back pain ($P = 0.037$). Knee pain was experienced daily by 3/91 (3%) urban men aged 70 years, compared with 951 (18%) of rural ($P = 0.01$). In the same age group, 72 (83%) of the urban men and

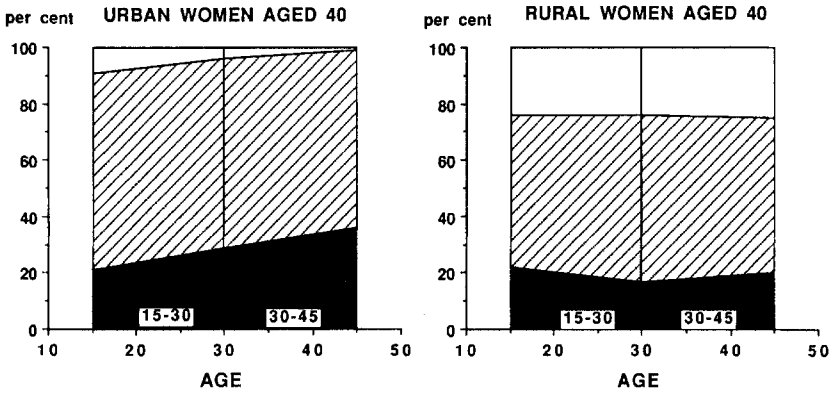

Fig. 7. Spare-time activities during the lifetime of women aged 40 years divided into two life periods. Urban compared with rural. Moderate activities significantly more common for urban women in life period 30–45 years ($P = 0.02$) and regular activities significantly more common for rural women during the same life period ($P = 0.006$). (□) Regular activities; (▨) moderate activities; (■) sedentary spare time.

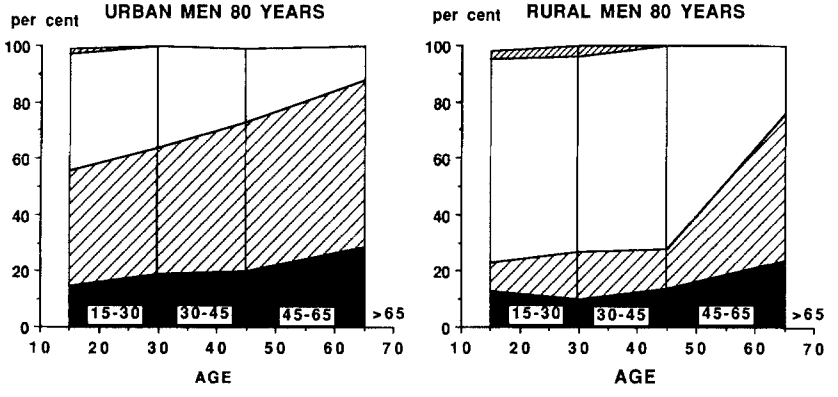

Fig. 8. Spare-time activities during the lifetime of men aged 80 years divided into four life periods. Urban compared with rural. Regular spare-time activities significantly more common in rural men during life periods 15–65 years ($P = 0.001$). Moderate activities significantly more common in urban men during life periods 15–65 years ($0.05 > P > 0.001$). (□) Elite activities; (▨) regular activities; (▨) moderate activities; (■) sedentary spare time.

33 (65%) of the rural men had never complained of knee pain ($P = 0.011$).

Bone Mass

The strongest association between activity score and BMC was found for work load in men. Significantly greater bone mass was found in men over median activity score for work than in men below the median activity score for both urban and rural residents, respectively. For all men, both urban and rural combined, the association between bone mass and physical activity at work persisted and was accentuated (Table 4). However, a greater spare-time activity was observed in men with high score for work load and a tendency towards better BMC for higher spare-time activities. There was no significant difference in the number of fractures between the probands above and below the median value.

For transportation, housing, spare-time activities, and work load for women, significantly higher BMC for more active probands was only sporadically observed.

Discussion

The rural population is and has been more physically active and the difference persists even after the official retirement age. Rural residents had heavier work load, more physically active spare time, and larger housing but more often used cars as a means of transportation probably because of greater distances. The same tendency persists in favor of probands without fractures when compared with those who had sustained a fracture where spare-time activities and household are concerned. This finding coincides with a higher prevalence of fractures in the urban part of the same population [6].

