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Holmberg, Anna H; Johnell, Olof; Nilsson, Peter; Nilsson, Jan-Åke; Berglund, Göran; Åkesson, Kristina

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Risk factors for hip fractures in a middle-aged population

– a study of 33 000 men and women

Anna H Holmberg[1], Olof Johnell[1], Peter M Nilsson[2], Jan-Åke Nilsson[2], Göran Berglund[2] and Kristina Åkesson[1]

[1]Department of Orthopaedics, Lund University, Malmö University Hospital, SE-205 02 Malmö, Sweden; [2]Department of Medicine, Lund University, Malmö University Hospital, SE-205 02 Malmö, Sweden

Correspondence to:

Anna H Holmberg
Department of Orthopaedics
Lund University
Malmö University Hospital
20502 Malmö
Sweden
Phone: +46-40-336123
Fax: +46 40–33 62 00
E-mail: Anna.Holmberg@skane.se; Anna_H.Holmberg@med.lu.se

Abstract

Background: Knowledge about subjects who sustain hip fractures in middle age is poor. This study prospectively investigated risk factors for hip fracture in middle age and compared risk factors for cervical and trochanteric hip fractures.

Methods: The Malmö Preventive Project consists of 22 444 men, mean age 44 years, and 10 902 women, mean age 50 years at inclusion. Baseline assessment included multiple examinations and lifestyle information. Follow-up was up to 16 years with regard to occurrence of fracture.

Results: 135 women had one low-energy hip fracture each, 93 of which were cervical and 42 trochanteric. 163 men had 166 hip fractures, of which 81 were cervical and 85 trochanteric.

In the final Cox' regression model for women the risk factors with the strongest associations with hip fracture were diabetes (risk ratio (RR) 3.89, 95% confidence interval (CI) 1.69-8.93, p=0.001) and poor self-rated health (RR 1.74, 95%CI 1.22−2.48, p=0.002). A history of previous fracture (RR 4.76, 95%CI 2.74−8.26, p=0.0001 was also a significant risk factor.

In men diabetes had the strongest association with hip fracture (RR 6.13, 95%CI 3.19-11.8, p=0.001). Smoking (RR 2.20, 95%CI 1.54-3.15, p=0.001), high serum γ-glutamyl transferase (RR 1.84, 95%CI 1.50−2.26, p=0.001), poor self-rated health (RR 1.49, 95%CI 1.06-2.10, p=0.02) and reported sleep disturbances (RR 1.52, 95%CI 1.03−2.27, p=0.04) were other significant risk factors.

Conclusion: The strongest risk factor for hip fracture for both women and men in middle age was diabetes. Many risk factors were similar for men and women, although the risk ratio differed. The risk factor pattern for cervical versus trochanteric fractures differed in both men and women. The findings indicate that those suffering a hip fracture before the age of 75 have a shorter life expectancy, suggesting that hip fractures affect the less healthy segment of the population.

Keywords: hip fracture, men, middle age, risk factor, women.

Introduction

Hip fracture is one of the most devastating outcomes of osteoporosis. It often leads to disability and loss of autonomy and sometimes, to death [1−5]. Hip fractures generate large social expenses for society, both directly during fracture treatment and indirectly, particularly during the first year post-fracture [4−6].

Furthermore, the number of persons suffering a hip fracture is expected to increase worldwide during the coming 25−50 years, reaching over 6.26 million by 2050 [7, 8]. The importance of preventing at least a part of these fractures through preventive work cannot be over-emphasized, and the gain for society and the individual in doing so also motivates research in this area. Middle age, when fragility fractures are still uncommon, is an ideal time for identifying high-risk individuals and applying fracture prevention measures.

Hip fractures related to low-energy trauma are uncommon in younger years since the incidence of fractures is strongly associated with increasing age, particularly after the age of 75 [9]. The mean age at which hip fracture occurs is 81 years for women and 78 years for men [10].

Hip fracture in the elderly has been extensively investigated, and much is known about risk factors and post-fracture living [11−13]. Less is known regarding individuals who fracture already in middle age and about possible differences between them and individuals fracturing in old age. In addition, previous studies have suggested that cervical and trochanteric hip fractures in the elderly may have different risk factors, suggesting different aetiologies [14−18]. Individuals suffering from trochanteric hip fractures have been reported to be older and thinner and to have lower trochanteric bone mineral density (BMD) and higher post-fracture mortality compared with those suffering from cervical hip fractures [19−21]. In this respect also, little is known about persons with a hip fracture at middle age.

The primary objective of this study was therefore to investigate the risk factor pattern for hip fractures occurring in middle age, i.e. at 48−68 years, and identify differences in risk between men and women. A secondary objective was to investigate whether risk factors differ between cervical and trochanteric hip fractures also already in middle age.

Materials and methods

The Malmö Preventive Project is a prospective, population-based, cardiovascular screening study started in the 1970s. It consists of 33 346 probands, 22 444 men and 10 902 women, representing 72% of the invited population [22]. Mean age at the baseline investigation was 44 (range 27−61) years for men and 50 (range 28−58) years for women. The inclusion period for men was 1974−1984 (10 years), and for women, from 1977 to 1992 (15 years). The primary objective of the Malmö Preventive Project was to describe cardiovascular risk factors and related conditions in a middle-aged population and improve the scientific base for cardiovascular disease prevention. The probands were followed prospectively with regard to incident fractures and mortality until the end of 1999, with a mean follow-up of 16 years (range 7−25 years) for men and 11 years (range 7−22 years) for women.

