

**The Tromsø Study:
Risk factors for non-vertebral fractures in a
middle-aged population.**

by

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List of papers

The present work is based on the following papers, which will be referred to by their Roman numerals:

- I Joakimsen RM, Fønnebø V, Magnus JH, Tollan A, Søgaard AJ, Størmer J. Registration of fractures - How good are Self-reports, a computerized radiographic Register and a Discharge Register vs. review of Radiographic Reports? Osteoporos Int. Submitted.
- II Joakimsen RM, Fønnebø V, Magnus JH, Tollan A, Søgaard AJ. The Tromsø Study: Body height, body mass index and fractures. Osteoporos Int 1998;8:436-42.
- III Joakimsen RM, Fønnebø V, Magnus JH, Søgaard AJ, Tollan A, Størmer J. The Tromsø Study: Physical activity and the incidence of fractures in a population. J Bone Miner Res 1998;13:1149-57.
- IV Joakimsen RM, Fønnebø V, Magnus JH, Søgaard AJ, Tollan A. The Tromsø Study: Alcohol-consumption and tobacco smoking related to non-vertebral fractures in a middle aged population. J Bone Miner Res. Submitted.
- V Joakimsen RM, Fønnebø V, Magnus JH, Tollan A, Søgaard AJ. The Tromsø Study: Height loss as a screening tool for subsequent fractures. Am J Med. Submitted.

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General introduction

History

Diseases of degeneration are a relatively new problem of public health. As late as the turn of the century, infectious diseases like smallpox, diphtheria, enteric fevers and tuberculosis were the health risks of main concern. Only during the last 50 years, a substantial proportion of the population has lived long enough to sustain conditions like cardiovascular diseases and diabetes. Shortly after the Second World War, there was a growing understanding that the incidence of fractures among elderly was increasing, and that this problem should be addressed. Studies on fracture incidence to verify the problem were undertaken (1-5), and hypotheses not very different from the present ones on the aetiology of osteoporosis were stated (6). In the 50s and 60s, measures of bone mass or density in vivo with better precision than eyeballing of radiographic films, were introduced (7). However, the means to explore risk factors were rudimentary, as modern epidemiology had not yet been developed (8). In Sweden, the awareness of osteoporosis was present very early (2), and in addition to excellent fracture registers (9, 10), the first bone densitometer used in epidemiological studies was developed there (2, 11-13). The introduction of this quantitative risk measure simplified osteoporosis research, and it also made investors see a potential in selling prevention of fracture risk as defined by bone densitometry. Osteoporosis is currently defined - not by fracture risk, - but by bone mass compared to young adult women (14). Huge resources have been used the last decade in development of medication to prevent osteoporosis, and several promising treatment alternatives have been found. Research on osteoporosis is still an area with rapid progress and continuous growth, reflected in the growing number of journals, conferences and projects dedicated to this theme.

Descriptive epidemiology of non-vertebral fractures

According to Swedish results, the incidence of practically all types of fractures has increased dramatically during the last decades (9, 15-19). Recent Finnish studies have reported the same trend (20, 20-26). The increased incidence is not a consequence of demography only; Sex- and age-specific incidence of all fractures has increased substantially, especially among middle-aged and elderly persons (9, 27).

Fractures at different locations dominate at different ages and differently among women and men. In general, three quarters of all fractures among men occur before the age of 45, while the opposite is true for women (28). Both among men and women, there seems to be a bimodal pattern, with more fractures in early childhood and in old age, and with less fractures in mature life. The incidence of fractures increases exponentially with age from approximately 45 years among women, and from approximately 70 years among men (27, 28). Overall, fractures are more frequent among men than women until the age of 50 years, then it becomes increasingly more frequent among women (27). Among children, fractures in the forearm, humerus and ankle dominate, while in old age, hip fracture is the most frequent non-vertebral fracture. In middle age, forearm and ankle fractures are the most frequent fractures. Despite the shift in fracture location with age, hospital admission rates increase exponentially with age for any fracture location (28, 29).

Geographical variation of other non-vertebral fractures than hip fractures is difficult to describe, as results are few. However, it seems that forearm and proximal humerus fractures are more incident in Scandinavia than anywhere else (27, 30-35).

Hip fractures

Hip fractures cause most suffering, comorbidity and expenses among the fractures, and the epidemiology of hip fractures is better studied than for other fractures. The incidence of hip fractures has increased dramatically in the developed world during the last decades, also when adjusting for age. The expected increase in number of elderly persons implies a further increase in hip fracture incidence worldwide (36). Lately, the age-adjusted increase has levelled out, first in the United States (37, 38), later in Denmark (39) and Sweden (40), but not yet in Finland (41) or Norway (42). The incidence of hip fractures varies with geographical region, race, sex and age (36, 43). Mean age of patients with hip fracture in developed countries is approximately 80 years, and hip fractures are twice as common among women than men. However, geographical variation is larger than variation across genders within regions (44, 45). The regions with highest incidence of hip fractures are Scandinavia and among whites of North-America (46).

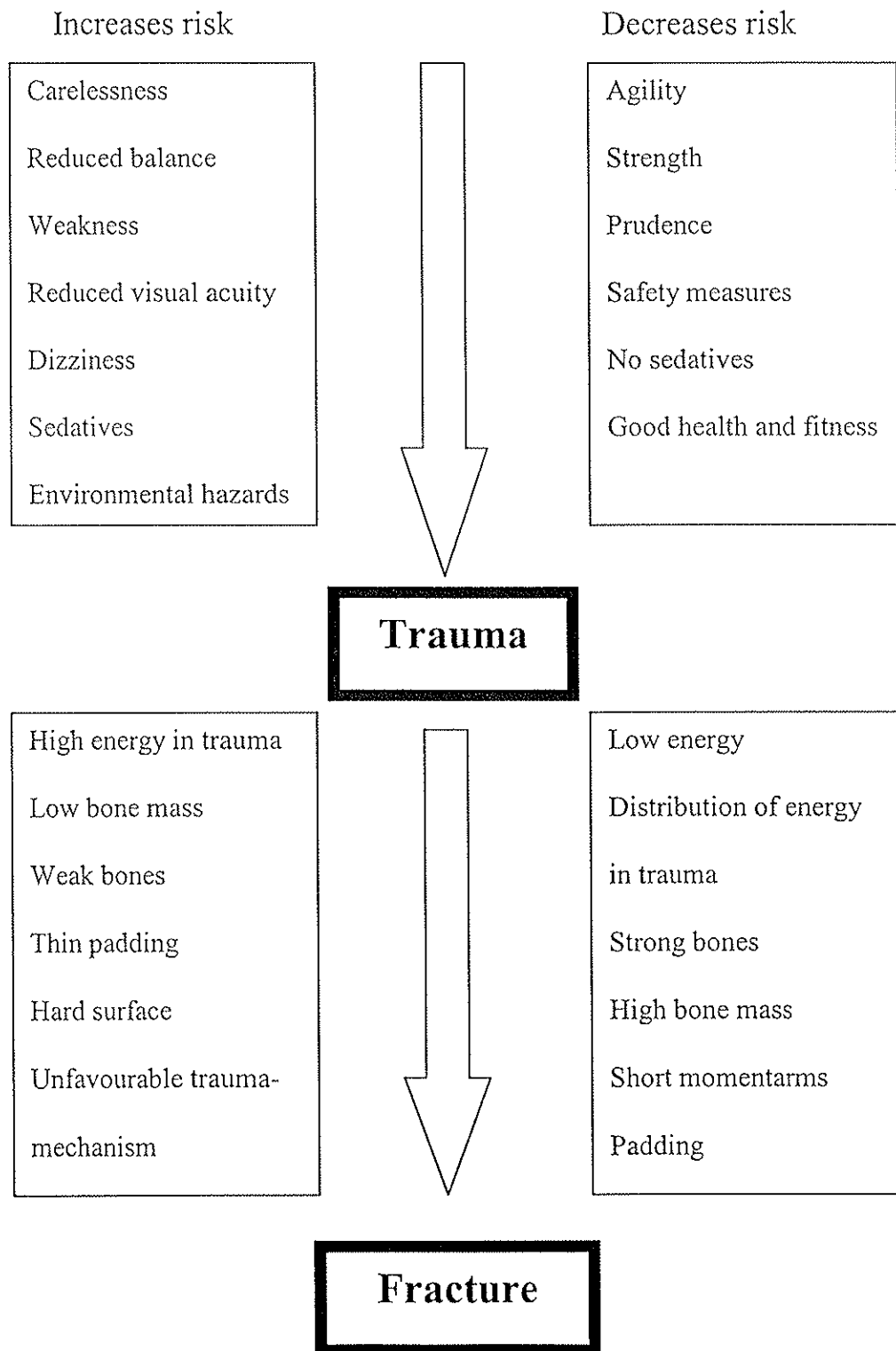
Risk factors of non-vertebral fractures

Several models exist to explain the occurrence of injuries, for instance Haddon's matrix (47). The most important factors in the models on fracture aetiology include (figure 1):

- (1) Risk factors for traumas (most often falls); Reduced balance or physical ability, dizziness, reduced cognitive abilities, use of sedatives, slippery surfaces etc.
- (2) The trauma: energy involved, direction of forces, forces on impact.
- (3) The skeletons' ability to resist a trauma. This is dependent on factors like bone mineral density, bone size, bone quality etc.
- (4) Protection; padding by soft tissue covering underlying skeletal structures etc.

Factors that influence fracture risk work through one or several of these mechanisms, and in the following, known risk factors of non-vertebral fractures will be discussed.

Figure 1. Model of fracture risk



Gender

Before the age of 55 years, the incidence of any fracture is higher among men than women. At higher age, some fracture sites are still more common among men (skull, chest, clavicle, scapula, metacarpals, phalanxes and radius/ulna shaft), although the gender difference is smaller. However, among older persons most fracture types (pelvis, humerus, upper and lower end of radius and ulna, carpals, femur, patella, tibia, fibula, ankle) are more incident among women than among men (27). The age-adjusted rate ratio of upper limb fractures among women compared to men among persons 65 years or older have been shown to be from 2.7 (Humerus other than proximal) to 4.9 (distal radius) among whites (31). Similar numbers for lower limb fractures are from 1.8 (Shaft/upper tibia/fibula) to 3.6 (Patella). With respect to hip fractures, age-specific incidence has mostly been reported to be approximately twice as high among women compared to men from the age of 50 years. The gender difference has possibly become smaller during the last decades (40). As women also have longer life expectancy, four out of five hip fractures occur among women (48).

There are several plausible reasons for the large gender differences with respect to fracture incidence: Men are more prone to suffer traumas in adolescence and young adulthood, both through accidents in sports and at work, and through risk seeking behaviour. Moreover, some fracture types are almost always a result of such behaviour, making these fractures more common among men, even in old age (i.e. metacarpal fractures). The fact that women have smaller skeletons with lower bone mineral density becomes more important with higher age, making most fractures more common among elderly women than among elderly men. However, we are not aware of studies that have

analysed what proportion of fractures among women that may be ascribed low bone mineral density/small skeletons compared to men.

Age

The incidence of all non-vertebral fractures reaches a top in adolescence among both women and men. Thereafter, it decreases until it increases again from the age of 45 years among women and from the age of 70 years among men. Different fracture locations have slightly different patterns: The incidence of hip fractures increases exponentially with age both among men and women, and it seldom occurs before the age of 60 years. Forearm fracture incidence has a top early in life, increases again in middle age (steeper among women than among men), and then levels out in old age. Proximal humerus fracture incidence increases steadily into old age, as does the incidence of distal humerus fractures, proximal radius/ulna fractures, pelvis fractures, distal femur fractures, patella fractures and proximal tibia/fibula fractures. Ankle fracture incidence, however, increases with age until the age of 70 years, thereafter it decreases (9, 31).

The effect of age might be explained in several ways: Bone mineral density is known to decrease steadily with age in a magnitude of approximately 1 % pr. year, although somewhat faster the first postmenopausal years among women (49, 50). Balance and physical ability decreases with age, and incidence of falls increases with age. Thus, among the elderly there are more traumas, and the energy and forces in a trauma needed to afflict a fracture is less than among younger persons. The reason why the fracture pattern shifts with increasing age might be slightly different traumas and different activity with increasing age: When middle aged persons fall, they fall forwards,

stretching out the hands in the fall: Thus, they hurt either ankles or forearms. In older age, persons tend to fall sideways without managing to break the fall with the arms, resulting in hip fractures (51).

Reproductive factors

Hormones have been shown to affect bone metabolism and fracture incidence (52). The use of oestrogen or hormonal substitution among postmenopausal women reduces bone loss (53), and according to several observational studies, it also halves the incidence of fractures (54-57). Natural exposition to hormones also seems to affect bone metabolism: Early menarche, many pregnancies and premenopausal status is positively associated with bone mineral density, at least among women under the age of 70 years (58, 59). With respect to hip fracture risk, some studies suggest that early menarche (60), long menstrual cycle length (61), late menopause (60), many pregnancies (61) and breastfeeding (62) decreases fracture risk, although other studies do not find these associations to be significant (late menopause (61, 63), parity (60, 62), lactation (60, 62, 63)). The effect of menopausal age seems to have an effect mainly the first years after menopause (59). One study finds the risk of hip fracture to be higher with lower age at menarche (61). The risk of wrist fractures decreases with length of fertile period (64), it decreases with age at menopause (64, 65) and increases with age at menarche (64), while there does not seem to be any association to breastfeeding or parity (64, 65). Primary amenorrhea is considered to be a major risk factor for osteoporosis and fractures, although results with respect to effect on fractures are scarce (66).

Androgens have also been associated with bone metabolism. Lack of testosterone is probably related to low bone mass, and treatment prevents bone loss (67,

68). However, measured blood concentration of testosterone does not seem to predict subsequent fractures (69).

How hormones affect fracture risk has until lately been assumed from observational studies, with the exception of a small clinical trial with transdermal oestrogen (70). Recently, a large double-blind and randomised clinical trial with hormone replacement therapy has been published, and there was no effect whatsoever with respect to fracture risk (71). Even if this study primarily was designed to study cardiovascular disease, it leaves questions about the actual effect of the various hormones, and what importance bias and confounding have had on the results in the cited observational studies.

Diet

Too low energy intake is probably frequent among the elderly, and this in itself is a risk factor for hip fractures (72).

In addition, bone metabolism is dependent on calcium and vitamin D. Achieved peak bone mass is dependent on adequate intake of these constituents of the diet (73), and calcium is also necessary to permit bone metabolism to respond to mechanical stimuli (74). From experimental evidence, it seems that present recommended daily allowances are too low to give optimal formation of bone, especially with respect to young women in growth (75). Furthermore, malnutrition in old age is frequent, thus among the elderly, intake of calcium and vitamin D is probably a major limiting factor with respect to bone health. This is verified in several intervention trials on hip fractures among old people (76). Observational studies, however, have not been convincing with respect to protective effect of calcium and vitamin D in the diet, which might reflect inherent

misclassification, confounding by indication (persons who know they are osteoporotic take more calcium) or better effect of controlled additions to the diet (76).

With respect to other constituents of the diet, many have been suggested as risk factors, although without consistent documentation: Diet high on iron, vitamin A, vitamin C and Magnesium seems to be a risk factor for hip fractures (77, 78). Diet high on proteins may be deleterious to the skeleton as it increases calcium excretion in the urine (79). However, recent results from large follow up studies actually suggest the opposite association, making this a case for further studies (80, 81). Excessive intake of caffeine may also be deleterious (82, 83), although this is debated (60, 84). Diet low on Vitamin K is suggested a risk factor for hip fractures (impaired carboxylation of the gla-containing proteins of bone) (85), but again, there are contradictory recent results (86). In conclusion, total energy intake, calcium and vitamin D seem to be the most important dietary factors with respect to hip fractures. With respect to other fractures and other dietary factors, there are many unanswered questions.

Physical activity

Physical inactivity leads to bone loss and weakens muscle strength and balance, and in a recent review, we found that physical activity seems to protect against hip fractures (87). In controlled randomised trials, physical activity seems to give a slight increase in bone mineral density, or at least it slows the rate of bone loss (22, 88, 89). However, physical activity may affect fracture risk through other mechanisms than through bone mass. Moreover, physical activity may affect the risk of fractures at different sites differently, an aspect which had not been explored at the initiation of this study, although some studies had suggested no relation between previous physical activity and fractures in distal forearm and humerus (65, 90-92).

Smoking

A lower bone mineral density in smokers was shown more than 20 years ago, but the clinical consequences of it have been disputed (93). The relation between tobacco smoking and non-vertebral fractures other than hip fractures have not been much studied, especially not among men. Follow up studies among women before the initiation of this study had not found smoking to be a risk factor for any fracture, or for fractures in proximal humerus or distal radius (65, 94). During the present study, other publications have found tobacco smoking to be unrelated to fractures in ankles and feet among elderly women (90), to any fracture among perimenopausal women (95), and to wrist fractures among male health professionals (96).

With respect to hip fractures, some follow up studies have found no association with smoking (94, 97, 98), while others have found tobacco smoking to be a weak risk factor for hip fractures (61, 99, 100). A recent meta-analysis on the subject has clarified the relation between smoking, bone mineral density and hip fractures among women (101). It seems that tobacco smoking is not related to lower bone mass or to hip fractures among premenopausal women. Among postmenopausal women, smokers lose approximately 2% more of their bone mass pr. decade than non-smokers. Consequently, the difference between smokers and non-smokers increases with age, and constitutes 6% at the age of 80 years. Thus, relative risk of hip fracture among smokers vs. non-smokers increases with age, from 1.17 (95% CI 1.05-1.30) at 60 years to 2.08 (95% CI 1.70-2.54) at 90 years. With incidence and prevalence figures with respect to hip fractures and smoking similar to those in England 1992-93, one of eight hip fractures may be ascribed smoking (101). The effect of tobacco smoking on hip fracture risk among men has been less studied, but seems to be similar as among women. The harmful effect of smoking seems to be more pronounced among women with low body

mass index than among women with higher body mass index, while a similar interaction has not been found among men (100).

The mechanisms of the effect of smoking on bone is unknown, but several hypotheses have been proposed: Smoking may reduce calcium absorption (102), there may be a direct toxic effect on bone (103), furthermore, the risk of falling is a little greater in smokers (104, 105). More commonly postulated mechanisms are lower body weight among smokers and actions of smoking on oestrogen. However, these mechanisms can account for only a small proportion of the effects seen (101).

Alcohol-consumption

In several large follow up studies, the incidence of hip and forearm fractures has been weakly related or not related at all to alcohol consumption (61, 63, 65, 96-98, 106-108). Studies on bone mineral density suggest that moderate alcohol consumption is related to higher bone mass, and one study even suggested a lower incidence of hip fractures among alcohol consuming women (109). All these studies have measured alcohol consumption as average consumption over some time, not as time spent with high blood concentration of alcohol. One study focusing on blood concentration of alcohol finds a very high risk of injurious falls when inebriated (110). Thus, alcohol consumption may be an important risk factor for fractures, despite the results from follow up studies on hip fractures. However, this risk would only be apparent when measuring alcohol consumption in terms of time spent inebriated/with a high blood alcohol concentration.

The relation between alcohol consumption and other fracture types was not known before the initiation of the present study. Later published follow up studies have found total intake of alcohol to be a risk factor for wrist fractures and for any fracture

among perimenopausal women (95), but not for fractures in ankles and proximal humerus among elderly women (90).

Anthropometric measures

Body height was first described as a risk factor for hip fractures in a large Norwegian follow up study among middle aged persons in 1993 (111). It has since been reproduced in several other large follow up studies, both among middle aged and elderly women and men (63, 107, 112). The relationship might be explained by longer hip axis length among tall people (113), and it might also be explained by more energy in falls among tall people (114). The relation between body height and hip fractures might explain parts of the regional differences as well as the some of the last decades' increase in age adjusted hip fracture incidence (45). The relation between body height and other fractures had been less described before the initiation of this study. Studies published later have found no relation between recent measured height and fractures in ankle and feet among elderly women (90), but there is an association between height at age 25 years and risk of any fracture among postmenopausal women (115).

Total body weight, hip girth, lean mass, fat mass, percent body fat and body mass index have all been shown to be associated with lower hip fracture incidence recently (116). More specifically: Thin people (persons in the lowest quartile) are at greater risk of hip fracture than persons of plumper build. Most of this association is explained by lower bone mineral density at the hip among thin persons. The relationship between body mass index and hip fractures is a consistent finding in numerous studies (60, 63, 72, 77, 97, 106, 111, 115, 117-119). Some follow up studies have found no statistically significant association between weight and distal forearm fractures (64, 65, 96) or proximal humerus fractures (65), while one recent study found distal radius

fractures to be less frequent among those with high body mass index (115), and this effect may be stronger among smokers (120). With respect to other fracture sites, this relation had been less studied before the initiation of this study. A later follow up study suggests that weight is a risk factor for ankle fractures but not foot fractures among elderly women (90).

Falls

As about 80 % of all non-vertebral fractures among white elderly women may be attributed to falls (121), it is important to be aware of risk factors for falls, and especially risk factors for falls leading to injuries. Falls in itself, injurious or not, are also a strong parameter for risk of institutionalisation (122). Hence, elderly persons that have experienced one or more falls need special attention whether they are injured or not (123). On the other hand, 90 % of falls do not result in an injury, and only about 5 % of falls in elderly women result in fractures and about 1 % result in hip fracture (121, 123-126). Among elderly, common risk factors for falls are cognitive impairment, presence of chronic conditions, balance and gait impairment, low body mass index and the use of various medications (127-129). Among younger age groups, alcohol consumption is possibly the most important risk factor for injurious falls (130).

Other traumas

Fractures are more often a result of high-energetic or severe traumas among men than women, and among young persons than among elderly (131-133). In a Norwegian population, 32 % of all fractures could be ascribed collision accidents with another person or with an object, and 22 % could be ascribed falling from a height (131). The age difference may be explained by a steep increase with age in the incidence of fractures caused by moderate traumas (134). In an American population, 18 % of all

fractures occurred in the context of sports activities (133). More of today's hip fractures seem to be the result of a moderate trauma than some decades ago (135), implying poorer bone quality nowadays than earlier. The distribution of trauma-mechanisms of various fractures at different ages was uncertain before the implementation of the present study.

Inheritance

In principle, all diseases are triggered by a sufficient cause that is composed of a large number of component causes. Removing one component from the sufficient cause is enough to avoid the disease. Thus, describing component causes by size in individuals carries little meaning (8). However, it is possible to describe population attributable risks in given settings. Correspondingly, heritability can not be generalised to other settings than those studied: In a population where some people have no food and others eat at leisure, this will be the factor explaining most of the variance with respect to almost any biological measure. On the other hand, in a population where everyone eats at leisure, genetics will probably explain substantial parts of corresponding variance. In some settings, heritability of bone mass has been reported as high as 85% (136).

According to twin studies, the distribution of femoral bone mass and the calculated structural strength of the proximal femur seem to be influenced by genetic factors (137, 138). Even among elderly, genetic factors seem to be important determinants of bone mass (studies from England and Australia) (139, 140), although not as important as among young persons (141). However, the association between genetic factors and bone loss seems to be weak or non-existent (142). The association between fractures among parents and offspring is moderately strong (63, 90, 143) or non-existent (144), and any relation is almost independent of bone mineral density (63). Thus, heritability is another

factor of many to account for in the puzzle of fracture aetiology. Although not treatable, it may be useful in the identification of persons at high risk of fractures.

Aims of the study

The aim of the Tromsø Osteoporosis Study (TROST) has been to study the phenomenon of osteoporosis in all aspects. Projects on aetiology, treatment, epidemiology, interventions, blood markers and bone mineral density have been planned, and most of them are implemented. When I entered the scene in 1994, the population of Tromsø had been thoroughly examined and questioned through three earlier surveys in 1974, 1979/80 and 1986/87. The aim of my thesis was to relate the extensive information acquired through the earlier surveys to the subsequent incidence of fractures. From the start, we were of the opinion that the analyses should be planned according to prior hypotheses, thus avoiding a fishing expedition, and rather testing hypotheses. Our focus has been on the effect of life-style factors and anthropometric measures, in addition to the descriptive epidemiology of fractures according to gender, age and trauma mechanism in the study population. Moreover, it has been important to find and validate a method of fracture registration in the population, with further research in this population in mind. Our hypotheses to test were as follows:

- A. Computer linkage with the radiographic archives in the University Hospital of Tromsø via the national personal identification number is the best method of fracture registration in the Tromsø-population, and this method is good enough for research.
- B. High body height and low body mass index are independent risk factors for any non-vertebral fracture.
- C. More physical activity, whether at work or in leisure time, is associated with lower incidence of fractures at any non-vertebral site.

- D. More alcohol consumption and tobacco smoking is associated with higher incidence of fractures at any non-vertebral site.
- E. Body height loss may predict subsequent non-vertebral fractures, and may be used as a screening tool in general practice.

In addition we wanted to describe the incidence of non-vertebral fractures in the population by age, gender, trauma-mechanism and fracture site.

Methodological considerations

Study design

The study design least vulnerable to bias is an experimental study, in which neither the participants nor the researcher are aware of exposure status of the study subjects, and the groups to compare are similar in all other aspects than the exposure of interest (“blinded randomised trial”). Furthermore, information on exposure and endpoints should be valid and precise, which requires prospective and preferably continuous collection of data.

The study population should be representative of the “target background population”, and the study population should be large to ensure power in the analyses. In real life, all these requirements are seldom possible to fulfil. For instance, few exposure factors (other than medications) are possible to test in randomised clinical trials due to practical and economical reasons, thus most “risk factors” are accepted on evidence from observational studies. However, in observational studies, in contrast to clinical trials, it is possible to observe entire populations, making external generalisation trustworthy.

The present study is a large, population-based (entire Tromsø population within described age groups), observational study. Information on exposure variables were obtained before any endpoint occurrence (prospective follow up study), and the registration of endpoints was in practice continuous (fracture registration at the department of radiology). Thus, the design should be optimal for the study of risk factors for fractures in a general population.

Study population

The Tromsø study is based on information gathered through population surveys in 1974, 1979/80, 1986/87 and 1994/95 (145) (Figure 2).

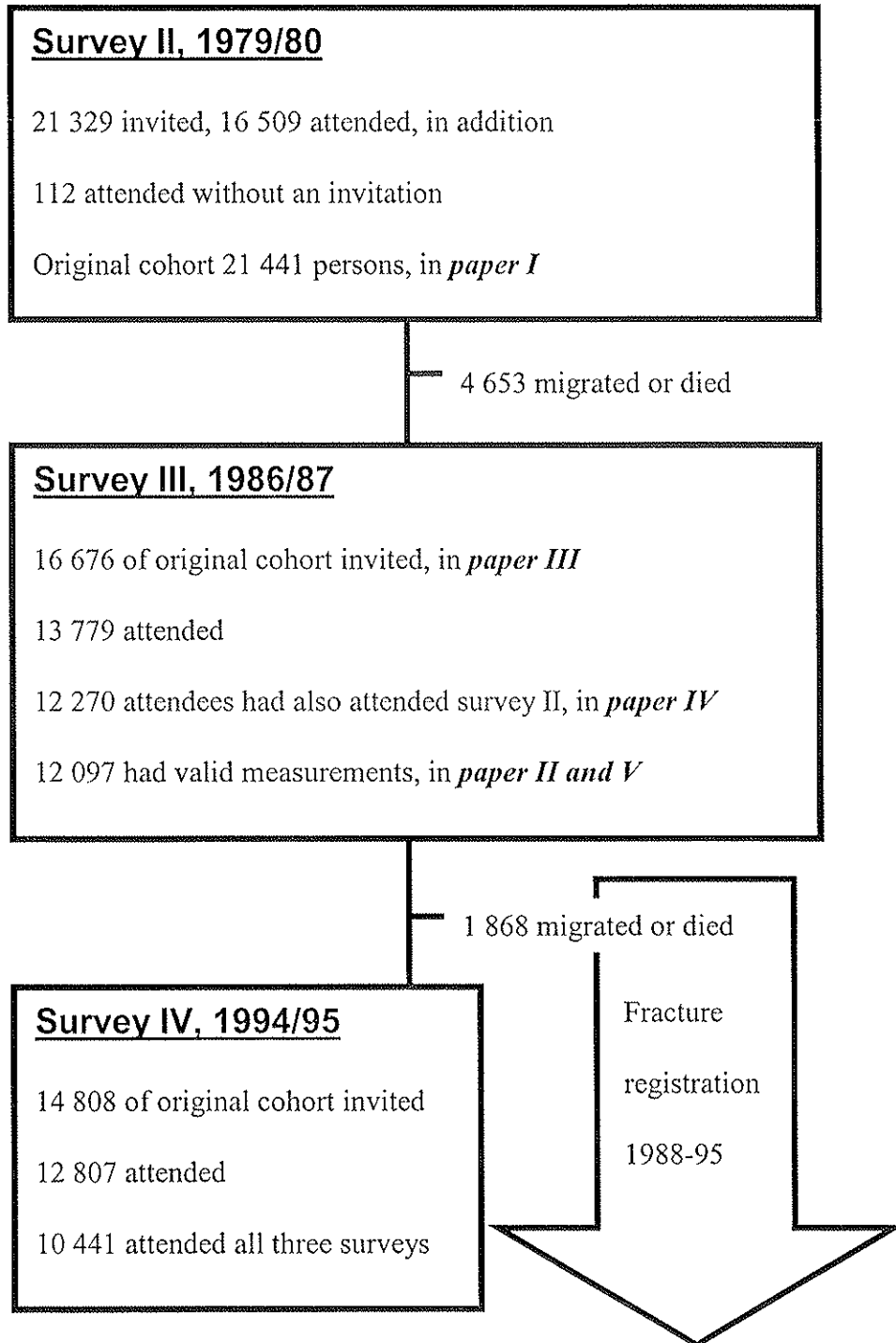


Figure 2. Study population in papers

In 1979/80, all males born 1925-59 and all females born 1930-59 were invited to the survey (21,329 persons), in addition 112 attended without an invitation (they became

residents during the survey). These 21,441 persons constitute the study population in paper I. Of this population, 16,676 persons were invited in both 1979/80 and 1986/87 (study population in paper III), of which 12,270 attended both surveys (study population in paper IV). Due to some invalid height/weight measurement (pregnancy, would not take shoes off, refused etc., n=173), the study population in paper II and V comprised 12,097 persons. These slightly different study populations account for the differences in presented fracture incidence between the papers.

Of the 21,441 persons that were invited in 1979/80, 14,808 were also invited to the survey in 1994/95, of which 11,626 answered and returned a questionnaire on hip and forearm fracture occurrence (used in analyses in paper I). Among the 12,270 persons invited in 1979/80 and 1986/87, 10,441 attended the survey in 1994/95 (some of this “retrospective information” was used in validation analyses in paper IV).

Fracture registration

All fractures suffered by persons in the cohort are registered at the University Hospital in Tromsø. The nearest alternative radiographic service or fracture treatment facility is located at a distance of 250 km from Tromsø. The only fractures that could be missed at the University Hospital would be fractures occurring while inhabitants were travelling and no control radiographic examination was done after returning home, in addition to fractures not radiographically examined.

The computerised records in the radiographic archives of the University Hospital contain codes for location, pathology (fracture, degeneration etc.), further description (operated, control, replaced etc.) and development (progression, regression) in addition to the national personal identification number and time of investigation. Ninety percent of the radiographic reports in our radiographic archives have the national personal

identification number recorded. The last 10 percent of records were registered with name and date of birth only. All records with a non-normal code (i.e. with any pathology, n = 12 509), which also had a personal identification number matching a person from our cohort, were retrieved and reviewed. In addition, records with a fracture code and with date of birth matching persons in our cohort were retrieved and reviewed. No additional fractures were found when also reviewing a random sample of 1,044 descriptions coded as normal/no pathology. All non-vertebral fractures were included in this registration.

In order to validate the registration at the department of radiology, we checked all patients (n = 550) with ICD-diagnoses 813, 820 or 824 (wrist, ankle or hip fracture) during 1994 at surgical departments and surgical outpatients' clinics at the University Hospital. Of these, only one had been missed by the radiographic archive (medical record states that radiographic film was given to patient without radiologists' assessment). From our cohort we also chose a random sample of 1,000 persons and checked the actual envelopes containing radiographic films, referrals and full text descriptions. We found 68 fractures, of which one had not been picked up by the review of radiographic descriptions. Previously we had only reviewed referrals and full text descriptions stored on microfilm.

A further validation of the fracture registration is described in paper I, but briefly, our mode of registration was superior to self-report of hip and forearm fractures by questionnaire and to hip fracture registration by discharge register. A less extensive validation is described in paper II and III, which compared self-reports among attendees to all the three surveys (n=10 441). As the corresponding comparison in paper I also included persons not attending the surveys in 1986/87 and 1979/80, the numbers presented are not quite similar to those presented in paper II and III.

Other possible fracture registration methods in our population would be continuous follow up through regular calls or mailed cards to the members of the cohort (63), or by continuous registration at the emergency clinic servicing the population (131). These methods may give a better view of the fracture circumstances (mechanism, location etc.). However, our loss to follow up is minimal and would probably not be less by any other registration method.

Registration of exposure variables and confounding factors

The routine in the surveys of the Tromsø Study has been to include a questionnaire printed on the reverse side of a letter of invitation. This questionnaire has included questions on the seven main topics (see appendix I and II):

- A. Known atherosclerotic disease, hypertension or diabetes mellitus.
- B. Symptoms possibly caused by coronary or peripheral atherosclerosis.
- C. Physical activity during leisure time.
- D. Smoking habits.
- E. Conditions of work – physical activity etc.
- F. Ethnic origin.
- F. Family history of cardiovascular disease.

The examination has consisted of miniature chest X-ray (only in 1979/80), blood pressure measurements, weight and height determination, and blood samples were obtained. Height and weight were measured to the nearest centimetre/kilogram once at each survey. The attendants wore light clothing without shoes, and the subjects were measured with their back against a wall on which a ruler was mounted. A bar

perpendicular to the ruler was positioned against the subject's vertex, and the corresponding reading was recorded. Remarks were made if height or weight measurement could be invalid (pregnancy, would not take shoes off, crippled, refused). During the examination, a trained nurse checked the questionnaire for inconsistency. Each person examined was handed a stamped, addressed envelope with a second questionnaire (see appendix I and II) which they were asked to complete at home and return by mail. The examinations in the 1994/95 survey were far more extensive, for details see (146). The second questionnaire comprised the four main topics:

- A. Previous and/or present dietary habits, including alcohol intake.
- B. Previous and/or present illnesses (not including osteoporosis), apart from those covered by the first questionnaire. Questions on hip and forearm/wrist fractures were included only in 1994/95.
- C. Illnesses in parents and siblings.
- D. Social conditions and psychological attributes.

Details on the implementation of the surveys are found elsewhere (145). The questions on physical activity in leisure time has been shown to correlate to both physical fitness (147) and to cardiovascular risk factors (148). The questions on tobacco smoking have been validated by comparison to blood concentration of thiocyanate (149), and the questions on alcohol consumption correlates both to a structured interview and to gammaglutamyl-transferase levels in the blood (150).

In the Tromsø study, the questions and routines have been similar in all surveys (apart from new extensions in later surveys), thus observed trends and individual changes should be valid. However, questions and measurements in the three first

surveys were originally planned to answer questions concerning risk of cardiovascular disease. Exposure registration with respect to the present study would possibly be better if planned for evaluation of fracture risk. For instance, height could have been measured more precisely and several times at each occasion, and more accurate questions on weight-bearing physical activity could have been asked. Unfortunately, the present study was planned and implemented after the data collection in the three first surveys, thus we can only discuss the implications of the mode of data collection. Briefly, the questions on physical activity have been rated high also with respect to other endpoints than cardiovascular disease (151). The height measurements are similar to those in general practise, and they seem to be reliable (152-154).

Analytical methods

In the validation study (paper I), the definition of a gold standard was intricate, as none of the registration methods were complete. To further complicate the picture, the registrations may be presented both as counts of fractures and count of persons with fractures. In my main presentation, I have visualised the five different ways of fracture registration compared to number of persons with verified fractures (by radiographic report, in three cases only by telephone interview) in the entire study population found by any of the methods. However, analyses were also made counting fractures (instead of persons with fracture), and comparisons were also made within the group that had self-reports on fracture-status (i.e. the percentage of self-reported fractures that were established as no fracture).

In the analyses on height, weight, alcohol consumption, tobacco smoking and physical activity (paper II-IV), I took advantage of the fact that these factors were measured at more than one point in time. Thus, the exposure variable has been defined

as both exposure at one point in time, accumulated exposure and change of exposure. Furthermore, analyses have been made with different endpoints according to fracture site (specific sites, weight-bearing or not weight-bearing site, and fractures in upper or lower extremities). Moreover, information in the referrals made it possible to restrict analyses to fractures after low-energetic traumas only. A disadvantage of the many exposure- and endpoint definitions is the resulting high number of analyses, leading to possibly coincidental statistically significant results. To cope with this problem, I have tried to describe/find patterns in the results.

In order to assess confounders, I have evaluated whether factors with a known or suspected association to both exposure of interest and the incidence of fractures have affected the relation between exposure and fracture incidence. In paper III and V, several factors did change one or more point estimates, and results adjusted for many factors were presented. In paper II and IV, few factors did actually confound the results, necessitating few presentations of adjusted results. However, gender was a strong confounding factor with respect to practically all analyses, as was age among women. Consequently, all analyses have been presented stratified by or adjusted for gender, and all analyses among women have been stratified by or adjusted for age.