The rural population has apparently had a more physically active life-style during both work and spare time. Åström et al. [12] found that physical activity during the fertile period of life reduces the risk of sustaining cervical hip fractures in women; this observation was confirmed in the present study. The lower incidence of hip fractures in rural areas in Scandinavia [1–6] might therefore, to some extent, be explained by differences in physical activities. Reduced physical activity during spare time and work was observed in the youngest rural participants. Yesterday's differences in life-style between urban and rural areas may disappear in the future, and with it, the differences in fracture incidence.

The findings on different activity between the groups are less likely to have been influenced by migration between areas, because the same differences were found when comparing lifelong-residents in the city with those at the countryside.

Bone mass is affected by increased physical activity [13], and we found a connection between work load and BMC in men. The lack of significant association among BMC, workload, and spare-time activities in women is probably due to narrower distribution of work load in women, with too few women in the highest classes.

For men with a history of moderate work load, there was a nonsignificant tendency towards increased fracture risk whereas the risk was reduced for heavy work load. The explanation might be that medium work load increases the risk of accidents without strengthening the bone sufficiently to

Table 3. Cumulated activity scores for work load, means of transportation, housing and spare time activities for lifelong urban residents (LUR) men and women in the city of Malmö, and lifelong rural residents (LRR) in the community of Sjöbo

Age (years)	40			50			60			70			80		
Residence	LUR	LRR	*P*	LUR	LRR	*P*	LUR	LRR	*P*	LUR	LRR	*P*	LUR	LRR	*P*
Women	n = 41	n = 20		n = 28	n = 22		n = 29	n = 29		n = 36	n = 42		n = 22	n = 27	
Work															
Median	2	3.5	0.04	3	5	0.006	4	7	0.001	4	8	0.001	4	10	0.001
Range	2–4	2–6		3–6	3–9		3–7	3–9		4–10	4–10		4–8	4–12	
Transports															
Median	4	2.5	0.4	7	9	0.7	8	7	0.9	10	10	0.3	10	11	0.3
Range	2–6	2–6		3–9	3–9		5–9	5–9		6–12	4–12		8–12	4–12	
Housing															
Median	4	6	0.001	3	9	0.001	4	9	0.001	6	12	0.001	4	12	0.001
Range	2–6	2–6		3–9	7–10		3–9	3–10		4–12	4–12		4–10	6–12	
Spare time															
Median	4	5	0.06	5.5	6.5	0.002	6	7	0.052	8	10	0.001	8	9.5	0.001
Range	2–6	2–6		3–8	3–9		3–8	3–9		4–12	4–12		4–12	7–12	
Men				n = 27	n = 29		n = 19	n = 28		n = 41	n = 38		n = 27	n = 25	
Work															
Median				5	9	0.001	3	7.5	0.002	6	10	0.001	7	10	0.001
Range				3–9	4–9		3–9	3–9		4–12	4–12		4–12	8–12	
Transports															
Median				5	3	0.04	7	5	0.19	10	8	0.03	10	8	0.9
Range				3–9	3–9		5–9	3–9		4–12	4–12		4–12	4–12	
Housing															
Median				5	9	0.001	5	9	0.008	6.5	12	0.001	6	12	0.001
Range				2–7	7–9		3–10	3–10		4–12	8–14		4–12	9–12	
Spare time															
Median				7	9	0.05	6	8	0.03	10	11	0.2	8	11	0.005
Range				3–10	3–10		4–12	5–10		4–13	6–14		4–13	4–13	

Statistical significance *P* after Mann-Whitney analysis

withstand the trauma. In women, the reduction of fracture risk with increasing work load and spare-time activities was not significant probably because of insufficient number of cases in the study.

Previously presented data from this study on bone mass in these two communities [7] showed a higher overall BMC for rural men; this BMC difference may be explained by a physically more active life style of rural men. The marginal differences in morbidity and mortality between the groups together with greater BMI and less consumption of alcohol in the rural population are unlikely to be the only explanations for the differences in fracture risk.

Calcium intake may affect the fracture incidence. Matkovic et al. [14] found a higher incidence of hip fractures in an area in Yugoslavia where there is low calcium consumption; however, there is no consensus on the role of dietary calcium in the prophylaxis against fractures [15, 16]. In this study, dairy consumption was insignificantly greater in rural men, with hardly any difference in women, who contribute most to the number of fractures. The differences in previous milk consumption was even smaller, so this factor can hardly account for the different fracture rates.