Physical examination
Baseline physical investigation included height and body weight measurement as well as triceps skinfold thickness. Blood pressure and pulse rate were measured twice after a 10-minute rest and a mean figure was recorded. Spirometry was performed and pulmonary function parameters were calculated.
In a subgroup of the cohort glucose tolerance was tested, and in another subgroup of women bone mineral density of the distal radius was measured[23].

Questionnaire
The probands completed a comprehensive questionnaire of around 260 questions at baseline. For the majority of questions the possible alternatives were yes or no or deferring from answering. Because of the extended inclusion period new questions were considered relevant and added, while others were withdrawn. The data for some variables are therefore incomplete.

The questionnaire focused on family history of cardiovascular disease, hypertension and diabetes, presence of signs of cardiovascular disease, use of cardiovascular medication, previous and present smoking habits, social background characteristics, alcohol drinking habits (including screening questions for alcoholism), physical activity both during work and during leisure time, and medical history and status. For women, questions about reproductive history and menopausal status were also included.

One of the questions with limited response rate was regarding previous fracture. This question was added in 1983, the later part of the inclusion period. The response rate was 74% for women but only 4% for men. The majority of the women were included in the study in the later part of the inclusion period and the majority of the men at the beginning, which explains the difference in response rate. Another question with limited response rate for women regarded hormone replacement therapy eliciting a response rate of 74%.
Questions with limited response rate in men concerned treatment for psychical illness, sick leave, appetite disturbances, sleep disturbances, and tightness of the chest, all with 72 % response rate.

Since the data are extensive, variables of biological interest and with possible impact on fracture risk were chosen and analysed in clusters of variables with possible interdependence.

Laboratory investigation
Blood samples were collected from the participants after an overnight fast. The following analyses were performed and used in this substudy: haematoglobin, sedimentation reaction (SR), serum creatinine, fasting blood glucose, serum γ-glutamyl transferase, serum triglycerides,

serum total cholesterol, serum uric acid and serum phosphate.

Fracture identification

The fracture data were obtained by linking the probands included in the Malmö Preventive Project with the register at the Department of Diagnostic Radiology at Malmö University Hospital. In the city of Malmö all emergency radiographic examinations are performed at the Department of Diagnostic Radiology at Malmö University Hospital. All fractures are recorded and the films saved. The unique ten-digit personal identification number, based on birth date and issued to every Swedish citizen, facilitates identification of cases. The diagnosed fractures were confirmed through manual search of the medical and radiological files. In this way virtually all fractures that Malmö citizens suffer are captured [24]. The fractures registered were classified into 20 different categories, including cervical and trochanteric hip fractures. Fractures below the lesser trochanter were registered as diaphyseal femoral fractures.

All high-energy fractures such as fractures caused by motor accidents or falling from heights were excluded, as were fractures of pathological origin (metastatic bone disease).

Mortality

Mortality data were obtained from the National Bureau of Statistics, Register of Death Certificates, Stockholm, Sweden.

Statistics

For this substudy, relevant data were extracted from the Malmö Preventive Project's main database. Baseline descriptive data of the whole cohort and the fracture groups were analysed by calculating means and standard deviations. Since the large size difference between the fracture and non-fracture groups was likely to cause statistically significant differences, we have deferred from using independent Student's *t*-test for the quantitative variables and chi-square test for the qualitative variables to compare the means.

In an age-adjusted Cox proportional hazard model each of the chosen variables was analysed, one by one. We chose to adjust for age since it is the most pronounced risk factor for fracture. The variables were sorted into different categories such as anthropometric, cardiovascular, metabolic, life style and psychosocial variables. From each category one or two variables were chosen based on the strength of their association with hip fracture risk. The same variables were chosen for men and women. These variables were included in a final multivariate Cox' regression model. The variables included were: age, body mass index, γ-glutamyl transferase, smoking, poor self-rated health and premature awakening.

For individuals suffering more than one hip fracture, the earliest occurring fracture was the one included in the calculation. P-values <0.05 were considered statistically significant. The statistical program used was SPSS 11.5 for Windows (Statistical Package for Social Sciences, Chicago, Illinois, USA).

Results

During the follow-up 137 women suffered a total of 137 low-energy hip fractures, 95 of which were cervical and 42 trochanteric hip fractures. Two of the cervical but none of the trochanteric hip fractures were excluded owing to being high-energy fractures or pathological fractures. A total of 93 cervical hip fractures and 42 trochanteric hip fractures in 135 women remained in the study. Mean age at hip fracture was 61.5 years (range 46.1−72.7, standard deviation (SD) ±5.7).

Altogether 181 men suffered 184 low-energy hip fractures during follow-up, 91 of which were cervical and 93 trochanteric. Ten cervical and eight trochanteric hip fractures were excluded being high-energy fractures or pathological fractures, leaving 163 men with 81 cervical and 85 trochanteric hip fractures in the study. Mean age at hip fracture was 62.0 years (range 36.6−77.8, SD±9.24). Mean age at the end of follow-up for women was 64.9 years (range 50.0−74.0, SD±5.6) excluding those who died during follow-up and for men, 63.5 years (range 50.0−79.0, SD±7.2). A total of 3412 men and 716 women died during the follow-up.