Prior to the analyses, we believed that age and gender would interact with several exposure factors, as gender and age were so strongly associated with the incidence of fractures. Beyond that, we had no well-founded algorithm on which factors to test for interaction. Consequently, we checked for interaction with all suspected confounding factors. According to this “fishing trip” approach, the interactions found should be verified in other populations. The interactions were analysed by stratified analyses and regression analyses with interaction terms.

In the handling of the analyses and data in this thesis, I have used several software packages. Punching, checking, dataset-formatting and some analyses (confidence intervals by exact binomial distribution) of the fracture registration were performed in Epi-info (155). Many initial analyses (cross-tabulations and logistic regressions) were performed in SPSS (156), while most of the final analyses presented (cross-tabulations, Mantel-Haentzel chi-square, Cox-proportional hazard, age-specific incidences) were executed in SAS (157). What programme I knew best at the time, and what was easiest available mostly decided the choice of programmes.

Many of the results presented in the theses have been analysed by Cox-proportional hazards regression, which is one form of survival analysis. This method has one important assumption: The hazard ratio is constant over time, or equivalently, the hazard for one individual is proportional to the hazard for any other individual, where the proportionality constant is independent of time. Basically, there are three ways to evaluate this assumption: a graphical approach (log-log survival curves should be parallel, expected and observed survival curves should be similar), a formal goodness-of-fit test and time-dependent analyses (158). I have plotted log-log survival curves with respect to the occurrence of any fracture related to the following exposures: Physical activity in leisure time and at work (from both surveys), smoking (the variables on accumulated exposure), body height loss (height loss or not), body height (in quartiles) and body mass index (in quartiles). As fracture incidence is strongly dependent on age among women, I have also plotted similar curves adjusted for age among women. According to these plots, the proportional hazard assumption is fulfilled in the analyses presented in the papers.

Summary of papers

Paper I

In this methodological study, our objective was to validate our fracture registration, and to compare different methods of fracture registration. As we had the 11-digit national personal identification number of all the persons in our study population, we could make a computer linkage to the archives of the local department of radiology in order to find all radiographic examinations in the population. We dealt with the resulting database of radiographic descriptions in three different ways: The descriptions were coded, and the first method was to use only the codes in order to find the fractures. The other method was to review all the descriptions coded as fractures, thereby ascertaining all cases. The third method was to review all full text descriptions in order to get full ascertainment. In addition to these three methods of registering all non-vertebral fractures, we sought hip and forearm fractures by self-report in a questionnaire handed out at a survey in 1994/95, and we sought hip fractures through the computerised discharge register of the local hospital. When not finding an explanation of a self-reported fracture, we also interviewed the person by telephone.

Briefly, the computer linkage to the local hospital was a very efficient method of fracture registration, but the fracture cases should be ascertained by review of the corresponding radiographic full text description. Self-report was vulnerable to loss to follow up, and even among the persons answering the questionnaire, only 85 % of forearm fractures were detected. The discharge register detected 87 % of the fracture cases, but the total number of hip fracture discharges was 11 % higher than the number of actual fractures.

Paper II

In this paper, our objective was to study the relation between non-vertebral fractures and anthropometric measures (stature, body mass index) in the study population. We found that the risk of non-vertebral fractures increased with higher body height. Although stature was not a strong risk factor, the trend of higher stature the last century (average height approximately 10 cm higher than 100 years ago) seems to explain a substantial proportion of the present fractures. High body mass index turned out to be protective against fractures, and women who had gained weight had lowered their risk of fractures in the lower extremities.

Paper III

In this paper, our objective was to study the relation between physical activity and the incidence of non-vertebral fractures. We found that physical activity seemed to protect against fractures in the weight-bearing skeleton, but not in the non weight-bearing skeleton. In this paper, we have also presented incidence numbers of different fracture types stratified by age. We found that the incidence of all types of fractures increased steeply with age among women, and that this was more pronounced with respect to fractures after low-energetic traumas. The incidence of fractures did not increase with age among men, consequently the female/male ratio increased steeply with age.

Paper IV

In this paper, the objective was to study the relation between alcohol consumption, tobacco smoking and the incidence of non-vertebral fractures. The incidence of non-vertebral fractures was positively associated with a score for total alcohol consumption among women, but not among men. Frequency of consumption of beer and spirits were weak risk factors for non-vertebral fractures among both men and women, especially for fractures in the lower extremities. In contrast, men consuming wine frequently had

lower incidence of non-vertebral fractures than non-consumers of wine. Persons getting inebriated frequently were more prone to suffer fractures than others. Among men, 18 % of all non-vertebral fractures could be ascribed smoking. Smoking was not a risk factor for fractures among women.

Paper V

In this paper, the objective was to study whether measured body height loss could predict subsequent non-vertebral fractures, and whether this simple measure can be used as a screening tool. We found that women that had lost height from 1979/80 to 1986/87 did suffer more non-vertebral fractures than women not losing height did. However, the relation was too weak to use as a screening tool, and there was no similar relation among men.

General discussion

Limitations: Validity and potential biases

External validity

Our study population includes all regular residents of a community, apart from persons temporarily living in Tromsø, and students not registered as inhabitants of the municipality. Thus, this is a study of a “normal” population which should be representative for any Scandinavian population, and possibly any small city population with range from low middle class to high middle class. However, the community is situated in a rather harsh coast climate, and the terrain is hilly. This should be kept in mind when making comparisons to other populations. Our results on body height, body height reduction and fractures might be dependent on Scandinavians’ generally tall stature. And the results on physical activity, alcohol consumption, smoking and different fractures are not convincingly strong. Thus, the results should be verified in other populations. This also applies to the validation of fracture registration by computerised search. The results on fracture pattern across genders, age groups and trauma-mechanisms are however consistent and highly significant, thus they are probably valid for other similar populations.

Internal validity

Scandinavian studies have proven to get high attendance rates compared to studies elsewhere (159), and in our study 73.6% of invited persons attended two consecutive surveys. The attendance rate increased with age both among men and women, and it was higher among women than men (table 1).

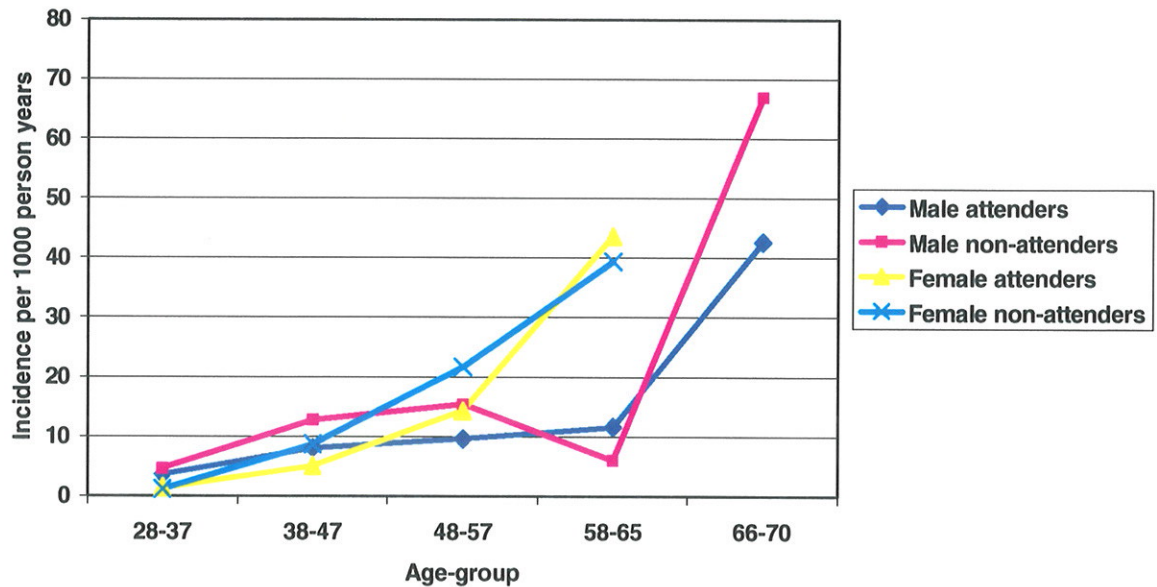
Table 1

Attendance rate among the 16 676 persons that were invited to surveys in 1979/80 and 1986/87 (attendees participated in both surveys).

Age-group by dec. 31, 1988 (years)	Men		Women	
	Attendance rate in percent (attended/invited)		Attendance rate in percent (attended/invited)	
25-29	42.6	(220/517)	59.6	(271/455)
30-34	51.4	(715/1392)	68.5	(1020/1490)
35-39	65.3	(1091/1671)	78.6	(1219/1551)
40-44	72.4	(1192/1646)	84.2	(1345/1597)
45-49	75.6	(975/1289)	85.2	(987/1158)
50-54	79.7	(791/992)	88.7	(768/866)
55-59	78.4	(728/929)	86.7	(474/547)
60-64	82.3	(474/576)		

It is possible to imagine an interaction dependent on attendance-status: The relation between physical activity, body height etc. and the incidence of fractures may be dissimilar among non-attendees compared to attendees. We have no means by which to explore this interaction, even if we know that age-adjusted mortality is higher among non-attendees than among attendees in Tromsø (160), and even if we know that the incidence of any fracture is almost similar in the two groups (figure 3). However, the high attendance rate leaves a limited potential for selection bias, as the presented results are valid for the great majority of the entire city population, despite any possible interaction with attendance-status.

Figure 3. Incidence of any non-vertebral fractures dependent on attendance status (attended both surveys vs. not attended both surveys)



Causal relations?

What is a cause? This question is worthwhile to philosophise about when doing research, especially in the field of epidemiology, where associations often are spurious or weak and difficult to interpret. Modern epidemiology claims that all effects (endpoints, events) are the consequence of many component causes, which in combination resemble a sufficient cause. Moreover, any effect may have an infinite number of possible sufficient causes. One specific component cause may be part of the sufficient cause in just a fraction of all cases (for instance brake failure in the car may be a component cause of some hip fractures, but not all). The factors associated with fracture incidence may be markers of some causal factor, or the factor may itself be a component cause in some or all the cases (8). There is no simple test to decide whether an association is “causal” or not. Hill (161) suggested nine criteria by which to judge causality: Temporality, strength,

experimental evidence, specificity, coherence and analogy. In modern medicine, the golden standard of demonstrating a causal relationship is experimental evidence through clinical trials, preferably by a blinded randomised design. Unfortunately, most factors are impossible or not viable for such studies, thus, the causality of most risk factors for fractures are uncertain and will remain uncertain. An evaluation of our results according to Hill's criteria reveals the following:

1. **Temporality:** As all baseline information was acquired before the follow up, this criterion is fulfilled.
2. **Strength:** Many of our presented results are relatively weak. One exception is the fracture pattern across age and genders.
3. **Consistency:** There is a paucity of studies on all fractures among middle aged persons. Hence, it is difficult to assess the consistency of our findings across different populations and time periods. Moreover, the associations found have not been very consistent even within our population (with respect to physical activity, body height, body mass and body height loss).
4. **Biological gradient:** When an association is weak, any trend may easily disappear in "random noise". Thus, a biological gradient may exist, despite seemingly non-linear patterns. In our results, some trends have been demonstrated, but none of them can be described as strong or convincing.
5. **Plausibility:** Refers to biologic plausibility of a hypothesis. Most of our results are biologically plausible according to present knowledge on the aetiology of fractures. However, this criterion is difficult to assess, as there are usually many possible modes of action for a component cause. (E.g. alcohol may increase bone

mineral density, but it may also increase the risk of traumas when inebriated.

Thus, “any” net effect of alcohol consumption is plausible.)

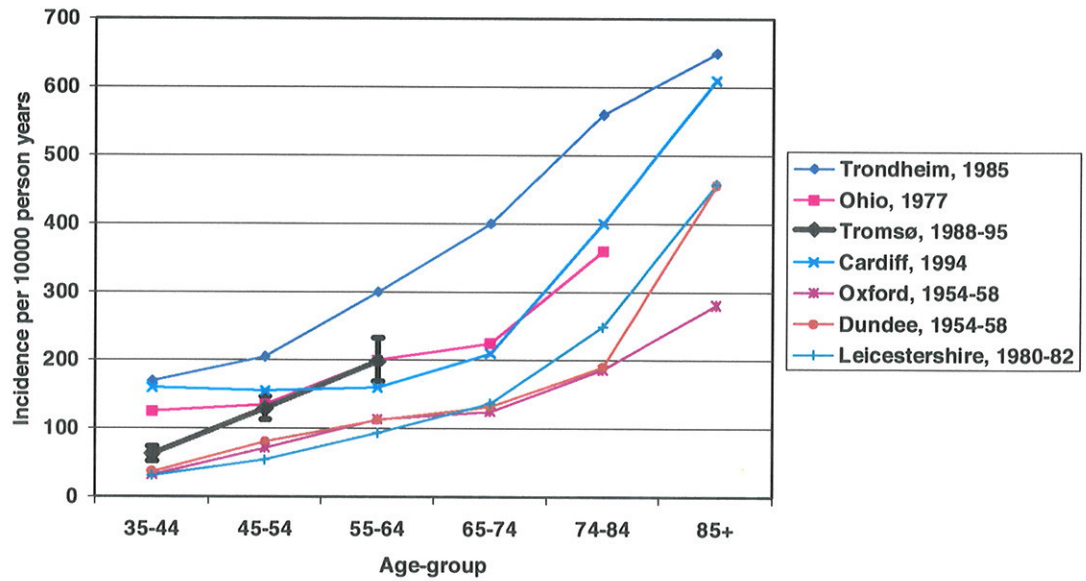
6. Experimental evidence: Human experimental evidence with respect to the effect of body height, body mass index, height loss, smoking and alcohol consumption on the incidence of fractures is hardly obtainable in practice. With respect to physical activity, attempts of getting such evidence have been made (162). However, the relatively low incidence of non-vertebral fractures requires very large studies.
7. Specificity: The criterion of specificity requires that a cause lead to one single effect, not multiple effects. This criterion is not fulfilled by any of our exposures. However, the criterion is actually invalid, specificity does not confer greater validity to any causal inference regarding the exposure effect (8).
8. Coherence: Present result should be coherent with previous knowledge. Same discussion as with plausibility.
9. Analogy: Not very relevant criterion, as lack of analogies may reflect lack of imagination and experience as well as falsity of the hypothesis.

In conclusion, we can not claim to have demonstrated any causal relationships in our study, with the possible exception of the effect of age and gender on fracture incidence. However, our study is large, and there is probably no better non-experimental study design with respect to potential for bias. Thus, this is probably among the most reliable results possible to get on the studied risk factors for fractures. Viable methods of strengthening a hypothesis of causality are by reproducing the results in other populations (demonstrating consistency), by implementing larger studies (increasing power) and by discovering and adjusting for presently unknown confounding factors.

Fracture incidence in the study population compared to other populations

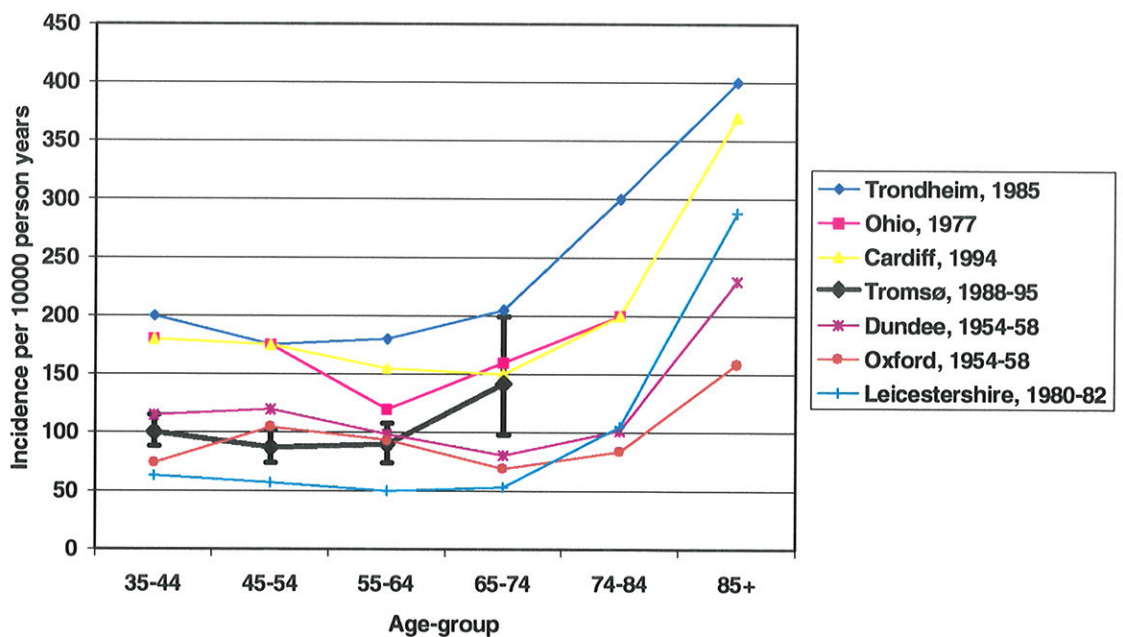
When comparing incidence numbers from different populations, the fracture registration should preferably be similar in the populations. Our registration of fractures is probably comparable to fracture registration in Malmø (9), which also has sought fractures in the department of radiology, though without a corresponding extensive validation as ours (paper 1). Most other studies have registered fractures through hospital registers, departments of surgery and/or outpatients' clinics, and the completeness of ascertainment has mostly not been validated. Moreover, the definition of fracture site varies across studies. For instance, some forearm studies have included only distal radius fractures (30, 32, 39, 134, 163-167), while other studies have included all distal forearm fractures (19, 33, 168, 169). Furthermore, some of the numbers compared are imprecise due to the formats in their presentation (different age-groups, presentations in figures). And no women in the oldest age group are older than 66 years of age in the Tromsø Study, possibly underestimating the incidence of wrist fractures in age group 60-69. All these reservations make the comparisons presented in figure 4 to figure 12 crude. In the figures, confidence intervals for the Tromsø incidence numbers are noted. As the populations in the other studies are larger than our study population, the corresponding confidence intervals are narrower than for the Tromsø-results. Figure 4 illustrates that the incidence of all fractures 1988-95 in the female Tromsø-population was higher than in previous studies from UK (Leicestershire) in 1954-58 and 1980-1981 (27), but similar to studies from UK (1994), Australia (1989) and Ohio (1977), and lower than incidence numbers from Trondheim (1985) (131, 133, 170, 171). Among men, the incidence rates were lower in Tromsø than in Trondheim, Ohio and Cardiff (figure 5).

Figure 4. Incidence of all fractures among women in defined populations

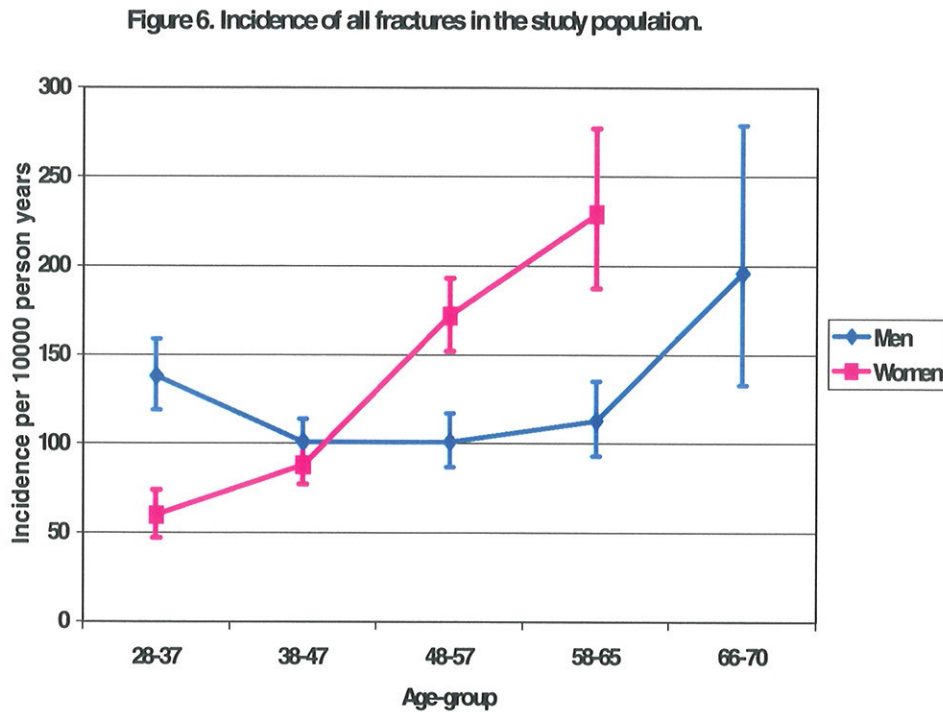


Among men, the incidence rates were lower in Tromsø than in Trondheim, Ohio and Cardiff (figure 5).

Figure 5. Incidence of all fractures among men in defined populations



The pattern of fracture incidence across age and gender is similar in the studies, verifying the gender and age differences (figure 6).



Many papers have studied the incidence of distal forearm fractures in different populations (19, 30, 32, 33, 39, 134, 163-169, 172), and comparison to our incidence numbers are presented in figure 7 and 8. The figures demonstrate that the incidence of distal forearm fractures is high in Scandinavia. The incidence of wrist fractures in Tromsø compares to similar numbers found in Oslo in 1979 (33), in Bergen in 1988 (30) and in Frederiksborg, Denmark in 1981 (32). The incidence of hip fractures increased both in Tromsø and Oslo from 1978 to 1989, and the incidence of hip fractures was higher in Oslo than in Tromsø (42). A similar relationship with respect to incidence of wrist fractures in Oslo and Tromsø is possible according to our results. Figure 7 demonstrates that distal forearm fracture incidence was extraordinary high in Helsinki,

Finland 1977-81 (168). Hip fracture incidence is lower in Tampere, Finland than in other Nordic cities (173), thus the geographical differences with respect to wrist fractures seem to differ from variation of hip fracture incidence.

Figure 7. Incidence of distal forearm fractures among women in defined populations

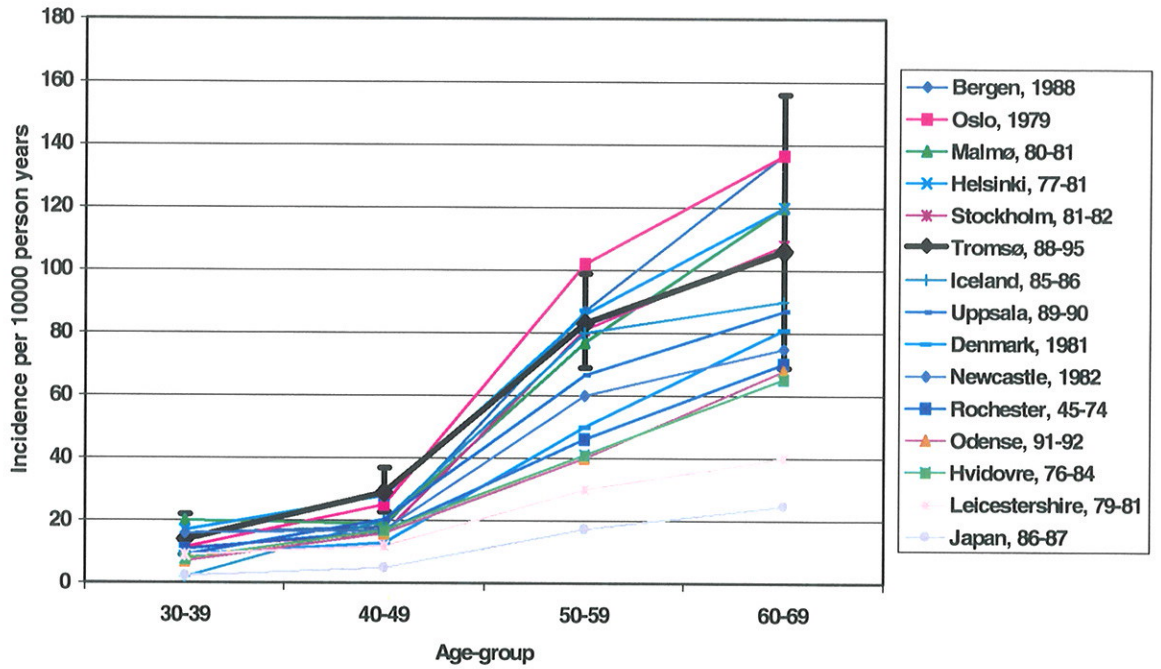
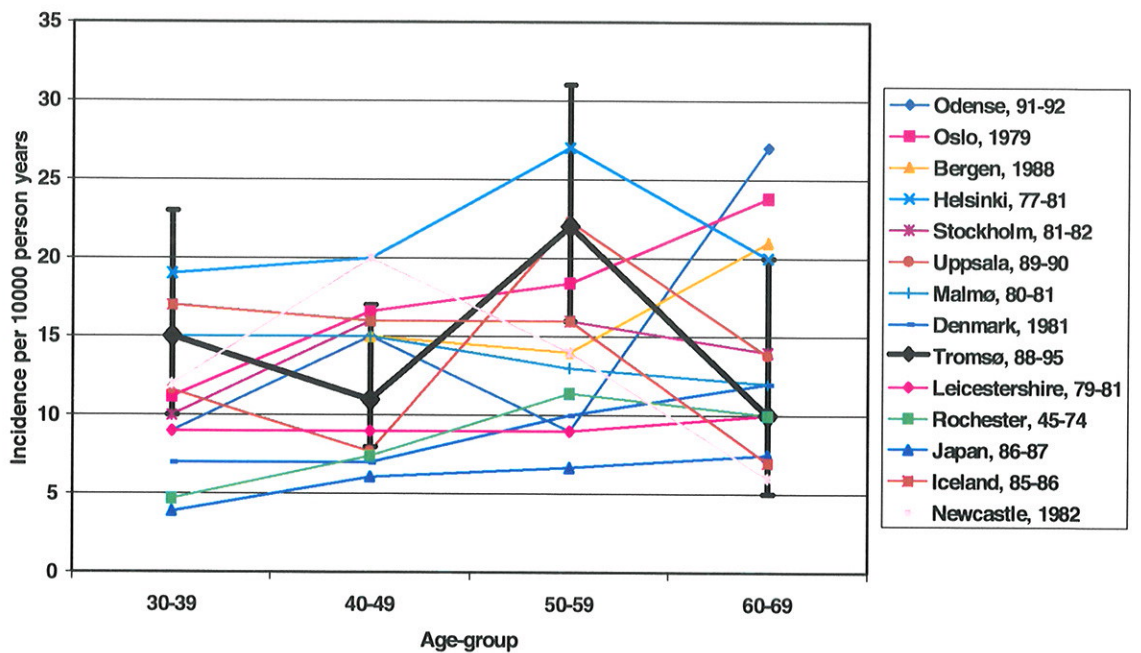
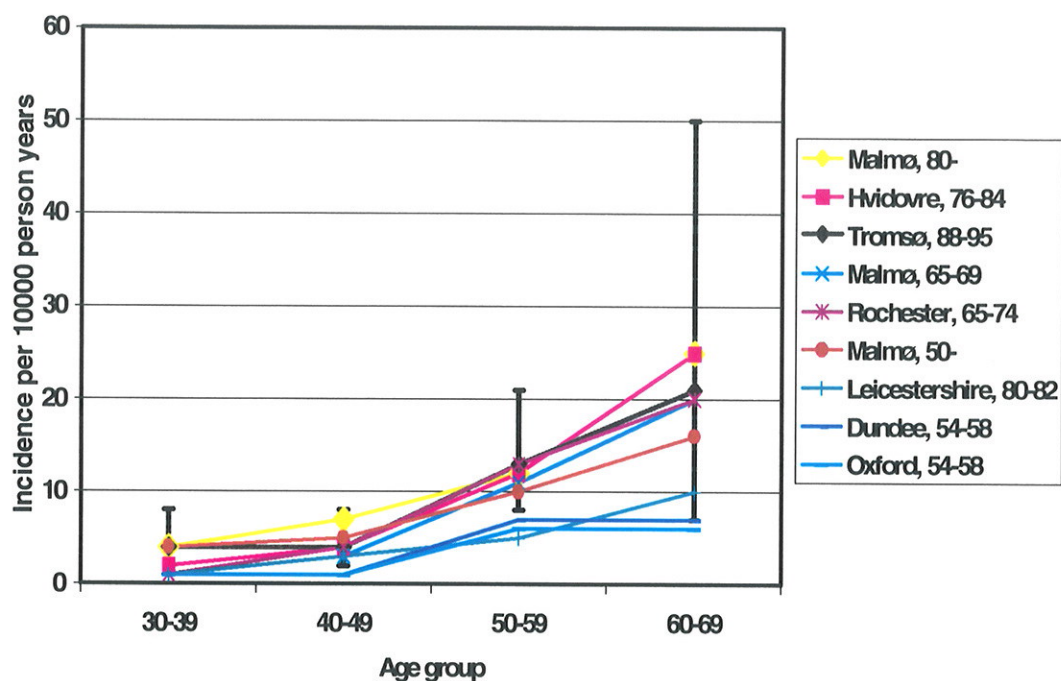


Figure 8. Incidence of distal forearm fractures among men in defined populations



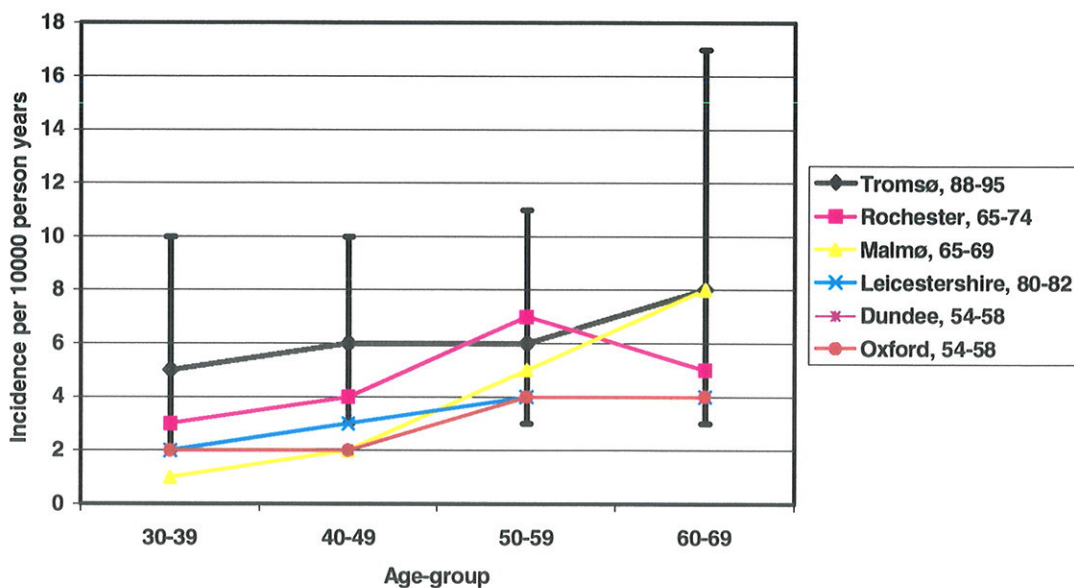
The incidence of proximal humerus fractures among women was lower in Malmø (1950s), Leicestershire (1980-82), Oxford and Dundee (1954-58) (5, 9, 27) than in Tromsø, while later in Malmø (1965-69 and 1980s) and Hvidovre (1976-84) (9, 35, 39) the incidence was similar to the one found in Tromsø (figure 9).

Figure 9. Incidence of proximal humerus among women in defined populations



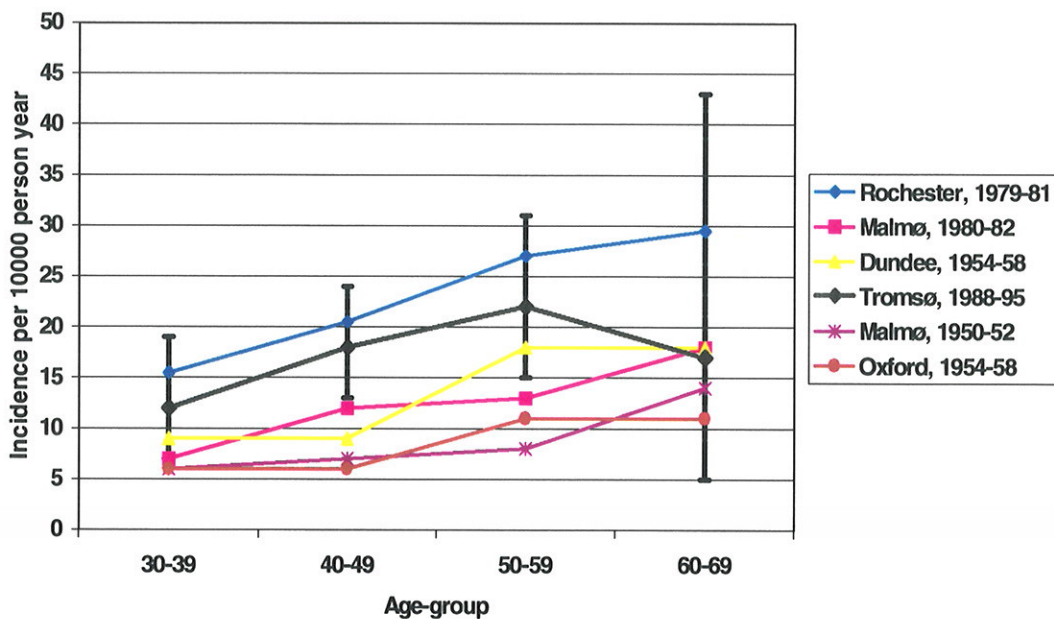
Among men, the incidence of fractures in the proximal humerus was higher in Tromsø 1988-95 than in Rochester, USA (1965-74), Malmø (1965-69), Leicestershire (1980-82), Dundee and Oxford (1954-58) (5, 27, 34, 35), but similar to later incidence numbers from Malmø (1981-81) (15) (figure 10). The studies from Malmø (9, 15, 35) suggest a substantial increase in the incidence of proximal humerus fractures from 1950 to 1980, thus the incidence of proximal humerus fractures in Tromsø is probably similar to other places in Scandinavia when numbers refer to the same time period.

Figure 10. Incidence of proximal humerus fractures among men in defined populations



Among women, the incidence of ankle fractures was higher in Tromsø 1988-95 than anywhere else (5, 9, 17), except in Rochester (1979-80) (174) (figure 11).

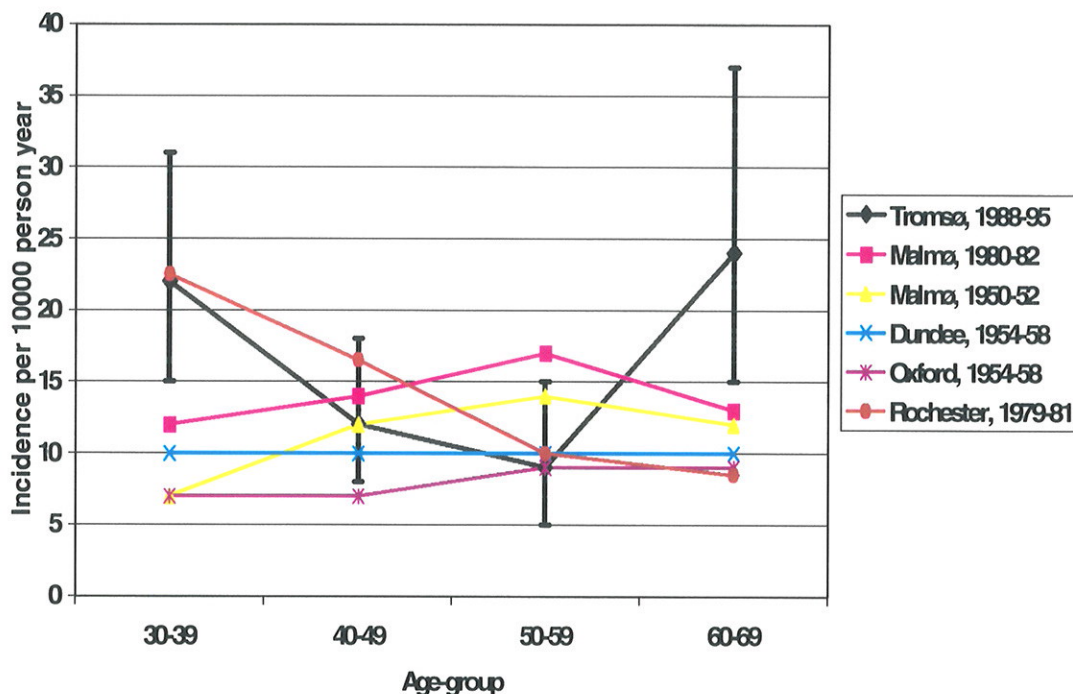
Figure 11. Incidence of ankle fracture among women in defined populations



Among men 60-69 years of age, the incidence of ankle fractures in Tromsø 1988-95 was higher than in earlier studies from Malmö (1950s and 1980s), Rochester (1979-81) and

UK (1954-58) (5, 9, 17, 174), and in the age group 30-39, it was similar to the incidence in Rochester (1979-81) (174), but higher than the others (5, 9, 17) (figure 12).

Figure 12. Incidence of ankle fractures among men in defined populations



Among men 40-59 years of age, the incidence of ankle fractures was similar in Tromsø 1988-95 as in the other places mentioned (5, 9, 17, 174).

The number of hip fractures in the present study population is small, as the population is young in terms of hip fracture incidence. Thus, comparison with other studies is futile, - but earlier studies suggest that the incidence of hip fractures in this area is substantially lower than in Oslo, both among women and men (42). This is probably due to an extraordinary high incidence of hip fractures in Oslo, compared to both other parts of Norway and compared to other countries (42, 48, 173, 175, 176).

