

Prevalence of coronary heart disease, associated manifestations and electrocardiographic findings in elderly Finns

MERJA AHTO^{1,2}, RAIMO ISOAHO², HANNU PUOLIJOKI³, PEKKA LAIPPALA⁴, MATTI ROMO⁵,
SIRKKA-LIISA KIVELÄ¹

¹Unit of General Practice, Oulu University Hospital and Department of Public Health Science and General Practice, University of Oulu, Aapistie 1, FIN-90220 Oulu, Finland

²Department of Public Health and General Practice, University of Turku, Lemminkäisenkatu 1, FIN-20520 Turku, Finland

³Medical School and ⁴Tampere School of Public Health/Biometry Unit, University of Tampere and Tampere University Hospital, P.O.B. 607, FIN-33101 Tampere, Finland

⁵Finnish Heart Association, Oltermannintie 8, FIN-00621 Helsinki, Finland

Address correspondence to: M. Ahto. Luusmäentie 5 as 3, FIN-21420 Lieto, Finland. Fax: (+358) 2 4890131.
E-mail: merja.ahto@utu.fi

Abstract

Objective: to study the prevalence of coronary heart disease (CHD) and its clinical manifestations among Finnish elderly people in a cross-sectional epidemiological survey in the rural district of Lieto, southwestern Finland, with special emphasis on the overlap of CHD manifestations with electrocardiogram (ECG) findings and factors associated with CHD.

Design: observational population-based study.

Setting: Health Centre in Lieto, Finland, 1990–91.

Subjects: 488 men and 708 women aged 64–97 years.

Main outcome measures: angina pectoris (AP) and dyspnoea were recorded using the London School of Hygiene cardiovascular questionnaires. Resting ECG findings were analysed and coded. Minnesota codes 1.1–1.3, 4.1–4.4, 5.1–5.3 or 7.1 were interpreted as ischaemic. The medical history of cardiovascular diseases was based on medical records.

Results: the prevalence of AP was 9.1% [95% confidence interval (CI): 6.7–12.0] among men and 4.9% (3.5–6.8) among women. The respective figures for myocardial infarction (MI) were 13.9% (10.9–17.0) and 6.5% (4.8–8.6). Ischaemic ECG findings were common: 32.9% (28.7–37.1) of men and 39.3% (35.7–43.0) of women had such changes, whereas only a minority of them reported typical AP. The total prevalence of CHD, including AP, MI, past coronary artery by-pass operation or angioplasty or ischaemic ECG findings, was 37.7% (33.4–42.0) in men and 42.0% (38.3–45.6) in women. Among men, a higher prevalence of CHD was associated with increasing age [odds ratio (OR) 1.81; 95% CI: 1.20–2.73] and a history of having smoked in the past (OR 1.66; 1.06–2.59), whereas among women it was associated with increasing age (OR 2.02; 1.48–2.77) and a lower educational level (OR 2.30; 1.37–3.86).

Conclusion: the prevalence of CHD among elderly people is high and the clinical picture of the disease is variable. The nature of CHD seems to be less severe among elderly women compared with men. Minor ECG changes, especially in the ST and T segments, are common with ageing and should not necessarily be interpreted as ischaemic. However, these findings combined with atypical chest pain or dyspnoea in an elderly person may indicate the possibility of CHD.

Keywords: aged, angina pectoris, atypical chest pain, chest pain, coronary disease epidemiology, electrocardiography, myocardial infarction, prevalence, risk factors

Introduction

The prevalence of coronary heart disease (CHD) increases with increasing age [1, 2]. An extensive autopsy study has shown occult significant coronary artery disease to be present in most elderly individuals [3]. Half of the deaths among the population aged 64 years or over in Finland are caused by cardiovascular diseases and every third death is caused by ischaemic heart disease, mainly acute myocardial infarction (MI) [4]. However, in many developed countries, CHD mortality in elderly people has decreased during the last two decades [5]. Because of the continuous increase in the elderly population and the high frequency of CHD world-wide, the disability caused by the disease will be common.