Estrogen medication did not differ between women in the two communities except for a more common use of oral contraceptives in 40-year-old rural women, a group that represents only a small fraction of the fractures. Mean age of menarche and menopause, along with the number of oophorectomies, did not differ between the urban and rural areas. More childbirths among the rural women might have reduced their BMC temporarily during pregnancy [17], whereas other studies have not found differences in bone mass during pregnancy [18]. However, the long-term effects of parity may be reduction of bone loss [19, 20] and possible reduction in the fracture incidence in the rural group.

Coxarthrosis is more common in farmers and rural residents than in urban residents in Sweden [21, 22]. Gonarthrosis is also more common in manual workers [23]. Therefore, it could be expected that locomotor discomfort is more common in Sjöbo; however, this is only true for men aged 70 with knee pain and may be explained by the inadequacy of the study to detect differences in the prevalence of osteoarthritis. Back pain was more common in 80-year-old urban women probably because of more spinal osteoporosis in that group.

Work load was estimated independently by the interviewer and the proband and both arrived at the same conclusion. However, the present work load in rural women may be underestimated because many of the rural housewives were living on farms and therefore probably involved in more physically demanding activities than their urban counterparts. The hypothesis that activity due to profession was probably greater in the rural group is confirmed by heavier previous work load for rural women.

Assessment of means of transportation into three groups made the questions easier to answer. It was done in order to evaluate the amount of the probands' own muscular activity. Evaluation of household was more difficult, because of similar household standards in both communities. However, the larger rural household should incur more cleaning and maintenance activity for both men and women. Therefore, we decided to draw the line between an apartment where the landlord usually provides services such as gardening, cleaning, and repair and a villa where this is usually taken care of by the owners. If the individual possessed a summer house,

Table 4. Bone mass for men, 1 and 6 cm proximal to the ulnar styloid process (BMC 1 and BMC 6, respectively; in mg/cm²)

	50						60					
Age (years)	Urban		Rural		All		Urban		Rural		All	
Median	5		8		8		6		7		7	
Score	Low/High	*P*	Low/High	*P*	Low/High	*P*	Low/High	*P*	Low/High	*P*	Low/High	*P*
BMC 1												
Number	17/16		19/17		30/27		23/22		15/17		45/28	
Mean	427/434	n.s.	421/442	n.s.	408/440	n.s.	355/390	0.034	406/476	0.003	391/441	0.005
SD	92/91		66/51		80/65		61/48		38/74		70/78	
BMC 6												
Number	17/16		8/17		30/27		23/22		15/17		45/28	
Mean	634/641	n.s.	647/689	n.s.	643/674	n.s.	597/640	0.023	621/700	0.004	611/669	0.001
SD	65/75		58/50		69/56		60/62		72/72		64/83	
M-SA	8/8		8/9		7/9		7/7		8/9		7/7	

	70						80					
Age (years)	Urban		Rural		All		Urban		Rural		All	
Median	7		9.5		8		7		10		9	
Score	Low/High	*P*	Low/High	*P*	Low/High	*P*	Low/High	*P*	Low/High	*P*	Low/High	*P*
BMC 1												
Number	40/35		25/25		69/56		20/27		6/9		41/39	
Mean	360/387	n.s.	357/432	0.001	366/406	0.004	356/379	n.s.	345/402	n.s.	361/378	n.s.
SD	68/84		59/81		68/84		77/89		28/99		85/85	
BMC 6												
Number	40/35		25/25		69/56		20/27		6/9		41/39	
Mean	565/594	n.s.	601/648	0.035	581/618	0.012	546/563	n.s.	530/644	0.02	548/587	0.04
SD	67/84		67/85		71/91		88/80		43/96		88/79	
M-SA	9/10		9/11		9/11		8/9		11/11		8/11	

The activity score above and below the median compared for work load among men. Median values for the age groups, number of probands, mean values for BMC, standard deviation for BMC. M-SA-median value for spare time physical activities within the group. Age groups 50–80 years in both urban and rural populations and the combined urban-rural probands (All). Statistical analysis using Student's-*t* test, *P* = probability

this was regarded as an extra source for physical activity during the summer season. Households were found to be larger in Sjöbo for both men and women in our study; this indicates that our selection of probands was representative of the populations, as 84% of all inhabitants of Sjöbo live in one-family homes compared with 17% in Malmö [7].

The rising incidence of hip fractures in mixed urban and rural catchment areas has been explained by an increasing number of elderly people [24], whereas in Malmö, increasing incidence for hip fractures was observed in the 1980s compared with the 1950s in spite of age-adjusted comparison [25].