Trauma mechanism

It has been shown repeatedly in large studies that bone mass decreases with age. Consequently, a trauma sufficient to cause a fracture should be less with increasing age, and the proportion of low-energetic fractures should increase with age for all fractures for both genders. In our study, this was the case with respect to all fractures, ankle fractures and fractures in the lower extremities among women, while the proportion of low-energetic fractures was constant across ages for wrist (table 2 and paper II). This is surprising, as ankle fractures have not been found to be associated with low bone mass in contrast to wrist fractures (177). Among men, the pattern was similar as among women, although without statistically significant results (table 2). A possible explanation for these findings, is that other factors than bone mass are as important among middle aged persons with respect to fracture risk. Another possible explanation is that fractures after high-energy traumas also are dependent on bone mass (178).

In our population, we also see that low-energetic fractures are more common among women than men. This might reflect both stronger bones and lower incidence of low-energy traumas among men. The incidence of low-energetic fractures at almost all sites increased steeply with age in our female population already from the age of 30 years. A similar pattern was not found among men, even if they also lose bone at a similar rate (50). This suggests either that the incidence of moderate traumas has a slower increase with age among men than women, or that these traumas do not result in fractures among men until old age. As the incidence of falls has been found to increase steeper with age among men than women (179, 180), the latter explanation seems most probable.

According to the “traditional” way of assessing “osteoporotic fractures”, low-energetic fractures are likely to be prevented by higher bone mass or better bone quality.

Thus, the proportion of fractures that are low-energetic should give information on how many fractures that might be prevented by maintaining or increasing bone mass. We have found that even among women as young as 60 to 66 years, above 80 % of all fractures are low-energetic. This is a surprisingly high number, given the fact that only 75 % of hip fractures among middle aged persons are low-energetic (111) and 44 % of ankle fractures among young and middle aged persons are low-energetic (174). However, above 90 % of wrist fractures were found to be low-energetic in a North-American population (35 years and above) (134), supporting the interaction between fracture location and trauma mechanism in our population.

Implications

Researchers in Malmø, Sweden have previously demonstrated that search in a department of radiology may be a good method of fracture registration (9). We have shown that a similar method in our local hospital is superior to any other fracture registration method, and that the method is viable with respect to all non-vertebral fractures. We have shown that this fracture registration method also is viable in follow up studies, where the fractures must be assigned to known persons. The Tromsø population has been surveyed several times, the last time also with respect to factors with a known or possible association to osteoporosis (for instance measured bone mineral density, balance, muscle strength). The development of a good method of fracture registration with a solid validation in this population establishes a necessary basis for further fracture research in Tromsø, and the registration method may simplify fracture research elsewhere.

The implication of the results in paper II-IV is mostly a deeper understanding of

the epidemic of fractures. For instance, it seems that fractures may be a consequence of a high standard of living, which has increased average stature. Physical activity does affect the incidence of fractures, but the net effect is not in itself a strong enough argument to promote physical activity. In contrast, the findings on alcohol and tobacco consumption may be an argument against alcohol-intoxication, high total alcohol consumption and tobacco smoking. To most people, both inside and outside of the medical community, the term osteoporosis is associated with a mental image of little old ladies getting shorter as they get older. In paper V, we have shown that this simple approach is not good enough as a clinical test in general practise among middle aged persons.

Further research

The great majority of studies on osteoporosis have had bone mass or bone mineral density as outcome variable. These measures are associated with fractures, but not strongly. And factors that influence bone mineral density do not necessarily affect fracture incidence. Another surrogate endpoint for fracture is falls. Studies on aetiology, risk factors for falls (especially injurious falls), and studies on how to prevent them are few and mostly focused on the elderly (129, 181). Thus, studies on risk factors and prevention of injurious falls and traumas, especially among middle aged persons, are needed. However, studies on fractures are preferable when making inferences to fracture incidence. Most studies on fractures have focused on hip fractures among elderly women, and many of the studies have been case-control studies. The epidemic of osteoporosis seems to include men, and it also includes fractures at any other site than the hip (9, 15-21, 23-26, 41, 182). Other fractures than hip fractures generally occur

earlier in life than hip fractures, thus they disrupt patients working capacity and they also bring suffering and costs (183). Hence, more large follow up studies on fractures at other sites than the hip are needed, especially among middle-aged persons and especially among men. It is relevant to identify both treatable and non-treatable risk factors in order to find persons at high risk, and then know what advice and treatment to give them.

Research on treatment

The main topic for further research on osteoporosis according to the most recent large consensus, is studies on medical treatment alternatives (14). The drug of choice among women until recently has been oestrogen replacement therapy (14, 184, 185). The consensus on this has been based on observational studies indicating that hormonal therapy lowers the risk of fractures. Moreover, blinded randomised clinical trials have shown that oestrogen reduces the age related loss of bone mass, and one little blinded randomised clinical trial has demonstrated reduction of vertebral fracture incidence among oestrogen users (70). A consensus based on a similarly somewhat weak documentation has existed with respect to the preventive effect of oestrogen on cardiovascular disease, although the consensus has not been unanimous and without reservations (14, 186). A recent large double blind clinical trial did not find any preventive effect of hormonal replacement therapy, neither with respect to cardiovascular disease nor with respect to fractures (187). These results call for new ideas and reassessment of present recommendations with respect to advice given to postmenopausal women. The expectations to presently ongoing trials on hormone replacement therapy and oestrogen analogs have diminished after this disturbing study, despite promising preliminary results, both with respect to reduction of fracture risk

(presented by Ettinger B, at the annual meeting of the European Congress on Osteoporosis in Berlin september 98) and with respect to reduction of breast cancer risk (presented by Cummings S, at the annual meeting of the American Society of Clinical Oncology in may, 1998). In contrast, bisphosphonates have a documented effect of fracture prevention among elderly women with low bone mass, but not among other women, and not among men (188-190). Calcitonin also reduces the risk of vertebral fracture, although with seemingly less effect than bisphosphonates (191, 192). The effect of Calcium and vitamin D additives has been debated, but they seem to reduce fractures risk among the oldest persons (76, 193). Moreover, supplement of calcium seems to be necessary in order to obtain an effect of other medication against bone loss (194).

As money, promotion and interest has been focused on medical prevention of osteoporosis and fractures, less attention has been paid to other approaches. However, community based interventions - e.g. Information on removal of environmental hazards in homes, promotion of use of safe footwear outdoors in winter etc., seem to reduce the incidence of both hip fractures (195) and other fractures (196). In institutions, hip protectors also seem to be a viable preventive measure of hip fractures (197-202). Thus, non-drug preventive measures exist, and they need further exploration.

Conclusions

In this large and population based follow up study among middle aged persons, we have found that search in local radiographic archives by computer linkage is a viable fracture registration method. We have found that the incidence of all fractures is high in Tromsø, and that the incidence of fractures in wrist, ankle, proximal humerus is comparable to results from other recent Scandinavian studies. The proportion of fractures that were low-energetic was higher among women than men in our study, and this proportion increased with age among women. The incidence of fractures increased with age at all fracture sites (except ankle fractures) among women, but not among men. Physical activity was a risk factor for fractures in the weight-bearing skeleton, but not in the non weight-bearing skeleton. High body height seemed to be a weak risk factor for any fracture. Thus, differences in average body height may explain regional differences and time trends with respect to all fractures, as suggested with respect to hip fractures. Low body mass index was a risk factor for any fracture, although too weak to have any clinical significance. Frequency of inebriation and consumption of spirits and beer was positively associated with the incidence of fractures, especially fractures in the lower extremities. Accumulated exposition to tobacco smoking was positively associated with the incidence of fractures, most among men, especially unemployed men. In this population, earlier loss of body height could not be used as a screening tool for subsequent fractures.

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Errata

During the comparison of the different fracture registration methods, a wrong coding of hip fractures suffered in 1995 was revealed. Consequently, 9 hip fractures were analysed as pelvis fractures in paper II and III. In principle, this should not lead to bias in the analyses on hip fractures, but power is decreased. The analyses have been repeated with correct classification, and the changes are as follows:

Paper II:

Table 1, persons with hip fracture are 18 men and 23 women, of which 67.7% and 73.9% were low-energetic respectively.

Table 5: When hip fractures suffered in 1995 is included, RR is 1.082 ($p=0.08$), and attributable risk to height increase from 1952 and 1900 is 25 % and 54 % respectively.

Text page 3, paragraph 3, line 4: Hip fractures should be left out in this sentence, as the association to stature became borderline significant in the new analysis ($p=0.07$). Text

page five, second paragraph, line 4: ((RR 0.72, CI 0.46-1.13), age adjusted per unit BMI increase).

Paper III:

Table 2, persons with hip fractures were 26 men and 30 women, of which 19 (73.1%) and 23 (76.7%) were low-energetic respectively. Cumulative incidence was 0.3% among men and 0.4 among women. No changes in text.

Paper I

The Tromsø Study: Registration of Fractures - How good are Self-reports, a computerized radiographic Register and a Discharge Register?

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Abstract

In order to compare different methods of fracture registration, we sought all non-vertebral fractures suffered during eight years (1988-1995) among 21,441 persons invited to a survey in 1979/80. We registered hip fractures through three separate sources (self-report, discharge register, computer linkage to the local radiographic archives), whereas forearm fractures were sought through two separate sources (self-report, computer linkage to the radiographic archives). The registration of fractures at other sites were from one source (computer linkage to the local radiographic archives), and we have compared three ways of obtaining data from this single source (no ascertainment, ascertainment of records coded as fracture, ascertainment of all records). Ninety-three percent of all hip fractures and 97% of all wrist fractures in the entire study population were found by computer linkage to the radiographic archives, and the discharge register detected 87% of all the hip fractures. Computer linkage with ascertainment gave no overreporting of fractures. Among the 11,626 persons that answered a follow up questionnaire in 1994/95, 97% (CI 84-100%) of all hip fractures and 85% (CI 80-90%) of all wrist fractures were self-reported. We conclude that computerized search in radiographic archives is a viable method of fracture registration.

Keywords: epidemiological methods; fractures; questionnaires; data collection, follow-up studies; recall

In epidemiological studies, misclassification is a ubiquitous problem with respect to both disease and exposure. Misclassification of outcome that is dependent on the exposure of interest (differential misclassification) leads to bias of unknown direction and magnitude, while non-differential misclassification in most cases leads to underestimation of effects (1). Thus, correct classification is necessary to get valid results.

Previous studies on the topic of agreement between questionnaires and medical records in the ascertainment of endpoints are few and have mostly focused on other diseases and exposures than fractures. They demonstrate that the agreement is dependent on nature of endpoint (2). In studies on fractures, the registration of outcome can be done in several different ways. Surveillance of medical records in nearby hospitals has been used in some large follow-up studies (3-6), while others have registered fractures by either self-reports only (7-10), self-reports complemented with review of medical records or radiographic reports (11, 12), or computerized registers (13, 14). The latter method might give misclassification if a fracture is overseen or if the same fracture has been registered several times due to rehospitalizations or transfers. Coding and punching errors could also lead to misclassification. Self-reports may give misclassification, and differently so for different fractures: Recall of fractures with major consequences (operated, mutilating, and debilitating) is possibly better than recall of fractures of fingers and toes. Furthermore, self-reports do not always correspond to medical records with respect to diagnosis or date of event. Surveillance in hospitals serving the study population might lead to underreporting, because of fractures suffered elsewhere.

The objective of this study was to compare different methods of fracture registration during eight years of follow-up in a large population-based cohort study. We have registered hip fractures through three separate sources (self-report, discharge register, computer linkage to the local radiographic archives), and we compare each of the methods to all hip fractures found by any of the methods. With respect to forearm fractures, we have a similar approach, as they also were registered through separate sources (self-report, computer linkage to the local radiographic archives). The registration of fractures at other sites were from only one source (computer linkage to the radiographic archives), and we have compared three methods of obtaining data from this single source (no ascertainment, ascertainment of records coded as fracture, ascertainment of all records). Thus, altogether five different ways of obtaining fracture data were compared.

MATERIALS AND METHODS

Subjects

The Tromsø study is based on information gathered through population surveys in 1974, 1979/80, 1986/87 and 1994/95 (15). In 1979/80, all males born 1925-59 and all females born 1930-59 were invited to the survey (21,329 persons), in addition 112 attended without an invitation (they became residents during the survey). These 21,441 persons constitute the study population in which fractures were registered from 1988 to 1995.

Treatment facilities for fractures in the study population

All fractures suffered by persons in the cohort are registered at the University Hospital in Tromsø. The nearest alternative radiographic service or fracture treatment facility is located at a distance of 250 km from Tromsø. The only fractures that could be missed at

the University Hospital would be fractures occurring while inhabitants were traveling and no control radiographic examination was done after returning home.

Ascertainment methods for suffered fractures

Fractures were sought for by all five methods in the follow-up period of January 1, 1988 through December 31, 1995. We have counted both fractures and number of persons with different fractures in this study.

Computer linkage with discharge register. In all Norwegian hospitals, information including ICD-code diagnosis on every hospitalization is registered in a computerized discharge register. We have registered all discharges from the University Hospital in Tromsø with the diagnosis hip fracture (ICD 9-code 820) occurring in the population cohort during the follow-up period.

Computer linkage with department of radiology database and no further ascertainment procedures. The computerized records in the radiographic archives contain codes for location, pathology (fracture, degeneration etc.), further description (operated, control, replaced etc.) and development (progression, regression) in addition to the national personal identification number and time of investigation. Ninety percent of the radiographic reports in our radiographic archives have the national personal identification number recorded. The last 10 percent of records were registered with name and date of birth only. All records with a fracture code and a personal identification number or with name and date of birth matching a person from our cohort were registered. We registered both number of persons with one or more fractures, and total number of fractures, excluding a new fracture registration at same site within one year of a previous registration. All non-vertebral fractures were included in this registration.

Computer linkage with department of radiology database with ascertainment procedures of examinations coded as fracture. Computer linkage was done as described above. In addition, every examination that had been given a fracture code was retrieved. The full text description was then reviewed and records that did not represent incident fractures were removed.

Computer linkage with department of radiology database with ascertainment procedures of all examinations. Computer linkage was done as described above. At this level of ascertainment, all records with a non-normal code (i.e. with any pathology, n = 12 509), which also had a personal identification number matching a person from our cohort, were retrieved and reviewed by the first author. No additional fractures were found when also reviewing a random sample of 1,044 descriptions coded as normal/no pathology. All non-vertebral fractures were included in this registration.

Self-reports. Questions on the last suffered hip and wrist/forearm fracture and the age at which they were suffered, were asked in a questionnaire handed out to the attendees of the 1994/95 survey. Of the 21,441 persons in our study cohort, 14,808 were invited to this survey (6,633 had migrated or died), of which 12,807 (86 percent) attended, and 11,626 of these answered and returned the questionnaire. We registered all persons with self-reported hip and forearm fractures in the follow-up period.

Validation of fracture registration

To validate the registration at the department of radiology, we checked all patients (n = 550) with ICD-diagnoses 813, 820 or 824 (wrist, ankle or hip fracture) during 1994 at surgical departments and surgical outpatients' clinics at the University Hospital. Of these, only one had been missed by the radiographic archive (medical record states that radiographic film was given to patient without radiologists' assessment). From our

cohort we also chose a random sample of 1,000 persons and checked the actual envelopes containing radiographic films, referrals and full text descriptions. We found 68 fractures, of which one had not been picked up by the review of radiographic descriptions. Previously we had only reviewed referrals and full text descriptions stored on microfilm.

Statistical analysis

In the analyses, the confidence intervals have been calculated according to exact binomial distribution. All confidence intervals (CI) have 95 percent limits.

RESULTS

Hip fractures

Underreporting. Among the 21,441 persons in the study population, a total of 54 persons had suffered a hip fracture before the last survey. (All hip fractures found by any of the three sources, all fractures were confirmed by radiographic report). Of the 54 hip fracture cases, the discharge register detected 47, computerized search with full ascertainment detected 50, computerized search with some or no ascertainment detected 44 and self-report by questionnaire detected 32 cases (figure 1). Among persons that answered the questionnaire in 1994/95 there were 33 hip fractures, of which 32 (97 percent, CI 84-100) were self-reported (one denied any hip fracture). Two of the persons with self-reported hip fracture did not report at what age they suffered the fracture. Four of the persons with hip fracture did not attend any of the surveys.

Overreporting. Overreporting in percentage of all persons with hip fractures is presented in figure 2. The following text counts number of fractures as well as number of persons with fractures.

Discharge register: Of 52 discharges with diagnosis of hip fracture, 5 registrations (10 percent, CI 3-21 percent) did not represent an incident hip fracture, identifying 2 persons without a hip fracture, which corresponds to 4 % of all hip fracture cases (figure 2). Two registrations were established as no hip fracture (one pelvis fracture and one complication to an earlier hip fracture) and three were rehospitalizations/transferrals (time period between discharges 11, 14 and 369 days respectively).

Computer linkage: There was no overreporting in the computer linkage with some or full ascertainment. In the computer linkage without ascertainment (but excluding examinations of same site within one year), 15 of 59 (25 percent, CI 15-38 percent) fracture records did not represent an incident hip fracture, erroneously identifying 13 persons as fracture patients, which corresponds to 24 percent of all the hip fracture patients (figure 2). (There were 44 records identifying incident fractures among 44 persons).

Self-report: A total of 42 persons reported a hip fracture in the period from 1988 to 1995 (according to reported age at time of fracture). Of these 42 reports, 11 were erroneous (26 percent CI 14-42 percent), which corresponds to 20 percent of all the hip fracture patients (figure 2). Seven were fractures of the shaft of femur, one had had a hip replacement without any preceding fracture, two denied any hip or femoral fracture when interviewed by telephone, and one fracture was suffered shortly before the follow up (date according to radiographic report). One self-reported hip fracture could neither be confirmed nor falsified, thus, 30 of the 42 self-reported hip fractures could be verified. In addition, 2 verified hip fractures were self-reported, but with no report on age by fracture. All the 30 hip fractures were reported within 3 years of the corresponding registered fractures.

Forearm fractures

Underreporting. A total of 294 persons had suffered a wrist fracture among the 21,441 persons before the last survey (291 confirmed by radiographic report and 3 by telephone interview after self-report). The computer linkage with full ascertainment detected 285, the computer linkage with some or no ascertainment detected 277 and the self-report detected 188 of these wrist fracture cases (figure 1). Fourteen of the persons with wrist fracture had not attended any of the surveys.

Among the persons that actually answered and returned the questionnaire in 1994/95, there were 220 wrist fractures. Of these, 188 (85 percent CI 80-90 percent) were reported, but 22 of the fracture patients had not reported the age at which the fracture was suffered. (Seventeen attendants denied such a fracture, five did not reply on that specific question, and 10 attendees reported a fracture occurring seven to 41 years before the registered fracture).

Overreporting. Overreporting in percentage of all persons with forearm fractures is presented in figure 2. The following text counts number of fractures as well as number of persons with fractures.

Computer linkage: There was no overreporting of fractures in the computer linkage with some or full ascertainment. In the computer linkage with no ascertainment, 33 of 316 (10 percent, CI 7-14 percent) wrist fracture records did not represent an incident fracture, identifying 23 persons without a wrist fracture, which corresponds to 8 percent of all the wrist fracture patients in the population (figure2). (There were 283 records with incident fractures among 277 persons).

Self-report: Of 243 self-reported wrist/forearm fractures, 37 (15 percent, CI 11-20 percent) were erroneously reported with respect to fracture status or time of event, which corresponds to 13 percent of all the wrist fracture patients in the population

(figure 2). Twenty-three reports (9 percent, CI 6-14 percent) were established as no wrist/forearm fracture (15 persons had a negative radiographic report of the forearm at the time of the alleged fracture, five had a fracture in the upper arm and three denied any forearm fracture when interviewed by telephone). Fourteen fractures were misclassified with respect to age at fracture: Three persons reported year of fracture instead of age at fracture (confirmed by telephone interview, the reported age at fracture corresponded to a date in the future) and 11 fractures were reported in the follow up period, but had actually occurred before the follow up period (according to radiographic reports).

Other non-vertebral fractures

Underreporting. Among the 21,441 persons that were invited to or attended the survey in 1979/80, 1,478 non-vertebral fractures were found by computer linkage to the local radiographic archives with full ascertainment. Of these, 1,405 (95 percent CI 94-96 percent) had a fracture code, thus, they were found by the computer linkage without full ascertainment. When counting persons with fracture(s) instead of number of fractures, 94 percent of fracture patients were identified through the computer linkage that included only records with a fracture code (table 1). At most fracture sites the detection rate was above 90 percent.

Overreporting. The computer linkage with some or full ascertainment of records coded as fracture did not give any overreporting. The computer linkage without ascertainment (when excluding fractures at same site within one year) found 1754 alleged fractures of which 356 (20 percent, CI 18-22 percent) did not represent incident fractures. The alleged fractures were among 1346 persons, of whom 118 did not have any verified

fracture and 164 had both correctly registered fractures and records erroneously coded as an incident fracture (table 2).

DISCUSSION

We have shown that radiologists code almost all fractures correctly. Thus, computerized records of fractures in a department of radiology can effectively register fractures in a large population. Discharge registers of hip fractures detect 9 out of ten hip fracture patients, but due to rehospitalizations and transferrals, multiple registrations are frequent. Self-report detects less than two thirds of all hip and wrist fractures, mostly due to loss to follow up. Among attendees, 85 percent of forearm fractures and 97 percent of hip fractures were reported. Self-report and computerized search gives overreporting, and should be complemented with ascertainment of cases.

Underreporting by self-reports

When referring to the entire study population, above one third of both wrist and hip fracture cases were not detected by self-report. In this population, there was exposure information from at least one survey among all the fracture cases, except for 18 persons (5 percent of the cases). Thus, self-report as a fracture registration method (even when confirmed by radiographic reports) is very vulnerable to loss to follow up, and choosing this registration method may increase the potential for selection bias and decrease power.

When comparing self-report of fractures to other registration methods among attendees that actually answered the questionnaire, detection of fractures was almost complete with respect to hip fractures, while more than one of ten forearm fractures

were not reported in a questionnaire. Earlier studies on this subject have given ambiguous results: Paganini-Hill et al. (16) compared self-reported hip fractures to discharge diagnoses from local hospitals in a large population twice (N1=9,734 and N2=8,884) and found that 11 and 24 percent of registered hip fractures were not reported. However, the use of discharge diagnoses was not validated, thus the gold standard is somewhat questionable. Huang et al. (5) found that 29 of 130 verified hip fractures in a large population (N=2,513) were not reported. This might be the result of loss to follow up rather than erroneous self-report, because information about loss to follow up was not given. Another paper from the same study population restricted to those with 100 percent follow up, found that only two of 84 women with confirmed hip fracture did not report it (sensitivity 98 percent CI 92-100 percent) (6). This is in accord with our results. Another study reviewed 283 medical charts out of 9,704 respondents, without finding any false negatives (17). This suggests 100 percent sensitivity, but due to the limited sample size, the confidence interval must be rather wide: However, their self-reports were results of extensive follow up with repeated questionnaires and several calls, making 100 percent sensitivity credible. In short, our high sensitivity of self-report of hip fractures among attendees is credible according to the few earlier studies on the subject. With respect to other fractures, a Finnish study found that only 77 percent of all fractures were reported, suggesting more underreporting of other fractures than of hip or forearm fractures (18). According to our results on underreporting, case finding in studies on forearm fractures should be based on more than self-report in a questionnaire, while self-report of hip fractures is a sufficiently sensitive method for research in cross-sectional studies (no loss to follow up). However, self-report as case-finding method is vulnerable to misclassification/no classification of date of event, increasing the potential for bias.

Overreporting by self-reports

One out of four self-reported hip fractures was established as no hip fracture. This is surprising, as earlier studies have found fewer false positive self reports: Nevitt et al. (17) found 11 percent (CI 5-19 percent), and Paganini-Hill et al. (16) found 7 percent (CI 3-13 percent) and 9 percent (CI 4-18 percent) false positive among self-reported hip fractures in two different questionnaires respectively. However, Farmer et al. (6) found 34 percent (CI 27-42 percent) false positive self-reported hip fractures among US residents. The explanation for the different results might be due to the regular calls supplementing the questionnaires in the first study, and the fact that the population in the second study was mostly well educated, while the last study was based on a random sample of the US population. Among the eleven persons erroneously reporting a hip fracture in our population, seven had suffered a fracture in the shaft of femur, and one person had misreported time of event. If defining this as correct reports, only 3 of 42 self-reported hip fractures were erroneous. Our percentage of false positive self-reported wrist/forearm fractures was similar to earlier results (17, 18), verifying the size of this problem, although the result would possibly be different when restricting the question to wrist fractures only. Our results show that self-reported fractures must be accompanied by radiographic verification to give a valid registration of fractures.

Comparison of the different registration methods

Our results suggest that computer linkage to a database at a department of radiology supplemented with full ascertainment is superior to any of the other fracture registration methods. Even when ascertaining only examinations coded as fractures, this method is very good, implying that this local radiographic archive was complete and accurate.

Computer linkage to a person-identifiable discharge register was almost complete with respect to hip fractures, and combining the two computer linkage methods yields 100 percent sensitivity with respect to hip fractures.

In the computerized linkage with full ascertainment, we did not review records without a full personal identification number and without a fracture code. However, the comparisons between computer linkage with no, some or full ascertainment did not change when including only records with full personal identification number. (That means leaving 23 persons found with fractures among the records without a full personal identification number out of the comparisons).

Use of computerized records

The geographic distance to the next service of radiographic examinations was very far in our population. Thus, our results on the sensitivity of fracture registration using only local registers could hardly become better in any population, and using one local register is probably suitable only in special settings as ours. However, computerized search in several hospitals serving the same population should be possible. Earlier studies have mostly based medical information on medical records or discharge diagnosis. With respect to fractures, this is an indirect route, as the verification of fractures is radiological, and all radiographic examinations are recorded in a separate archive. When the radiographic archive is computerized, which now is mostly the case, and there is a identifiable key to all persons, like social security number or a national identification number, we have shown that the archive can be a strong tool in endpoint-registration. A limiting factor is the coding by radiologists, that is, any fracture that is not coded as fracture will be lost to follow up. Overreporting is less of a problem, as text description and the corresponding films might verify the fracture codes, just as with

self-reports. One earlier study has found that Medicare files might be used in case finding according to acceptable specificity, although sensitivity of the method could not be studied (19). (There is usually a trade off between sensitivity and specificity, hence these results might be uncertain). We have shown that computer linkage to a radiographic archive is much better than self-report by questionnaire with respect to follow up studies. Even among attendees, computer linkage compares to self-report of hip and forearm fractures. The self-report of fractures other than hip and forearm gives overreporting (17), and sensitivity is possibly lower than for hip fractures. Moreover, discharge diagnosis cannot be used, as few fracture patients (except hip fracture patients) are hospitalized. Thus, computerized search in radiographic archives makes research on fractures at all locations viable.

Applicability to other populations. Our results on computerized radiographic records are good. However, this might be specific for this hospital, and for this department of radiology, where an enthusiastic and competent doctor is in charge of the registration (JS). In our department, all radiographic reports are checked against the national registry with respect to national personal identification number as they are written, and the staff has been thoroughly instructed with respect to codes and routines. However, radiographic archives in general are dependent on reliability of their registry, not only for research, but in order to function at a daily basis: Income for the hospital is based on documented activity, and service to referring hospitals and doctors is dependent on proper registration. Hence, we believe that our results might reflect the quality of any well-functioning department of radiology. Using computerized radiographic records is probably a cost-effective, sensitive and specific method of fracture registration for research.

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TABLE 1. Number of persons with fractures found by computer linkage to radiographic archives in Tromsø 1988-1995 among 21 441 residents.

Fracture location	Computer linkage with ascertainment of all records	Computer linkage with no or some ascertainment		
	Persons with fracture	Persons with fracture	% (95 % confidence interval)	
All locations	1321	1247	94	(93- 96)
Ankle	198	191	96	(93- 99)
Hands and fingers	241	228	95	(91- 97)
Feet and toes	184	172	93	(89- 97)
Crus	67	67	100	(95- 100)
Proximal humerus	83	73	88	(79- 94)
Elbow	51	44	86	(74- 94)
Clavicle	37	36	97	(86- 100)
Knee	42	41	98	(87- 100)
Face	57	54	95	(85- 99)
Pelvis	36	21	58	(41- 75)
Other*	81	61	75	(65- 84)

* The category of other includes fractures in os coccyx, ribs, lower-arm (not wrist), sternum, mandible, shaft of upper arm and shaft of femur.

TABLE 2. Overreporting by computer linkage without ascertainment (no review of radiographic reports). Number of persons with fracture records with no corresponding incident fracture in Tromsø 1988-1995 among 21 441 residents.

Fracture location	Persons without fracture	In % of number of persons with incident fracture (95 % confidence interval)	
All locations	282*	21	(19- 24)
Ankle	36	18	(13- 24)
Hands and fingers	22	9	(6- 14)
Feet and toes	17	9	(6- 14)
Crus	22	33	(22- 45)
Proximal humerus	13	16	(9- 25)
Elbow	7	14	(6- 26)
Clavicle	9	24	(12- 41)
Knee	20	48	(32- 64)
Face	3	5	(1- 15)
Pelvis	25	69	(52- 84)
Other†	50	62	(50- 72)

* Including persons without any fracture (n=118) and persons with erroneously registered fractures in addition to any verified fractures (n=164).

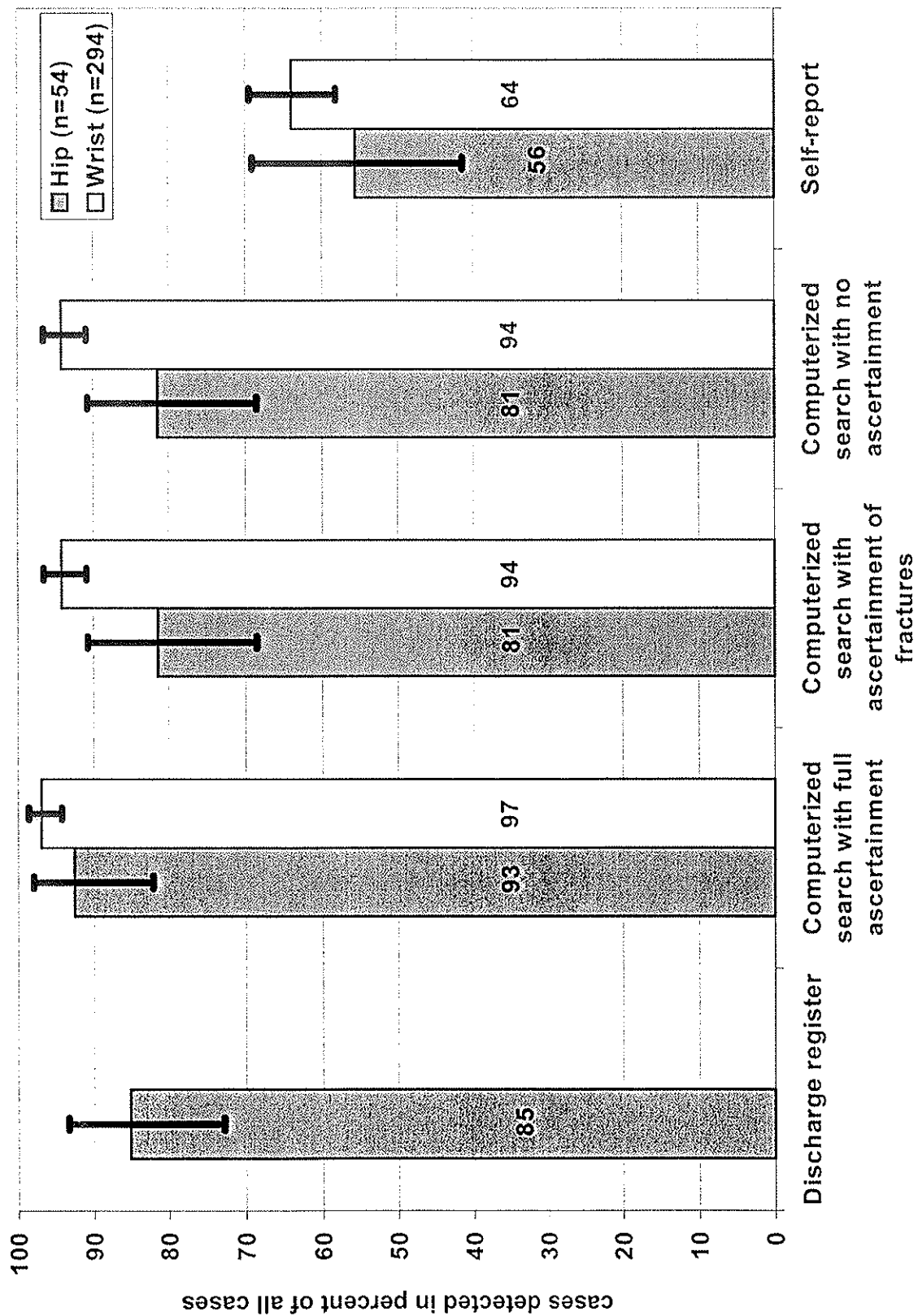
† The category of other includes fractures in os coccyx, ribs, lower-arm (not wrist), sternum, mandible, shaft of upper arm and shaft of femur.

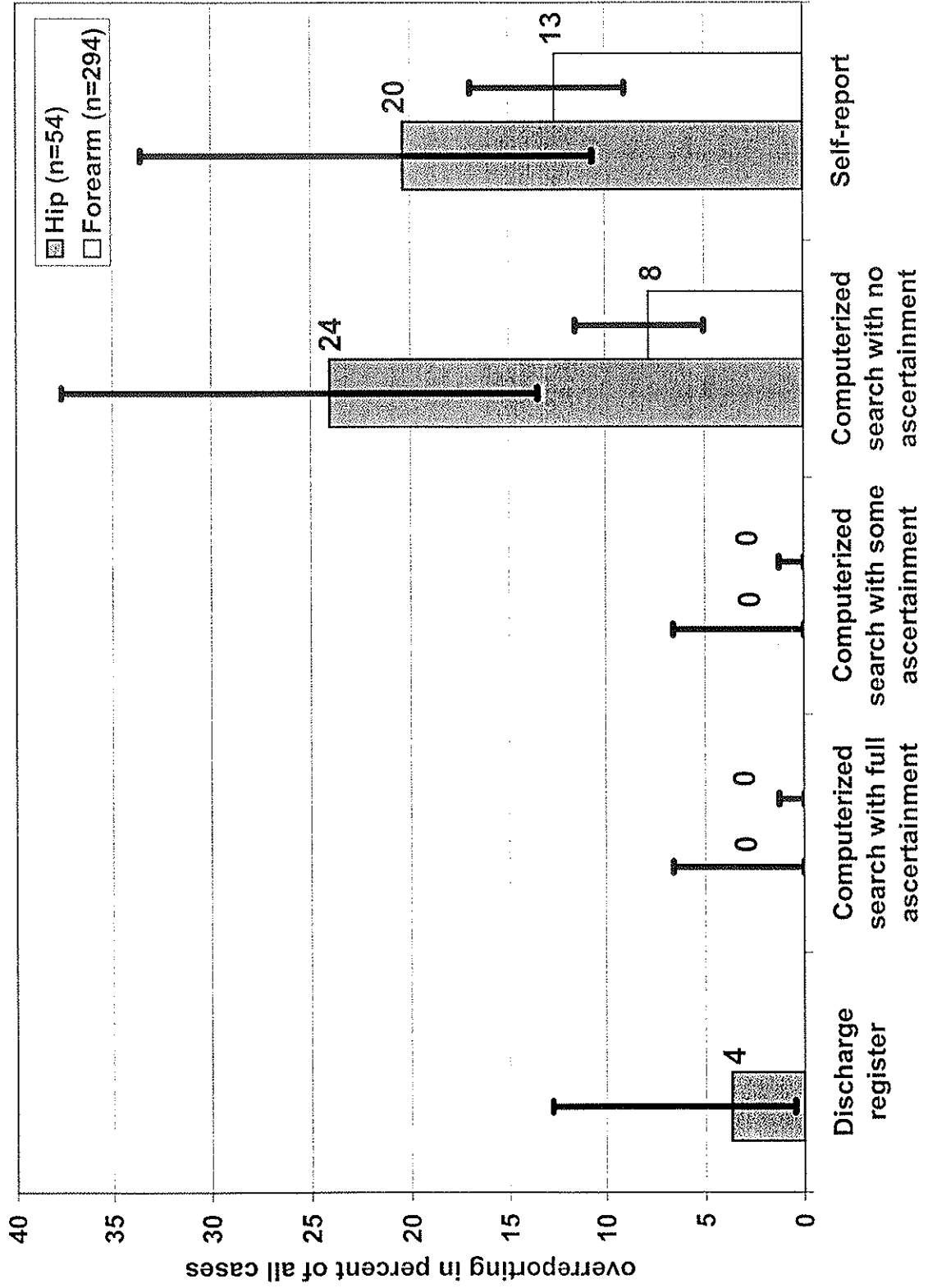
Figure 1

Comparison of fracture registration methods: Percentage of all persons with fracture detected by different registration methods among 21,441 Tromsø residents from 1988 to 1995. (With 95 percent confidence intervals).

Figure 2

Overreporting by different registration methods among 21,441 Tromsø residents from 1988 to 1995. Number of persons registered with a fracture, but with no verified fracture, - in percent of persons with verified fracture. (With 95 percent confidence interval).