Descriptives

The women suffering from cervical hip fractures represented a significantly older segment of the study population at baseline, while the mean age for women with trochanteric hip fractures was similar to that of the background population. The women with cervical hip fractures had normal body weight and BMI, while those sustaining trochanteric hip fractures weighed on average 5.7 kg less than the background population, and also had a lower BMI (Table 1).

The men suffering from either cervical or trochanteric hip fractures also represented a significantly older segment of the study population at baseline. The men with cervical hip fractures had normal body weight and BMI, while men sustaining trochanteric hip fractures on average weighed 3.9 kg less than the study population and had a lower BMI (Table 2).

In the following, risk factors for men and women are reported separately.

Risk factors, women

All hip fractures in women

Self-reported diabetes at baseline increased the hip fracture risk four times (risk ratio (RR) 4.07, 95% confidence interval (95% CI) 1.79−9.26, p=0.001) and having a history of hospital admittance for mental disorder doubled the risk (RR 2.17, 95% CI 1.19−3.85, p=0.01) (table 3). Current smoking or poor self-rated health was associated with risk increases of 1.47 (95% CI 1.04−2.08, p=0.03) and 1.82 (95% CI 1.30−2.56, p=0.001), respectively. A high BMI was protective against hip fracture (RR 0.63, 95%CI 0.51-0.78, p=0.0001).
Fractures earlier in life were registered at baseline for women. A history of previous fractures was associated with an almost fivefold increase in hip fracture risk (RR 4.76, 95% CI 2.74−8.26, p=0.001) in middle-aged women.

Cervical hip fractures in women

Diabetes was not associated with any significant risk increase in women, nor was having a history of hospital admittance for mental disorder. Poor self-rated health increased the cervical hip fracture risk by 1.82 (95% CI 1.21−2.74, p=0.004) while current smoking was a non-significant risk factor. A high BMI was protective against hip fracture (RR 0.77, 95%CI 0.60-0.98, p=0.03).
A history of previous fractures more than tripled the risk for cervical hip fracture (RR

3.41, 95% CI 1.63−7.14, p=0.001) and was the strongest risk factor in this subgroup.

Trochanteric hip fractures in women

Diabetes was the second strongest risk factor in this subgroup, increasing the trochanteric hip fracture risk more than seven times (RR 7.46, 95% CI 2.28−24.4, p=0.001) while having a history of hospital admittance for mental disorder did not significantly increase the risk. Poor self-rated health increased the trochanteric hip fracture risk by 1.84 (95% CI 1.00−3.39, p=0.05) Current smoking more than doubled the risk for having a trochanteric hip fracture (RR 2.25, 95% CI 1.21−4.17, p=0.001). The strongest risk predictor for trochanteric hip fractures was a history of previous fracture. In this subgroup the risk increase was almost ninefold (RR 8.93, 95% CI 3.80−21.3, p=0.0001).

Final multivariate Cox' regression model for women

In order to evaluate the relative importance of each factor and also calculating with interdependence between the variables we constructed a final multivariate Cox' model. Seven variables were included, one or two from each subgroup. Five of these variables were significantly associated with hip fracture risk (Table 5).

The factor with the strongest association to cervical hip fracture was having a poor self-rated health (RR 1.78, 95% CI 1.16-2.73, p=0.008). Belonging to the upper part of the age segment of the study population and having a high level of γ-glutamyl transferase (RR 1.38, 95% CI 1.01-1.90, p=0.05) also increased the cervical hip fracture risk. A high BMI was protective from cervical hip fracture.

Having diabetes increased the risk of trochanteric hip fractures almost 8 times (7.75, 2.34-25.6), while belonging to the upper part of the age segment of the study population only gave a moderate risk increase. A high BMI was protective from trochanteric hip fracture also.

Risk factors men

All hip fractures in men

Self-reported diabetes at baseline elevated the hip fracture risk more than seven times (RR 7.75, 95% CI 4.37-13.7, p=0.001), making this the strongest risk factor for hip fracture in men (table 4). High diastolic blood pressure and elevated resting pulse were both associated with increased risk of hip fracture. Elevated serum γ-glutamyl transferase increased the risk by 1.45 (95% CI 1.28-1.65, p=0.0001). Current smoking was a strong risk factor for hip fracture (RR 2.72, 95% CI 1.94−3.80, p=0.001) as were a poor self-rated health (RR 1.83, 95% CI 1.33−2.50, p=0.001) and a sleep disturbance, premature awakening (RR 1.84, 95% CI 1.25−2.70, p=0.002). Having a history of hospital admittance for a mental disorder was associated with a risk increase of 2.64 (95 % CI 1.46-4.76, p=0.001). A high BMI was protective against hip fracture (RR 0.63, 0.53-0.76, p=0.0001).

Cervical hip fractures in men

The strongest risk factor for cervical hip fracture in men was diabetes (RR 6.37, 95% CI 2.56-15.9, p=0.001). High diastolic blood pressure and elevated resting pulse were not associated with increased risk of cervical hip fracture. Elevated serum γ-glutamyl transferase was associated with a risk increase of 1.34 (95% CI 1.10−1.62, p=0.003). Current smoking was a strong risk factor for cervical hip fracture (RR 2.44, 95% CI 1.52−3.94, p=0.001) as was poor self-rated health (RR 2.19, 95% CI 1.40−3.42, p=0.001) and premature awakening (RR 2.29, 95% CI 1.35-3.89, p=0.002). Having a history of hospital admittance for a mental disorder was not associated with any increased risk of fracture. A high BMI was protective against hip fracture (RR 0.76, 0.59-0.97, p=0.03).