In conclusion, differences in life-style, including physical activity, between urban and rural residents may explain the differences in fracture incidence observed between these areas.

Acknowledgements. This work was supported by the Swedish Medical Research council (project No. -89-27X-07975-93), the Herman Järnhardt, Greta and Johan Koch, and Alfred Österlund Foundations.

References

1. Falch J, Ilebekk A, Slungaard U (1985) Epidemiology of hip fractures in Norway. Acta Orthop Scand 55:12–16
2. Finsen V, Benum P (1987) Changing incidence of hip fractures in rural and urban areas of central Norway. Clin Orthop 218: 104–110
3. Mannius S, Mellström D, Odén A, Rundgren A, Zetterberg C (1987) Incidence of hip fracture in western Sweden 1974–1982. Acta Orthop Scand 58:38–42
4. 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
5. Larsson S, Eliasson P, Hansson L-I (1989) Hip fractures in northern Sweden 1973–1984: a comparison of rural and urban populations. Acta Orthop Scand 60:567–571
6. Jónsson B, Gärdsell P, Johnell O, Redlund-Johnell I, Sernbo I (1992) Differences in fracture pattern between an urban and a rural population: a comparative population-based study in southern Sweden. Osteoporosis Int 2:269–273
7. Gärdsell P, Johnell O, Nilsson BE, Sernbo I (1991) Bone mass in an urban and a rural population: a comparative, population-based study in southern Sweden. J Bone Miner Res 6:67–75
8. Keys A (1980) Physical activity. In: Seven countries: a multivariate analysis of death and coronary heart disease. Harvard University Press, Cambridge Mass, London, pp 196–217
9. Gärdsell P, Johnell O, Nilsson BE (1989) Predicting fractures in women by using forearm bone densitometry. Calcif Tissue Int 44:235–342
10. Isacsson S-O, Hansson BS, Janzon L, Lindell SE, Steen B (1987) Methods to assess alcohol consumption in 68-year-old men: results from the population study "Men born in 1914," Malmö, Sweden. Br J Addict 82:1235–1244
11. Nauclér LOW, Nilsson BE, Westlin NE (1974) An apparatus for gamma absorptiometry of bone-technical data. Opuscula Medicotechnica Lundensia 12:1
12. Åström J, Ahnqvist S, Beertema J, Jónsson B (1987) Physical activity in women sustaining fracture of the neck of the femur. J Bone Joint Surg 69-B:381–388
13. Smith E, Gilligan C (1991) Physical activity effects on bone metabolism. Calcif Tissue Int 49(suppl):S50–S54
14. Matkovic V, Kostial K, Simonovic I, Buzina R, Brodarec A,

Nordin BEC (1979) Bone status and fracture rate in two regions in Yugoslavia. Am J Clin Nutr 32:540–549
15. Kanis JA, Passmore RA (1989) Calcium supplementation of diet: not justified by present evidence. BMJ 298:137–140, 205–208
16. Nordin BEC, Heany RP (1990) Calcium supplementation of the diet: justified by present evidence. BMJ 30:1056–1060
17. Lamke B, Brundin J, Moberg P (1977) Changes of bone mineral content during pregnancy and lactation. Acta Obstet Gynecol Scand 56:217–219
18. Sonwers M, Crutchfield M, Jannausch M, Updike S, Corton G (1991) A prospective evaluation of bone mineral change in pregnancy. Obstet Gynecol 77:841–845
19. Nilsson BE (1969) Parity and osteoporosis. Surg Gynecol Obstet 129:27–28
20. Johnell O, Nilsson BE (1984) Life-style and bone mineral mass in perimenopausal women. Calcif Tissue Int. 36:354–356
21. Axmacher B, Lindberg H (in press) Coxarthrosis in farmers. Clin Orthop
22. Forsberg K, Nilsson BE (1992) Coxarthrosis on the island of Gotland: increased prevalence in a rural population. Acta Orthop Scand 63:1–3
23. Lindberg H, Montgomery F (1987) Heavy labour and the occurrence of gonarthrosis. Clin Orthop 214:235–236
24. Rehnberg L, Olerud C (1990) Incidence of hip fractures in the elderly: Uppsala county 1980–1987. Acta Orthop Scand 61:148–151
25. Johnell O, Nilsson B, Obrant K, Sernbo I (1984) Age and sex patterns of hip fracture: changes in 30 years. Acta Orthop Scand 55:290–294