Paper II

Original Article

The Tromsø Study: Body Height, Body Mass Index and Fractures

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Abstract. Tall persons suffer more hip fractures than shorter persons, and high body mass index is associated with fewer hip and forearm fractures. We have studied the association between body height, body mass index and all non-vertebral fractures in a large, prospective, population-based study. The middle-aged population of Tromsø, Norway, was invited to surveys in 1979/80, 1986/87 and 1994/95 (The Tromsø Study). Of 16 676 invited to the first two surveys, 12 270 attended both times (74%). Height and weight were measured without shoes at the surveys, and all non-vertebral fractures in the period 1988–1995 were registered (922 persons with fractures) and verified by radiography. The risk of a low-energy fracture was found to be positively associated with increasing body height and with decreasing body mass index. Furthermore, men who had gained weight had a lower risk of hip fractures, and women who had gained weight had a lower risk of fractures in the lower extremities. High body height is thus a risk factor for fractures, and 1 in 4 low-energy fractures among women today might be ascribed to the increase in average stature since the turn of the century. Low body mass index is associated with a higher risk of fractures, but the association is probably too weak to have any clinical relevance in this age category.

Keywords: Anthropometry; Body mass index; Fractures; Stature

Introduction

In most of the western world, the incidence of hip fractures has increased dramatically during the last decades, even when adjusted for age [1]. Studies on fractures at other locations are few, but they indicate a similar pattern [2]. The explanation for this development is unknown, although a more sedentary lifestyle is likely to explain the increase at weight-bearing sites in part [3]. Average body height has also increased substantially during the last decades: Norwegian army recruits are approximately 10 cm taller today than 100 years ago [4], and women are also taller [5]. As high body height is a known risk factor for hip fractures [6–10], this increase in height can possibly explain some of the increase in hip fracture incidence. Similarly, height differences might explain regional differences in hip fracture risk [11]. The reasons we are taller today are probably a more optimal diet and a better general standard of living: height is an indicator of public health [12,13] and is a sensitive within-population marker of socio-economic status. If body height is a risk factor not only for hip and forearm fractures [7–9,11,14–16], the increase in age-adjusted fracture incidence may be due to a better standard of living. This is contrary to the current focus on sedentary lifestyle, smoking and other unhealthy habits.

Being lean has been considered healthy, mostly because of a lower risk of cardiovascular disease [18]. A low body mass index, however, is a risk factor for hip fractures among the elderly [6,9,10,19–24], and weight gain has been shown to be protective [9,20]. One study suggests, however, that any change in body weight is a risk factor for hip fractures [25]. Distal radius fractures have in one study been shown to be less frequent among those with a high body mass index [9], but others have found no statistically significant associations between weight and distal forearm [17,26,27] or proximal

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humerus fractures [26]. We have studied the association between non-vertebral fractures and height, body mass index, and change in body mass index.

Materials and Methods

Subjects

Tromsø is a Norwegian city with 55 000 inhabitants. The Tromsø Study is based on four population surveys in 1974, 1979/80, 1986/87 and 1994/95. In this study we have used information from the last three surveys. All men born in 1925–59 and women born in 1930–59 were invited to the second survey; the third survey also included those born in 1960–66 [28]. Of 16 676 persons invited to surveys II and III, 12 270 (74%) attended both. Ten thousand four hundred and forty-one (92.4%) of those alive and still living in Tromsø attended the survey in 1994/95. Follow-up time was assigned from 1 January 1988 to date of fracture (first fracture in the respective category which is analysed) or to 31 December 1995. Among the 12 270 who attended, 972 had migrated or died before the end of follow-up, and these were assigned a follow-up time to date of fracture or to 31 December 1991 (halfway through follow-up). Those with invalid height/weight measurements ($n = 173$) were excluded from the analyses, giving a final study population of 12 097 persons.

Questionnaires and Measurements

The questionnaires have been described in detail elsewhere [28,29]. They contained questions about previous and current diseases, medication, diet, physical activity, alcohol consumption, smoking and several other parameters. Height and weight were measured once at each survey. The subject wore light clothing without shoes. Height was measured to the nearest centimetre with a wall-mounted ruler – a method that has been shown to be as precise as a stadiometer [30]. Height and/or weight measurement was considered invalid in the following instances: pregnancy, disablement, refusal to take shoes off, or refusal for any other reason. The questionnaire in the last survey (1994/95) included self-reported hip fractures and forearm fractures, and the age at which they were suffered.

Fractures

Non-vertebral fractures that had occurred in the study population were sought in the radiographic archives of the University Hospital by computer linkage using the 11-digit national personal identification number. All fractures suffered by persons in the cohort are registered here, as the University Hospital is the only hospital in Tromsø, and there is no other radiography service in the

city or within 250 km. The only exception to this would be fractures occurring while travelling with no control radiograph after returning home. The radiologists describe the radiographic examination in full text, and they assign a diagnostic code. To ensure complete registration and to categorize the trauma mechanism as low-energy (fall from standing height, not a traffic accident), pathological (tumour or metastasis) or high-energy (fall from a height or traffic accident), we checked all referrals and full text descriptions of examinations with any pathology ($n = 12 509$). We found no additional fractures when also checking a random sample of 1044 descriptions coded as normal. There was complete 11-digit personal identification number on 90% of radiographic examinations performed. From the 10% without a complete number, we selected those with registered fractures (by code) in the archives and searched for them in our cohort by date of birth, finding 23 additional persons with fractures (1.8% of all persons with fracture).

Among the persons who attended surveys II and III, 922 had suffered 1048 fractures, of which 866 (82.6%) could be classified according to trauma mechanism.

As a proxy for vertebral fractures, we used change in body height between survey III (1986/87) and survey IV (1994/95).

Validation of Fracture Registration

To validate the registration at the department of radiology, we checked 550 patients registered in 1994 with fracture of hip, distal forearm or ankle at other departments in the hospital in 1994. Of these, only one had been missed by the radiography archive. From our cohort we also chose a random sample of 1000 persons and checked the actual envelopes in the archive, finding 68 fractures of which only one had not been identified by our initial registration.

To further validate the recording of fractures, we compared self-reported (in the survey in 1994/95) hip and forearm fractures in the follow-up period with fractures found in the computer linkage. Of 33 self-reported hip fractures, eight were erroneously reported (24.2%) (6 were fractures of the shaft of femur, 1 was suffered before the follow-up period and 1 had had a hip replacement without any preceding fracture). We had recorded 23 of the 25 reported fractures (92.0%). Of 202 self-reported forearm fractures, 26 were erroneously reported (12.9%) (13 had a negative radiograph of the forearm at the time of the alleged fracture, 10 had a forearm fracture before the follow-up period, 3 had a fracture in the upper arm). We had recorded 166 of the 176 reported forearm fractures (94.3%).

Statistical Analysis

Our main independent variables were stature, body mass index (weight divided by stature squared) and change in

body mass index between the two surveys. In different models we have used different fractures at different locations as dependent variable. The independent variables have been analysed both as continuous variables and grouped into quartiles. To choose which variables to adjust for, variables that might be associated with stature and/or weight, and that are known or suspected risk factors for fractures, were included one at a time in a model with the variable of interest (height, body mass index or change in body mass index) and age. If the effect of stature, body mass index or change in body mass index changed, the variable was included in the final model. Possible interaction was checked by including interaction terms in the regression analyses and by stratified analyses. The data have been analysed by χ^2 , Mantel-Haentzel- χ^2 , and Cox proportional-hazard regression and multiple regression in SAS [31]. In the analyses of the association between stature and body height loss, stature was calculated as the mean of the height measurement in 1986/87 and 1994/95 in order to avoid the effect of regression to the mean [32].

Results

The age of the study-population ranged from 32 to 66 years for men (mean 48.7 years, SD 9.3) and from 32 to 61 years for women (mean 45.9 years, SD 7.8) in the middle of the follow-up period (31 December 1991). Among the 12097 subjects we found 922 persons with 1048 verified fractures, of which 648 (61.8%) were categorized as low-energy (Table 1).

Stature and Fractures

Body height decreased with age among both men and women (Table 2). Analyzed as a continuous variable, stature in women was associated with a higher risk ($p < 0.05$) of all fractures, hip fractures and fractures in the upper and lower extremities when adjusted for age.

Among men, a similar trend was found for all fractures. Persons in the top quartile of height had a relative risk of 1.3 (CI 1.0–1.7) among men and 1.4 (CI 1.1–1.8) among women when compared with those in the lowest quartile with respect to all fractures. The point estimates were higher when only low-energy fractures were included in the analyses (Table 3).

High body height was negatively associated with height loss between 1986/87 and 1994/95 among both men and women when analyzing both height loss and stature as continuous variables and adjusting for age ($p < 0.001$). Relative risk of height loss of 2 cm or more in height quartile 4 compared with quartile 1 adjusted for age was 0.7 (0.5–0.9) among men and 0.9 (0.7–1.2) among women.

Table 1. Number of persons who suffered a fracture in the period from 1 January 1988 to 31 December 1995 among those who attended surveys in 1979/80 and 1986/87^a

Fracture location	Men (n=6136)		Women (n=5961)	
	All	Low-energy (%) ^b	All	Low-energy (%) ^b
All fractures	439	54.7	483	75.2
Upper extremities	243	55.1	296	80.7
Proximal humerus	26	65.4	33	84.8
Wrist	71	60.6	192	88.0
Hand (except fingers)	51	49.0	20	60.0
Fingers	64	45.3	28	60.7
Other sites	40	52.5	33	63.6
Lower extremities	186	53.2	191	63.9
Hip	12	50.0	20	75.0
Knee	16	50.0	10	60.0
Ankle	57	71.9	76	73.7
Foot (except toes)	48	39.6	40	52.5
Toes	17	35.3	27	51.9
Other sites	39	51.3	24	45.8
Other sites	27	40.7	14	78.6

^aPersons might have more than one fracture, hence the same person might be found in several categories of fracture.

^bThe percentage of all fractures (including those for which the trauma mechanism was unknown) classified as low-energy.

Table 2. Stature (average from the surveys in 1979/80 and 1986/87; cm), body mass index (BMI; kg/m²) in 1986/87, change in BMI from 1979/80 to 1986/87, and change in stature from 1986/87 to 1994/95 according to age group at 31 December 1991

Age group (years)	Men					Women				
	n	Stature (SE)	BMI (SE)	BMI change ^a (SE)	Stature change (SE)	n	Stature (SE)	BMI (SE)	BMI change ^a (SE)	Stature change (SE)
32–41	1550	178.2 (0.2)	24.3 (0.1)	1.0 (0.0)	–0.1 (0.0)	1906	164.8 (0.1)	22.4 (0.1)	0.8 (0.0)	0.1 (0.0)
42–51	2266	177.1 (0.1)	25.1 (0.1)	0.7 (0.0)	–0.3 (0.0)	2480	164.2 (0.1)	23.6 (0.1)	1.0 (0.0)	–0.3 (0.0)
52–61	1569	175.8 (0.2)	25.4 (0.1)	0.4 (0.0)	–0.4 (0.0)	1575	162.3 (0.2)	24.7 (0.1)	0.7 (0.0)	–0.7 (0.1)
62–66	751	174.9 (0.2)	25.3 (0.1)	0.2 (0.1)	–0.4 (0.1)					
<i>p</i> for trend		<i>p</i> < 0.001	<i>p</i> < 0.001	<i>p</i> < 0.001	<i>p</i> < 0.001		<i>p</i> < 0.001	<i>p</i> < 0.001	NS	<i>p</i> < 0.001
All	6136	176.8 (0.1)	25.0 (0.0)	0.6 (0.0)	–0.3 (0.0)	5961	163.9 (0.1)	23.5 (0.1)	0.8 (0.0)	–0.3 (0.0)

SE, standard error of the mean.

^aCorrect number of persons with respect to BMI change is 6043 for men and 5816 for women, due to some missing data. With respect to stature change, there were 5132 men and 5160 women (only measured on those that also attended in 1994/95).

Table 3. Relative risk of low-energy fracture according to stature in quartiles among 12 097 persons attending surveys in 1979/80 and 1986/87

	Men				Women				
	Stature (cm)	Fracture	RR	RR ^a (95% CI)	Stature (cm)	Fracture	RR	RR ^a (95% CI)	
All fractures	< 172 cm	41	1.0	1.0	< 160	86	1.0	1.0	
	172-175	56	1.5	1.5 (1.0-2.3)	160-163	90	1.1	1.2 (0.9-1.6)	
	176-179	53	1.3	1.4 (0.9-2.1)	164-167	83	1.1	1.2 (0.9-1.6)	
	≥ 180	90	1.6	1.7 (1.1-2.4)	≥ 168	104	1.2	1.6 (1.2-2.1)	
	Per cm increase			1.02 (1.00-1.04)	Per cm increase			1.03 (1.01-1.05)	
Upper extremities	< 172 cm	27	1.0	1.0	< 160	63	1.0	1.0	
	172-175	31	1.2	1.4 (0.8-2.3)	160-163	61	1.0	1.1 (0.8-1.6)	
	176-179	25	1.1	0.9 (0.5-1.6)	164-167	50	1.0	1.0 (0.7-1.4)	
	≥ 180	51	1.4	1.4 (0.9-2.3)	≥ 168	65	1.1	1.4 (0.9-1.9)	
	Per cm increase			1.01 (0.98-1.03)	Per cm increase			1.02 (1.00-1.05)	
Lower extremities	< 172 cm	13	1.0	1.0	< 160	20	1.0	1.0	
	172-175	23	1.9	1.8 (0.9-3.6)	160-163	31	1.7	1.7 (1.0-2.9)	
	176-179	27	1.9	2.2 (1.1-4.0)	164-167	31	1.4	1.8 (1.0-3.2)	
	≥ 180	36	1.9	2.1 (1.1-4.0)	≥ 168	40	1.8	2.5 (1.5-4.3)	
	Per cm increase			1.03 (0.99-1.06)	Per cm increase			1.05 (1.01-1.08)	

Number of persons in stature-quartiles: Men: Q1, 1426; Q2, 1307; Q3, 1412; Q4, 1991; Women: Q1, 1555; Q2, 1456; Q3, 1421; Q4, 1529.

^aAdjusted for age.

Table 4. Relative risk of low-energy fracture according to body mass index (BMI) in quartiles among 12 097 persons attending surveys in 1979/80 and 1986/87

	Men				Women				
	BMI (kg/m ²)	Fracture	RR	RR ^a (95% CI)	BMI (kg/m ²)	Fracture	RR	RR ^a (95% CI)	
All fractures	< 23.0	66	1.0	1.0	< 21.1	77	1.0	1.0	
	23.0-24.6	74	1.1	1.1 (0.8-1.5)	21.2-22.7	95	1.2	1.1 (0.8-1.5)	
	24.7-26.7	51	0.8	0.8 (0.5-1.2)	22.8-25.0	102	1.2	0.9 (0.7-1.3)	
	≥ 26.8	49	0.8	0.8 (0.5-1.2)	≥ 25.1	89	1.1	0.8 (0.6-1.1)	
	Per kg/m ² increase			0.96 (0.92-1.01)	Per kg/m ² increase			0.96 (0.93-0.99)	
Upper extremities	< 23.0	38	1.0	1.0	< 21.1	51	1.0	1.0	
	23.0-24.6	43	1.2	1.1 (0.7-1.7)	21.2-22.7	63	1.3	1.1 (0.7-1.6)	
	24.7-26.7	27	0.8	0.8 (0.5-1.2)	22.8-25.0	64	1.3	0.9 (0.6-1.2)	
	≥ 26.8	26	0.8	0.7 (0.4-1.2)	≥ 25.1	61	1.2	0.8 (0.5-1.1)	
	Per kg/m ² increase			0.94 (0.89-1.01)	Per kg/m ² increase			0.95 (0.92-0.99)	
Lower extremities	< 23.0	27	1.0	1.0	< 21.1	26	1.0	1.0	
	23.0-24.6	30	1.0	1.0 (0.6-1.8)	21.2-22.7	30	1.0	1.0 (0.6-1.8)	
	24.7-26.7	22	0.8	0.8 (0.4-1.4)	22.8-25.0	37	1.2	1.1 (0.6-1.8)	
	≥ 26.8	20	0.7	0.8 (0.4-1.4)	≥ 25.1	29	1.1	0.8 (0.5-1.4)	
	Per kg/m ² increase			0.98 (0.92-1.06)	Per kg/m ² increase			0.96 (0.91-1.02)	

Number of persons in BMI quartiles: Men: Q1, 1549; Q2, 1562; Q3, 1518; Q4, 1507; Women: Q1, 1447; Q2, 1483; Q3, 1559; Q4, 1472.

^aAdjusted for age.

The analyses on stature and fractures and on stature and height loss did not change substantially after adjustment for body mass index, occupational and recreational physical activity, tobacco smoking, level of education, coffee and milk consumption, age at menarche, menopausal status, number of children or use of oestrogen (last four factors among women only), although some of the results changed from just statistically significant ($p = 0.03-0.04$) to borderline significance ($p = 0.05-0.08$) when adjusted. There was no interaction with the above-mentioned factors or with age.

Body Mass Index and Fractures

Body mass index increased with age among both men and women, while change in body mass index decreased with age, especially among men (Table 2). Analyzed as a continuous variable, body mass index in women was significantly ($p < 0.05$) associated with a lower risk of all fractures, fractures in upper extremities, wrist and hip when adjusted for age. Among men, the point estimates were similar, but they did not reach statistical significance. The association was stronger when including only low-energy fractures (Table 4). When analyzing

body mass index grouped into quartiles, none of the single estimates was statistically significant, but the trends were apparent (Table 4). The analyses on body mass index and fractures did not change substantially after adjustment for stature, occupational and recreational physical activity, tobacco smoking, level of education, coffee and milk consumption, age at menarche and menopause, number of children or use of oestrogen (last four factors among women only), and there was no interaction with the above-mentioned factors or with age, although some of the results changed from just statistically significant ($p=0.03-0.04$) to borderline significance ($p=0.05-0.08$) when adjusted.

Change in body mass index was not associated with fractures among men, except for a lower incidence of hip fractures (not only low-energy) among those who had gained weight (RR 0.69, CI 0.50-0.95, age adjusted per unit BMI increase). Women who had increased their body mass index had a lower risk of all low-energy fractures (RR 0.95, CI 0.90-1.01, age adjusted per unit BMI increase) and of low-energy fractures in the lower extremities (RR 0.88, CI 0.80-0.97, age adjusted per unit BMI increase). This did not change when adjusting for change of habits with respect to smoking and physical activity. There was no interaction with age.

Discussion

We have found that high stature and low body mass index were risk factors for low-energy fractures among middle-aged men and women. Furthermore, men who had gained weight had a lower risk of hip fractures, and women who had gained weight had a lower risk of fractures in the lower extremities.

Selection Bias, Information Bias and Confounding

The eligible study population does not include those who had moved between the two surveys II and III (1979/80-1986/87), neither does it include students temporarily living in Tromsø. However, external validity should be good, as all regular residents of a 'normal' community are in the eligible population. The potential for selection bias in the study is not large, with more than 70% of the eligible population included in the analyses.

There is probably some information bias in the study. Height was measured to the nearest centimetre, and both height and weight were measured only once at each visit. However, similar height measurements have been found to be very reliable [33]. Furthermore, any misclassification is probably non-differential: there is no reason to believe that height or weight was measured differently according to future risk of fractures. Thus, if there is misclassification, the relative risk estimates are underestimated.

We have checked the results for possible confounding factors. We have not chosen which confounding factors to include according to statistical significance of the

factor because confounding is not dependent on sample size. The selection of possible confounding factors might be questioned, as some of the factors are only suspected risk factors for fractures. No factor apart from age, however, turned out to confound the results substantially, suggesting that there is an effect of stature and body mass index on fracture risk, independent of other factors. Furthermore, this effect is not modified by age, lifestyle or reproductive factors.

Fractures Attributable to Time Trend of Stature

In this study cohort, women aged 52-61 years were on average 2.5 cm shorter than women aged 32-41 years, and men aged 62-66 years were on average 3.3 cm shorter than men aged 32-41 years. This complies closely with official statistics on stature among Norwegian conscripts [4], and with results from large population surveys on both women and men [5]. Calculated from the analyses on stature as a continuous variable, and with estimates from Norwegian conscripts on time trend of stature (increase from 1900 was 9.9 cm and from 1952 it was 3.7 cm), 1 in 4 low-energy fractures among women might be ascribed to the increase in average stature since 1900 (Table 5). (Formula: Attributable risk = $(RR - 1)/RR$, and $RR = (\text{regression estimate})^{(\text{height increase})}$).

Table 5. Proportion of low-energy fractures among women in the study cohort, that might be ascribed to increased stature in recent decades, calculated from risk estimates in models with stature as continuous variable

Fracture location	RR per cm, age adjusted	Attributable risk to height increase from 1952 (%)	Attributable risk to height increase from 1900 (%)
All fractures	1.029**	10	25
Upper extremities	1.024*	8	21
Wrist	1.019	7	17
Lower extremities	1.045**	15	35
Ankle	1.031	11	26
Hip	1.119**	34	67

* $p < 0.05$; ** $p < 0.01$.

Stature and Fractures

A considerable proportion of the present low-energy fractures might be ascribed to the presently higher average stature than some decades ago, even though the calculations must be considered with caution, as such theoretical calculations always carry uncertainty. The proposed mechanism of the association between hip fractures and height, has been that higher body height gives more force in falls [34,35], moreover, height is possibly a surrogate measure of geometric properties of

the hip [11,36,37]. A similar explanation is plausible for the association of height with other fractures: tall people suffer more fractures because they fall harder, and they have longer bones giving longer moment arms for the forces in the fall.

Body height is not a treatable risk factor; moreover body height is a correlate of standard of living. Thus, our findings have little practical clinical relevance, but they can partly explain the epidemic of osteoporotic fractures in recent decades: our lives have become so healthy that we reach a higher body height potential, and hence increase our risk of fractures.

Body Mass Index and Fractures

We have found that women with a high body mass index are at a somewhat lower risk of low-energy fractures than lean women. The point estimates suggest the same relation for men, without reaching statistical significance. There is, however, no apparent threshold, as proposed for hip fractures [23], and the association between body mass index and all fractures is weaker than previously suggested for hip fractures [6,19,22,23]. Body mass may influence fracture risk in three different ways: (1) energy on impact in a trauma is dependent on body mass [34,35], (2) body mass is positively correlated with bone mass [38], (3) and body mass is correlated with the amount of soft tissue protecting the underlying skeletal structures [34]. The last factor is probably important at sites with substantial amounts of soft tissue covering the skeleton, as at the hips [34]. However, our material included mostly fracture sites not covered with much soft tissue (wrists, ankles, hands and feet), making the association with bone mass the more likely explanation.

There was no association between change in body mass index and all fractures, either among men or women. The weak 'protective' effect of weight gain with respect to fractures in lower extremities among women and hip fractures among men is consistent with the findings of the study by Cummings et al. [20]. We did not find that change in body mass index in any direction increased the risk of fracture, as proposed with respect to hip fractures [25], nor did we find an increased risk of non-vertebral fractures with weight loss, as recently found among elderly women [39]. In our study, we had the statistical power to detect a relative risk of 1.5 with respect to forearm fractures and 1.9 with respect to hip fractures for each sex separately. Due to this limited power, our confidence intervals when doing subanalyses on change in body mass index grouped as increase/no change/decrease were wide. An effect of weight change thus cannot be completely ruled out.

Our findings on body mass index and fractures do have clinical relevance: the association between body mass index and fractures is so weak that any protective effect of extra weight on fractures is probably lost in the increased risk of cardiovascular disease and diabetes. Thus, patients should still be advised to have a 'normal

weight', or they should at least avoid overweight, according to present guidelines on the definition of a healthy weight [40,41].

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Paper III

1950

The Tromsø Study: Physical Activity and the Incidence of Fractures in a Middle-Aged Population

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ABSTRACT

We have studied the relation of occupational and recreational physical activity to fractures at different locations. All men born between 1925 and 1959 and all women born between 1930 and 1959 in the city of Tromsø were invited to participate in surveys in 1979–1980 and 1986–1987 (The Tromsø Study). Of 16,676 invited persons, 12,270 (73.6%) attended both surveys. All nonvertebral fractures ($n = 1435$) sustained from 1988 to 1995 were registered in the only hospital in the area. Average age in the middle of the follow-up period (December 31, 1991) was 47.3 years among men and 45.1 years among women, ranging from 32 to 66 years. Fracture incidence increased with age at all locations among women, but it decreased with or was independent of age among men. Low-energetic fractures constituted 74.4% of all fractures among women and 55.2% among men. When stratifying by fracture location, the most physically active persons among those 45 years or older suffered fewer fractures in the weight-bearing skeleton (relative risk [RR] 0.6, confidence interval [CI] 0.4–0.9, age-adjusted), but not in the non-weight-bearing skeleton (RR 1.0, CI 0.7–1.2, age-adjusted) compared with sedentary persons. The relative risk of a low-energetic fracture in the weight-bearing skeleton among the most physically active middle-aged was 0.3 (CI 0.1–0.7) among men and 0.9 (CI 0.4–1.8) among women compared with the sedentary when adjusted for age, body mass index, body height, tobacco smoking, and alcohol and milk consumption. It seems that the beneficial effect on the skeleton of weight-bearing activity is reflected also in the incidence of fractures at different sites. (*J Bone Miner Res* 1998;13:1149–1157)

INTRODUCTION

OSTEOPOROSIS AND OSTEOPOROTIC fractures have become an epidemic in the industrialized world, and prospects on the incidence of hip fractures suggest a further increase, even if age-specific incidence is retained at the present level.^(1,2) The knowledge of hip fracture etiology, epidemiology, consequences, and costs is extensive, at least for fractures occurring in women.⁽³⁾ Both crude and age-specific incidence of other fractures has also increased, and they also involve high costs.^(4,5) Apart from fractures of the distal forearm and humerus, the knowledge about risk factors for other fractures is scarce. A more sedentary lifestyle

today than some decades ago is most often mentioned as a reason for the rise in age-specific incidence of fractures.⁽⁶⁾ High physical activity has been shown to be associated with a lower incidence of hip fractures,⁽⁷⁾ while studies on physical activity and other fractures are few and have given ambiguous results.^(8–13)

A large number of studies focus on the positive relationship between physical activity and bone mass.^(14,15) Many of these indicate an effect on fracture incidence, overlooking the fact that physical activity might affect fracture incidence through other mechanisms than bone quality and quantity. The purpose of this study was to examine the effect of physical activity, both at work and in leisure time, and

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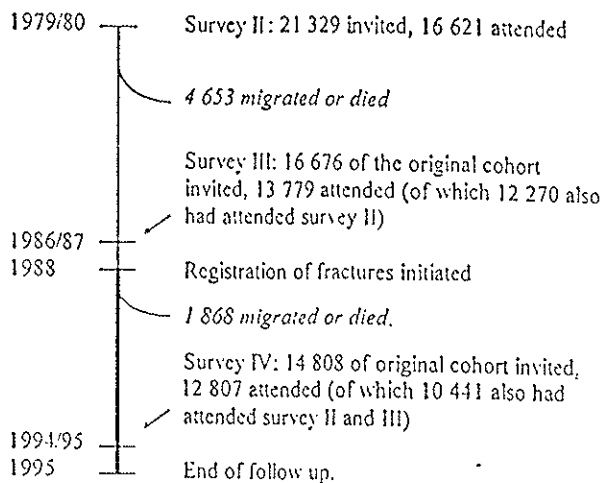


FIG. 1. Flowchart for study-cohort including all men born 1925–1959 and all women born 1930–1959 in the Tromsø population by 1979.

change of this activity on the incidence of fractures in Tromsø, Norway.

MATERIALS AND METHODS

Subjects

The Tromsø study is based on information gathered through population surveys in 1974, 1979–1980, 1986–1987, and 1994–1995. We have used information from the last three surveys. All males born 1925–1959 and all females born 1930–1959 were invited to the surveys⁽¹⁶⁾ (Fig. 1). The 16,676 persons invited to survey II and III constitute the study population; 12,270 (73.6%) attended both surveys. Among persons 45 years of age or older, 77.0% of the men and 86.3% of the women had attended both surveys. Follow-up time was assigned from January 1, 1988 to date of fracture or to end of follow up (December 31, 1995). The 1868 persons who had migrated or died before survey IV were assigned follow-up time to date of fracture or to December 31, 1991 (halfway through follow up).

Questionnaires and measurements

The questionnaires have been described elsewhere in detail.⁽¹⁷⁾ They included questions about diet, physical activity in leisure time and at work (Table 1), alcohol consumption, smoking, coffee and milk consumption, and several other parameters. The questions on physical activity have been shown to correlate both to physical fitness⁽¹⁸⁾ and to cardiovascular risk factors.⁽¹⁹⁾ At the examination height and weight were measured.

Fractures

Nonvertebral fractures that had occurred in the study population were sought in the X-ray archives of the University Hospital by computer linkage using the 11-digit

TABLE 1. QUESTIONS ASKED ABOUT PHYSICAL ACTIVITY TO 16,676 PERSONS INVITED TO SURVEYS IN 1979–1980 AND 1986–1987

Physical activity in leisure time:	
Exercise and physical exertion in leisure time. If your activity varies much, for example between summer and winter, then give an average. The questions refer only to the last 12 months. Tick the most appropriate box:	
Reading, watching TV, or other sedentary activity?	Yes <input type="checkbox"/> 1
Walking, cycling, or other forms of exercise at least 4 h a week? (Including cycling to place of work, Sunday walking, etc.)	<input type="checkbox"/> 2
Participation in recreational sports, heavy gardening, etc.? (Note: duration of activity at least 4 h a week.)	<input type="checkbox"/> 3
Participation in hard training or sports competitions regularly several times a week?	<input type="checkbox"/> 4
Physical activity at work:	
During the past year have you had: Tick the most appropriate box.	
Mostly sedentary work? (Office work, watchmaker, light manual work).	Yes <input type="checkbox"/> 1
Work requiring a lot of walking? (Shop assistant, light industrial work, teaching.)	<input type="checkbox"/> 2
Work requiring a lot of walking and lifting? (Postman, heavy industrial work, construction.)	<input type="checkbox"/> 3
Heavy manual labor? (Forestry, heavy farmwork, heavy construction.)	<input type="checkbox"/> 4

national personal identification number. All fractures suffered by persons in the cohort are registered here, because the University Hospital is the only hospital in Tromsø and there is no other X-ray service in the city or within 250 km. The only exception to this would be fractures occurring while traveling with no control X-ray after returning home. The radiologists describe the X-ray examination in full text, and they assign a diagnostic code. To ensure complete registration and to categorize the trauma mechanism as low-energetic (fall from same level, non-traffic accident), pathologic (tumor or metastasis) or high-energetic (fall from a height or traffic accident), we checked all referrals and full text descriptions of examinations with any pathology ($n = 12,509$). We found no additional fractures when also checking a random sample of 1044 descriptions coded as normal.

There was complete 11-digit personal identification number on 90% of X-ray examinations performed. From the 10% without a complete number, we selected those with registered fractures (by code) in the archives and searched for them in our cohort by date of birth, finding 23 additional persons with fractures (1.8% of all persons with fracture). Among those invited to survey II and III, it was possible to code 1175 of a total of 1435 fractures (81.9%) according to trauma mechanism.

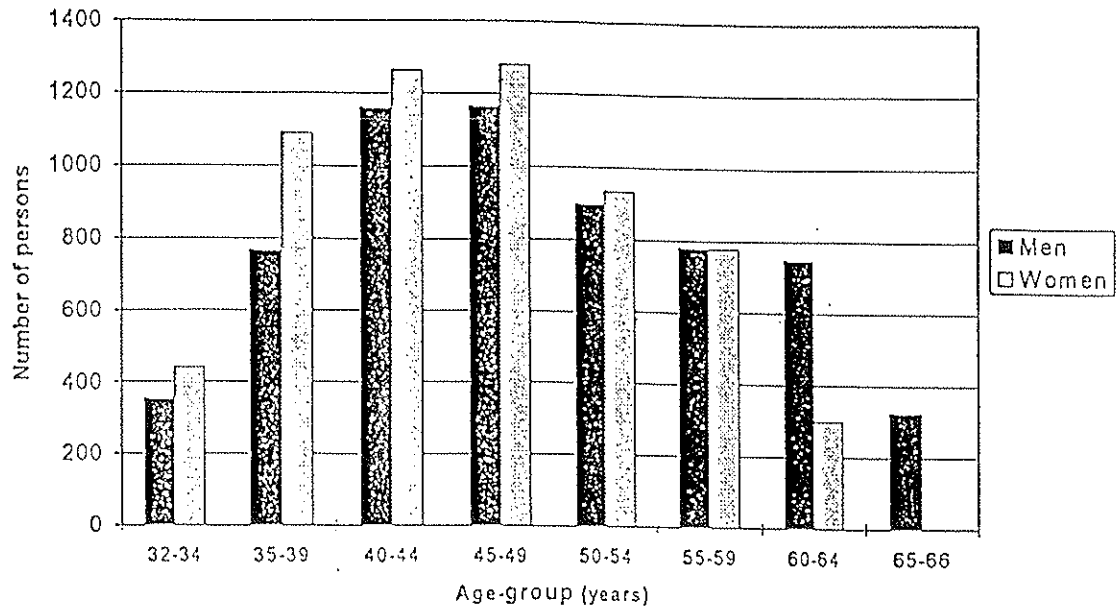


FIG. 2. Age distribution of study cohort by December 31, 1991 (halfway through follow up).

Validation of fracture registration

To validate the registration at the Department of Radiology, we checked 550 patients registered in 1994 with fracture of hip, distal forearm, or ankle at other departments in the Hospital in 1994. Of these, only one had been missed by the X-ray archive. From our cohort, we also chose a random sample of 1000 persons and checked the actual envelopes in the X-ray archive, finding 68 fractures, of which only 1 had not been identified by our initial registration.

To validate further the recording of fractures, we compared self-reported (in the survey in 1994-1995) hip and forearm fractures in the follow-up period with fractures found in the computer linkage. Of 33 self-reported hip fractures, 8 were erroneously reported (24.2%) (6 were fractures of the shaft of femur, 1 was suffered before the follow-up period, and 1 had had a hip replacement without any preceding fracture). We had recorded 23 of the 25 reported fractures (92.0%). Of 202 self-reported forearm fractures, 26 were erroneously reported (12.9%) (13 had a negative X-ray of the forearm at the time of the alleged fracture, 10 had a forearm fracture before the follow-up period, 3 had a fracture in the upper arm). We had recorded 166 of the 176 reported forearm fractures (94.3%).

Statistical analysis

The data was analyzed by χ^2 , Mantel-Haentzel χ^2 , and Cox proportional hazard regression analysis in SAS (SAS Institute, Cary, NC, U.S.A.).⁽²⁰⁾ In several analyses, there was interaction with age necessitating age-stratified presentation of all results. Fractures were grouped according to location and according to weight-bearing site or not (pelvis, hip, femur, knee, leg, ankle, and feet except toes vs. fingers, hands, wrists, elbows, upper arms, clavicle, face, skull, ster-

num, toes, and os coccyx). The two highest categories of physical activity were merged except for physical activity at work among men (Table 1). Change in physical activity was defined as no change, increase, or decrease.

When scoring physical activity, the variables were added and then grouped into approximate tertiles. The maximum total score was 16 (level four in occupational and recreational activity at both surveys), and the scores in the respective tertiles were: 4-7, 8-9, and ≥ 9 for men 45 years or older, and 4-6, 7-8, and ≥ 8 for women 45 years or older. Scores were made in a similar way for physical activity in leisure time, at work, all activity in 1979-1980, and all activity in 1986-1987.

RESULTS

Fractures

The average age in the middle of the follow-up period (December 31, 1991) was 47.3 (SD 9.5) years among men and 45.1 (SD 8.0) years among women (Fig. 2). Among the 16,676 persons invited to survey II and III, 1258 persons had suffered a total of 1435 fractures. Cumulative incidence of fractures was 7.3% among men and 7.8% among women (Table 2). Among women, 74.4% of the first fractures that occurred were low-energetic, while the corresponding number among men was 55.2 ($p < 0.001$). The gender difference was most pronounced in the upper extremities. The female/male ratio was 1.1 for all fractures, rising to 1.4 when including only low-energetic fractures. This ratio increased significantly with age for nearly all locations, even for typically "accidental" fracture sites, indicating that the incidence of all fractures declined with age among men but increased steeply with age among women (Table 3). In women, the proportion of fractures that were low-energetic increased statistically significantly with age with respect to

TABLE 2. NUMBER OF PERSONS WITH DIFFERENT FRACTURES AND CUMULATIVE INCIDENCES OF FRACTURES SUFFERED FROM 1988-1995 IN THE COHORT WHO WERE INVITED TO SURVEYS IN 1979-1980 AND 1986-1987 (n = 16,676)*

Fracture location	Men (n = 9012)			Women (n = 7664)		
	Persons with fracture	Cumulative incidence (%)	Low-energetic fractures (%)	Persons with fracture	Cumulative incidence (%)	Low-energetic fractures (%)
All fractures	661	7.3	365 (55.2)	597	7.8	444 (74.4)
upper extremities	348	3.9	192 (55.2)	354	4.6	283 (79.9)
proximal humerus	38	0.4	25 (65.8)	39	0.5	33 (84.6)
wrist	95	1.1	62 (65.3)	223	2.9	195 (87.4)
hand	80	0.9	37 (46.3)	27	0.4	15 (55.6)
finger	91	1.0	37 (40.7)	34	0.4	20 (58.8)
lower extremities	286	3.2	156 (54.5)	245	3.2	161 (65.7)
hip	20	0.2	13 (65.0)	27	0.4	21 (77.8)
ankle	97	1.1	69 (71.1)	95	1.2	70 (73.7)

* Persons might have suffered more than one fracture, hence the same person might be found in several categories of fracture. Thus, fractures at weight-bearing and non-weight-bearing sites add up to more than the total of 1258 persons with any fracture. Only first fracture at same site is included.

all fractures (from 67.9% among those below 35 years of age to 81.3% among those 55 years of age or older), fractures in the weight-bearing skeleton, and ankle fractures (from 50.0% among those below 35 years of age to 88.2% among those 55 years of age or older). In men, this proportion did not increase with age. High-energetic fractures constituted 26.6% among men and 11.7% among women.