Trochanteric hip fractures in men

Diabetes was an even stronger risk factor for trochanteric hip fractures than for cervi-

cal hip fractures (RR 8.42, 95% CI 3.85-18.4, p=0.001). High diastolic blood pressure and elevated resting pulse were both associated with increased risk of trochanteric hip fracture. Elevated serum γ-glutamyl transferase was associated with a risk increase of 1.56 (95% CI 1.32−1.86, p=0.0001). Current smoking tripled the trochanteric hip fracture risk (RR 3.06, 95% CI 1.88−4.96, p=0.001). However, neither poor self-rated health nor premature awakening was significantly associated with trochanteric hip fracture risk. Having a history of hospital admittance for a mental disorder was associated with increased risk of fracture (RR 3.09, 95% CI 1.42-6.71, p=0.005). A high BMI was protective against hip fracture (RR 0.53, 0.41-0.69, p=0.0001).

Final multivariate Cox' regression model for men

In the final Cox' model all seven variables were associated with increased risk of hip fracture. These factors were also associated with cervical hip fracture risk, although with different strengths of the associations. The factor with the strongest association to cervical hip fracture was having diabetes, with a five-fold risk increase (5.03, 1.81-14.1, p=0.002). Smoking, a poor self-rated health and having sleep disturbances each doubled the risk of cervical hip fracture.

Five variables out of seven were associated with trochanteric hip fractures, diabetes being the one with the strongest risk association with a more than eight-fold risk increase (8.42, 3.85-18.4) A poor self-rated health and having sleep disturbances were not associated with any increased risk of trochanteric hip fracture (Table 5).

Mortality

In the non-fracture population 693 women (6.4%) and 3 346 men (15%) died during the mean follow-up period of 11 (women) and 16 years (men). Mean age at death for the women in the non-fracture population was 61.0 years (range 32.0−73.5, SD±6.32), while for men it was 61.1 years (range 29.8−78.6, SD±8.34). There was excess mortality in the hip fracture population, with 23 of 135 women (16.8%) dying on average 2.5 years (range 0.6−8.3, SD±2.7) after the hip fracture, and 66 of 163 men (40.5%) dying on average 3.25 years (range 0−19.2, SD±3.5) after the hip fracture. In the hip fracture population mean age at death for women was 64.2 years (range 51.2−71.1, SD±5.2) and for men, 66.4 years (range 41.5−77.6, SD±7.5).

Discussion

This study describes a group of patients with hip fracture − those suffering from hip fracture already in middle age − a group previously not well described. In this young population we identified several risk factors prospectively associated with increased hip fracture risk. When we compared these risk factors with those found in studies of elderly hip fracture patients, some were the same, for example height, low body weight and low BMI [12, 13, 25]. Having diabetes in our study more than tripled the risk for future hip fracture in women, and a history of fracture earlier in life gave an almost fivefold risk increase. Previous fracture was the risk factor with the largest impact on women. A recent meta-analysis confirms the strong association between previous fractures and hip fracture risk in both men and women [26].

In men diabetes and smoking were the risk factors with the largest impact, diabetes increasing the hip fracture risk more than six times, and smoking more than doubling the risk.

Cardiovascular risk factors

Since the Malmö Preventive Project was primarily designed to evaluate cardiovascular hazards, factors that could affect the cardiovascular system were extensively registered. Some of these variables also appear to be of importance for hip fracture. High diastolic blood pressure and an elevated resting pulse were associated with a risk increase in men, especially men with trochanteric hip fractures, while an elevated resting pulse increased the hip fracture risk in women. This confirms the findings in the Study of Osteoporotic Fractures (SOF) study which showed elevated resting pulse is a significant risk factor for hip fracture in women over 65 years of age [13]. These cardiovascular factors could represent a poorer state of the cardiovascular system, indicating an individual with comorbidity and greater proneness to fracture. Contradictory to our findings are the results from the Mediterranean Osteoporosis Study (MEDOS) group, in which myocardial infarction in men was associated with lower risk for hip fracture, and no association was found with heart disease or hypertension [25]. In the MEDOS study there was a large age span, and one could theorize that men with myocardial infarction more often than those without die at an early age and are therefore not affected by a significant number of fractures [27].

Metabolic risk factors

Diabetes was associated with a large fracture risk increase for all male hip fractures as well as for women with trochanteric hip fractures; however, with a broad CI. In the final multivariate model the risk increases were only slightly altered. These data are consistent with a Norwegian study by Meyer et al. performed in subjects of the same age group [28]. A recent study has shown that individuals with type 1 diabetes have a slightly lower BMD than do the general population, indicating increased risk of fracture, while individuals with type 2 diabetes have a higher BMD [29]. This could, however, be influenced by the fact that individuals with type 1 diabetes have a longer disease duration, with negative effects on the bone mass, while those with type 2 diabetes often have higher body weight, high BMI being one of the factors most strongly related to a high BMD. A study of 32 089 women in Iowa, USA, gave the same indications. Individuals with type 1 diabetes had a twelve times higher risk for hip fracture than the background population, and those with type 2 diabetes had a 1.7 higher risk [30]. Prolonged disease duration of type 2 diabetes was also associated with an elevated hip fracture risk.