The prevalence rates of CHD are usually based on cardiovascular questionnaires, medical records and electrocardiogram (ECG) changes. The problem with questionnaires is that characteristic angina is not always the predominant presenting symptom of myocardial ischaemia in an elderly patient, but shortness of breath, weakness, confusion or even syncope may occur [6]. Ischaemic ECG changes are common in elderly individuals and have been considered somewhat non-specific. A classification system for resting ECG in population studies has been developed and also tested in an elderly population [7].

This study is part of a research project on the epidemiology of cardiovascular and respiratory [8] diseases in elderly people (the Lieto study). The aim of the present study was to investigate the prevalence of CHD and its manifestations in an elderly population.

Population and methods

The Lieto study

This cross-sectional survey was carried out in the semi-industrialized rural community of Lieto, Finland, in 1990–91. The survey population consisted of subjects born in or before 1926, residing in Lieto and registered on 23 March 1990. Of 1360 residents who were invited to participate, 77 died before they could be examined and 1196 individuals—488 men and 708 women—took part in the study, giving a 93% participation rate. The survey started in October 1990 and lasted until the end of December 1991 [8].

The study protocol included interviews, tests and measurements. Personal data, socio-economic and other background data (e.g. drug use and the history of smoking) were recorded. Emphasis was placed on physical, mental and social functional abilities as well as on tests assessing cognitive impairment and depressive symptoms. Cardiovascular symptoms were recorded using the London School of Hygiene cardiovascular questionnaires [9]. Dyspnoea was measured

by Medical Research Council questionnaires [10, 11]. Due to an inability to walk, physical disability or severe dementia, no graded dyspnoea data were obtained from 10 men and 34 women. Chest radiographs (posterior-anterior and lateral views) were taken and heart size was measured [12, 13]. Twelve-lead resting ECGs were recorded (MAC 6, Marquette Electronics, Milwaukee, WI, USA). The electrocardiograms were coded by a member of the research team (H.P.) according to the Minnesota code 1982 [9].

The participants made two visits to the health centre, and during the first visit were examined by two trained nurses. Previous medical records, completed questionnaires and other results from the survey examinations were reviewed before the participants came for their second visit, during which a clinical examination by a physician (R.I.) was carried out. Eight out of the 1196 participants (0.7%) refused to be examined by the physician after their first visit.

Definitions and diagnostic criteria

Angina pectoris (AP)

A person was defined as having AP if he/she had chest pain on effort fulfilling the Rose questionnaire's criteria [9]. AP was divided into two grades of severity according to the same criteria.

Atypical chest pain

Atypical chest pain was present if a person had felt discomfort or pain in the chest on effort not fulfilling the AP criteria or at rest. In cases of severe dementia, the assessment of chest pain was based on previous clinical documents and proxy interviews.

MI

A person was defined as having MI if he/she had a positive history of MI in the medical records (a summary report after discharge from a hospital or a health centre inpatient ward) or a major or moderate Q/QS item (Minnesota code 1.1 or 1.2) on electrocardiography [14].

Dyspnoea

The grades of dyspnoea were defined according to the Medical Research Council criteria [9], but grade 0 was assigned to those who answered 'no' to all the dyspnoea questions.

Minor ECG changes

These were defined as positive Minnesota codes 1.3, 4.1–4.4, 5.1–5.3, or 7.1 on ECG.

CHD

CHD was defined as being present when the person

met at least one of the following criteria: (i) typical history of AP, (ii) previous MI, (iii) ischaemia on ECG: Minnesota codes 1.1-1.3, 4.1-4.4, 5.1-5.3, or 7.1 positive [14], (iv) history of coronary by-pass surgery or (v) history of coronary angioplasty.