Physical activity

Few persons practiced vigorous exercise regularly, and few women had jobs involving heavy labor (Table 4).

Physical activity and fractures

The analyses on physical activity and fractures include only persons that attended the surveys. Apart from a higher incidence of fractures in fingers and toes (data not shown) among the physically active, there was no apparent relation between physical activity and fractures among persons under the age of 45 years.

Among persons 45 years or older, there was no significant association between physical activity and overall incidence of fractures, apart from a lower incidence of all low-energetic fractures among physically active men. However, when stratifying by fracture location, 1979-1980 physical activity, both in leisure time and at work, was associated with a lower incidence of low-energetic fractures in the weight-bearing skeleton among men (Table 5). A similar relation was found with respect to 1986-1987 physical activity at work among women. Physical activity in leisure time in 1986-1987 was associated with a higher incidence of low-energetic fractures in the non-weight-bearing skeleton among

men (Table 5). When including all fractures in the analyses, the point estimates were closer to one, but the pattern was similar (data not shown).

There was no substantial difference between the effect of a score for physical activity in leisure time and a score for physical activity at work, with one exception: recreational, but not occupational, activity was associated with higher incidence of fractures in fingers and toes among older men (data not shown).

When making a total score out of physical activity, the most active men 45 years or older had less low-energetic fractures, especially in the weight-bearing skeleton, and women 45 years or older had more low-energetic fractures in the non-weight-bearing skeleton (Table 6). Among women 55 years or older, the most active women had lower risk of fractures in the weight-bearing skeleton (RR medium score 0.5 [0.2-1.0], RR high score 0.6 [0.3-1.2], age adjusted, compared with low score). Adjustment among women for estrogen use, age at menarche, menopausal status, and number of children did not change the estimates. Menopausal status did not modify the effect of physical activity on fractures.

When analyzing on all "non-low-energetic" fractures (including fractures that could not be classified with respect to trauma mechanism), the persons 45 years or older with physically demanding work had more fractures at non-weight-bearing sites, especially with respect to work in 1979-1980 among men (RR = 1.9 [1.1-3.3] and women (RR = 2.1 [1.0-4.2]), most active vs. sedentary, age-adjusted). The incidence of non-low-energetic fractures at weight-bearing sites was not associated with physical activity.

Change of physical activity was not associated with fractures, neither with respect to recreational nor occupational physical activity. Stratifying by physical activity in 1979-1980 did not change this result.

TABLE 3. NUMBER OF PERSONS WITH DIFFERENT FRACTURES AND INCIDENCES OF FRACTURES SUFFERED FROM 1988-1995 IN THE COHORT WHO WERE INVITED TO SURVEYS IN 1979-1980 AND 1986-1987

Fracture location	Men (n = 9012)			Women (n = 7664)			Female/male ratio (95% confidence interval)*	
	Persons with fracture	Person years at risk	Incidence pr. 10 ⁴ Pyar	Persons with fracture	Person years at risk	Incidence pr. 10 ⁴ Pyar		
All fractures								
28-37 years	167	13,165	127	71	13,360	53	0.4	(0.3-0.6)
38-47 years	218	23,785	92	187	23,098	81	0.9	(0.7-1.1)
48-57 years	160	17,150	93	255	15,458	165	1.8	(1.5-2.2)
58-65 years	93	9652	96	84	4039	208	2.2	(1.6-2.9)
66-70 years	23	1418	162	0	0			
Non-weight-bearing skeleton								
28-37 years	107	13,332	80	44	13,447	33	0.4	(0.3-0.6)
38-47 years	153	24,110	64	116	23,351	50	0.8	(0.6-1.0)
48-57 years	109	17,364	63	186	15,724	118	1.9	(1.5-2.4)
58-65 years	54	9798	55	61	4168	146	2.7	(1.8-3.8)
66-70 years	13	1471	88	0	0			
Wrist								
28-37 years	17	13,601	13	14	13,538	10	0.8	(0.4-1.7)
38-47 years	26	24,646	11	56	23,542	24	2.3	(1.4-3.6)
48-57 years	39	17,649	22	115	15,977	72	3.3	(3.3-4.7)
58-65 years	10	9963	10	38	4278	89	8.8	(4.4-17.7)
66-70 years	3	1515	20	0	0			
Hand								
28-37 years	30	13,554	22	2	13,577	2	0.1	(0.0-0.3)
38-47 years	32	24,604	13	13	23,695	6	0.4	(0.2-0.8)
48-57 years	8	17,712	5	7	16,324	4	0.9	(0.3-2.6)
58-65 years	9	9995	9	5	4471	11	1.2	(0.4-3.7)
66-70 years	1	1521	7	0	0			
Weight-bearing skeleton								
28-37 years	67	13,466	50	29	13,487	22	0.4	(0.3-0.7)
38-47 years	77	24,366	32	78	23,466	33	1.1	(0.8-1.4)
48-57 years	55	17,520	31	78	16,053	49	1.5	(1.1-2.2)
58-65 years	43	9868	44	26	4341	60	1.4	(0.9-2.2)
66-70 years	11	1472	75	0	0			

Relative risk of fracture among women compared with men stratified by age.

* All trends $p < 0.001$, tested by interaction term in Cox proportional hazard model with age as continuous variable.

DISCUSSION

Many elderly are afraid to participate in physical activity because they are afraid of falling and suffering fractures.⁽²¹⁾ This study suggests that among middle-aged people, the risk of the most disabling fractures, i.e., fractures in the lower extremities, is lower among the most physically active. It further shows that fracture incidence is independent of age among middle-aged men.

Selection bias, information bias, and confounding

The study population does not include those having migrated between the two surveys, neither does it include students temporarily living in Tromsø. However, external validity should be good because all regular residents of a

"normal" community is in the eligible population. The potential for selection bias in the study is limited, with more than 70% of the eligible population included in the analyses.

Even extensive questionnaires about physical activity have been shown to give misclassification, especially when assessing moderate physical activity.^(22,23) Thus, there is probably some misclassification with respect to physical activity, even though our questions have been found to give meaningful categories.^(13,19) Because our study is prospective and longitudinal, there is no reason to believe that our misclassification of physical activity will be differential: any misclassification as sedentary or active is not dependent on future fractures. Our relative risk estimates are therefore underestimates, whatever direction.⁽²⁴⁾ The misclassification of physical activity is probably larger among women

TABLE 4. DISTRIBUTION OF PHYSICAL ACTIVITY AND CHANGE OF PHYSICAL ACTIVITY IN 1979-1980 AND 1986-1987 AMONG THOSE WHO ATTENDED BOTH SURVEYS (n = 12,270)

Physical activity	< 45 years of age		≥ 45 years of age		
	Men % (n = 2276)	Women % (n = 2793)	Men % (n = 3910)	Women % (n = 3291)	
In leisure time in 1979/80	sedentary	19.8	23.9	19.6	20.3
	walking	41.2	63.8	49.5	65.7
	recreational sports	29.6	10.6	27.8	13.6
	vigorous exerciser	9.5	1.7	3.1	0.4
In leisure time in 1986/87	sedentary	23.4	24.5	21.9	23.5
	walking	45.8	65.5	57.1	67.9
	recreational sports	26.9	9.5	19.7	8.3
	vigorous exerciser	3.9	0.5	1.4	0.3
At work in 1979/80	mostly sitting	34.2	31.0	40.7	26.0
	walking	24.4	52.0	26.3	56.6
	walking/lifting	30.0	16.5	19.9	15.6
	heavy work	11.4	0.5	13.1	1.8
At work in 1986/87	mostly sitting	41.3	37.7	45.4	35.3
	walking	25.4	44.8	27.3	46.3
	walking/lifting	24.0	16.6	16.9	16.5
	heavy work	9.2	0.9	10.5	2.0
Change of activity in leisure time	reduced by 2 or 3 cat.	6.2	2.5	4.0	2.1
	reduced by 1 category	27.0	18.8	24.6	20.6
	unchanged	47.6	60.2	54.1	62.1
	increased by 1 category	16.2	16.7	15.7	14.5
	increased by 2 or 3 cat.	3.1	1.5	1.6	0.8
Change of activity at work	reduced by 2 or 3 cat.	9.8	3.5	6.3	3.0
	reduced by 1 category	18.8	18.9	16.2	19.2
	unchanged	53.1	60.2	63.7	62.3
	increased by 1 category	14.6	15.0	11.0	13.9
	increased by 2 or 3 cat.	3.7	2.5	2.9	1.7

because women traditionally have many tasks involving physical activity (while caring for small children or fragile elderly), which in a questionnaire might be misclassified, as found in another study on fractures.⁽²⁵⁾ Change of physical activity was a variable computed from two other variables (physical activity in survey II and III), both with some misclassification. Thus, the misclassification with respect to change is probably substantial. The fact that we do not know when a possible change occurred might also obscure the results. Our classification of fractures is valid, confirmed by our control procedures and self-reports.

Physical activity turns out to be associated with unchanged or increased incidence of fractures in the non-weight-bearing skeleton and decreased incidence of fractures in the weight-bearing skeleton. Most potential confounders affect either bone quality (hormones, smoking, etc.) or the risk of injurious falls (risk-seeking behavior, carelessness, etc.). Such confounders would probably either be a risk factor or a protective factor for all types of fractures, they would not differentiate between fractures in weight-bearing and non-weight-bearing skeleton. Thus, proper adjustment for all possible confounders might shift the general effect of physical activity on fractures, but the opposite effect on fractures in weight-bearing and non-weight-bearing skeleton would still be present.

Physical activity and fractures

Many studies have focused on different types of physical activity and bone mineral density (BMD) or bone turnover. It seems certain that immobility or weightlessness is detrimental to bones, but the exact relationship between level of physical activity and bone mass is not known. Animal studies and human observational studies suggest that loading or strain is an important stimulus for bone formation and that high intensity rather than many repetitions is necessary. Furthermore, the bone response seems to be site-specific, and continued increased load is necessary to keep a gain in bone mass. Cross-sectional studies suggest a substantial difference in BMD between sedentary and active persons, while intervention trials (duration mostly 1 year) have been less convincing; it seems that the physical activity needed to obtain gains in bone mass must be rather vigorous, and even then the gains are modest. (For recent reviews on physical activity and bone mass, see Refs. 14, 15, and 26.)

Our study was conducted in a general population, and there were not many persons practicing vigorous exercise regularly. Even so, physical activity was associated with a substantially reduced incidence of fractures at weight-bearing sites among the middle-aged, while it possibly increased fracture risk at other sites. This is somewhat surprising

TABLE 5. ASSOCIATION BETWEEN PHYSICAL ACTIVITY AT DIFFERENT TIMES AND THE CUMULATIVE INCIDENCE OF LOW-ENERGETIC FRACTURES FROM 1988-1995 AMONG PERSONS 45 YEARS OR OLDER IN THE COHORT WHO WERE INVITED TO SURVEYS IN 1979-1980 AND 1986-1987

Physical activity	Fracture location		Men			Women				
			Persons with fracture	n	RR age-adj.	95% Confidence interval	Persons with fracture	n	RR age-adj.	95% Confidence interval
Physical activity in leisure time 1979-1980	non-weight-bearing skeleton	low	18	765	1.0		42	668	1.0	
		medium	45	1930	1.0	(0.6-1.7)	145	2159	1.1	(0.8-1.5)
		high*	35	1206	1.2	(0.7-2.1)	22	461	0.8	(0.5-1.3)
	weight-bearing skeleton	low	22	765	1.0		19	668	1.0	
		medium	21	1930	0.4	(0.2-0.7)	54	2159	0.9	(0.5-1.5)
		high*	15	1206	0.4	(0.2-0.9)	8	461	0.6	(0.3-1.4)
Physical activity at work 1979-1980	non-weight-bearing skeleton	low	44	1589	1.0		59	854	1.0	
		medium -	23	1028	0.8	(0.5-1.3)	111	1857	0.8	(0.6-1.2)
		medium +	18	777	0.8	(0.5-1.5)	39	570	0.9	(0.6-1.4)
	weight-bearing skeleton	low	13	513	0.9	(0.5-1.7)	†			
		medium -	29	1589	1.0		22	854	1.0	
		medium +	15	1028	0.8	(0.4-1.5)	42	1857	0.9	(0.5-1.4)
		high	13	777	0.9	(0.5-1.7)	17	570	1.1	(0.6-2.0)
		high	1	513	0.1	(0.0-0.7)	†			
		high	1	513	0.1	(0.0-0.7)	†			
Physical activity in leisure time 1986-1987	non-weight-bearing skeleton	low	16	855	1.0		40	773	1.0	
		medium	50	2230	1.2	(0.7-2.1)	151	2233	1.3	(0.9-1.8)
		high*	32	824	2.0	(1.1-3.7)	18	283	1.3	(0.7-2.2)
	weight-bearing skeleton	low	14	855	1.0		19	773	1.0	
		medium	33	2230	1.0	(0.5-1.9)	52	2233	0.9	(0.5-1.6)
		high*	11	824	1.0	(0.5-2.2)	10	283	1.5	(0.7-3.2)
Physical activity at work 1986-1987	non-weight-bearing skeleton	low	51	1774	1.0		73	1160	1.0	
		medium -	22	1066	0.7	(0.4-1.2)	95	1520	1.0	(0.7-1.3)
		medium +	15	659	0.8	(0.4-1.4)	41	606	1.0	(0.7-1.5)
	weight-bearing skeleton	low	10	409	0.9	(0.4-1.7)	†			
		medium -	30	1774	1.0		38	1160	1.0	
		medium +	14	1066	0.8	(0.4-1.5)	31	1520	0.6	(0.4-1.0)
		medium +	9	659	0.8	(0.4-1.7)	12	606	0.6	(0.3-1.1)
		high	5	409	0.7	(0.3-1.7)	†			
		high	5	409	0.7	(0.3-1.7)	†			

* The two highest categories have been merged (see Table 1).

† The two highest categories of physical activity at work among women have been merged (see Table 1).

because studies on bone mass suggest that moderate physical activity is of little importance. However, even if moderate physical activity gives little gain in bone mass, a level of moderate physical activity over years might affect the age-related bone loss and consequently protect against fractures at weight-bearing sites, because the bone loss otherwise would have accumulated. A question on present physical activity is likely to reflect level of activity over many years, because habits, even good ones, die hard.⁽²⁷⁾ Thus, the cross-sectional studies, which show a larger effect of prolonged physical activity on bone mass than intervention trials (with a follow-up period of generally 1 year, but up to 4 years), might better reflect the effect of an active lifestyle over years than intervention trials. Large population-based studies (with few vigorous exercisers) support the premise that physical activity is associated with higher BMD at weight-bearing sites.^(9,28,29) However, one population-based study on ankle and foot fractures among elderly

women found vigorous physical activity to be a weak risk factor for ankle fractures.⁽¹¹⁾ However, their explicit question about vigorous exercise might describe something other than our categorization of mainly moderate physical activity, and their response rate of 8-19% makes the potential for selection bias substantial.⁽³⁰⁾ Another large study found no association between physical activity and osteoporotic fractures,⁽⁹⁾ which is consistent with our general finding underscoring that analyses should be stratified by fracture location.

The positive effect on weight-bearing sites in this study is not surprising, because most regular physical activity in our cohort probably was weight bearing (walking, work with loads, skiing, jogging, etc.). Physical activity might also be a parameter for time spent at risk for fracture, and it might be a parameter for risky behavior or risky jobs with respect to fractures, resulting in an increase of fractures at non-weight-bearing sites. Results from studies among runners

TABLE 6. ASSOCIATION BETWEEN TOTAL SCORE FOR ACTIVITY IN 1979-1980 AND 1986-1987, BOTH IN LEISURE TIME AND AT WORK, AND DIFFERENT LOW-ENERGETIC FRACTURES SUFFERED FROM 1988-1995 AMONG PERSONS 45 YEARS OR OLDER IN THE COHORT WHO WERE INVITED TO SURVEYS IN 1979-1980 AND 1986-1987

Fracture location	Score for physical activity	RR age-adj.	95% confidence interval	RR multiple-adj.*	95% confidence interval
Men					
all fractures	low	1.0		1.0	
	medium	1.0	(0.7-1.4)	0.9	(0.6-1.3)
	high	0.7	(0.5-1.1)	0.5	(0.3-0.8)
non-weight-bearing skeleton	low	1.0		1.0	
	medium	0.9	(0.5-1.5)	0.8	(0.4-1.3)
	high	1.0	(0.6-1.7)	0.6	(0.4-1.2)
weight-bearing skeleton	low	1.0		1.0	
	medium	1.0	(0.6-1.8)	1.0	(0.5-1.8)
	high	0.3	(0.1-0.8)	0.3	(0.1-0.7)
Women					
all fractures	low	1.0		1.0	
	medium	0.8	(0.6-1.1)	0.9	(0.6-1.3)
	high	0.9	(0.7-1.3)	1.3	(0.9-1.8)
non-weight-bearing skeleton	low	1.0		1.0	
	medium	0.8	(0.6-1.2)	1.0	(0.6-1.5)
	high	1.0	(0.7-1.5)	1.5	(1.0-2.3)
weight-bearing skeleton	low	1.0		1.0	
	medium	0.8	(0.5-1.4)	0.9	(0.5-1.7)
	high	0.8	(0.4-1.4)	0.9	(0.4-1.8)

* Adjusted for age, body mass index, body height, tobacco smoking, and milk, coffee, and alcohol consumption.

and former athletes might be interpreted to support this.^(12,13)

Physical activity might also lower fracture risk at weight-bearing sites through better balance and muscle strength, leading to fewer injurious falls. Among elderly, it seems that physical activity might reduce the risk of falling, but the activity must be designed for this purpose, and even if designed properly, the magnitude of the effect on injurious falls is still uncertain.⁽³¹⁻³⁴⁾ However, any such effect would probably also affect the risk of low-energetic fractures at other sites; therefore, it cannot explain the seemingly different effect of physical activity on fractures in weight-bearing and non-weight-bearing sites. (The effect on hip fractures might be special because physically active persons might be less prone to fall sideways when they fall.^(35,36) This cannot explain our results because they are mainly based on fractures at other locations.)

We did not find any association between physical activity and fractures (except fractures in fingers and toes) among persons under the age of 45 years. This may have several possible explanations, of which the most plausible is that the trauma is relatively more important than bone mass at young age because young bones are larger and more solid.

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Paper IV

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The Tromsø study: Alcohol consumption and tobacco smoking related to non-vertebral fractures in a middle-aged population.

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Abstract

We have studied the relation of alcohol consumption and tobacco smoking to non-vertebral fractures. All men born 1925-1959 and all women born 1930-1959 in the city of Tromsø were invited to surveys in 1979/80, 1986/87 and 1994/95 (The Tromsø Study). Of 16,676 invited persons, 12,270 (73.6 %) attended the two first surveys. All non-vertebral fractures (N = 935) sustained from 1988 to 1995 were registered in the only hospital in the area. Average age in the middle of the follow-up period was 48.8 years among men and 45.9 years among women, ranging from 32 to 66 years. The incidence of non-vertebral fractures was positively associated with tobacco smoking among men, but not among women. Frequency of inebriation and consumption of beer and spirits was associated with higher incidence of all non-vertebral fractures among both men and women, and these associations were stronger with respect to fractures in lower extremities. More frequent consumption of wine was associated with lower incidence of fractures. Among men, 18 % of all fractures could be ascribed smoking.

Keywords: Alcohol, Smoking, Tobacco, Osteoporosis, Fractures

Introduction

Studies on the relationship between alcohol consumption, tobacco smoking and fractures have mostly focused on hip or forearm fractures in women. In several large follow-up studies, the incidence of hip and/or forearm fractures is not related⁽¹⁻⁶⁾ or only weakly related to alcohol consumption⁽⁷⁾, while long-time female smokers seem to be at a higher risk of hip fractures⁽⁸⁾. Alcohol consumption increases the risk of injurious falls^(9, 10), but it is not associated with the incidence of falls in general⁽¹¹⁻¹³⁾. Alcohol consumption is, however, positively associated with bone mineral density^(14, 15), which should reduce fracture risk. It is therefore difficult from the present knowledge to predict how the risk of fractures is affected by alcohol consumption.

We hypothesize that alcohol consumption and tobacco smoking are weak risk factors for any non-vertebral fracture among middle-aged persons, and we have studied this relationship prospectively in a large population-based cohort. The population has been surveyed several times, we can therefore report on the effect of changes in these habits with respect to fractures.

Material and Methods

Subjects

The Tromsø study is based on information gathered through population surveys in 1974, 1979/80, 1986/87 and 1994/95. We have used information from the three most recent surveys. 16,676 males (born 1925-59) and females (born 1930-59) were invited in both 1979/80 and 1986/87. Of these, 12,270 persons (73.6 %) attended both surveys, of which 10,441 attended the 1994/95 survey. Average age in the middle of the follow-up period among the 12,270 attendees was 48.8 (SD 9.3) ranging from 32 to 66 years

among men and 45.9 (SD 7.9) ranging from 32 to 61 years among women. Follow-up time was assigned from January 1, 1988 to date of fracture or to end of follow-up (December 31, 1995). The 1,868 persons who had migrated or died before the 1994/95 survey were assigned follow-up time to date of fracture or to Dec. 31, 1991.

Questionnaires and measurements

The questions had, with few exceptions, given answer alternatives. The questionnaires have previously been described in detail elsewhere^(16,17). The questions on alcohol consumption in 1979/80 were as follows:

1. Are you a teetotaler?
2. If not, how often do you drink beer? Identical questions were asked with respect to wine and spirits.
3. Approximately how often in the past year have you drunk so much wine, beer and spirits that you got drunk?

Questions on alcohol consumption in 1986/87 were similar, except the question on inebriation, which reads:

Approximately how often in the past year have you drunk alcohol corresponding to at least 5 small bottles of beer, a bottle of wine, or a quarter bottle of spirits?

In the 1994/95 survey, identical questions were asked as in 1986/87, in addition there were questions on number of glasses of beer, wine or spirits usually consumed during a fortnight.

The questions on tobacco smoking included the following questions in all surveys:

1. Do you smoke daily at present?
2. If "yes", do you smoke cigarettes daily (hand-rolled or factory made)?

3. If you do not smoke cigarettes daily at present: Have you previously smoked cigarettes daily?
4. If “yes”, how long is it since you stopped?
5. For those who smoke or have smoked previously: How many years altogether have you smoked daily?
6. For those who smoke or have smoked previously: How many cigarettes do you, or did you, smoke daily? Give number of cigarettes per day (hand-rolled + factory made)

The questionnaires also included questions about diet, physical activity in leisure time and at work, coffee and milk consumption, and various diseases and symptoms. The questions on alcohol consumption have been validated by comparison with a structured interview and blood concentration of gamma-glutamyltransferase^(18, 19). Table 1 also shows that the “frequency of consumption” variables in 1986/87 correspond well with the “amount of consumption” variable in 1994/95. This both indicates a stable pattern of alcohol use over time, and it allows us to consider the “frequency of consumption” variables in 1979/80 and 1986/87 as proxies for amount alcohol consumed before we started follow-up. The questions on tobacco smoking have been validated by comparison with blood concentration of thiocyanate⁽²⁰⁾.

Fractures

Non-vertebral fractures that had occurred in the study population were sought for in the radiographic archives of the University Hospital by computer linkage, using the 11-digit national personal identification number as the person-identifiable key. All fractures suffered by persons in the cohort are registered here, as the University Hospital is the

only hospital in Tromsø, and there is no other radiographic service in the city or within 250 km. The only exception to this would be fractures occurring while traveling with no control radiographic examination after returning home. The radiologists describe the radiographic film in full text, and they assign a diagnostic code. To ensure complete registration and to categorize the trauma mechanism as low-energetic (fall from same level, not traffic accident), pathologic (tumor or metastasis) or high-energetic (fall from a height or traffic accident), we checked all referrals and full text descriptions of examinations with any pathology (n=12,509). We found no additional fractures when also checking a random sample of 1 044 descriptions coded as normal.

There was a complete 11-digit personal identification number on 90 % of all radiographic reports in the radiographic archives. From the 10 % without a complete number, we selected those with registered fractures (by code) in the archives and searched for them in our cohort by date of birth, finding 23 additional persons with fractures (1.8 % of all persons with fracture).

Among the 12,270 attendees to the 1979/80 and 1986/87 surveys, 935 persons had suffered a total of 1,063 fractures, of which 876 (82.4 %) could be coded according to trauma mechanism. Of all the fractures, 657 (62%) were the result of a low-energetic trauma (table 2).

Validation of fracture registration

To validate the registration at the department of radiology, we checked the 550 patients who in 1994 were registered as treated for fracture of hip, distal forearm or ankle in other departments in the hospital. Only one of these had been missed by the X-ray archive. From our cohort we also chose a random sample of 1,000 persons and

checked the actual envelopes in the X-ray archive finding 68 fractures, of which only one had not been identified by our initial registration.

Statistical analysis

As we have information about alcohol consumption and tobacco smoking from two surveys before the occurrence of a fracture, we have performed the analyses with respect to exposure both at one point in time, as accumulated exposure, and with respect to change of exposure. Accumulated exposure with respect to alcohol consumption has been studied in two ways: 1) Analyses restricted to persons with identically reported habits in the 1979/80 and 1986/87 surveys. 2) Analyses on scores for frequency of alcohol consumption of any kind. The scores were computed by adding the variables with respect to consumption of beer, wine and spirits, which then were categorized into approximate quartiles. A similar frequency of consumption of beer, wine and spirits may not reflect identical consumption of total amount of alcohol. To explore this, we have put weights from 1 to 3 on beer, wine and spirits consumption in the score analyses.

Accumulated exposure with respect to tobacco smoking has been dealt with in two ways: 1) Analyses on a computed variable describing number of years smoking 20 cigarettes per day (pack-years). 2) Analyses on a variable describing smoking status at the three different surveys.

Change of alcohol consumption and tobacco smoking was analyzed in two ways: 1) Regression analyses with the variables change, age and baseline consumption /smoking in the model. 2) Analyses comparing “starters” with never users, and those who had stopped with current users in 1986/87. The analyses have had the following

end-points: Any non-vertebral fracture, any fracture in upper extremities and any fracture in lower extremities.

In order to adjust for confounding factors, we included one potential confounder at a time into models with alcohol consumption or tobacco smoking and age, and assessed whether this changed the hazard ratio estimate of alcohol consumption or smoking with respect to fracture incidence. We have assessed interaction by both interaction terms and stratified analyses.

The data were analyzed by χ^2 , Mantel-Haentzel- χ^2 , and Cox proportional hazard regression analysis in SAS ⁽²¹⁾.

Results

Alcohol consumption and fractures

A score for frequency of any alcohol-consumption in 1979/80 and a similar score for alcohol consumption in 1986/87 were not associated with the incidence of subsequent fractures among men regardless of weights put on beer, wine and spirits consumption. However, the women in the highest quartile of alcohol-consumption in 1986/87 had higher risk of all fractures (RR 1.4, CI 1.0-1.8, age-adjusted) and of fractures in lower extremities (RR 1.6, CI 1.1-2.4, age-adjusted) compared to women in the lowest quartile when weighting wine, beer and spirits consumption equally. According to this relationship, 15 % of fractures in lower extremities could be attributed to alcohol consumption among women. The association grew stronger when putting more weight on consumption of beer and spirits than of wine, but it did not disappear even when putting a double weight on wine consumption compared to beer and spirits.

Weekly consumption of beer and spirits and frequent inebriation was associated with a higher incidence of non-vertebral fractures (table 3). This was more pronounced for women than men, it was more pronounced for consumption reported eight years before follow-up than consumption reported the year before follow-up, and it was more pronounced for persons with similar habits through all surveys (data not shown). Consumption of wine was associated with lower incidence of fractures among men, but not among women.

There was no clustering of fractures in weekends according to date of radiographic examination, neither with respect to all fractures, fractures in upper extremities, lower extremities, wrists nor ankles.

Frequency of spirits consumption and frequency of inebriation was associated with higher incidence of fractures in lower extremities among women (age adjusted HR for weekly consumption of spirits vs. never in 1979/80 1.9, CI 1.2-2.9, inebriation monthly vs. never, HR 2.6, CI 1.6-4.3). When restricting the analyses to persons 45 years of age or older, the point estimates increased somewhat, although the interaction was not statistically significant. In this age group, age-adjusted HR for fractures in lower extremities among women inebriated monthly vs. never was 4.6 (CI 2.5-8.4). Restricting analyses to low-energetic fractures did not alter the results (data not shown).

Accumulated exposure to alcohol and change of alcohol consumption

When including only persons with similar habits with respect to alcohol consumption in the three surveys (or missing in the last survey), the same pattern emerged: Persons who weekly consumed beer, spirits and/or were monthly inebriated sustained more fractures, while men who consumed wine weekly suffered fewer

fractures (data not shown). Among men, a score for the frequency of all consumption of alcohol in the two surveys, and with equal weights for beer, wine and spirits consumption, was not associated with the subsequent incidence of non-vertebral fractures. Among women, however, such an association became statistically significant with respect to fractures in lower extremities when weighting spirits consumption heavier than beer and wine consumption (weight 2:1:1, HR 1.5, CI 1.1-2.1, age-adjusted, highest compared to lowest quartile of consumption).

Change of alcohol consumption between the two surveys showed no clear relationship to the incidence of non-vertebral fractures.

Confounding and interaction

Adjustment for body mass index, body height, coffee and milk consumption, level of education, tobacco smoking and physical activity in leisure-time and at work did not substantially change the estimates in the analyses on alcohol consumption and fractures. Adjustment for frequency of consumption of other alcoholic beverages than the one of interest did not change the estimates among men, but among women all hazard ratios moved closer to one with the exception of consumption of spirits (data not shown). Among women, the “effect” of beer consumption was stronger among women with physically hard work (table 4). Stratified analyses and models with interaction-terms did not reveal any other interactions with respect to body mass index, body height, coffee consumption, milk consumption, employment status (full time job, part-time job, no job) or physical activity in leisure-time or at work.

Tobacco smoking and fractures

Tobacco smoking was as frequent among women as among men, but male smokers smoked more cigarettes. Tobacco smoking was associated with higher incidence of non-

vertebral fractures among men, to a lesser extent among women (table 5). Analyses restricted to fractures in upper and lower extremities respectively gave no significant results among men. Tobacco smoking was, however, associated with more fractures in lower extremities among women (p for trend < 0.01 with respect to number of cigarettes smoked each day both in 1979/80 and in 1986/87). Restricting analyses to low-energetic fractures did not alter the results much, except a slightly stronger association between tobacco smoking and fractures in lower extremities among women (data not shown).

Prolonged exposure to cigarette smoking was associated with a higher incidence of non-vertebral fractures, more pronounced among men (table 5).

Men who had stopped smoking between 1979/80 and 1986/87 suffered less non-vertebral fractures than men who smoked at both surveys (age-adjusted HR 0.7, CI 0.5-1.1). Similar analyses restricted to fractures in lower extremities showed a stronger association (age-adjusted HR 0.5, CI 0.2-1.0). Change of smoking habits among women was not associated with the incidence of non-vertebral fractures.

Among men, 18 percent of all fractures could be ascribed smoking according to smoking status at the different surveys (calculated from numbers in table 5).

Corresponding number among women was 9 percent.

Confounding and interaction

Adjustment for body mass index, body height, coffee- and milk consumption, level of education, alcohol consumption and physical activity in leisure-time and at work did not substantially change the estimates in the analyses on tobacco smoking and fractures. Analyses stratified by employment-status revealed a stronger association between smoking and fractures among the few men without a job (table 6, interaction-term $p < 0.001$). The described interaction was the only one found after stratified analyses

and models including interactions-terms with respect to body mass index, body height, employment-status, consumption of coffee, milk, beer, wine and spirits and physical activity in leisure time and at work.

When comparing persons smoking at least 20 cigarettes daily and getting inebriated at least monthly (370 men and 99 women in 1986/87) to persons not smoking and never getting inebriated, the age-adjusted HR of non-vertebral fractures was 1.8 (CI 1.2-2.7) among men and 1.5 (CI 0.8-2.8) among women.

Discussion

In this large, prospective and population-based study, we found that the incidence of non-vertebral fractures was weakly related to tobacco smoking among middle-aged men, but not among women. Frequency of beer and spirits consumption was positively associated with the incidence of non-vertebral fractures among both men and women, especially with respect to fractures in lower extremities. Men who had stopped smoking had lowered their risk of fractures in the lower extremities. Among middle-aged men, almost one of five fractures could be ascribed tobacco smoking.

Selection bias, information bias and confounding

The study population does not include those having migrated between the two surveys, neither does it include students temporarily living in Tromsø. However, external validity should be good, as all regular residents of a «normal» community are in the eligible population.

The potential for selection bias in the study is limited, with more than 70 % of the eligible population included in most of the analyses.

Our baseline description is mostly a picture of drinking patterns (frequency, not amount), but we have shown in table 1 that it could be used as a proxy for amount alcohol consumed. Frequency of inebriation can be used as a proxy for time spent with high blood concentration of alcohol, even if the use of a proxy leads to misclassification. Any misclassification with respect to information from 1979/80 and 1986/87 is likely to be non-differential: Persons that will suffer a fracture are not likely to report their drinking habits differently from others. Thus, all the estimates presented are probably underestimates due to non-differential misclassification.

The weighting of beer, wine and spirits consumption in the scores is uncertain, as we do not know the amount of alcohol intake that corresponds to the frequencies reported. The data from 1994/95 suggests equal weights on beer, wine and spirits consumption among men, and heavier weight on wine consumption among women. However, we have explored this uncertainty by analyzing with different weights.

According to a recent review on smoking and hip fractures, accumulated exposure to smoking is probably a more meaningful categorization than current smoking⁽⁸⁾. We have assessed accumulated exposure to tobacco smoking according to number of cigarettes smoked per day in the last attended survey before the follow-up and number of years smoked. This categorization is crude, as our estimate of average number of cigarettes smoked per day is uncertain. Any misclassification is however, unlikely to be differential, hence the estimates are probably underestimated.

Alcohol and non-vertebral fractures

When analyzing alcohol intake with respect to different beverages, consumption of wine seemed to be protective with respect to fractures among men, even after adjustment for potential confounders. Consumption of alcohol-containing beverages is

dependent on culture, and it is possible that wine consumption is a marker of healthy habits with respect to bone health and/or low inclination to fall among men. Our results suggested stronger associations among women with respect to frequency of consumption of specific alcoholic beverages. But the men who consumed liquor or were inebriated frequently were many (about one out of three men). The corresponding women were few (only about one out of ten women), and they may be special with respect to inclination to suffer traumas and bone quality. The explanation for the described interaction may be that women with physically hard work drink more when drinking, than women with sedentary work. The unaltered results when restricting the analyses to “low-energetic” fractures is plausible, as inebriation may increase the risk of both high- and low-energetic traumas. Besides, a recently published study suggests that categorization of fractures according to energy in trauma is questionable ⁽²²⁾. The stronger effect with respect to fractures in lower extremities compared to upper extremities is surprising, but may reflect inability to break a fall with the arms when inebriated due to slow reflexes ⁽²³⁾. Earlier follow-up studies have found a smaller “effect“ of moderate consumption than this study ^(1-6, 24-27). However, our analyses considered intake of beer, wine and spirits separately. The suggested protective effect of wine consumption (possibly a marker of other protective factors) may mask the effect of other alcoholic beverages in analyses on total alcohol consumption.

The present study and all the referenced studies on fractures have measured exposure to alcohol as average consumption or average frequency of consumption. These measures should be able to detect any effect on bone metabolism resulting in altered bone strength. However, inebriation, that is blood alcohol concentration above a certain level, seems to be a very strong risk factor for injurious falls ⁽¹⁰⁾. The measures on average alcohol consumption would possibly fail to classify persons precisely

according to time spent intoxicated. Thus, even if daily alcohol consumption might seem to protect against injurious falls among elderly⁽²⁸⁾, getting drunk is probably still a risk factor for falls and fractures, as suggested by some of our results on frequency of inebriation and fractures.

The estimates on population attributable risk of alcohol consumption must be looked upon with caution, as the assumptions of the calculations are that the hazard ratio point estimates are true, and that there is a causal link between alcohol consumption and fractures.

Tobacco smoking and non-vertebral fractures

We have found tobacco smoking to be associated with non-vertebral fractures among men. The “harmful effect” of smoking is not strong, and may be the effect of confounding factors: Smokers may be different from non-smokers in many ways. However, adjustment for potential confounding factors did not change the estimates, and the results suggested a dose-response relationship with respect to accumulated exposure to tobacco smoking among men. The lowered risk of fractures in lower extremities among men that had quit smoking supports the association between smoking and the incidence of fractures. The interaction with employment status was surprising, but we believe smoking must be a marker of other unhealthy behavior/factors in this group.

A lower bone mineral density in smokers was shown more than 20 years ago⁽²⁹⁾, and several cohort studies have found tobacco smoking to be a weak risk factor for hip fractures^(2, 3, 30, 31). Thus, our results are plausible, even if some cohort studies have found no relation between smoking and hip fractures^(4, 7, 27). According to a recent meta-analysis among women, tobacco smoking is not related to lower bone mass or to

hip fractures among premenopausal women. Among postmenopausal women, smokers lose approximately 2% more of their bone mass pr. decade than non-smokers.