At older ages, many individuals with type 1 diabetes die from other complications of their disease and this could explain why the

risk association in older age groups is much weaker. Diabetes type was not recorded in the present study.

High levels of serum lipids were associated with increased risk of cervical hip fracture in men, while high levels of serum cholesterol was associated with decreased relative risk of hip fracture in women. Although there is no clear association pattern between serum lipids and fracture risk, it is interesting to note that other recent studies have found connections between BMD and serum lipids [27, 31, 32]. More research in this field is needed.

Psychosocial and life style risk factors
Various lifestyle factors are implicated as risk factors for fractures, these include smoking and alcohol over-consumption. In the present study the probands who were smokers at baseline all had increased risk for hip fracture, especially the men. This is consistent with a recently published meta-analysis of smoking and fracture risk [33].

Gamma-glutamyl transferase levels above normal may be regarded as an indicator of alcohol over-consumption reaching pathophysiological effects [34]. This test is possibly more reliable than personal reporting of alcohol consumption. In this study elevated serum γ-glutamyl transferase was associated with an 18 % risk increase for hip fracture in women and a 45% risk increase in men. In the final multivariate analysis the risk of hip fracture was in women increased by 35 % and in men by 80 %. Previous studies have presented inconsistent results in establishing connections between alcohol consumption and hip fracture in men [35-37]. In the MEDOS results, alcohol over-use almost doubled the hip fracture risk, a result similar to ours. This study was, like ours, performed on middle-aged men. In the elderly, where most hip fracture studies have been done, many alcoholics are already dead from the consequences of their alcohol over-consumption and their input to the studies is lost.

Poor self-rated health was in the final Cox' model associated with increased risk of cervical hip fracture in both men and women, as was sleep disturbances in men. These factors could be signs of psychological disorders such as depression and problems in coping with every day life [38].

Comparison of risk factors for cervical and trochanteric hip fractures
Middle-aged individuals suffering from cervical or trochanteric hip fractures have many risk factors in common but differences are also noticed, especially in women. The only factors common to both fracture types in women in the final Cox' model were being in the higher age segment of the study population and having a low BMI. Diabetes only increased the risk of trochanteric hip fracture, while having a high level of γ-glutamyl transferase and reporting poor self-rated health were associated with increased risk of cervical hip fracture. Differences in risk factor patterns may in part explain why the number of cervical hip fractures in our study was twice that of trochanteric hip fractures.

In men the risk factor patterns for the two different fracture types were more similar.

Only two risk factors were of importance for both types of hip fracture in both men and women; belonging to the higher age segment of the study population and having a low BMI. This illustrates the complexity and multitude of risk factors associated with hip fracture. A comparison of fracture types showed that men and women with trochanteric hip fractures in this study had five risk factors in common, while men and women suffering from cervical hip fractures had four in common. Previous studies have shown lower BMD in patients with trochanteric hip fractures compared with cervical hip fracture patients [19, 20]. Since

some significant risk factors for trochanteric hip fracture identified in this study are also risk factors for having low BMD, one could speculate that individuals suffering from trochanteric hip fracture may also have low BMD already in middle age [39-42]. Unfortunately, baseline assessment in this population was done before access to DXA (dual x-ray absorptiometry) and we are therefore unable to evaluate our speculations.

Despite the size of our study and the duration of follow-up, we are unable to identify risk factor patterns distinctive enough to definitely differentiate the pathogeneses for cervical and trochanteric hip fractures, although, as in previous studies, the indications are strong in this direction.

This study has some limitations. The number of fractures is relatively small owing to a low incidence of hip fractures in middle age. However, to our knowledge, this is one of the first prospective studies looking at hip fractures in middle age and in both sexes. Our study is large and population-based and the population is relatively homogeneous. Follow-up is long but unfortunately not similar. When the study was initiated the primary target group was men and they were therefore recruited earlier into the study compared to the women. Due to financial problems the study was terminated earlier than expected, reflecting the difference in mean age and size of the male and female population.
The population has to some extent been subject to intervention against cardiovascular diseases, diabetes and alcohol abuse. This could possibly affect the fracture incidence. However, the intervention studies did not record any effect on cardiovascular disease, diabetes or alcohol abuse in the study cohort [43]. Therefore an effect on fracture incidence seems unlikely.

Conclusions

Risk factors for hip fracture can be detected already in middle age, with many factors similar both in middle age and old age. Among the hip fracture patients we also note an excess mortality. Our data indicate that in a middle-aged population the risk factor patterns for trochanteric and cervical hip fractures are different and suggest that the individuals suffering from trochanteric hip fractures have a frailer constitution. This information is of use when considering prevention strategies. How to identify the high-risk individuals that could benefit from risk factor intervention remains a problem both among the elderly and in middle age. The present study provides additional arguments for the necessity to acknowledge fracture prevention also in middle age particularly in those with impaired health.

Table 1

Descriptives of variables in women with no hip fractures, women with hip fractures and women with cervical or trochanteric hip fractures.