Smoking

A person who had smoked at least one cigarette per day (or one large cigar per week or 28 g (1 ounce) of tobacco per month) for as long as a year or more and who, at the time of the interview, had not smoked for the previous 6 months or more was defined to be an ex-smoker [11]. A person who had still smoked during the last 6 months was defined as a smoker.

Statistical methods

The results were analysed by cross-tabulation. The χ^2 test or Fisher's exact test was used in comparing the categorical variables. The 95% confidence intervals (CI) were calculated by the Confidence Interval Analysis software [15]. The associations between the occurrence of CHD and possible risk factors, socio-demographic factors and clinical characteristics were studied with logistic regression analysis, the results of which were summarized using odds ratios with 95% confidence intervals. The fit of the model was measured using Hosmer-Lemeshow statistics [16]. The computation was carried out on an IBM VM/SP computer using the SAS library [17] and the BMDP statistical software [18].

Results

The mean age of men was 72 years (SD 7 years, range 64-97 years) and that of women 74 years (SD 7 years, range 64-96 years). The mean age of male patients with CHD was 74 years (SD 6 years, range 64-97 years) and that of female patients 76 years (SD 7 years, range 64-96 years).

Of the whole study population, 96% of men and 94% of women lived at home. The remaining 4% of men and 6% of women were in long-term institutional care, as compared with 5% of men and 10% of women with CHD.

Subjects with AP

The prevalence of AP based on Rose's questionnaire was 9% in men and 5% in women (Table 1). The prevalences for AP based on medical records were higher: 13% among men and 8% among women. 57% (95% CI: 41.0-71.6) of men with AP and 54% (36.7-71.2) of women had ischaemic findings on ECG.

Subjects with atypical chest pain

Atypical chest pain was reported by 26% (95% CI: 21.7-29.5) of men and 28% (24.3-30.8) of women. 44% (35.3-52.7) of men with atypical chest pain and 54% (47.1-61.2) of respective women had ischaemic ECG abnormalities. 65% of men and 68% of women did not report any kind of chest pain.

The Venn diagram in Figure 1 shows the numbers of people with atypical chest pain, MI and minor ECG changes.

Table 1. Number (*n*) and proportion (%) of subjects meeting different coronary heart disease (CHD) criteria by sex

Criterion	Sex						Difference (<i>P</i> -value)
	Men (<i>n</i> = 488)			Women (<i>n</i> = 708)			
	<i>n</i>	%	95% CI	<i>n</i>	%	95% CI	
Chest pain on effort (grade) ^a							
I or II	44	9	6.7-12.0	35	5	3.5-6.8	0.01
I	22	5	2.9-6.8	25	4	2.3-5.2	-
II	22	5	2.9-6.8	10	1	0.7-2.6	<0.01
History of myocardial infarction	44	9	6.6-11.9	19	3	1.6-4.2	<0.01
Coronary by-pass surgery	2	0.4	0.1-1.5	0	0	0.0-0.5	0.17
Angioplasty	0	0	0.0-0.8	1	0.1	0.0-0.8	0.99
ECG findings (Minnesota code) ^b							
1.1-1.2	44	9	6.7-12.0	29	4	2.8-5.9	<0.01
1.1-1.3, 4.1-4.4, 5.1-5.3, 7.1	160	33	28.7-37.1	275	39	35.7-43.0	0.02
Total ^c	184	38	33.4-42.0	297	42	38.3-45.6	0.14

CI, confidence interval; ECG, electrocardiogram.

^aInformation of chest pain was not obtained from two men.

^bECG recording was not obtained from two men and nine women.

^cA subject may meet more than one criterion.

Subjects with previous MI

Sixty-eight men and 46 women were diagnosed as having previous MI. Thus, the prevalences were 14% (95% CI: 10.9–17.0) for men and 7% (4.8–8.6) for women. The prevalence of MI based purely on medical records was lower: 9% of men and 3% of women (Table 1).

The patients with previous MI reported atypical

chest pain more commonly than typical AP (Figure 1).