Consequently, the difference between smokers and non-smokers increases with age, and constitutes 6% at the age of 80 years. Thus, relative risk of hip fracture among smokers vs. non-smokers increases with age, from 1.17 (95% CI 1.05-1.30) at 60 years to 2.08 (95% CI 1.70-2.54) at 90 years ⁽⁸⁾.

Several hypotheses on the effect of smoking on bone have been proposed: Smoking may reduce calcium absorption ⁽³²⁾, there may be a direct toxic effect on bone ⁽³³⁾, furthermore, the risk of falling is a little greater in smokers ^(34,35). Commonly postulated mechanisms as lower body weight among smokers and actions of smoking on estrogen, can account for only a small proportion of the effects seen in these studies ⁽⁸⁾.

Our finding that tobacco smoking was a stronger risk factor among middle aged men than women may reflect that male smokers smoke more cigarettes per day than female smokers do, even though the categorization of smoking was similar among men and women.

Studies on other types of fractures, especially among men, are few, but one cohort study among men found no relation between current or past smoking and forearm fractures ⁽⁶⁾. Cohort studies among women have found no relationship between smoking and humerus, forearm, ankle or foot fractures ^(5-7, 24, 26), neither have case-control-studies with respect to forearm fractures among women ⁽³⁶⁻³⁹⁾. One case-control study found smoking to be a risk factor for vertebral fractures among men ⁽⁴⁰⁾, while a large cross-sectional Finnish study among perimenopausal women found that tobacco smoking was related to prevalence of ankle fractures and any fracture, but not to wrist fractures ⁽⁴¹⁾.

As with alcohol consumption, the population attributable risks with respect to smoking must be looked upon with caution. However, the known relation between

smoking and bone mineral density and hip fractures makes a causal link plausible. Thus, our results suggest that even among middle aged men, a considerable proportion of all non-vertebral fractures might be attributable to tobacco smoking.

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Table 1

Amount of alcoholic beverages consumed (reported in 1994/95) stratified by frequency of consumption of the relevant beverage (reported in 1986/87) in The Tromsø Study.

Frequency of alcohol consumption	Average number of glasses of the relevant beverage consumed during a fortnight in 1994/95	
	Men	Women
Beer		
Never/seldom	0	0
1-2/month	2	1
1/week	4	2
2-3/week	7	3
daily	15	12
Wine		
Never/seldom	0	0
1-2/month	2	2
1/week	5	5
2-3/week	8	9
daily	19	19
Spirits		
Never/seldom	0	0
1-2/month	2	1
1/week	4	3
2-3/week	7	4
daily	16	8
Frequency of inebriation ¹		
Not at all	3	2
A few times	5	4
1-2/month	10	8
≥3/week	20	19
n ²	4741	4784

¹ Slightly different questions in the two surveys, see text. Total number of glasses of alcohol the last fortnight in 1994/95.

² Number of persons is not exactly the same in all analyses according to some missing data.

Table 2

Number of persons who suffered a fracture from 1988 to 1995 among 12,270 Tromsø residents who attended surveys 1979/80 and 1986/87.*

FRACTURE LOCATION	MEN (N = 6 186)		WOMEN (N = 6 084)	
	All	Low energetic(%)	All	Low energetic (%)
All fractures	444	55	491	75
Upper extremities	246	55	298	81
Wrist	71	61	194	88
Lower extremities	188	53	196	64
Ankle	57	72	76	74
Hip	18	33	23	70
Fingers and toes	179	44	115	57

*Persons might have more than one fracture, hence the same person might be found in several categories of fracture.

Table 3
 Frequency of alcohol consumption and the risk of any subsequent non-vertebral fracture 1988-1995 among 12,270 Tromsø residents who attended surveys in 1979/80 and 1986/87.

Frequency of alcohol-consumption	MEN			WOMEN		
	Person-years	Cases with fracture	Hazard ratio, age adjusted (95 % CI)	Person-years	Cases with fracture	Hazard ratio, age adjusted (95 % CI)
In 1979/80 (8 years before follow up)						
Beer						
Never/seldom	14 985	139	1.0	25 842	286	1.0
1-2/month	12 418	115	1.0 (0.8-1.3)	9 024	82	1.0 (0.8-1.3)
Weekly	12 428	138	1.2 (1.0-1.5)	4 185	52	1.3 (1.0-1.7)
Wine						
Never/seldom	28 238	279	1.0	27 143	291	1.0
1-2/month	7 893	73	0.9 (0.7-1.2)	9 391	103	1.2 (0.9-1.5)
Weekly	2 994	26	0.9 (0.6-1.3)	3 109	39	1.2 (0.9-1.7)
Spirits						
Never/seldom	13 493	122	1.0	23 426	236	1.0
1-2/month	15 846	149	1.0 (0.8-1.3)	12 913	137	1.2 (1.0-1.5)
Weekly	10 672	122	1.3 (1.0-1.6)	3 599	60	1.6 (1.2-2.2)
Frequency of inebriation						
Never	9 122	88	1.0	20 773	256	1.0
Seldom	19 997	167	0.9 (0.7-1.1)	15 873	136	1.0 (0.8-1.2)
Monthly	10 730	138	1.4 (1.1-1.8)	2 751	32	1.6 (1.1-2.4)
In 1986/87 (The year before follow up)						
Beer						
Never/seldom	15 049	129	1.0	25 343	299	1.0
1-2/month	13 264	116	0.9 (0.7-1.2)	10 075	79	0.8 (0.7-1.1)
Weekly	13 679	148	1.1 (0.9-1.4)	5 087	66	1.4 (1.0-1.8)

Wine													
Never/seldom	25 285	251	1.0		23 368	277	1.0						
1-2/month	10 908	99	0.9	(0.7-1.1)	11 960	115	1.0	(0.8-1.2)					
Weekly	5 191	36	0.7	(0.5-0.9)	5 885	66	1.1	(0.8-1.4)					
Spirits													
Never/seldom	15 792	154	1.0		26 800	281	1.0						
1-2/month	15 255	126	0.8	(0.6-1.0)	10 591	130	1.3†	(1.1-1.6)					
Weekly	11 164	116	1.0	(0.8-1.2)	3 863	45	1.1	(0.8-1.5)					
Frequency of inebriation													
Never	10 436	96	1.0		22 652	266	1.0						
Seldom	18 780	165	0.9	(0.7-1.1)	13 568	138	1.1	(0.9-1.4)					
Monthly	12 547	132	1.0	(0.8-1.3)	3 375	38	1.3	(1.0-1.9)					

† Difference between genders, $p < 0.05$.

Table 4

The effect of frequency of beer consumption on the incidence of all non-vertebral fractures 1988-95 dependent on physical activity at work among women in Tromsø.

Frequency of beer consumption 1986/87	<u>Women with sedentary work</u>				<u>Women with some physical strain at work</u>				<u>Women with physically hard work</u>			
	Person- years	Cases with fracture	Incidence per 1000 pyar	HR, age- adjusted	Person- years	Cases with fracture	Incidence per 1000 pyar	HR, age- adjusted	Person- years	Cases with fracture	Incidence per 1000 pyar	HR, age- adjusted
Never/seldom	7 210	84	12	1.0	9 771	99	10	1.0	3 826	48	13	1.0
1-2/month	4 145	29	7	0.7	4 183	31	7	0.9	1 746	19	11	1.2
Weekly	2 230	22	10	0.9	2 236	32	14	1.6	620	12	19	2.0

Table 5
Tobacco smoking and the risk of any subsequent non-vertebral fracture 1988-1995 among 12,270 Tromsø residents that attended surveys in 1979/80 and 1986/87.

Tobacco smoking	MEN			WOMEN		
	Person- years	Cases with fracture	Hazard ratio, age adjusted (95 % CI)	Person- years	Cases with fracture	Hazard ratio, age adjusted (95 % CI)
In 1979/80						
Not current smoker	24 103	214	1.0	24 179	277	1.0
1-9 cigarettes/day	3 822	42	1.2 (0.9-1.7)	7 029	52	0.7† (0.5-1.0)
10-14 cigarettes/day	6 746	70	1.2 (0.9-1.5)	7 916	92	1.2 (0.9-1.5)
>14 cigarettes/day	10 964	118	1.2 (1.0-1.5)	5 938	70	1.2 (0.9-1.5)
p for trend			0.13			0.14
In 1986/87						
Not current smoker	25 453	220	1.0	24 839	287	1.0
1-9 cigarettes/day	3 159	38	1.4 (1.0-2.0)	5 623	45	0.7† (0.5-1.0)
10-14 cigarettes/day	5 889	58	1.1 (0.9-1.5)	7 398	81	1.1 (0.8-1.4)
>14 cigarettes/day	11 133	128	1.3 (1.1-1.7)	7 162	78	1.1 (0.8-1.4)
p for trend			<0.01			0.62
Pack-years ¹						
0	8 918	73	1.0	13 276	146	1.0
>0-9	4 115	47	1.3 (1.0-1.8)	7 034	65	1.0† (0.8-1.3)
10-19	7 189	73	1.2 (0.9-1.5)	9 016	85	0.9† (0.7-1.2)
20-29	5 121	62	1.4 (1.1-1.9)	3 360	43	1.0 (0.8-1.4)
30+	4 679	50	1.2 (0.9-1.7)	1 375	15	0.8 (0.5-1.3)
p for trend			0.09			0.74
Accumulated exposition						
Never smoked	9 432	76	1.0	13 879	154	1.0

Smoked before surveys	8 565	81	1.2	(0.9- 1.6)	5 347	72	1.3	(1.0- 1.7)
Smoked at some, but not all attended surveys	15 778	155	1.2	(0.9- 1.6)	12 631	141	1.3	(1.0- 1.6)
Smoked at all attended surveys (two or three), but not always >14 cig. per day.	7 828	90	1.4	(1.1- 2.0)	10 955	98	0.9†	(0.7- 1.2)
Smoked more than 14 cig. /day at all surveys	3 991	42	1.3	(0.9- 1.9)	2 226	26	1.2	(0.8- 1.9)
p for trend†				0.03				0.79

‡ A substantial number of the persons not smoking in any of the surveys reported to have smoked for some years without reporting quantity. These persons are missing with respect to number of pack-years.

† Difference between genders, $p < 0.05$.

‡ Difference between genders, $p < 0.01$.

Table 6
 The effect of smoking on the incidence of all non-vertebral fractures 1988-95 dependent on employment status among men in Tromsø.

Accumulated exposition to smoking	<u>Unemployed men</u>		<u>Employed men</u>	
	Person- years	Cases with fracture per 1000 pyar	Person- years	Cases with fracture per 1000 pyar
Never smoked	280	0	8 552	69
Smoked before surveys	383	1	7 555	73
Smoked at some, but not all attended surveys	1 073	13	13 175	124
Smoked at all attended surveys (two or three), but not always >14 cig. per day.	554	10	6 605	66
Smoked more than 14 cig. /day at all surveys	235	7	3 343	29

Paper V

The Tromsø study: Height loss as a screening tool for subsequent non-vertebral fractures before age 65

Running head: Height loss and fractures

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Abstract

Purpose: Earlier fracture is a strong risk factor for subsequent fracture, and height loss is strongly associated to vertebral fractures. We hypothesise that height loss predicts subsequent fractures.

Materials and Methods: The young adult and middle aged population of Tromsø were invited to surveys in 1979/80 and 1986/87 (The Tromsø Study). Of 16 676 invited, 12 270 attended both surveys (74 %). All non-vertebral fractures in the period 1988-1995 (922 persons with fractures) were verified by x-ray, and height was measured by a wall mounted ruler.

Results: Women with a height loss compared to women with no height loss suffered more low-energetic fractures (RR = 1.3 CI 1.0-1.7, adjusted for confounding factors). However, sensitivity, specificity positive predictive and negative predictive value was only 25, 82 and 11 and 92 % respectively for height loss considered as a clinical test among women 40 years or older. There was no association between height loss and subsequent fractures among men.

Conclusion: Height loss is a predictor of fractures among middle aged women. However, the relation is too weak to use height measurements as a screening tool.

Keywords: Osteoporosis, fractures, screening, risk assessment

INTRODUCTION

The incidence of fractures in the western world has increased dramatically during the last decades [1;2]. This is due both to more people reaching old age, and higher age-adjusted incidence of any fractures at any location [1;3]. Measures to prevent this development is called for, and one current strategy is to intervene among groups at high risk of fractures. Several predictive factors have been found, the most important being bone mineral density, which explains 40-80% of the variance in bone strength [4]. Bone mineral density measurements in combination with other recorded risk factors makes it possible to identify groups with a 25-fold risk of hip fracture compared to those with the lowest risk [5]. Thus, with a proper patient history and a thorough examination supplemented by a measurement of bone mineral density, it is possible to focus intervention at groups with very high risk of hip fracture. A quick and inexpensive test, however, had been preferable in order to screen populations in general practise. A previous fracture of any kind is a strong predictor of subsequent fractures [6;7]. The most prevalent fracture, vertebral, is difficult to diagnose without misclassification [8]. Reduction in body height closely reflects, however, degree of degeneration of vertebrae [9-14], and to most people, both inside and outside the medical community, the term osteoporosis is associated with a mental image of little old ladies getting shorter as they get older. Kelsey et al. [15], found that height loss (asked, not measured) since the age of 25 years was a weak risk factor for proximal humerus fractures. We hypothesise that decrease in measured body height is a predictor of any subsequent fracture and subsequent height loss and have tested the hypothesis in a large population based study.

MATERIAL AND METHOD

Subjects

Tromsø, a Norwegian city with presently 55 000 inhabitants, is situated at a latitude of 70°N. The Tromsø study is based on information gathered through four population surveys in 1974 (I), 1979/80 (II), 1986/87 (III) and 1994/95 (IV). We have used information from survey II and III. All males born 1925-59 and females born 1930-59 were invited to both these surveys [16]. Of 16 676 persons invited, 12 270 (73.6 %) attended both surveys. Follow up time was assigned from Jan. 1, 1988 to date of fracture or to Dec. 31, 1995. Among the 12 270 attendants, 972 had migrated or died before end of follow up, and they were assigned follow up time to date of fracture or to Dec. 31, 1991 (Halfway through follow up). Those with invalid height/weight measurements (n = 173) were excluded from the analyses, thus 12 097 subjects were analysed.

Questionnaires and measurements

The questionnaires have been described elsewhere in detail [16;17]. They contained questions about diseases, medication, diet, physical activity in leisure time and at work, alcohol consumption, smoking and several other parameters. Height and weight were measured to the nearest centimeter/kilogram once at each survey. The attendees wore light clothing without shoes, and the subjects were measured with their back against a wall on which a ruler was mounted. A bar perpendicular to the ruler was positioned against the subject's vertex, and the corresponding reading was recorded. A similar method has been shown to have similar precision as Harpenden stadiometer [18]. Remarks were made if height or weight measurement could be invalid (pregnancy, would not take shoes off, crippled, refused). The questionnaire in the last survey

included self reported hip fractures and forearm fractures, and the age at which they were suffered.

Fractures

Non-vertebral fractures which had occurred in the study population, were sought for in the x-ray archives of the university hospital by computer linkage using the 11-digit national personal identification number. All fractures suffered by persons in the cohort are registered here, as the University Hospital is the only hospital in Tromsø, and there is no other x-ray service in the city or within 250 km. The only exception to this would be fractures occurring while travelling with no control x-ray after returning home. The radiologists describe the x-ray examination in full text, and they assign a diagnostic code. To ensure complete registration and to categorise the trauma mechanism as low-energetic (fall from same level, not traffic accident), pathologic (tumour or metastasis) or high-energetic (fall from a height or traffic accident), we checked all referrals and full text descriptions of examinations with any pathology (n=12 509). We found no additional fractures when also checking a random sample of 1 044 descriptions coded as normal. The x-ray archive had a complete 11-digit personal identification number on 90 % of those examined after 1987. From the 10 % without a complete number, we selected those with registered fractures (by code) in the archives and searched in our cohort by date of birth to find matches, finding 23 additional persons with fractures. Among the persons that attended survey II and III and had valid height/weight measurements, 922 persons had suffered 1 048 fractures, of which 866 (82.6 %) could be classified according to trauma mechanism.

Validation of fracture registration

In order to validate the registration at the department of radiology, we checked 550 patients registered with fracture of hip, distal forearm or ankle by ICD-9 code at other departments in the hospital in 1994. Of these, only 1 was missed by the x-ray archive, and the hospital record of this person states that the x-ray films were removed and never described by a radiologist. From our cohort we also chose a random sample of 1000 persons and checked the actual envelopes in the x-ray archive to find 68 fractures, of which only one had not been found by our initial registration.

To further validate the recording of fractures, we compared self reported (in the survey in 1994/95) hip and forearm fractures in the follow up period with fractures found in the computer linkage. Of 33 self-reported hip fractures, eight were erroneously reported (24.2 %) (six were fractures of the shaft of femur, one was suffered before the follow up period and one had operated in a hip replacement without any preceding fracture), and we had recorded 23 of 25 fractures (92.0 %). Of 202 self reported forearm fractures, 26 were erroneously reported (12.9 %) (13 had a negative x-ray of the forearm at the time of the alleged fracture, 10 had a forearm fracture before the follow up period, three had a fracture in the upper arm), and we had recorded 166 of 176 forearm fractures (94.3 %).

Power calculation

Prior to our study we made power calculations based on fracture incidence in Trondheim, another Norwegian city [19]. Given our population size and an $\alpha=0,05$ and $\beta=0,20$, it would be possible to detect significant relative risks down to 1,5 for forearm and 1,9 for ankle fractures when stratified by gender.

Statistical analysis

Our main independent variable was height loss prior to follow up, and we assessed this as difference between measurements in 1986/87 and 1979/80, and categorised it as height loss or not. In some analyses we categorised height loss by z-score. To choose which variables to adjust for, we checked variables which are known or suspected risk factors for fractures (questions answered in survey III): Alcohol consumption (frequency of consumption of beer, spirits and wine), milk consumption (number of glasses each day), smoking (yes/no), menopausal status (premenopausal/perimenopausal/postmenopausal), oestrogen use (current/not current), age at menarche and first pregnancy, physical activity in leisure time and at work, last fortnights use of analgesics and use of birth-control pills. We included one variable at a time into a model with height loss, body mass index, age and mean height in survey II and III, and assessed whether the relative risk estimate of height loss on fractures and subsequent height loss changed. Then we included an interaction term for each potential confounding factor. No interaction term for the potential confounders were statistically significant. The final models contain all variables that changed the relative risk estimate of height loss on fractures. The data was analysed by χ^2 , Mantel-Haentzel- χ^2 , Cox proportional hazard regression and correlation analysis (Pearson) in SAS [20].

RESULTS

Height loss and subsequent fractures

The age of the study-population ranged from 28 to 62 years for men (mean 44.7 years, SD 9.3) and from 28 to 57 years for women (mean 41.9 years, SD 7.8) at the start

of the follow up period (January 1, 1988). Among the 12 097 subjects we found 922 persons with 1 048 verified fractures, of which 65.4% were categorised as low-energetic (table 1). 26.6 % of the men and 14.5 % of the women had experienced height loss of 1 cm or more between 1979/80 and 1986/87, and the proportion that experienced height loss increased steeply with age ($p < 0.001$), although few had experienced height loss above 2 cm (table 2). Height reduction predicted fractures among women (table 3), but not among men. Adjustment for age made the association between height loss and fractures weaker. There was a suggested weaker effect among young women, although the interaction was not statistically significant (table 4). Analyses with adjustment for alcohol- and coffee consumption, smoking, educational level, physical activity in leisure time and at work did not alter the relative risk estimates. Neither did analyses without persons with height change above 2 cm, nor analyses with height loss as percentage of body height or height loss measured as z-score in each age group. Analyses with height loss as a continuous variable did not turn out to be statistically significant. The relative risk of fracture dependent on height loss did not show any relation to time since the last height-measurement. Table 5 displays the characteristics of height loss considered as a clinical test.

DISCUSSION

We have found that height loss is weakly associated with subsequent fractures among women, but not among men. The relation is too weak to be used as a clinical test in a middle aged population.

Selection bias, information bias and confounding

The eligible study population includes all regular residents in the described age groups in Tromsø. It does not include those having migrated between surveys II and III (1979/80 - 1986/87), neither does it include students temporarily living in Tromsø. However, external validity should be good, as all regular residents of a «normal» community is in the eligible population.

The potential for selection bias in the study is not large with 71 % of the eligible population included in the analysis.

The height was measured to the nearest cm, and it was measured once at each visit. Since the majority of those having changed height had changed only 1-2 cm (table 2), natural diurnal variation [11;21-23] and lack of precision have probably brought misclassification, even though reliability of similar height measurements as ours have been found very high [18;24;25]. This misclassification is certainly non-differential: There is no reason to believe that height was measured differently according to future fractures. Thus, the relative risk estimates are probably underestimated somewhat. We also found that some persons had increased their body height, suggesting some error in the measurements. However, analysing height loss measured as z-score did not change the results, and diurnal variation might explain this finding [22;26]. Our height-measurements are similar to measurements in clinical practice, making inferences to general practice viable, even though measurements with a stadiometer might have increased precision [11;21].

Misclassification with respect to registration of fractures is probably also non-differential, i.e. it is not dependent on height reduction. Thus, even if we have missed some fractures, this would not overestimate our relative risk estimates [27]. The classification of trauma mechanism as high or low energetic was not planned when the

referrals where submitted, but even if it were, this classification would be crude, because description and measurement of forces and moment arms in the trauma are rather difficult to quantify. Again, there is no reason to believe that the classification of trauma mechanism was dependent on degree of height reduction, thus the effect of trauma mechanism on the relative risk estimates is probably underestimated. Another question, is if the classification of fractures according to trauma-mechanism is very meaningful in terms of classifying fractures as “osteoporotic” or not: A recent study finds fractures after high-energetic traumas to be strongly associated with bone mineral density [28].

Assuming that height reduction is partially based on vertebral fractures and partially disc degeneration and increased spinal curvature [29;30], any risk factor for fractures would be a potential confounder for the association between height reduction and subsequent fractures, with the possible exception of physical activity, which may be in the causal pathway from height reduction to fracture [27]. But even after adjusting for most known confounders, earlier fracture is known to be an independent risk factor for subsequent fractures of any type [6]. Some confounding will however always be present, also after adjustment, due to unknown confounding factors and due to misclassification of the factors adjusted for. We hypothesise that earlier fracture and height reduction are variables that sum up these unknown confounding factors, giving them possibly predictive strength independent of known risk factors. (Other mechanisms that have been proposed to explain the fact that earlier fracture predict subsequent fractures, are bone loss as a consequence of a fracture, and mechanical deformity leading to changed distribution of strain in the skeleton [6]).

Height loss and fractures

We have found height loss to be associated with subsequent fractures among women in this young to middle aged population. This association is stronger with respect to low-energetic fractures, and it is not dependent on time since the last height measurement. Our findings are however marginal, and height loss considered as a clinical test, is not good. And as height measurements with a wall mounted ruler have been found reliable [18;24;25], they would probably not have changed much with more precise and repeated measurements of height. The high negative predictive value reflects a relatively the low cumulative incidence of fractures. Thus, we do not believe that measurement of height loss is a clinical useful predictor of subsequent fractures at ages below 62 years of age.

Earlier studies on height loss have mostly been on elderly persons, and height loss has been shown to be strongly associated with vertebral fractures [9-14;31], but only weakly or not at all with low spinal bone mass [13;32]. In these studies, a usual cut off for height loss has been 4 cm or more. Furthermore, height loss was self reported (not measured), leading to potential for misclassification, which possibly is differential (those aware of vertebral fractures are more likely to be aware of height loss). In our population, only 0.5 % had lost 4 cm or more in height (from 1979/80 to 1986/87). Studying the association between self reported substantial height loss and subsequent fractures among elderly would possibly give different results from ours, although, reported height loss among middle aged and elderly Norwegian has been found to be only weakly associated to fragility fractures in a recent cross-sectional study [31].

Height loss was more prevalent among men than women our this study. This was expected, since the incidence of vertebral fractures is higher among men until the age of about 60 years [33].

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Table 1

Number of persons who suffered a fracture in the period from Jan. 1, 1988 to Dec. 31, 1995 among those that attended surveys 1979/80 and 1986/87.^a

FRACTURE LOCATION	MEN (N = 6 136)		WOMEN (N = 5 961)	
	All	Low energetic(%)	All	Low energetic (%)
All fractures	439	54.7	483	75.2
Non weight bearing skeleton	289	52.2	336	78.0
Wrist	71	60.6	192	88.0
Fingers and toes	175	44.0	114	56.1
Weight bearing skeleton	170	55.3	164	65.9
Ankle	57	71.9	76	73.7
Hip	12	50.0	20	75.0

^a Persons might have more than one fracture, hence the same person might be found in several categories of fracture. Thus, fractures at weight bearing and non weight bearing sites do sum to more than the total of 922 persons with any fracture.

Table 2

Distribution (%) of body height loss between survey II and III (height 1986/87-height 1979/80) according to age group by start of follow up (Dec.31, 1987).

Agegroup by start of follow up	% of persons in groups of height loss (cm)				N ^a	Mean change of height (cm)
	No height loss	-1 cm	-2 cm	≤ -3 cm		
Men						
28-37	84.4	13.4	1.8	0.5	1 528	0.26
38-47	78.0	19.2	2.3	0.6	2 239	0.07
48-57	65.4	28.9	4.4	1.3	1 544	-0.22
58-62	53.4	35.1	8.3	3.3	736	-0.49
N ^a	4 438	1 337	208	64		
Women						
28-37	92.4	6.6	0.7	0.3	1 821	0.53
38-47	85.8	12.9	0.8	0.6	2 436	0.28
48-57	77.1	19.7	2.2	0.9	1 566	0.04
N ^a	4 980	743	67	33		

^a N less than in table 1 because of some missing data.

Table 3
Relative risk (RR) of low-energetic fractures dependent on body height loss between 1979/80 and 1986/87 among women.

FRACTURE LOCATION	Persons with fracture	N	RR, age adjusted (95 % confidence interval)		RR, multiple adjusted ^a (95 % confidence interval)	
			RR	% confidence interval	RR	% confidence interval
All fractures	No height loss	4 974	1.0	1.0	1.0	1.0
	Height loss	843	1.6	1.3 (1.0 - 1.7)	1.5	1.5 (1.0 - 2.2)
Non weight bearing skeleton	No height loss	4 974	1.0	1.0	1.0	1.0
	Height loss	843	1.6	1.3 (1.0 - 1.8)	1.5	1.5 (0.9 - 2.4)
Wrist	No height loss	4 974	1.0	1.0	1.0	1.0
	Height loss	843	1.8	1.4 (0.9 - 2.0)	1.3	1.3 (0.7 - 2.3)
Fingers and toes	No height loss	4 974	1.0	1.0	1.0	1.0
	Height loss	843	1.4	1.1 (0.6 - 2.1)	2.8	2.8 (1.0 - 8.0)
Weight bearing skeleton	No height loss	4 974	1.0	1.0	1.0	1.0
	Height loss	843	1.7	1.3 (0.8 - 2.1)	1.6	1.6 (0.8 - 3.1)
Ankle	No height loss	4 974	1.0	1.0	1.0	1.0
	Height loss	843	1.6	1.2 (0.6 - 2.4)	3.0	3.0 (1.0 - 9.1)
Hip	No height loss	4 974	1.0	1.0	1.0	1.0
	Height loss	843	2.4	1.2 (0.4 - 4.0)	1.1	1.1 (0.3 - 4.1)

^a Adjusted for age, body mass index, average height of the two surveys, oestrogen use, milk consumption, frequency of inebriation, and last fortnights use of analgesics.

Table 4

Point estimates of the relative risk (RR) of low-energetic fractures dependent on body height loss between 1979/80 and 1986/87 among women stratified by age at start of follow up.

FRACTURE LOCATION	Age (years)		
	28-39	40-49	50-57
All fractures	0.7	1.4	1.3
Non weight bearing skeleton	1.1	1.4	1.3
Wrist	1.1	1.5	1.4
Fingers and toes	0.0	1.1	1.6
Weight bearing skeleton	0.0	1.7	1.3
Ankle	0.0	1.3	1.5
Hip	*	2.8	0.9

* No hip fractures in this age-group.

Supplementary material: Results among men

Relative risk (RR) of low-energetic fractures dependent on body height loss between 1979/80 and 1986/87 among men.

Fracture location	Persons with fracture	N	RR	RR, age adjusted (95 % confidence interval)		RR, multiple adjusted ^a (95 % confidence interval)	
				RR	% confidence interval	RR	% confidence interval
All fractures	No height loss	4 437	1.0	1.0	1.0	1.0	
	Height loss	1 608	1.1	(0.8 - 1.5)	1.1	(0.8 - 1.5)	
Non weight bearing skeleton	No height loss	106	1.0	1.0	1.0	1.0	
	Height loss	44	1.1	(0.9 - 1.8)	1.2	(0.8 - 1.9)	
Wrist	No height loss	30	1.0	1.0	1.0	1.0	
	Height loss	12	1.1	(0.5 - 2.0)	1.2	(0.6 - 2.4)	
Fingers and toes	No height loss	55	1.0	1.0	1.0	1.0	
	Height loss	22	1.1	(0.8 - 2.4)	1.2	(0.7 - 2.2)	
Weight bearing skeleton	No height loss	68	1.0	1.0	1.0	1.0	
	Height loss	25	1.0	(0.6 - 1.6)	0.8	(0.4 - 1.4)	
Ankle	No height loss	27	1.0	1.0	1.0	1.0	
	Height loss	13	1.3	(0.6 - 2.6)	1.1	(0.5 - 2.4)	
Hip	No height loss	6	1.0	1.0	1.0	1.0	
	Height loss	0	0.0				

^a Adjusted for age, body mass index, average height of the two surveys, milk consumption, frequency of inebriation, and last fortnights use of analgesics.

Appendix

Questionnaire; Tromsø 1979/80 – Questionnaire I and II

English translation of the questionnaire used in the cardiovascular disease study in Oslo* 1972-73, Norwegian counties 1974-78 (Finnmark, Oppland and Sogn og Fjordane) and Tromsø 1974.

English translation: Mr. Kevin McCafferty

Tick "yes/no" or "yes", as appropriate.

Part A

Have you, or have you had:
a heart attack?
angina pectoris (heart cramp)?
any other heart disease?
hardened arteries in the legs?
a cerebral stroke?
diabetes?

Are you being treated for:
high blood pressure?

Do you use:
nitroglycerine?

Part B

Do you have pain or discomfort in the chest when:
- walking up hills or stairs, or walking fast on level ground?
- walking at normal pace on level ground?

If you get pain or discomfort in the chest when walking, do you usually:
(1) stop?
(2) slow down?
(3) carry on at the same pace?

If you stop or slow down, does the pain disappear:
(1) within 10 minutes?
(2) after more than 10 minutes?

Do you have pain in the calf while:
- walking?
- resting?

If you get pain in the calf, then:
- does the pain increase when you walk faster or uphill?
- does the pain disappear if you stop?

Do you usually have:
- cough in the morning?
- phlegm chest in the morning?

Part C

Exercise and physical exertion in *leisure time*.
If your activity varies much, for example between summer and winter, then give an average. The questions refer only to the last twelve months.

Tick "YES" beside the description that fits best:

- (1) Reading, watching TV, or other sedentary activity?
- (2) Walking, cycling, or other forms of exercise at least 4 hours a week? (including walking or cycling to place of work, Sunday-walking, etc.)
- (3) Participation in recreational sports, heavy gardening, etc.? (note: duration of activity at least 4 hours a week).
- (4) Participation in hard training or sports competitions, regularly several times a week?

Part D*

Do you smoke daily at present?
If "Yes":
Do you smoke cigarettes daily?
(handrolled or factory made)

If you do not smoke cigarettes at present:
Have you previously smoked cigarettes daily?

If "Yes", how long is it since you stopped?
(1) Less than 3 months?
(2) 3 months to 1 year?
(3) 1 to 5 years?
(4) More than 5 years?

For those who smoke or have smoked previously:

How many years altogether have you smoked daily? Number of years

How many cigarettes do you, or did you, smoke daily? Give number of cigarettes per day (handrolled + factory made)
Number of cigarettes

Do you smoke tobacco products other than cigarettes daily?
- cigars or cigarillos?
- a pipe?

If you smoke a pipe, how many packs of tobacco (50 grams) do you smoke per week?
Give average number of packs per week.
Number of tobacco packs

Part E

Do you usually work shifts or at night?
Can you usually come home from work:
- every day?
- every weekend?

Are there periods during which your working days are longer than usual? (e.g.: fishing season, harvest)

*In Oslo preset groups of cigarettes smoked per day and packs of pipe tobacco smoked per day (see original questionnaire)

During the last year, have you had: (Tick "YES" beside description that fits best):

- (1) mostly sedentary work? (e.g., office work, watchmaker, light manual work)
- (2) work that requires a lot of walking? (e.g., shop assistant, light industrial work, teaching)
- (3) work that requires a lot of walking and lifting? (e.g., postman, heavy industrial work, construction)
- (4) heavy manual labour? (e.g., forestry, heavy farmwork, heavy construction)

During the last 12 months, have you had to move house for work reasons?
Is housekeeping your main occupation?
Have you within the last 12 months received unemployment benefit?
Are you at present on sick leave, or receiving rehabilitation allowance?
Do you receive a complete or partial disability pension?

Part F (alternatives: yes, no, don't know)

Have one or more of your parents or sisters or brothers had a heart attack (heart wound) or angina pectoris (heart cramp)?

In Finnmark and Tromsø only:

Are two or more of your grandparents of Finnish origin?

Are two or more of your grandparents of Lapp origin?

MELDING OM SKJERMBILDEFOTOGRAFERING
OG HJERTE-KARUNDERSØKELSE

(Gjelder bare den person brevet er adressert til)

Skjermbildefotograferingen kommer nå til
Deres distrikt.

Tid og sted for Deres fram møte vil De finne
nedenfor.

Også denne gangen vil en del av befolkningen
få tilbud om hjerte-karundersøkelse. De tilhører
denne gruppe. En orientering om undersøkelsen
er gitt i vedlagte brosjyre.

Vennligst fyll ut spørreskjemaet på baksiden
og ta det med til undersøkelsen. Ta også med
tuberkulinkort eller helsebok, om De har.

Fravær bes eventuelt meldt på vedlagte seddel.

Med hilsen

HELSE RÅDET FYLKESLEGEN
STATENS SKJERMBILDEFOTOGRAFERING

Født dato	Personnr.	Kommune	Kreisnr.
Møtested		Kjønn	Kiokkeslett
		Forste bokstav etternavn Dag og dato	

SKRIV IKKE HER!

T. S. M.: _____ M: _____ F: _____ / _____ 20 _____ 21 _____ 22

A		JA	NEI	D		JA	NEI
Har De, eller har De hatt:				Røyker De daglig for tiden?			
Hjerteinfarkt?				Hvis svaret var „JA“ på forrige spørsmål, besvar da:			
Angina pectoris (hjertekrampe)?				Røyker De sigaretter daglig?			
Annen hjertesykdom?				(håndrullede eller fabrikkframstilte)			
Åreforkalkning i beina?				Hvis De ikke røyker sigaretter nå, besvar da:			
Hjerneslag?				Har De røykt sigaretter daglig tidligere?			
Sukkersyke?				Hvis De svarte „JA“, hvor lenge er det siden De sluttet?			
Er De under behandling for:				1 Mindre enn 3 måneder?			
Høyt blodtrykk?				2 3 måneder - 1 år?			
Bruker De:				3 1 - 5 år?			
Nitroglycerin?				4 Mer enn 5 år?			
B		JA	NEI	Besvares av dem som røyker nå eller har røykt tidligere:			
Får De smerter eller ubehag i brystet når De:				Hvor mange år tilsammen har De røykt daglig?			Antall år
Går i bakker, trapper eller fort på flat mark? ..				Hvor mange sigaretter røyker eller røykte De daglig? Oppgi antall pr. dag (håndrullede + fabrikkframstilte)			Ant. sigaretter
Går i vanlig takt på flat mark?				Røyker De noe annet enn sigaretter daglig?			
Hvis De får smerter eller ubehag i brystet ved gange, pleier De da å:				Sigarer eller serutter/cigarillos?			
1 Stanse?				Pipe?			
2 Sakte farten?				Hvis De røyker pipe, hvor mange pakker tobakk (50 gram) bruker De i pipe pr. uke?			Ant. tobakkepakker
3 Fortsette i samme takt?				Oppgi gjennomsnittlig antall pakker pr. uke:			
Hvis De stanser eller sakter farten, forsvinner smertene da:				E		JA	NEI
1 Etter mindre enn 10 minutter?				Har De vanligvis skiftarbeid eller nattarbeid? ..			
2 Etter mer enn 10 minutter?				Kan De vanligvis komme hjem fra arbeidet:			
Får De smerter i tykkleggen når De:				Hver dag?			
Går?				Hver helg?			
Er i ro?				Har De i perioder lengre arbeidsdager enn vanlig?			
Hvis De får leggsmerter, besvar da:				(f.eks. under sesongfiske, annerbeid)			
Forverres smertene ved raskere tempo eller i bakker?				Har De i løpet av siste året hatt:			
Gir smertene seg når De stopper?				Selt kryss i den ruten hvor „JA“ passer best			
Har De vanligvis:				1 Overvående stillestående arbeid? ..			
Hoste om morgenen?				(f.eks. skrivebordsarb., urmakerarb., monterer)			
Oppspytt fra brystet om morgenen? ..				2 Arbeid som krever at De gjør mye? ..			
C		JA		(f.eks. ekspeditørarb., lett industriarb., utstasjon)			
Bevegelse og kroppslig anstrengelse i Deres fritid.				3 Arbeid hvor De går og løfter mye? ..			
Hvis aktiviteten varierer meget f.eks. mellom sommer og vinter så ta et gjennomsnitt.				(f.eks. postbud, tyngre industriarb., byggingarb.)			
Spørsmålet gjelder bare det siste året.				4 Tungt kropearbeid?			
Selt kryss i den ruten hvor „JA“ passer best.				(f.eks. stograrbeid, tungt jordarbeid, tungt byggearb.)			
1 Leser, ser på fjernsyn eller annen stillestående beskjeftigelse?				Har De i løpet av de siste 12 mnd måttet flytte fra hjemstedet på grunn av forandring i arbeidssituasjonen?			
2 Spiserer, sykler eller beveger Dem på annen måte minst 4 timer i uken? ..				Er husmorarbeid Deres hovedyrke?			
(Heri medregnes også gang eller sykling til arbeidstedet, søndagsturer m.m.)				Har De i løpet av de siste 12 mnd fått arbeidsledighetsstrygd?			
3 Driver mosjonsidrett, tyngre hagearbeid e.l.?				Er De for tiden sykmeldt, eller får De attføringspenger?			
(Merk at virksomheten skal være minst 4 timer i uken.)				Har De full eller delvis uførepensjon? ..			
4 Trener hardt eller driver konkurransedrett, regelmessig og flere ganger i uken?				F		JA	NEI
G		JA	NEI	Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)? ..			
Har noen i Deres husstand (utenom Dem selv) vært under bilrønnundersøkelse hos østrikkelegen eller forrige hjerte-kar undersøkelse? ..				Er to eller flere av Deres beste foreldre av finsk ætt?			
				Er to eller flere av Deres beste foreldre av samisk ætt?			