Variable (unit)	**No hip fracture n=10767**		**Hip fracture n=135**		**Cervical hip fracture n=93**		**Trochanteric hip fracture n=42**	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
Age (yrs)	49.6	± 7.4	51.7	± 5.14	52.0	± 5.1	51.0	± 5.30
Height (cm)	164	± 6.08	164	± 5.75	164	± 5.8	165	± 5.70
Weight (kg)	65.4	± 11.6	62.7	± 11.3	64.0	± 11.6	59.7	± 10.1
BMI (kg/m²)	24.4	± 4.22	23.2	± 3.93	23.8	± 3.9	21.9	± 3.70
Forced vital capacity (L)	3.28	± 0.67	3.12	± 0.74	3.04	± 0.72	3.26	± 0.76
Systolic blood pressure (mm Hg)	124.6	±16.6	125.5	± 17.6	124.9	± 16.5	127.0	± 20.0
Diastolic blood pressure (mm Hg)	81.6	±9.2	83.4	± 9.8	83.5	± 10.1	83.1	± 9.1
Resting pulse (beats /minute)	68	±9	70	± 9	70	± 10	70	± 8
Serum –triglycerides (mmol/L)	1.11	± 0.60	1.19	± 0.74	1.17	± 0.79	1.24	± 0.62
Serum cholesterol (mmol/L)	5.81	± 1.11	5.75	± 1.15	5.75	± 1.17	5.75	± 1.11
Sedimentation rate (mmol/L)	9.9	± 7.7	10.3	± 8.1	10.3	± 8.5	10.4	± 7.4
γ-glutamyl transferase (mmol/L)	0.31	± 0.59	0.36	± 0.79	0.36	± 0.84	0.36	± 0.68
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Diabetes	126	1.2	6	4.4	3	3.2	3	7.1
Manual work	4491	41.7	55	40.7	39	41.9	16	38.1
Smoking	3751	34.8	57	42.2	35	37.6	22	52.4
Poor self-rated health	3314	30.8	62	45.9	43	46.2	19	45.2
Premature awakening	2438	22.6	43	31.9	31	33.3	12	28.6
Previous fracture history	300	2.8	15	11.1	8	8.6	7	16.7

Table 2

Descriptives of variables in men with no hip fractures, men with hip fractures and men with cervical or trochanteric hip fractures.

Variable (unit)	No hip fracture n=22 281		Hip fracture n=163		Cervical hip fracture n=81		Trochanteric hip fracture n=85	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Age (yrs)	43.7	± 6.6	48.1	± 6.50	47.7	± 6.8	48.5	± 6.0
Height (cm)	177	± 6.7	178	± 7.7	178	± 8.6	177	± 6.9
Weight (kg)	77.3	± 11.5	74.7	± 12.8	76.2	± 13.5	73.4	± 12.1
BMI (kg/m²)	24.7	± 3.3	23.7	± 3.5	24.1	± 3.8	23.2	± 3.3
Forced vital capacity (L)	4.53	± 0.91	4.18	± 1.01	4.20	± 1.01	4.14	± 1.01
Systolic blood pressure (mmHg)	127.0	± 14.9	130.4	± 17.6	129.5	± 18.8	131.2	± 16.7
Diastolic blood pressure (mmHg)	85.5	± 9.6	88,4	± 10.9	87.6	± 11.9	88.9	± 10.2
Resting pulse (beats /minute)	67.2	± 10.1	70.7	± 10.5	69.4	± 10.2	72.0	± 10.7
Serum –triglycerides (mmol/L)	1.51	± 1.02	1.75	± 3.04	2.07	± 4.25	1.42	± 0.66
Serum cholesterol (mmol/L)	5.61	± 1.09	5.71	±1.40	5.87	± 1.67	5.50	± 1.11
Sedimentation rate (mmol/L)	5.8	± 6.0	7.3	± 5.9	7.9	± 6.6	7.1	± 5.8
γ-glutamyl transferase (mmol/L)	0.53	± 0.62	0.72	±0.89	0.67	±0.83	0.76	± 0.93
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Diabetes	236	1.1	13	8.0	6	7.4	8	9.4
Manual work	9536	42.8	78	47.9	34	42.0	45	52.9
Smoking	10927	49.0	114	69.9	55	67.9	61	71.8
Poor self-rated health	5981	26.8	66	40.5	36	44.4	31	36.5
Premature awakening	2242	10.1	34	20.9	19	23.5	15	17.6

Table 3

Age-adjusted risk factors for hip fracture in women analysed in an estimated Cox' proportional regression model. Risk ratios are calculated for one standard deviation change for the continuous variables and for yes versus no for the categorical variables.