Subjects with dyspnoea

19% (95% CI: 15.5–22.6) of men and 18% (14.6–20.4) of women suffered from troublesome breathlessness (grade II, III or IV). Nearly half the men with moderate

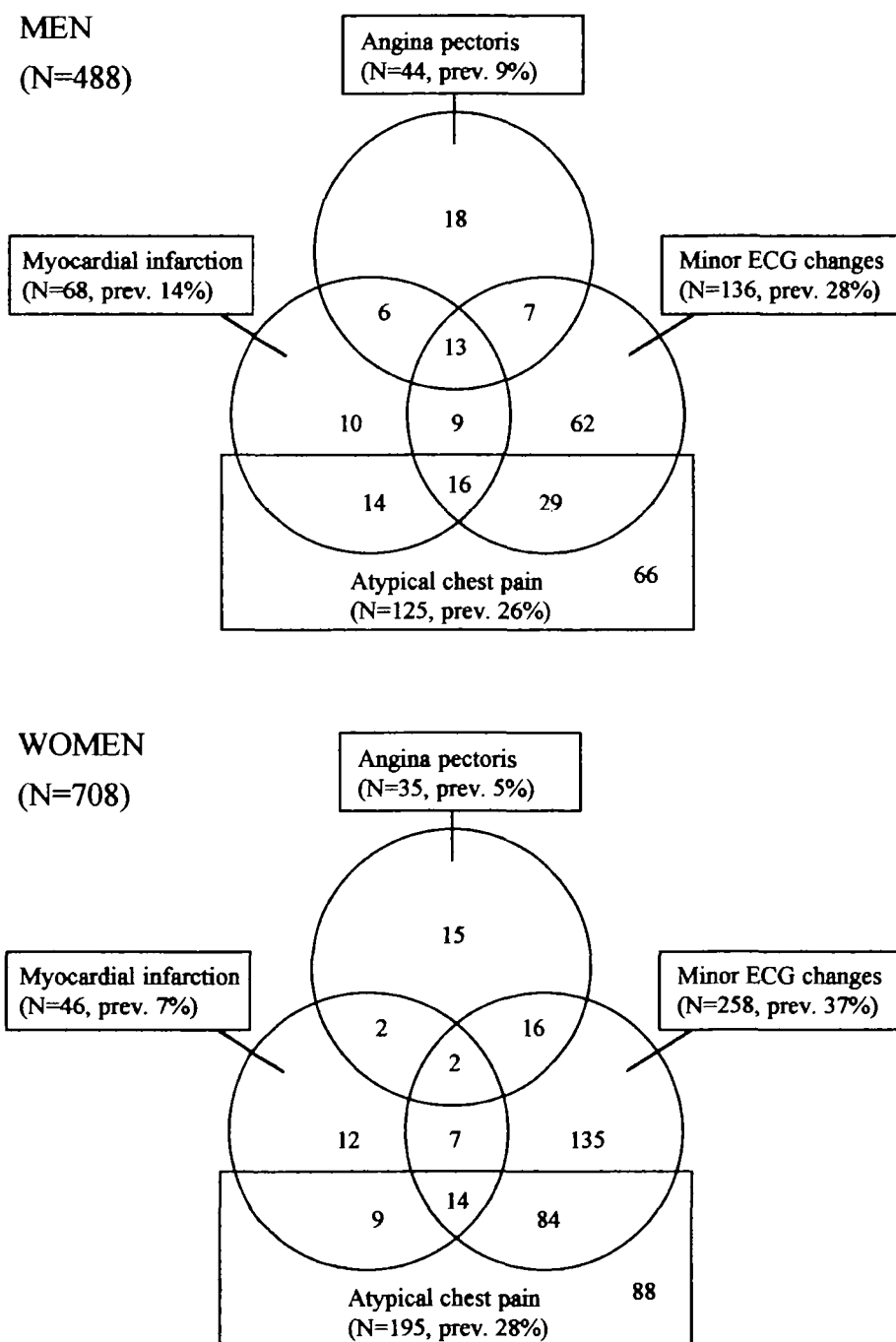


Figure 1. Venn diagrams showing the number of elderly men and women with various manifestations of coronary heart disease and minor electrocardiogram (ECG) changes and their overlap. The rectangle shows the number of elderly persons with atypical chest pain and its overlap by myocardial infarction and minor ECG changes.