**ADDITIONAL QUESTIONS FOR PERSONS ATTENDING THE MASS
X-RAY EXAMINATION IN TROMSØ.**

English translation: Mrs. Anne Clancy and Mr. Kevin McCafferty

Together with the invitation to attend you received a questionnaire from the National Mass Radiography Service. You delivered this questionnaire at the examination.

Cardiovascular diseases are, however, a complex group of diseases. The causes are still partly unknown. In Tromsø we are therefore trying to obtain a more complete description of factors which may be of importance for the course of these diseases, such as diet, psychological pressure ("stress"), social conditions, and occurrence of disease in relatives. We hope you will take the trouble to complete this questionnaire as well, and return it to the Tromsø Board of Health in the enclosed envelope.

All information in connection with the mass x-ray examination will be treated as strictly confidential.

I YOUR OWN DIET

1. What type of bread do you usually eat?
Tick the most appropriate box; Yes
- | | |
|---------------------------------|--------------------------|
| White bread (e.g. French bread) | <input type="checkbox"/> |
| Ordinary bread (light texture) | <input type="checkbox"/> |
| Whole meal (brown) bread | <input type="checkbox"/> |
| Home-made (brown) bread | <input type="checkbox"/> |

3. How many slices of bread do you usually eat daily?
Tick the most appropriate box; Yes
- | | |
|----------------------|--------------------------|
| Less than two slices | <input type="checkbox"/> |
| 2-6 slices | <input type="checkbox"/> |
| 7-12 slices | <input type="checkbox"/> |
| 13 or more slices | <input type="checkbox"/> |

2. What type of butter or margarine do you usually eat?
Tick the most appropriate box; Yes
- | | |
|-----------------------|--------------------------|
| Butter | <input type="checkbox"/> |
| Ordinary margarine | <input type="checkbox"/> |
| Plant margarine | <input type="checkbox"/> |
| Soft margarine spread | <input type="checkbox"/> |

4. What type of milk do you usually drink?
Tick the most appropriate box; Yes
- | | |
|---|--------------------------|
| Do not drink milk | <input type="checkbox"/> |
| Full cream milk: ordinary type or curdled | <input type="checkbox"/> |
| Skimmed milk: ordinary type or curdled | <input type="checkbox"/> |
| Mixture of full cream and skimmed milk | <input type="checkbox"/> |

5. The drawings below show cubes of butter or margarine(actual size).
Tick the box above the cube which best resembles the amount you spread on a slice of bread. If in doubt, try buttering a slice.

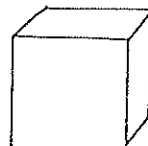
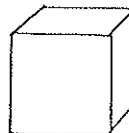
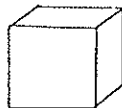
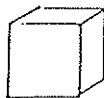
Do not use butter or margarine

1.

2.

3.

4.



6. How many glasses/cups of milk do you usually drink daily?
Tick the most appropriate box *Yes*
 Do not drink milk, or drink less than
 1 glass /cup
 1-2 glasses
 3-4 glasses/cups
 5 or more glasses/cups

7. How many cups of coffee do you usually drink daily?
Tick the most appropriate box *Yes*
 Do not drink coffee or drink less than
 1 cup
 1 - 4 cups
 5 - 8 cups
 9 or more cups

8. Are you a teetotaler? *Yes No*

 If "No":
 How often do you usually drink beer?
Tick the most appropriate box *Yes*
 Never or just a few times a year
 Once or twice a month
 About once a week
 2-3 times a week
 More or less daily

How often do you usually drink wine?
Tick the most appropriate box *Yes*
 Never or just a few times a year
 Once or twice a month
 About once a week
 2-3 times a week
 More or less daily

How often do you usually drink spirits?
Tick the most appropriate box *Yes*
 Never or a just few times a year
 Once or twice a month
 About once a week
 2-3 times a week
 More or less daily

9. Approximately how often during the past 12 months have you drunk so much wine, beer or spirits that you got drunk?
Tick the most appropriate box *Yes*
 Have never been drunk, or have not been drunk during the past year
 A few times during the last year
 Once or twice a month
 Once or twice a week
 3 or more times a week

10. How often does your main meal consist of fish or fish dishes?
Tick the most appropriate box *Yes*
 Less than once a week
 Once or twice a week
 3 - 4 times a week
 5 - 6 times a week
 7 days a week

11. How often do you eat fruit or vegetables?
Tick the most appropriate box *Yes*
 Never eat fruit or vegetables
 A few times a year
 Once or twice a month
 About once a week
 2 to 3 times a week
 More or less daily

12. How many times a month do you eat boiled sausages or fried meat balls, processed meat, etc.?
Tick the most appropriate box *Yes*
 Never or less than once a month
 Once or twice a month
 3 - 4 times a month (up to once a week)
 5 - 8 times a month (up to twice a week)
 More than 8 times a month, (more than twice a week)

13. Have you made any changes in your diet during the last 5 years as regards the following food items?
Tick each item in the appropriate box

	<i>As</i>	<i>More</i>	<i>Less</i>
	<i>before</i>	<i>now</i>	<i>now</i>
Ordinary margarine or butter:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skimmed milk :	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean meat:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Full cream milk:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Soya margarine (soft):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fatty meat:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

II. OWN ILLNESSES PAST OR PRESENT

Tick the appropriate box "Yes" or "No"

14. Have you ever had ? *Yes No*
 - Sudden paralysis or numbness on one side of your face or body, in your hand or foot
 -Sudden loss of ability to speak
 -Sudden loss of eyesight, complete or partial, or sudden onset of double vision

15. Have you had a peptic ulcer? *Yes No*

 Do you often have a gnawing pain in the upper part of your stomach?
 Do you suffer much from heartburn or regurgitation of gastric juices?
 Do you suffer much from wind and rumbling in your stomach?
 Do you often get cramps in your stomach ?
 Have you ever had your large intestine x-rayed?
 Have you ever had gall stones?

16. Have you had kidney stones or stones in the urinary tract? *Yes No*

 If yes, how many times ?
 and
 When did you have your last attack? *Year:.....*

17. Have you ever had cancer? *Yes No*
 If "yes", in what year was the disease discovered?
Year:

18. Do you have, or have had you the skin disease psoriasis? *Yes No*

19. Have you had allergy-induced eczema on your hands during the last 12 months? *Yes No*

20. Have you been on sick leave, or been unable to work due to allergic eczema on your hands at any time during the past 3 years? *Yes No*

21. Have you ever had arthritis? *Yes No*
 (chronic rheumatoid arthritis)

22. Have you suffered from back pain during the past 12 months lasting for more than 4 weeks? *Yes No*

If "Yes" did the back pain improve if you exercised? *Yes No*

23. Have you suffered from morning stiffness in your back lasting more than 30 minutes? *Yes No*

24. Have you suffered from pains lasting more than 3 months, in the joints listed below during the last 3 years? *Yes No*
 Knees:
 Elbows:
 Innermost finger joints:
 Other joints:

If "Yes", did you suffer from stiff joints in the mornings lasting more than 30 minutes? *Yes No*

25. Have you had any infectious disease during the past 14 days? *Yes No*

 (influenza , common cold , vomiting, diarrhoea, etc.)

26. Have you taken iron tablets during the past 14 days? *Yes No*

27. How often do you take painkillers such as Globoid, Novid, Dispril, Albyl, etc.? *Yes*
 Tick the appropriate box
 1 - 3 times a week
 1 - 3 times a month
 Seldom or never

Have you used such painkillers during the past 14 days? *Yes No*

28. Have you changed the amount of physical exercise you take in leisure during time the last five years? *Yes*
 Tick the most appropriate box.
 As before
 More than before
 Less than before

III ILLNESS IN PARENTS AND SIBLINGS

29. Have any of these relatives had:	mother	father	sister	brother
Cerebral stroke or brain haemorrhage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diabetes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Arthritis (chronic rheumatoid arthritis)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cancer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kidney stones or stone in urinary tract	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Psoriasis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Peptic ulcer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
None of the above-mentioned illnesses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IV SOCIAL CONDITIONS AND PSYCHOLOGICAL PRESSURE ("STRESS")

30. How many years schooling have you had? (including secondary and folk high schools) number of years

31. What was your family's financial situation when you were growing up?
Tick the appropriate box *Yes*

Very good

Good

Poor

Very poor

32. Do you suffer from sleeplessness? *Yes No*

If "yes", at what time of the year do you suffer from sleeplessness?
Tick the appropriate box *Yes*

No particular time

Especially during the 'dark time'

Especially during the arctic summer (midnight sun)

Especially in spring and autumn

What form your sleeplessness take?
Tick the most appropriate box *Yes*

Difficult to fall asleep at night?

Wake up a lot during the night?

Wake up very early in the morning?

33. Have you had difficulty sleeping in the past couple of weeks?

Tick the most appropriate box *Yes*

Not at all

No more than usual

Rather more than usual

Much more than usual

34. Have you felt unhappy and depressed during the past couple of weeks?

Tick the appropriate box *Yes*

Not at all

No more than usual

Rather more than usual

Much more than usual

35. Have you felt unable to cope with your difficulties during the past couple of weeks?

Tick the appropriate box *Yes*

Not at all

No more than usual

Rather more than usual

Much more than usual

ETIKETT

TILLEGGSPØRSMÅL FOR DEM SOM HAR VÆRT
TIL SKJERMBILDEUNDERSTØKELSE I TROMSØ

Sammen med innkallingen fikk De et spørreskjema fra Statens Skjermbilde-
fotografering. Dette leverte De ved undersøkelsen.

Hjertekarsykdommene er imidlertid en mangeartet sykdomsgruppe med tildels dårlig
kjente årsaksforhold. I Tromsø vil vi derfor forsøke å få en mer fullstendig kartlegging
av forhold som kan være av betydning for sykdommens forløp, f.eks. kosthold, psykisk
press ("stress"), sosiale forhold og sykdomsforekomst blant slektninger. Vi håper De vil
være brydd med å fylle ut også dette skjema, og sende det tilbake til Tromsø Helseråd
i den utleverte konvolutt.

Alle opplysninger i forbindelse med skjermbildeundersøkelsen vil bli behandlet
strengt konfidensielt.

I EGET KOSTHOLD

1. Hva slags brød spiser De oftest?
Sett kryss i den ruten der "JA" passer best.

- Loff
- Fint (lyst) brød, alminnelig brød
- Grovt (mørkt) brød, kneipp o.l.
- Hjemmebakt (grovt) brød

JA

3. Hvor mange brødskeer spiser De
vanligvis daglig?
Sett kryss i den ruten der "JA" passer best.

- Mindre enn 2 skiver
- 2-6 skiver
- 7-12 skiver
- 13 skiver eller flere

JA

2. Hva slags smør eller margarin
bruker De oftest?
Sett kryss i den ruten der "JA" passer best.

- Meieri eller fjellsmør
- Vanlig margarin
- Plantemargarin
- Myk (soft) margarin

JA

4. Hva slags melk drikker De vanligvis?
Sett kryss i den ruten der "JA" passer best.

- Drikker ikke melk
- Melk (helmelk), søt, sur
- Skummet melk, søt, sur
- Blanding av skummet og helmelk

JA

5. Tegningen nedenfor forestiller terninger av smør eller margarin i naturlig størrelse.
Kryss av for den terning som likner mest på den mengde De bruker til 1 skive brød.

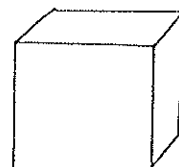
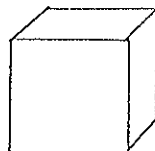
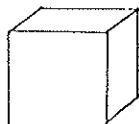
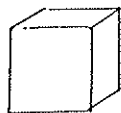
Er De i tvil, forsøk å prøvesmøre en skive.
Bruker ikke smør eller margarin.....

1

2

3

4



6. Hvor mange glass/kopper melk drikker De vanligvis daglig?
 Sett kryss i den ruten der „JA“ passer best.
 Drikker ikke, eller mindre enn et glass/en kopp 1
 1-2 glass/kopper 2
 3-4 glass/kopper 3
 5 eller flere glass/kopper 4

JA

7. Hvor mange kopper kaffe drikker De vanligvis daglig?
 Sett kryss i den ruten der „JA“ passer best.
 Drikker ikke, eller mindre enn en kopp 1
 1-4 kopper 2
 5-8 kopper 3
 9 eller flere kopper 4

JA

8. Er De totalavholdsmann/kvinne?
 Hvis nei,
 — Hvor ofte pleier De å drikke øl?
 Sett kryss i den ruten der „JA“ passer best.
 Aldri, eller noen få ganger i året 1
 1-2 ganger i måneden 2
 Omtrent 1 gang i uken 3
 2-3 ganger i uken 4
 Omtrent hver dag 5
 — Hvor ofte pleier De å drikke vin?
 Sett kryss i den ruten der „JA“ passer best.
 Aldri, eller noen få ganger i året 1
 1-2 ganger i måneden 2
 Omtrent 1 gang i uken 3
 2-3 ganger i uken 4
 Omtrent hver dag 5
 — Hvor ofte pleier De å drikke brennevin?
 Sett kryss i den ruten der „JA“ passer best.
 Aldri, eller noen få ganger i året 1
 1-2 ganger i måneden 2
 Omtrent 1 gang i uken 3
 2-3 ganger i uken 4
 Omtrent hver dag 5

JA NEI

9. Omtrent hvor ofte har De i løpet av de siste 12 måneder drukket så mye øl, vin eller brennevin at De har vært beruset?
 Sett kryss i den ruten der „JA“ passer best.
 Har aldri vært beruset eller ikke vært beruset i løpet av siste år 1
 Noen få ganger i året 2
 1-2 ganger i måneden 3
 1-2 ganger i uken 4
 3 eller flere ganger i uken 5

JA

10. Hvor ofte består middagsmåltidet av fisk eller retter med fisk?
 Sett kryss i den ruten der „JA“ passer best.
 Sjeldnere enn 1 gang i uken 1
 1-2 ganger i uken 2
 3-4 ganger i uken 3
 5-6 ganger i uken 4
 7 ganger i uken 5

JA

11. Hvor ofte bruker De frukt eller grønnsaker?
 Sett kryss i den ruten der „JA“ passer best.
 Bruker aldri frukt eller grønnsaker 1
 Noen få ganger i året 2
 1-2 ganger i måneden 3
 Omtrent 1 gang i uken 4
 2-3 ganger i uken 5
 Omtrent hver dag 6

JA

12. Hvor mange ganger i måneden spiser De kokte eller stekte pølser, kjøttkaker eller annen opplaget kjøttmat?
 Sett kryss i den ruten der „JA“ passer best.
 Aldri eller sjeldnere enn 1 gang i måneden 1
 1-2 ganger i måneden 2
 3-4 ganger i måneden (inntil 1 gang i uken) 3
 5-8 ganger i måneden (inntil 2 ganger i uken) 4
 Mer enn 8 ganger i måneden, (mer enn 2 ganger i uken) 5

JA

13. Har De i løpet av de siste 5 årene forandret
Deres kosthold når det gjelder disse varene?
Sett ett kryss for hver enkelt vare.

	Som før	Mer nå	Mindre nå
Vanlig margarin eller smør.....			
Skummet melk.....			
Magert kjøtt.....			
Helmelk.....			
Soya (soft) margarin.....			
Kjøtt med mye fett.....			

II TIDLIGERE/NÅVERENDE EGNE SYKDOMMER

14. Har De noen gang hatt?

Plutselig lammelse eller nummenhet
i en side av kropp eller ansikt,
i en hånd eller fot.....

Plutselig tap av taleevnen.....

Plutselig tap av synet helt eller
delvis, eller plutselig dobbeltsyn.....

15. Har De hatt magesår?

Har De ofte sugende smerter
øverst i magen?

Har De mye plager med sure
oppstøt eller halsbrann?

Er De mye plaget av oppblåsthet
og rumling i magen?

Har De ofte knipsmerter i magen?

Har De noen gang tatt røntgenbilde
av tykktarmen?

Har De hatt gallestein?

16. Har De hatt nyrestein (nyregrus)
eller stein i urinveier?
Hvis ja, hvor mange ganger?
og når hadde De siste anfall?

17. Har De noen gang hatt kreftsykdom?
Hvis ja, hvilket år ble sykdommen
oppdaget?

18. Har De, eller har De hatt
hudsykdommen psoriasis?

19. Har De i løpet av de siste 12 m^åne-
der hatt allergisk eksem på hendene?

20. Har De i løpet av de siste 3 år vært
sykemeldt eller arbeidsufør p.g.a.
allergisk eksem på hendene?

21. Har De, eller har De hatt leddgikt?
(Kronisk reumatisk artritt.)

22. Har De i løpet av de siste 12 m^åne-
der vært plaget av smerter i ryggen
som har vart lenger enn 4 uker?
Hvis ja, bedrer ryggsmertene seg
dersom De beveger Dem?

23. Har De vært plaget av stivhet i
ryggen om morgenen som varte
lenger enn 30 minutter?

24. Har De i løpet av de siste 3 år vært
plaget av smerter i noen av de følgende
ledd i mer enn 3 måneder?

Kneleddene
Albueleddene
De innerste fingerleddene
Andre ledd

Hvis ja, merket De stivhet i
leddene om morgenen av mer
enn 30 minutters varighet?

25. Har De hatt noen infeksjonssykdom
de siste 14 dagene?
(Influensa, forkjølelse, "ræksjuka," ell.)

26. Har De brukt jerntabletter de
siste 14 dagene?

27. Hvor ofte bruker De smertestillende midler som Globoid, Novid, Dispril, Alloyd e.l.? Selt kryss i den ruten der „JA“ passer best.	JA	NEI	28. Har De endret mengden av fysisk aktivitet i fritiden de siste 5 årene? Selt kryss i den ruten der „JA“ passer best.	JA
1-3 ganger i uken.....			Som før.....	1
1-3 ganger i måneden.....			Mer enn før.....	2
Sjelden eller aldri.....			Mindre enn før.....	3
Har De brukt slike smertestillende midler de siste 14 dagene?				

III SYKDOMMER HOS FORELDRE OG SØSKEN

29. Har noen av disse slektninger hatt:	Mor	Far	Søsster	Barn
Hjerneslag eller hjerneblødning.....				
Sukkersyke.....				
Leddgikt (kronisk reumatisk artritt).....				
Kreft.....				
Nyrestein eller stein i urinveier.....				
Psoriasis.....				
Magesår.....				
Ingen av nevnte sykdommer.....				

IV SOSIALE FORHOLD OG PSYKISK PRESS ("STRESS")

30. Hvor mange års skolegang har De? (Medregnet folkeskole og ungdomsskole.)	SOSIAL ÅR		33. Har De i de siste par ukene hatt vansker med å sove? Selt kryss i den ruten der „JA“ passer best.	JA
31. Hvordan var de økonomiske forhold i familien under Deres oppvekst? Selt kryss i den ruten der „JA“ passer best.	JA	NEI	Ikke i det hele tatt.....	1
Meget gode.....			Ikke mer enn vanlig.....	2
Gode.....			Heller mer enn vanlig.....	3
Vanskelige.....			Mye mer enn vanlig.....	4
Meget vanskelige.....				
32. Hender det at De er plaget av søvnløshet? Hvis ja, når på året pleier De å være plaget? Selt kryss i den ruten der „JA“ passer best.	JA	NEI	34. Har De i de siste par ukene følt Dem ulykkelig og nedtrykt (deprimert)? Selt kryss i den ruten der „JA“ passer best.	JA
Ingen spesiell tid.....			Ikke i det hele tatt.....	1
Særlig i mørketiden.....			Ikke mer enn vanlig.....	2
Særlig i midnattstid.....			Heller mer enn vanlig.....	3
Særlig høst og vår.....			Mye mer enn vanlig.....	4
Hvordan arter søvnløsheten seg?				
Vanskelig å sovne om kvelden.....			35. Har De i de siste par ukene følt Dem ute av stand til å mestre Deres vanskeligheter? Selt kryss i den ruten der „JA“ passer best.	JA
Våkner ofte i løpet av natten.....			Ikke i det hele tatt.....	1
Våkner tidlig om morgenen.....			Ikke mer enn vanlig.....	2
			Heller mer enn vanlig.....	3
			Mye mer enn vanlig.....	4

Questionnaire; Tromsø 1986/87 – Questionnaire I and II

**QUESTIONNAIRE I, TROMSØ
SURVEY 1986-87**

English translation; Mrs. Anne Clancy and
Mr. Kevin McCafferty

A FAMILY

Have one or both of your parents, or any of
your siblings (brothers and sisters) had a
heart attack or angina pectoris
(heart cramp)?

Yes No Don't know

B OWN ILLNESSES

Have you, or have you had: Yes No

A heart attack?
Angina pectoris (heart cramp)?
A cerebral stroke?
Diabetes?

Are you receiving treatment for: Yes No

High blood pressure?

Do you use nitroglycerine?

C SYMPTOMS

Do you get pain or discomfort
in the chest, when: Yes No

Walking up hills, stairs or walking
fast on level ground?
Walking at ordinary pace
on level ground?

If you get pain or discomfort in your
chest when walking, do you usually:

Yes
Stop
Slow down
Carry on at the same pace

If you stop or slow down, does the pain
disappear:

Yes
After less than 10 minutes?
After more than 10 minutes?

D EXERCISE

Exercise and physical exertion in leisure
time. If your activity varies much, for
example between summer and winter, then
give an average. The questions refer only to
the last twelve months.

Tick "yes" in the most appropriate box:

- Reading, watching TV or other
sedentary activity? Yes
- Walking, cycling or other forms of
exercise at least 4 hours a week?
(including walking or cycling to place
of work, Sunday walking, etc.)
- Participation in recreational sports,
heavy gardening, etc.? (Note: duration
of activity at least 4 hours a week)
- Participation in hard training or sports
competitions regularly several times
a week?

E SALT/ FAT

How often do you use salted meat or
salted fish for dinner?

Tick the appropriate box Yes

Never or less than once a month
Once a week or less
Twice a week or less
More than twice a week

How often do you add extra salt to
your dinner?

Tick the appropriate box Yes

Rarely or never
Sometimes or often
Always or nearly always

What type of margarine or butter do
you usually use on your bread?

Tick the most appropriate box Yes

Do not use margarine or butter
on bread
Butter
Margarine
Soft (soya) margarine spread
Butter/ margarine mixtures

What type of cooking fat do you
normally use in your household?

Tick the appropriate box. Yes

Butter or hard margarine
Soft (soya) margarine or oil
Butter/ margarine mixtures

F SMOKING

Do you smoke daily at present? Yes No

If "Yes":

Do you smoke cigarettes daily?
(hand-rolled or factory made)

If you do not smoke cigarettes at present:

Have you previously smoked cigarettes on a daily basis? Yes No

If "Yes", how long is it since you gave up smoking? Yes

More than 3 months?

3 months to 1 year?

1 - 5 years?

More than 5 years?

The following questions are to be answered by those who smoke at present or who have smoked previously.

How many years altogether have you smoked on a daily basis:

How many cigarettes do you smoke or did you smoke daily:
(hand-rolled + factory made)

Do you smoke anything else other than cigarettes daily? Yes

Cigars, cigarillos, cheroots?

Pipe?

If you smoke a pipe, how many packets of tobacco (50 gr.) do you smoke in a week?

Give the average number of packets a week:

G COFFEE

How many cups of coffee do you usually drink daily?

Tick the most appropriate box Yes

Do not drink coffee, or less than one cup

1 - 4 cups

5 - 8 cups

9 or more cups

What type of coffee do you usually drink daily?

Coarse ground coffee for brewing (boiled)

Finely ground filter coffee

Instant coffee

Caffeine free coffee

Do not drink coffee

H EMPLOYMENT

Have you received unemployment benefit within the past 12 months? Yes No

Are you at present on sick leave, or receiving rehabilitation allowance?

Are you on a full time or partial disability pension? Yes No

Do you usually work shifts or do night work?

During the past year have you had: Tick the most appropriate box. Yes

- Mostly sedentary work? (office work, watchmaker, light manual work)

- Work requiring a lot of walking? (shop assistant, light industrial work, teaching)

- Work requiring a lot of walking and lifting? (postman, heavy industrial work, construction)

- Heavy manual labour? (forestry, heavy farmwork, heavy construction)

Is house-keeping your main occupation? Yes No

I FOLLOW - UP EXAMINATION

Has any one in your household (other than yourself) been called in to a doctor for further medical examination after the previous cardiovascular disease survey? Yes No

If as a result of this survey you need further medical examination, which general practitioner do you wish to be referred to? Write the doctor's name here:

.....

No particular doctor

HELSEUNDERSØKELSEN I TROMSØ

(Gjelder bare den person som brevet er adressert til.)

Helseundersøkelsen kommer nå til Deres distrikt.

Tid og sted for frammøte vil De finne nedenfor.

De finner en orientering om undersøkelsen i den vedlagte brosjyren.

Vi ber Dem vennligst fylle ut spørreskjemaet på baksiden og ta med dette til undersøkelsen.

Vi ber Dem eventuelt melde fra om fravær på den vedlagte fraværsmeldingen.

Med hilsen

KOMMUNEHELSE-TJENESTEN I TROMSØ
 FYLKESLEGEN I TROMS UNIVERSITETET I TROMSØ
 STATENS HELSEUNDERSØKELSER

Født dato Personnr Kommune Kretsnr.
 Møtested Kjønn Første bokstav i etternavn Dag og dato Klokkeslett

FØDDE MÅLING 1	M P O KODE 75 MÅLING 2	AVVIK ARIM MAN APP NR TS1162 MÅLING 3
MAR S [] 85 [] 88 HR D [] 103 [] 122	MAR S [] 91 [] 94 HR D [] 109 [] 112	MAR S [] 97 [] 100 HR D [] 115 [] 118

A FAMILIE

Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)? 12

B EGEN SYKDOM

Har De, eller har De hatt:

Hjerteinfarkt? 13

Angina pectoris (hjertekrampe)? 14

Hjerneslag? 15

Sukkersyke? 16

Er De under behandling for:

Høyt blodtrykk? 17

Bruker De:

Nitroglycerin? 18

C SYMPTOMER

Får De smerter eller ubehag i brystet når De:

Går i bakker, trapper eller lørt på flat mark? 19

Går i vanlig takt på flat mark? 20

Dersom De får smerter eller vondt i brystet ved gange, pleier De da:

Stoppe? 21

Sakne farten? 22

Fortsatte i samme takt? 23

Dersom De stopper eller saktner farten, går da smertene bort:

Etter mindre enn 10 minutter? 24

Etter mer enn 10 minutter? 25

Har De vanligvis:

Hoste om morgenen? 26

Ocs spytt fra brystet om morgenen? 27

D MOSJON

Bevegelse og kroppslig aktivitet i Deres fritid. Dersom aktiviteten varierer mye, f.eks. mellom sommer og vinter, så ta ett gjennomsnitt. Spørsmålet gjelder bare det siste året.

Sett kryss i den ruten som passer best.

Leser, ser på fjernsyn eller annen stillesittende beskjeftigelse? 28

Spaserer, sykler eller beveger Dem på annen måte minst 4 timer i uken? 29

(Her skal De også regne med gang eller sykling til arbeidsstedet, søndagsturer m.m.)

Driver mosjonsidrett, tyngre hagearbeid e.l.? ... (Her skal aktiviteten skal være i minst 4 timer i uken) 30

Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uken? 31

E SALT/FETT

Hvor ofte bruker De salt kjøtt eller salt fisk til middag?

Sett kryss i den ruten som passer best.

Aldri eller sjeldnere enn en gang i måneden? 32

Inntil en gang i uken? 33

Inntil to ganger i uken? 34

Mer enn to ganger i uken? 35

Hvor ofte pleier De å stro ekstra salt på middagsmaten?

Sett kryss i den ruten som passer best.

Sjelden eller aldri 36

Av og til eller ofte 37

Alltid eller nesten alltid 38

Hva slags margarin eller smør bruker De vanligvis på brødet?

Sett kryss i den ruten som passer best

Bruker ikke smør eller margarin på brød 39

Smør 40

Hard margarin 41

M'yk (Soft) margarin 42

Smør/margarin blanding 43

Hva slags fett blir vanligvis brukt til matlaging i husholdningen Deres?

Sett kryss i den ruten som passer best

Smør eller hard margarin 44

M'yk (Soft) margarin eller olje 45

Smør/margarin blanding 46

F RØYKING

Røyker De daglig for tida? 30

Dersom svaret er «JA», svar da på dette:

Røyker De sigaretter daglig? 31

(håndrullede eller fabrikkfremstilte)

Dersom De ikke røyker sigaretter nå, svar da på dette:

Har De røykt sigaretter daglig tidligere? 32

Dersom De svarte «JA», hvor lenge er det da siden De sluttet?

Mindre enn 3 måneder? 33

3 måneder - 1 år? 34

1-5 år? 35

Mer enn 5 år? 36

Skal besvares av de som røyker nå eller som har røykt tidligere:

Hvor mange år til sammen har De røykt daglig? 37

Hvor mange sigaretter røyker eller røykte De daglig?

Gi opp antallet sigaretter daglig 38

(håndrullede + fabrikkfremstilte)

Røyker De noe annet enn sigaretter daglig?

Sigarer eller seruller/sigarillos? 39

Pipe? 40

Dersom De røyker pipe, hvor mange pakker tobakk (50 gram) bruker De i pipen på en uke?

Gi opp gjennomsnittlig tall på pakker i uken 41

G KAFFE

Hvor mange kopper kaffe drikker De vanligvis hver dag?

Sett kryss i den ruten som passer best.

Driker ikke kaffe, eller mindre enn en kopp 42

1 - 4 kopper 43

5 - 8 kopper 44

9 eller flere kopper 45

Hva slags kaffe drikker De vanligvis hver dag?

Kokekaffe 46

Filtrekaffe 47

Pulverkaffe 48

Kolleintri kaffe 49

Driker ikke kaffe 50

H ARBEID

Har De i de siste 12 månedene fått arbeidsledighetstrygd? 51

Er De for tiden sykemeldt, eller får De attføringspenger? 52

Har De full eller delvis uførepensjon? 53

Har De vanligvis skiftarbeid eller nattarbeid 54

Har De i det siste året hatt:

Sett kryss i den ruten som passer best.

For det meste stillesittende arbeid? 55

(f.eks. skrivebordsarb., utmakerarb., montering)

Arbeide som krever at De går mye? 56

(f.eks. ekspedientarb., feltindustriarb., undervisn.)

Arbeide der De går og løfter mye? 57

(f.eks. postbud, tyngre industriarb., bygningsarb.)

Tungt kroppsarbeid? 58

(f.eks. skogsarb., tungt jordbruksarb., tungt bygningsarb.)

Er husmorarbeid hovedyrket Deres? 59

I ETTERUNDERSØKELSE

Har noen i husstanden Deres (utenom Dem selv) vært innkalt til nærmere undersøkelse hos lege etter den siste hjerte-karundersøkelsen? 60

Dersom denne helseundersøkelsen viser at De bør undersøkes nærmere: Hvilken almenpraktiserende lege ønsker De da å bli henvist til?

Skriv navnet på legen her

..... 61

Ingen spesiell lege 62

JA NEI VET IKK

JA NEI

JA NEI

JA NEI

JA NEI

JA NEI

JA NEI

JA NEI

JA NEI

JA NEI

JA NEI

1
2
3
4

År

Sigaretter

Tobakkspk.

1
2
3
4

JA NEI

JA NEI

JA NEI

JA NEI

1
2
3
4

JA NEI

JA NEI

JA NEI

Ikke skriv her

Ikke skriv her

Ikke skriv her

**ADDITIONAL QUESTIONS THE
TROMSO HEALTH SURVEY,
1986 - 87.**

English translation: Mrs. Anne Clancy and
Mr. Kevin McCafferty

Cardiovascular heart and circulatory diseases, on which the surveys of 1974 and 1979-80 focused, are a very varied category of diseases whose causes are still partly unknown. In Tromso we are therefore trying to obtain a more complete description of factors which may be important for the course of these diseases, such as diet, psychological pressure, "stress", social conditions and the occurrence of disease in relatives. Such a description is also important in the search for factors that contribute to cancer, a group of diseases which we will also be trying to combat in the coming years.

When you were called in, you received a questionnaire which you handed in at the survey. The present questionnaire asks for further

GENERAL STATE OF HEALTH

How is your health?

Tick the appropriate box. Yes

Very bad	<input type="checkbox"/>
Bad	<input type="checkbox"/>
Neither good nor bad. "middling"	<input type="checkbox"/>
Good	<input type="checkbox"/>
Excellent	<input type="checkbox"/>

information about your health and includes questions on various diseases and physical and psychological complaints. We have included questions on pregnancy, birth and menstruation.

In addition, we are interested in obtaining information on the public use of medical services in order to find out how to improve the health service.

We hope that you will take the trouble to fill in yet another questionnaire and return it to "Tromso Board of Health" in the enclosed envelope. All information will be treated in strict confidence. If you have any comments to make on the survey, you may write them down in the space provided on the last page of the questionnaire.

Yours sincerely

*Tromso Board Department of
of Health Medicine,
University of Tromso*

ILLNESS

Have you/ have you had: Tick
"yes" or "no" for each question. Yes No

The skin disease psoriasis?	<input type="checkbox"/>	<input type="checkbox"/>
Asthma?	<input type="checkbox"/>	<input type="checkbox"/>
Allergic eczema?	<input type="checkbox"/>	<input type="checkbox"/>
Hay fever?	<input type="checkbox"/>	<input type="checkbox"/>
Chronic bronchitis?	<input type="checkbox"/>	<input type="checkbox"/>
Stomach ulcer?	<input type="checkbox"/>	<input type="checkbox"/>
Duodenal ulcer?	<input type="checkbox"/>	<input type="checkbox"/>
Your appendix removed?	<input type="checkbox"/>	<input type="checkbox"/>
An operation for a stomach ulcer?	<input type="checkbox"/>	<input type="checkbox"/>
Chronic rheumatoid arthritis?	<input type="checkbox"/>	<input type="checkbox"/>
Cancer?	<input type="checkbox"/>	<input type="checkbox"/>
Epilepsy?	<input type="checkbox"/>	<input type="checkbox"/>
Migraine?	<input type="checkbox"/>	<input type="checkbox"/>

INFECTIONS

How many times in the last 6 months have you had infections like a cold, influenza (flu) diarrhoea/vomiting, or similar illnesses? *Number of times:*

Have you had one of these infection in the past 14 days? *Yes No*

ILLNESS IN PARENTS OR SIBLINGS

Tick the appropriate box for relatives that have, or have had the following illnesses:

	Mother	Father	Brother	Sister
Cerebral stroke or brain haemorrhage:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diabetes:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rheumatoid arthritis:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cancer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Psoriasis:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stomach or duodenal ulcer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Asthma:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Tick the appropriate box if neither your parents nor siblings have or have had any of the above illnesses. *Yes No*

MEDICINES

Have you during the last year used tablets/sprays or had injections for asthma or allergies? *Yes No*

Have you used any of the following medicines in the past 14 days? *Yes No*

Painkillers:

Antipyretics (to reduce fever):

Eczema ointment:

Blood pressure medication:

Heart medication:

Sleeping tablets:

Nerve tablets:

Migraine medication:

Epilepsy medication:

Other medicines:

CONTACT DUE TO OWN HEALTH OR ILLNESS

How many visits have you made during the past year due to your own health or illness? *Number of visits*

To a GP(general practitioner):

To a specialist, (non hospital):

Emergency GP

Medical officer at work :

Physiotherapist:

Chiropractor:

Nature healer(homeopath etc.):

Hospital outpatient department

Number of hospital admissions in the past year:

DIET

How many slices of bread do you usually eat daily ?

Tick the most appropriate box. *Yes*

Less than 2 slices

2 - 4 slices

5 - 6 slices

7 -12 slices

13 or more slices

What type of milk do you usually drink?