Variable	Hip fracture n=135			Cervical hip fracture n=93			Trochanteric hip fracture n=42		
	RR	**CI 95 %**	**p**	**RR**	**CI 95 %**	**p**	**RR**	**CI 95 %**	**p**
Age	2.21	1.71-2.86	**0.0001**	2.16	1.58-2.93	**0.0001**	2.35	1.46-3.77	**0.0004**
Body height	1.18	0.99-1.40	0.06	1.10	0.90-1.36	0.35	1.37	1.00-1.88	**0.05**
Body weight	0.72	0.59-0.88	**0.001**	0.83	0.66-1.04	0.11	0.48	0.32-0.73	**0.001**
Body mass index, BMI	0.63	0.51-0.78	**0.0001**	0.77	0.60-0.98	**0.03**	0.34	0.21-0.55	**0.0001**
>10 kg weight gain since age 30	0.67	0.45-0.99	**0.04**	0.80	0.51-1.26	0.34	0.40	0.18-0.90	**0.03**
Skinfold	0.83	0.73-0.94	**0.004**	0.95	0.78-1.16	0.63	0.71	0.62-0.82	**0.0001**
Forced vital capacity, FVC	0.90	0.74-1.10	0.31	0.81	0.64-1.03	0.09	1.12	0.80-1.59	0.51
Systolic blood pressure	0.96	0.81-1.15	0.68	0.92	0.74-1.13	0.42	1.08	0.79-1.46	0.63
Diastolic blood pressure	1.11	0.93-1.31	0.25	1.12	0.91-1.37	0.28	1.08	0.79.1,47	0.64
Resting pulse	1.22	1.05-1.43	**0.01**	1.26	1.04-1.51	**0.02**	1.16	0.87-1.54	0.32
Serum-triglycerides	1.09	0.94-1.26	0.26	1.06	0.88-1.27	0.55	1.14	0.91-1.44	0.25
Serum-cholesterol	0.82	0.67-0.99	**0.04**	0.80	0.63-1.01	0.06	0.86	0.61-1.21	0.37
γ -glutamyl transferase	1.18	1.01-1.38	**0.04**	1.18	0.98-1.42	0.08	1.17	0.88-1.55	0.27
Serum-phosphate	1.13	0.86-1.48	0.40	1.05	0.75-1.49	0.76	1.26	0.81-1.95	0.30
Serum-creatinine	0.90	0.75-1.09	0.29	0.90	0.72-1.12	0.35	0.92	0.65-1.29	0.62
Serum-uric acid	0.85	0.71-1.01	0.07	0.79	0.64-0.98	**0.04**	0.98	0.72-1.33	0.88
Blood-haemoglobin	1.05	0.89-1.25	0.57	1.15	0.94-1.42	0.18	0.86	0.64-1.16	0.32
Sedimentation reaction, SR	1.02	0.86-1.20	0.82	1.01	0.82-1.24	0.93	1.04	078-1.40	0.78
Diabetes	4.07	1.79-9.26	**0.001**	2.85	0.90-9.01	0.08	7.46	2.28-24.4	**0.001**
Smoking	1.47	1.04-2.08	**0.03**	1.22	0.54-1.26	0.37	2.25	1.21-4.17	**0.01**
Sick leave at present	0.77	0.41-1.42	0.40	0.75	0.36-1.55	0.43	0.82	0.25-2.65	0.73
Squeezing of chest	0.87	0.61-1.25	0.46	0.90	0.58-1.39	0.62	0.82	0.43-1.56	0.55
Poor self-rated health	1.82	1.30-2.56	**0.001**	1.82	1.21-2.74	**0.004**	1.84	1.00-3.39	**0.05**
Poor appetite	0.63	0.23-1.72	0.37	0.89	0.22-3.60	0.87	0.38	0.09-1.59	0.19
Premature awakening	0.68	0.47-0.98	**0.04**	0.65	0.42-1.00	**0.05**	0.76	0.39-1.50	0.43
Hospital admittance for mental disorder	2.17	1.19-3.85	**0.01**	2.04	0.98-4.17	0.06	2.50	0.89-7.14	0.08
Physical activity	1.13	0.93-1.37	0.21	0.71	0.45-1.11	0.14	1.00	0.48-2.10	1.00
HRT	0.55	0.26-1.19	0.13	0.21	0.05-0.85	**0.03**	0.61	0.23-1.63	0.33
Previous fracture	4.76	2.74-8.26	**0.001**	3.41	1.63-7.14	**0.001**	8.93	3.80-21.3	**0.001**

Table 4

Age-adjusted risk factors for hip fracture in men analysed in an estimated Cox' proportional regression model. Risk ratios are calculated for one standard deviation change for the continuous variables and for yes versus no for the categorical variables.

Variable (mean, SD)	Hip fracture n=163			Cervical hip fracture n=81			Trochanteric hip fracture n=85		
	RR	**CI 95 %**	**p**	**RR**	**CI 95 %**	**p**	**RR**	**CI 95 %**	**p**
Age	2.08	1.77-2.43	**0.0001**	1.93	1.54-2.43	**0.0001**	2.25	1.80-2.81	**0.0001**
Body height	1.20	1.02-1.40	**0.03**	1.22	0.98-1.54	0.08	1.18	0.94-1.48	0.14
Body weight	0.75	0.64-0.89	**0.001**	0.88	0.69-1.11	0.27	0.65	0.51-0.83	**0.001**
Body mass index, BMI	0.63	0.53-0.76	**0.0001**	0.76	0.59-0.97	**0.03**	0.53	0.41-0.69	**0.0001**
>10 kg weight gain since age 30	0.96	0.67-1.37	0.82	0.63	0.39-1.01	0.06	0.68	0.39-1.19	0.17
Skinfold	0.86	0.74-1.00	**0.05**	0.89	0.71-1.11	0.31	0.85	0.68-1.05	0.14
Forced vital capacity, FVC	0.82	0.69-0.97	**0.02**	0.85	0.67-1.09	0.21	0.82	0.64-1.04	0.11
Systolic blood pressure	1.07	0.93-1.24	0.33	1.03	0.83-1.27	0.79	1.12	0.92-1.36	0.27
Diastolic blood pressure	1.18	1.02-1.36	**0.03**	1.12	0.91-1.39	0.29	1.25	1.03-1.53	**0.03**
Resting pulse	1.34	1.17-1.53	**0.0001**	1.20	0.97-1.47	0.09	1.46	1.22-1.74	**0.0001**
Serum-triglycerides	1.13	1.05-1.21	**0.001**	1.17	1.10-1.25	**0.0001**	0.90	0.68-1.19	0.45
Serum-cholesterol	1.01	0.86-1.19	0.87	1.19	1.05-1.34	**0.006**	0.86	0.67-1.09	0.21
γ -glutamyl transferase	1.45	1.28-1.65	**0.0001**	1.34	1.10-1.62	**0.003**	1.56	1.32-1.86	**0.0001**
Serum-phosphate	1.20	0.97-1.48	0.09	1.20	0.89-1.60	0.23	1.19	0.88-1.61	0.27
Serum-creatinine	0.89	0.72-1.11	0.30	0.96	0.72-1.28	0.76	0.86	0.64-1.17	0.35
Serum-uric acid	1.03	0.89-1.20	0.70	1.06	0.85-1.31	0.61	1.03	0.83-1.27	0.79
Blood-haemoglobin	1.00	0.86-1.16	0.99	1.01	0.81-1.26	0.90	1.00	0.81-1.24	0.98
Sedimentation reaction, SR	1.11	1.00-1.23	**0.05**	1.13	0.99-1.29	0.07	1.05	0.88-1.26	0.59
Diabetes	7.75	4.37-13.7	**0.001**	6.37	2.56-15.9	**0.001**	8.42	3.85-18.4	**0.001**
Smoking	2.72	1.94-3.80	**0.001**	2.44	1.52-3.94	**0.001**	3.06	1.88-4.96	**0.001**
Sick leave at present	1.99	1.01-3.91	**0.05**	1.39	0.44-4.42	0.58	2.66	1.15-6.13	**0.02**
Squeezing of chest	0.96	0.67-1.38	0.83	0.96	0.57-1.62	0.89	0.92	0.56-1.52	0.75
Poor self-rated health	1.83	1.33-2.50	**0.001**	2.19	1.40-3.42	**0.001**	1.55	0.99-2.44	0.06
Poor appetite	2.10	1.03-4.27	**0.04**	-	-	-	4.40	2.11-9.17	**0.001**
Premature awakening	1.84	1.25-2.70	**0.002**	2.29	1.35-3.89	**0.002**	1.54	0.87-2.70	0.14
Hospital admittance for mental disorder	2.64	1.46-4.76	**0.001**	2.29	0.92-5.68	0.07	3.09	1.42-6.71	**0.005**
Physical activity	0.78	0.54-1.12	0.18	0.83	0.48-1.42	0.49	0.75	0.45-1.25	0.27

Table 5

Definite Cox model with risk factors for hip fracture in women and men were all variables are included. Risk ratios are calculated for one standard deviation change for the continuous variables and for yes versus no for the categorical variables.

Variable (unit)	Hip fracture n=135			Cervical hip fracture n=93			Trochanteric hip fracture n=42		
WOMEN	**RR**	**CI 95 %**	**p**	**RR**	**CI 95 %**	**p**	**RR**	**CI 95 %**	**p**
Age (year)	1.12	1.08-1.16	**0.001**	1.11	1.06-1.16	**0.001**	1.15	1.08-1.23	**0.001**
Body mass index, BMI	0.89	0.84-0.93	**0.001**	0.92	0.87-0.98	**0.005**	0.80	0.72-0.89	**0.001**
Diabetes	3.89	1.69-8.93	**0.001**	2.52	0.78-8.13	0.12	7.75	2.34-25.6	**0.001**
γ -glutamyl transferase	1.35	1.03-1.77	**0.03**	1.38	1.01-1.90	**0.05**	1.30	0.79-2.14	0.30
Smoking	1.24	0.87-1.76	0.24	1.06	0.69-1.63	0.80	1.73	0.93-3.25	0.09
Poor self-rated health	1.74	1.22-2.48	**0.002**	1.78	1.16-2.73	**0.008**	1.65	0.87-3.13	0.13
Premature awakening	1.26	0.86-1.85	0.23	1.33	0.85-2.10	0.21	1.13	0.55-2.32	0.73
	n=163			**n=81**			**n=85**		
MEN	**RR**	**CI 95 %**	**p**	**RR**	**CI 95 %**	**p**	**RR**	**CI 95 %**	**p**
Age (year)	1.12	1.09-1.16	**0.001**	1.11	1.06-1.16	**0.001**	1.14	1.09-1.19	**0.001**
Body mass index, BMI	0.85	0.81-0.90	**0.001**	0.89	0.83-0.96	**0.004**	0.82	0.76-0.88	**0.001**
Diabetes	6.13	3.19-11.8	**0.001**	5.03	1.81-14.1	**0.002**	8.81	3.77-20.4	**0.001**
γ -glutamyl transferase	1.84	1.50-2.26	**0.001**	1.49	1.08-2.06	**0.01**	2.29	1.76-2.99	**0.001**
Smoking	2.20	1.54-3.15	**0.001**	2.09	1.25-3.47	**0.005**	2.42	1.44-4.07	**0.001**
Poor self-rated health	1.49	1.06-2.10	**0.02**	1.88	1.16-3.06	**0.01**	1.55	0.99-2.44	0.06
Premature awakening	1.52	1.03-2.27	**0.04**	1.89	1.09-3.26	**0.02**	1.24	0.76-2.02	0.39

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