Tick the most appropriate box. *Yes*

Do not drink milk

Full cream milk (ordinary or curdled)

Light milk

Skimmed milk (ordinary or curdled)

How many glasses/cups of milk do usually drink daily? *Yes*

Less than 1 glass/cup

1 - 2 glasses/cups

3 - 4 glasses/cups

5 or more glasses/cups

FISH

How often do you eat cod, coal fish, red snapper or other lean fish for dinner or in a sandwich?

Tick the most appropriate box *Yes*

Less than once a week

Once a week

Twice a week

3 or more times a week

How often do you eat cod/pollock or other lean fish for dinner or in a sandwich?

- Tick the most appropriate box.* Yes
- Less than once a week
- Once a week
- Twice a week
- 3 or more times a week

How often do you eat fat fish, such as herring, halibut, mackerel, salmon or trout for dinner or in a sandwich?

- Tick the most appropriate box* Yes
- Less than once a week
- Once a week
- Twice a week
- 3 or more times a week

Do you take cod liver oil regularly?

- Tick the most appropriate box* Yes
- No
- 'Dark-time' (mid-winter)
- All year

BREAKFAST

Do you usually eat breakfast every day? Yes No

-

DINNER

How often do you eat meat for dinner?

- Tick the appropriate box* Yes
- Less than once a week
- Once or twice a week
- 3 - 4 times a week
- 5 or more times a week

How often do you use fat like butter, margarine, mayonnaise, etc. with your dinner?

- Tick the most appropriate box* Yes
- Less than once a week
- Once or twice a week
- 3 - 4 times a week
- 5 or more times a week

Do you usually eat vegetables with your dinner? Yes No

-

FRUIT

How often do you usually eat fruit?

- Tick the appropriate box.*
- Less than once a week
- About once a week
- 2 - 3 times a week
- 4 - 5 times a week
- More or less

ALCOHOL

Are you a teetotaler? Yes No

-

If "not", how often do you drink beer?

- Tick the most appropriate box* Yes
- Never or just a few times a year
- Once or twice a month
- About once a week
- 2 - 3 times a week
- More or less daily

How often do you drink wine?

- Tick in the most appropriate box* Yes
- Never or just a few times a year
- Once or twice a month
- About once a week
- 2 - 3 times a week
- More or less daily

How often do you drink spirits?

- Tick the appropriate box* Yes
- Never or just a few times a year
- Once or twice a month
- Approximately once a week
- 2 or 3 times a week
- More or less daily

Approximately how often in the past year have you drunk alcohol corresponding to at least 5 small bottles of beer, a bottle of wine, or a quarter bottle of spirits?

- Tick the most appropriate box* Yes
- Not at all the past year
- A few times
- Once or twice a month
- 3 or more times a week

PHYSICAL ACTIVITY

How often do you take part in physical activity lasting at least 20 minutes, which makes you perspire or become breathless?

- Tick the appropriate box. *Yes*
- Rarely or never
 - Weekly
 - Several times a week
 - Daily

If you usually take part in this type of activity at least weekly, how much time do you spend exercising?

- Tick the most appropriate box. *Yes*
- Less than 30 minutes a week
 - Between 30 minutes and one hour weekly
 - Between 1 and 2 hours a week
 - More than 2 hours a week

CHANGE IN DIETARY HABITS AND OTHER HABITS

Have you changed any of the following habits during the last 5 years?

- Tick the appropriate box. *Use now*
- | | <i>More</i> | <i>As before</i> | <i>Less</i> |
|-------------------------|--------------------------|--------------------------|--------------------------|
| Dietary fat | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Soya margarine or oil | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Skimmed or low fat milk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Coffee intake | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Alcohol intake | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Physical activity | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

MARRIAGE / PARTNER

Are you married or 'living together? *Yes No*

How old were you when you first married or moved in with a partner? *age:*

HOUSEHOLD

How many persons live in your household? *Number of persons:*

- Is anyone in your household 10 years or younger? *Yes No*
- Does anyone in your household need special care/assistance? *Yes No*
(Other than the children)

SCHOOLING

How many years schooling have you had? (include secondary and folk high schools)
Number of years:

EMPLOYMENT

- Have you had paid work this past year?
Tick the appropriate box *Yes*
- Full-time work
 - Part-time work
 - Unpaid work

How much house work do you normally do yourself?

- Tick the appropriate box *Yes*
- All or almost all
 - At least half
 - More than a quarter
 - Less than a quarter

BACK AND JOINTS CONDITIONS

During this last year have you suffered from backache that has lasted longer than 4 weeks? *Yes No*

If "yes", does the pain improve when you exercise? *Yes No*

Have you suffered from morning stiffness in your back lasting more than 30 minutes? *Yes No*

During the past 3 years have you suffered from pain in any of the following joints lasting more than 30 minutes? *Yes No*

- Knees
- Elbows
- Innermost finger joints
- Other joints

If "yes", have you suffered from stiff joints in the mornings lasting more than 30 minutes? *Yes No*

NECK HEAD AND SHOULDER COMPLAINTS

How often do you suffer headache?
Tick the appropriate box Yes
Rarely or never
Once or twice a month
Once or twice a week
Daily

How often do you suffer pain in the neck or shoulder?
Tick the appropriate box Yes
Rarely or never
Once or twice a month
Once or twice a week
Daily

Do these complaints inhibit your ability to work?
Tick the appropriate box. Yes
Little or no effect
To some degree
To a large degree
Cannot do ordinary work

Have your back, shoulders, and /or neck ever been x-rayed? Yes No

SLEEPLESSNESS / LOSS OF CONSCIOUSNESS

Have you ever suffered from sleeplessness? Yes No

If "yes", at what time of the year do you usually suffer from sleeplessness?
Tick the appropriate box Yes
No particular time
Especially during the 'dark time'
Especially during the arctic summer (midnight sun)
Especially in spring and autumn

Have you at any time during the last 12 twelve months suffered from tiredness that has affected your work performance? Yes No

Have you suffered from sudden loss of consciousness in the past year? Yes No

Have you noticed sudden changes in your pulse rate or heartbeat in the past year? Yes No

REACTION TO PROBLEMS

If you have major personal problems, do you expect to get help and support from your spouse or family? Yes No

In the last year, have you long felt a need to seek help with personal problems, without doing so? Yes No

During the past 2 weeks have you felt unable to cope with your problems?
Tick the appropriate box Yes
Seldom or never
Sometimes
Often
Nearly always

During the past 2 weeks have you felt unhappy or depressed?
Tick the appropriate box Yes
Seldom or never
Sometimes
Often
Nearly always

Do you ever feel lonely?
Tick the appropriate box Yes
Very often
Sometimes
Rarely or never

THE REMAINING SECTION OF THE QUESTIONNAIRE APPLIES TO WOMEN ONLY.

MENSTRUATION

How old were you when you started menstruating? age:

When did you start (date, month, year) your last period?

How many days usually pass from the first day of one period to the first day of your next period (the time lapsed between the start of two periods)?
Number of days:

Do/did you menstruate regularly? Yes No

Do you usually need pain-killers during menstruation? Yes No

PRE-MENSTRUAL TENSION

Do you have any of the following complaints before your period?

Are you depressed or irritable?
Tick the appropriate box Yes
Hardly at all
Noticeably
Very much so

Are your breasts painful?
Tick the appropriate box Yes
Hardly at all
Noticeably
Very much so

Do you have swollen hands/feet, put on weight, or feel bloated?
Tick the appropriate box. Yes
Hardly at all
Noticeably
Very much so

Do the complaints disappear when you get your period? Yes No

What type of medication do you use for these complaints?

Tick the appropriate box. Yes
Diuretics
Other medicines

PREGNANCY

How many children have you had?
Number of children:

How old were you when you got pregnant for the first time? Age:

CONTRACEPTION

Do you now use or have you ever used the contraceptive pill or an intrauterine device?
Yes No

If "yes", for how many years altogether have you used: Number of years
The pill:
An intrauterine device:

How old were you when you started using:
The pill: age:
An intrauterine device: age:

If you stopped taking the pill, did 6 months or more pass without menstruating (having a period), without your being pregnant?
Yes No

Did you have to stop taking the pill due to high blood pressure? Yes No

CERVICAL SMEAR TEST

How many times have you had a cervical smear test in the last 3 years?
Number of times:

How many years is it since you had your last cervical smear test?
Number of years:

Comments

.....

Thank you for your help! Remember to post the questionnaire today!
The Tromso survey 1986-1987.

Tilleggsspørsmål til Helseundersøkelsen i Tromsø 1986-87.

Hjerte-karsykdommene, som Hjerte-karundersøkelsen i 1974 og 1975-80 spesielt tok opp, er en mangartede sykdomsgruppe med tildels dårlig kjente årsaksforhold. I Tromsø vil vi derfor forsøke å få en mer fullstendig kartlegging av forhold som kan være av betydning for sykdommens forløp, f.eks. kosthold, psykisk press «stress», sosiale forhold og sykdomsforekomst blant slektninger. En slik kartlegging er også viktig for å finne fram til sykdomsskapende forhold for kreftsykdommene, som er en sykdomsgruppe vi også vil prøve å bekjempe i årene som kommer.

Sammen med innkallingen fikk De et spørreskjema som De leverte ved undersøkelsen. Dette spørreskjema kartlegger helseforholdene bedre og inkluderer spørsmål om noen forskjellige sykdommer og fysiske/psykiske plager. Spesielt er det tatt med spørsmål vedrørende svangerskap, fødsel og menstruasjon.

Dessuten er vi interessert i å få oversikt over hvordan folk bruker helsetjenesten, for å få kunnskap om hvordan helsetjenesten kan bedres.

Vi håper De vil være brydd med å fylle ut også dette skjemaet, og sende det tilbake til Tromsø Helseråd i den utleverte konvolutt. Alle opplysninger i forbindelse med Helseundersøkelsen vil bli behandlet strengt konfidensielt. Har De noen kommentarer til undersøkelsen kan De skrive dem i kommentarfeltet på siste side.

Med hilsen

Tromsø Helseråd Fagområdet medisin

HELSEHILSTAND	
Hvordan er Deres helsestilstand?	
Sett kryss i den ruten der «Ja» passer best.	
Meget dårlig	12
Dårlig	
Hverken god eller dårlig, middels	
Bra	
Utmerket	
SYKDOM	
Har De, eller har De hatt	
Kryss av «Ja» eller «Nei» for hvert spørsmål	
Hudsykdommen psoriasis	13
Astma	14
Allergisk eksem	15
Hocynue	16
Kronisk bronkitt	17
Sår på magesekken	18
Sår på tolvfingertarmen	19
Blindtarmsoperasjon	20
Magesårsoperasjon	21
Leddgikt (kronisk revmatoid artritt)	22
Kreftsykdom	23
Epilepsi (fallesyke)	24
Migræne	25
INFEKSJON	
Hvor mange ganger har De hatt infeksjon slik som lorkjølelse, influensa, «ræksjuka» og lignende siste halvår?	
	26
Har De hatt slik infeksjon siste 14 dager?	
	27

SYKDOM HOS FORELDRE OG SØSKEN	
Kryss av for de slektningene som har eller har hatt noen av sykdommene.	
Hjerneslag eller hjerneblødning	28
Sukkersyke	32
Leddgikt (revmatoid artritt)	36
Kreft	40
Psoriasis	44
Magesår eller tolvfingertarmsår	48
Astma	52
Kryss av dersom slektningene ikke har eller har hatt noen av disse sykdommene	
	56
MEDISINER	
Har De siste år brukt tabletter, sprøyter eller astmaspray mot astma eller allergi	
	60
Har De brukt følgende medisiner siste 14 dager?	
Smertestillende	61
Febersenkende	62
Eksemsalve	63
Blodtrykksmedisin	64
Hjertemedisin	65
Sovemedisin	66
Nervemedisin	67
Migrænemedisin	68
Medisin mot epilepsi (fallesyke)	69
Annen medisin	70

KONTAKT PGA. EGEN HELSE ELLER SYKDOM

Hvor mange besøk har De hatt siste år på grunn av egen helse eller sykdom?	Antall besøk
Hos vanlig lege	71 <input type="checkbox"/>
Hos spesialist utenfor sykehuset	72 <input type="checkbox"/>
På legevakta	85 <input type="checkbox"/>
Hos bedriftslege	87 <input type="checkbox"/>
Hos fysioterapeut	89 <input type="checkbox"/>
Hos kiropraktor	81 <input type="checkbox"/>
Hos naturmedisinere (homeopat, soneterapeut o.l.)	83 <input type="checkbox"/>
På sykehusets poliklinikk	85 <input type="checkbox"/>
Antall innleggelses på sykehus siste år	87 <input type="checkbox"/>

KOSTHOLD

Hvor mange brødskiver spiser De vanligvis daglig?	Ja
Sett kryss i den ruten der «Ja» passer best	<input type="checkbox"/>
Mindre enn 2 skiver	1 <input type="checkbox"/>
2 - 4 skiver	2 <input type="checkbox"/>
5 - 6 skiver	3 <input type="checkbox"/>
7 - 12 skiver	4 <input type="checkbox"/>
13 eller flere skiver	5 <input type="checkbox"/>
Hva slags melk drikker de vanligvis?	Ja
Sett kryss i den ruten der «Ja» passer best.	<input type="checkbox"/>
Drikker ikke melk	1 <input type="checkbox"/>
Melk (helmelk), søt, sur	2 <input type="checkbox"/>
Lettmelk	3 <input type="checkbox"/>
Skummet melk, søt, sur	4 <input type="checkbox"/>
Hvor mange glass/kopper melk drikker De vanligvis daglig?	Ja
Sett kryss i den ruten der «Ja» passer best.	<input type="checkbox"/>
Mindre enn ett glass/kopp	1 <input type="checkbox"/>
1 - 2 glass/kopper	2 <input type="checkbox"/>
3 - 4 glass/kopper	3 <input type="checkbox"/>
5 eller flere glass/kopper	4 <input type="checkbox"/>

FISKEMAT

Hvor ofte spiser De torsk/sei eller annen mager fisk til middag eller som pålegg?	Ja
Sett kryss i den ruten der «Ja» passer best.	<input type="checkbox"/>
Sjeldnere enn en gang i uken	1 <input type="checkbox"/>
1 gang i uken	2 <input type="checkbox"/>
2 ganger i uken	3 <input type="checkbox"/>
3 eller flere ganger i uken	4 <input type="checkbox"/>
Hvor ofte spiser De fet fisk som sild, kveite, øst, makrell, laks, ørret til middag eller som pålegg?	Ja
Sett kryss i den ruten der «Ja» passer best.	<input type="checkbox"/>
Sjeldnere enn en gang i uken	1 <input type="checkbox"/>
1 gang i uken	2 <input type="checkbox"/>
2 ganger i uken	3 <input type="checkbox"/>
3 eller flere ganger i uken	4 <input type="checkbox"/>
Braker De tran regelmessig?	Ja
Sett kryss i den ruten der «Ja» passer best.	<input type="checkbox"/>
Nei	1 <input type="checkbox"/>
I merketida	2 <input type="checkbox"/>
Hele året	3 <input type="checkbox"/>

FROKOST

Spiser De vanligvis frokost daglig?	Ja	Nei
	<input type="checkbox"/>	<input type="checkbox"/>

MIDDAGSMAT

Hvor ofte spiser De vanligvis kjøtt til middagen?	Ja	
Sett kryss i ruten der «Ja» passer best.	<input type="checkbox"/>	
Sjeldnere enn en gang i uken	1 <input type="checkbox"/>	
1 - 2 ganger i uken	2 <input type="checkbox"/>	
3 - 4 ganger i uken	3 <input type="checkbox"/>	
5 eller flere ganger i uken	4 <input type="checkbox"/>	
Hvor ofte bruker De fett (smør, margarin, remulade, majones og lignende) til eller på middagsmaten?	Ja	
Sett kryss i ruten der «Ja» passer best.	<input type="checkbox"/>	
Sjeldnere enn en gang i uken	1 <input type="checkbox"/>	
1 - 2 ganger i uken	2 <input type="checkbox"/>	
3 - 4 ganger i uken	3 <input type="checkbox"/>	
5 eller flere ganger i uken	4 <input type="checkbox"/>	
Braker De vanligvis grønnsaker som del av middagsmaten?	Ja	Nei
	<input type="checkbox"/>	<input type="checkbox"/>

FRUKT

Hvor ofte spiser De vanligvis frukt?	Ja
Sett kryss i ruten der «Ja» passer best.	<input type="checkbox"/>
Sjeldnere enn en gang i uken	1 <input type="checkbox"/>
Omtrent en gang i uken	2 <input type="checkbox"/>
2 - 3 ganger i uken	3 <input type="checkbox"/>
4 - 5 eller flere ganger i uken	4 <input type="checkbox"/>
Omtrent daglig	5 <input type="checkbox"/>

ALKOHOL

Er De total avholdsmann/kvinne	Ja	Nei
	<input type="checkbox"/>	<input type="checkbox"/>
Hvis nei, - Hvor ofte pleier De å drikke øl?	Ja	
Sett kryss i ruten der «Ja» passer best.	<input type="checkbox"/>	
Aldri, eller noen få ganger i året	1 <input type="checkbox"/>	
1 - 2 ganger i måneden	2 <input type="checkbox"/>	
Omtrent 1 gang i uken	3 <input type="checkbox"/>	
2 - 3 ganger i uken	4 <input type="checkbox"/>	
Omtrent hver dag	5 <input type="checkbox"/>	
Hvor ofte pleier De å drikke vin?	Ja	
Sett kryss i ruten der «Ja» passer best.	<input type="checkbox"/>	
Aldri, eller noen få ganger i året	1 <input type="checkbox"/>	
1 - 2 ganger i måneden	2 <input type="checkbox"/>	
Omtrent 1 gang i uken	3 <input type="checkbox"/>	
2 - 3 ganger i uken	4 <input type="checkbox"/>	
Omtrent hver dag	5 <input type="checkbox"/>	
- Hvor ofte pleier De å drikke brennevin?	Ja	
Sett kryss i ruten der «Ja» passer best.	<input type="checkbox"/>	
Aldri, eller noen få ganger i året	1 <input type="checkbox"/>	
1 - 2 ganger i måneden	2 <input type="checkbox"/>	
Omtrent 1 gang i uken	3 <input type="checkbox"/>	
2 - 3 ganger i uken	4 <input type="checkbox"/>	
Omtrent hver dag	5 <input type="checkbox"/>	
Omtrent hvor ofte har De i løpet av siste år drukket alkohol tilsvarende minst 5 halvflasker øl, en helflaske vin eller ¼ flaske brennevin?	Ja	
Sett kryss i ruten der «Ja» passer best.	<input type="checkbox"/>	
Ikke siste år	1 <input type="checkbox"/>	
Noen få ganger	2 <input type="checkbox"/>	
1 - 2 ganger i måneden	3 <input type="checkbox"/>	
3 eller flere ganger i uken	4 <input type="checkbox"/>	

FYSISK AKTIVITET

Hvor ofte utfører De fysisk aktivitet av minst 20 minutters varighet og som fører til at De blir svett eller andpusten?

- Sett kryss i ruten der ~Ja- passer best.
- | | | | | |
|---------------------|-----|----|--------------------------|---|
| Sjelden eller aldri | 104 | Ja | <input type="checkbox"/> | 1 |
| Ukentlig | | | <input type="checkbox"/> | 2 |
| Fleire ganger i uka | | | <input type="checkbox"/> | 3 |
| Daglig | | | <input type="checkbox"/> | 4 |

Dersom De vanligvis utfører slik aktivitet minst en gang i uka, hvor mye tid bruker De ukentlig til slik aktivitet?

- Sett kryss i ruten der ~Ja- passer best.
- | | | | | |
|------------------------------------|-----|----|--------------------------|---|
| Mindre enn 30 minutter i uka | 105 | Ja | <input type="checkbox"/> | 1 |
| Mellom 30 minutter og 1 time i uka | | | <input type="checkbox"/> | 2 |
| Mellom 1 og 2 timer i uka | | | <input type="checkbox"/> | 3 |
| Mer enn 2 timer i uka | | | <input type="checkbox"/> | 4 |

VANER OG KOSTENDRINGER

Har De endret Deres vaner/kosthold i løpet av de siste 5 år når det gjelder: (Sett kryss for hvert spørsmål)

- | | | | | | | | |
|-----------------------------|-----|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Fett i kosten | 106 | mer | <input type="checkbox"/> | likt | <input type="checkbox"/> | mindre | <input type="checkbox"/> |
| Soyamargarin eller matoljer | 107 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Skummet melk eller lettmeik | 108 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Kaffe-forbruk | 109 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Alkohol-forbruk | 110 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Fysisk aktivitet | 111 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

EKTESKAP/SAMBO-FORHOLD

Er De gift eller samboende

- Ja Nei

Hvor gammel var De da De første gang giftet Dem eller inledet et samboerforhold?

år

HUSSTAND

Hvor mange personer bor det i deres husstand?

Antall

Er noen i Deres husstand 10 år eller yngre?

- Ja Nei

Trenger noen i Deres husstand spesielt tilsyn/pleie - utenom barna?

- Ja Nei

SKOLEGANG

Hvor mange års skolegang har De (la også med folkeskole og ungdomsskole)?

år

ARBEID

Har De hatt lønnet arbeid hele siste år?

- Ja

Sett kryss i ruten der ~Ja- passer best.

Fulltidsarbeid	121	<input type="checkbox"/>	1
Deltidsarbeid		<input type="checkbox"/>	2
Ikke lønnet arbeid		<input type="checkbox"/>	3

Hvor stor del av det daglige arbeid i hjemmet gjør De vanligvis selv?

- Sett kryss i ruten der ~Ja- passer best.
- | | | | |
|-------------------------|-----|--------------------------|---|
| Allt eller nesten alt | 122 | <input type="checkbox"/> | 1 |
| Minst halvparten | | <input type="checkbox"/> | 2 |
| Mer enn en fjerdedel | | <input type="checkbox"/> | 3 |
| Mindre enn en fjerdedel | | <input type="checkbox"/> | 4 |

RYGG- OG LEDDLAGER

Har De i løpet av siste år vært plaget av smerter i ryggen som har vart lenger enn 4 uker? . . . 123

- Ja Nei

Hvis ja, bedrer ryggsmertene seg dersom De beveger Dem? . . . 124

-

Har De vært plaget av stivhet i ryggen om morgenen som varte lenger enn 30 minutter? . . . 125

-

Har De i løpet av siste 3 år vært plaget av smerter i noen av de følgende ledd i mer enn 3 måneder?

- Ja Nei

- | | | | |
|---------------------------|-----|--------------------------|--------------------------|
| Kneleddene | 126 | <input type="checkbox"/> | <input type="checkbox"/> |
| Albueleddene | 127 | <input type="checkbox"/> | <input type="checkbox"/> |
| De innerste fingerleddene | 128 | <input type="checkbox"/> | <input type="checkbox"/> |
| Andre ledd | 129 | <input type="checkbox"/> | <input type="checkbox"/> |

Hvis ja, merket De stivhet i leddene om morgenen av mer enn 30 minutters varighet . . . 130

-

PLAGER I HODE, NAKKE OG SKULDRE

Hvor ofte er De plaget av hodepine?

Sett kryss i ruten der ~Ja- passer best.

- Ja

- | | | | |
|---------------------------------|-----|--------------------------|---|
| Sjelden eller aldri | 131 | <input type="checkbox"/> | 1 |
| En eller flere ganger i måneden | | <input type="checkbox"/> | 2 |
| En eller flere ganger i uken | | <input type="checkbox"/> | 3 |
| Daglig | | <input type="checkbox"/> | 4 |

Hvor ofte er De plaget av smerter i nakke eller skuldre?

Sett kryss i ruten der ~Ja- passer best.

- Ja

- | | | | |
|---------------------------------|-----|--------------------------|---|
| Sjelden eller aldri | 132 | <input type="checkbox"/> | 1 |
| En eller flere ganger i måneden | | <input type="checkbox"/> | 2 |
| En eller flere ganger i uken | | <input type="checkbox"/> | 3 |
| Daglig | | <input type="checkbox"/> | 4 |

Reduserer plagene i hodet, nakken eller skuldrene Deres arbeidsevne?

Sett kryss i ruten der ~Ja- passer best.

- Ja

- | | | | |
|--------------------------------|-----|--------------------------|---|
| Aldri, eller i ubetydelig grad | 133 | <input type="checkbox"/> | 1 |
| I noen grad | | <input type="checkbox"/> | 2 |
| I betydelig grad | | <input type="checkbox"/> | 3 |
| Klarer ikke vanlig arbeid | | <input type="checkbox"/> | 4 |

Har De noen gang fått rontgenundersøkt ryggen, nakken og/eller skuldre . . . 134

- Ja Nei

SØVNLØSHET/BEVISSTLØSHET

Hender det at De er plaget av søvnløshet . . . 135

- Ja Nei

Hvis ja, når på året er De mest plaget?

Sett kryss i ruten der ~Ja- passer best.

- Ja

- | | | | |
|------------------------|-----|--------------------------|---|
| Ingen spesiell tid | 136 | <input type="checkbox"/> | 1 |
| Særlig mørketiden | | <input type="checkbox"/> | 2 |
| Særlig i midnattstiden | | <input type="checkbox"/> | 3 |
| Særlig høst og vår | | <input type="checkbox"/> | 4 |

Har De gjennom hele siste år vært plaget av søvnløshet slik at det går ut over arbeidsevnen? . . . 137

- Ja Nei

Har De siste år hatt anfall med plutselig tap av bevissthet? . . . 138

- Ja Nei

Har De merket anfall med plutselig endring i pulsen eller hjerterytmen siste år . . . 139

- Ja Nei

REAKSJONER PÅ PROBLEMER			
Hvis De får store personlige problemer, regner De da med å få hjelp og støtte fra ektefelle, samboer eller familie? 140	Ja <input type="checkbox"/> Nei <input type="checkbox"/>	Har De i de siste 14 dager følt Dem ulykkelig og nedtrykt (deprimert)? Sett kryss i ruten der <input type="checkbox"/> -Ja- passer best. Aldri eller sjelden 143	Ja <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
Har De i lengere tid følt behov for å oppsøke noen på grunn av personlige problemer siste år, uten at De har tatt slik kontakt? 141	Ja <input type="checkbox"/> Nei <input type="checkbox"/>	Hender det ofte at De føler Dem ensom? Sett kryss i ruten der <input type="checkbox"/> -Ja- passer best. Meget ofte 144	Ja <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
Har De i de siste 14 dager følt Dem ute av stand til å takle Deres vanskeligheter? Sett kryss i ruten der <input type="checkbox"/> -Ja- passer best. Aldri eller sjelden 142	Ja <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4	Av og til	
Av og til		Ofte	
Nesten hele tiden		Nesten hele tiden	
RESTEN AV SKJEMAET BESVARES BARE AV KVINNER			
MENSTRUASJON		Forsvinner plagene når menstruasjonen kommer? 160	Ja <input type="checkbox"/> Nei <input type="checkbox"/>
Hvor gammel var De da De fikk menstruasjon første gang? 145	<input type="checkbox"/> år	Bruker De mot slike plager - vanndrivende tabletter? 161	Ja <input type="checkbox"/> Nei <input type="checkbox"/>
Når begynte Deres siste menstruasjon? 147	dag / /	- andre medisiner? 162	<input type="checkbox"/> <input type="checkbox"/>
Hvor mange dager er/var det vanligvis fra menstruasjonens 1. blødningsdag til neste menstruasjonens 1. blødningsdag (= tiden mellom to menstruasjoners begynnelse)? 153	<input type="checkbox"/> dager	SVANGERSKAP	
Plasert/pleide menstruasjonen å være regelmessig 155	Ja <input type="checkbox"/> Nei <input type="checkbox"/>	Hvor mange barn har De født? 163	Antall <input type="checkbox"/>
Bruker De vanligvis smertestillende tabletter under menstruasjonen? 156	Ja <input type="checkbox"/> Nei <input type="checkbox"/>	Hvor gammel var De første gang De var gravid? 164	<input type="checkbox"/> år
PLAGER FOR MENSTRUASJON		PREVENSJON	
Har De for menstruasjon noen av disse plagene: - Er De nedtrykt (deprimert) eller irritable? Sett kryss i ruten der <input type="checkbox"/> -Ja- passer best. Ubetydelig 157	Ja <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3	Bruker eller har De brukt P-piller eller spiral? 166	Ja <input type="checkbox"/> Nei <input type="checkbox"/>
- Har De smertefulle bryster? Sett kryss i ruten der <input type="checkbox"/> -Ja- passer best. Ubetydelig 158	Ja <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3	Hvis ja, hvor mange år har De tilsammen brukt P-piller? 167	<input type="checkbox"/> år
- Har De hovne hender/føtter, vektøkning, eller følelse av å «ese ut»? Sett kryss i ruten der <input type="checkbox"/> -Ja- passer best. Ubetydelig 159	Ja <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3	Spiral? 169	<input type="checkbox"/> år
		Hvor gammel var De da De begynte med P-piller? 171	<input type="checkbox"/> år
		Spiral? 173	<input type="checkbox"/> år
		Hvis De har sluttet med P-piller, utoble da menstruasjonen i mer enn 6 måneder uten at De var gravid? 175	Ja <input type="checkbox"/> Nei <input type="checkbox"/>
		Har de måttet slutte med P-piller fordi De fikk høyt blodtrykk? 176	Ja <input type="checkbox"/> Nei <input type="checkbox"/>
		KREFTPROVE	
		Hvor mange ganger har De fått tatt kreftprøve (celleprøve) fra livmorhalsen siste 3 år? 177	Antall prøver <input type="checkbox"/>
		Hvor mange år siden er det siden siste prøve? 178	<input type="checkbox"/> år
Deres kommentarer 179			

Takk for hjelpen! Husk å postlegge skjemaet idag!
 Tromsundersøkelsen 1986-7

ISM SKRIFTSERIE - FØR UTGITT:

1. Bidrag til belysning av medisinske og sosiale forhold i Finnmark fylke, med særlig vekt på forholdene blant finskattede i Sør-Varanger kommune.
Av Anders Forsdahl, 1976. (nytt. opplag 1990)
2. Sunnhetstilstanden, hygieniske og sosiale forhold i Sør-Varanger kommune 1869-1975 belyst ved medisinalberetningene.
Av Anders Forsdahl, 1977.
3. Hjerte-karundersøkelsen i Finnmark - et eksempel på en populasjonsundersøkelse rettet mot cardiovasculære sykdommer. Beskrivelse og analyse av etterundersøkelsesgruppen.
Av Jan-Ivar Kvamme og Trond Haider, 1979.
4. The Tromsø Heart Study: Population studies of coronary risk factors with special emphasis on high density lipoprotein and the family occurrence of myocardial infarction.
Av Olav Helge Førde og Dag Steinar Thelle, 1979.
5. Reformen i distriktshelsetjenesten III: Hypertensjon i distriktshelsetjenesten.
Av Jan-Ivar Kvamme, 1980.
6. Til professor Knut Westlund på hans 60-års dag, 1983.
- 7.* Blodtrykksovervåkning og blodtrykksmåling.
Av Jan-Ivar Kvamme, Bernt Nesje og Anders Forsdahl, 1983.
- 8.* Merkesteiner i norsk medisin reist av allmennpraktikere - og enkelte utdrag av medisinalberetninger av kulturhistorisk verdi.
Av Anders Forsdahl, 1984.
9. "Balsfjordsystemet." EDB-basert journal, arkiv og statistikkssystem for primærhelsetjenesten.
Av Toralf Hasvold, 1984.
10. Tvunget psykisk helsevern i Norge. Rettsikkerheten ved slikt helsevern med særlig vurdering av kontrollkommisjonsordningen.
Av Georg Høyer, 1986.

11. The use of self-administered questionnaires about food habits. Relationships with risk factors for coronary heart disease and associations between coffee drinking and mortality and cancer incidence.
Av Bjarne Koster Jacobsen, 1988.
- 12.* Helse og ulikhet. Vi trenger et handlingsprogram for Finnmark.
Av Anders Forsdahl, Atle Svendal, Aslak Syse og Dag Thelle, 1989.
13. Health education and self-care in dentistry - surveys and interventions.
Av Anne Johanne Søgaard, 1989.
14. Helsekontroller i praksis. Erfaringer fra prosjektet helsekontroller i Troms 1983-1985.
Av Harald Siem og Arild Johansen, 1989.
15. Til Anders Forsdahls 60-års dag, 1990.
16. Diagnosis of cancer in general practice. A study of delay problems and warning signals of cancer, with implications for public cancer information and for cancer diagnostic strategies in general practice.
Av Knut Hultedahl, 1991.
17. The Tromsø Survey. The family intervention study. Feasibility of using a family approach to intervention on coronary heart disease. The effect of lifestyle intervention of coronary risk factors.
Av Synnøve Fønnebo Knutsen, 1991.
18. Helhetsforståelse og kommunikasjon. Filosofi for klinikere.
Av Åge Wifstad, 1991.
19. Factors affecting self-evaluated general health status - and the use of professional health care services.
Av Knut Fylkesnes, 1991.
20. Serum gamma-glutamyltransferase: Population determinants and diagnostic characteristics in relation to intervention on risk drinkers.
Av Odd Nilssen, 1992.
21. The Healthy Faith. Pregnancy outcome, risk of disease, cancer morbidity and mortality in Norwegian Seventh-Day-Adventists.
Av Vinjar Fønnebo, 1992.

22. Aspects of breast and cervical cancer screening.
Av Inger Torhild Gram, 1992.
23. Population studies on dyspepsia and peptic ulcer disease: Occurrence, aetiology, and diagnosis. From The Tromsø Heart Study and The Sørreisa Gastrointestinal Disorder Studie.
Av Roar Johnsen, 1992.
24. Diagnosis of pneumonia in adults in general practice.
Av Hasse Melbye, 1992.
25. Relationship between hemodynamics and blood lipids in population surveys, and effects of n-3 fatty acids.
Av Kaare Bønaa, 1992.
26. Risk factors for, and 13-year mortality from cardiovascular disease by socioeconomic status. A study of 44690 men and 17540 women, ages 40-49.
Av Hanne Thürmer, 1993.
27. Utdrag av medisinalberetninger fra Sulitjelma 1891-1990.
Av Anders Forsdahl, 1993.
28. Helse, livsstil og levekår i Finnmark. Resultater fra Hjerte-karundersøkelsen i 1987-88. Finnmark III.
Av Knut Westlund og Anne Johanne Søgaard, 1993.
29. Patterns and predictors of drug use. A pharmacoepidemiologic study, linking the analgesic drug prescriptions to a population health survey in Tromsø, Norway.
Av Anne Elise Eggen, 1994.
30. ECG in health and disease. ECG findings in relation to CHD risk factors, constitutional variables and 16-year mortality in 2990 asymptomatic Oslo men aged 40-49 years in 1972.
Av Per G. Lund-Larsen, 1994.
31. Arrhythmia, electrocardiographic signs, and physical activity in relation to coronary heart risk factors and disease. The Tromsø Study.
Av Maja-Lisa Løchen, 1995.
32. The Military service: mental distress and changes in health behaviours among Norwegian army conscript.
Av Edvin Schei, 1995.
33. The Harstad injury prevention study: Hospital-based injury recording and community-based intervention.
Av Børge Ytterstad, 1995.

- 34.* Vilkår for begrepsdannelse og praksis i psykiatri.
En filosofisk undersøkelse.
Av Åge Wifstad, 1996. (utgitt Tano Aschehoug forlag 1997)
35. Dialog og refleksjon. Festskrift til professor Tom Andersen på hans 60-års dag, 1996.
36. Factors affecting doctors' decision making.
Av Ivar Sønbo Kristiansen, 1996.
37. The Sørreisa gastrointestinal disorder study. Dyspepsia, peptic ulcer and endoscopic findings in a population.
Av Bjørn Bernersen, 1996.
38. Headache and neck or shoulder pain. An analysis of musculoskeletal problems in three comprehensive population studies in Northern Norway.
Av Toralf Hasvold, 1996.
39. Senfølger av kjernefysiske prøvespreninger på øygruppen Novaya Semlya i perioden 1955 til 1962. Rapport etter programmet "Liv". Arkangelsk 1994.
Av A.V. Tkatchev, L.K. Dobrodeeva, A.I. Isaev, T.S. Podjakova, 1996.
40. Helse og livskvalitet på 78 grader nord. Rapport fra en befolkningsstudie på Svalbard høsten 1988.
Av Helge Schirmer, Georg Høyer, Odd Nilssen, Tormod Brenn og Siri Steine, 1997.
41. Physical activity and risk of cancer. A population based cohort study including prostate, testicular, colorectal, lung and breast cancer.
Av Inger Thune, 1997.
42. The Norwegian - Russian Health Study 1994/95. A cross-sectional study of pollution and health in the border area.
Av Tone Smith-Sivertsen, Valeri Tchachtchine, Eiliv Lund, Tor Norseth, Vladimir Bykov, 1997.
43. Use of alternative medicine by Norwegian cancer patients
Av Terje Risberg, 1998.
44. Incidence of and risk factors for myocardial infarction, stroke, and diabetes mellitus in allmenn general population. The Finnmark Study 1974-1989.
Av Inger Njølstad, 1998.

45. General practitioner hospitals: Use and usefulness.
A study from Finnmark County in North Norway.
Av Ivar Aaraas, 1998.
- 45B. Sykestuer i Finnmark. En studie av bruk og nytteverdi.
Av Ivar Aaraas, 1998.
46. No går det på helsa laus. Helse, sykdom og risiko for
sykdom i to nord-norske kystsamfunn.
Av Jorid Andersen, 1998.

De som er merket med * har vi dessverre ikke flere eksemplarer av.