Table 2. Prevalence of the ischaemia-associated electrocardiography (ECG) findings which differed significantly in their occurrence by sex

		Sex				
		Men (<i>n</i> = 488)		Women (<i>n</i> = 708)		
Minnesota code	ECG abnormality ^a	<i>n</i>	%	<i>n</i>	%	Difference (<i>P</i> -value)
1.1	Major Q/QS pattern	17	4	6	1	<0.01
1.1-1.3	Total Q/QS pattern	63	13	59	8	0.01
4.3	ST junction depression of <0.5 mm	26	5	70	10	<0.01
4.1-4.4	Total ST junction depression	68	14	163	23	<0.01
5.3	T wave inversion of <1 mm	62	13	127	18	0.01
5.1-5.3	Total T wave inversion	116	24	222	32	<0.01

^aECG recording was not obtained from two men and nine women.

or severe dyspnoea and slightly more than half the respective women had ischaemic ECG abnormalities.

ECG findings

The most common ischaemic ECG finding was T wave inversions (Minnesota codes 5.1-5.3) among both sexes (Table 2). A major Q/QS pattern (code 1.1) was more common in men, whereas minor ST junction depressions (code 4.3) and minor T wave inversions (code 5.3) were more common in women (Table 2). The most common Q/QS patterns were a moderate Q/QS pattern (code 1.2) among men and a minor Q/QS pattern (code 1.3) among women. A moderate Q/QS pattern and T wave inversions of 1-5 mm and less than 1 mm (codes 5.2 and 5.3) were the three most common ischaemic findings among men. ST junction depressions of less than 0.5 mm (code 4.3) and T wave inversions of 1-5 mm and less than 1 mm were the three most common ischaemic findings in women.

The prevalence of atrial fibrillation was 9% (95% CI: 6.3-11.5) in men and 4% (2.9-6.1) in women. Atrial fibrillation was more common among CHD patients than among those without CHD: 15% (10.0-20.4) of men with the disease and 5% (2.6-7.7) of men without it had atrial fibrillation on ECG, while for women the corresponding figures were 9% (6.1-12.9) and 1% (0.2-2.2).

Figure 1 illustrates how often the minor ECG changes occurred without a previous MI or a history of AP.

Subjects with CHD

Total CHD prevalence was 38% in men and 42% in women (Table 1). Among men, the prevalence was highest in those aged 75-84 years, while among women it was highest in the oldest age group of 85 years or over (Figure 2).

In the group with CHD, 60% of men and 6% of

women were ex-smokers and 12% of men and 4% of women were current smokers.

Hypertension was more common among CHD patients than among those without the disease: 35% (95% CI: 28.4-42.2) of men with CHD and 22% (17.4-26.7) of men without had a diagnosis of hypertension in the medical records. The corresponding figures for women were 49% (43.1-54.5) and 33% (28.3-37.4).

Twenty-four percent (95% CI: 17.7-30.1) of men and 12% (8.1-15.5) of women with CHD suffered from AP, while atypical chest pain was reported by 32% (25.3-38.8) of men and 36% (30.9-41.8) of women. Subjects without CHD reported atypical chest pain less frequently than those with the disease present: in this group the figures were 22% (17.1-26.3) in men and 21% (17.2-25.1) in women.

In the CHD group, 37% (95% CI: 30.0-43.9) of men and 16% (11.4-19.6) of women had had a previous MI. The number of undiagnosed MIs in the total study population was low: 5% among men and 4% among women.

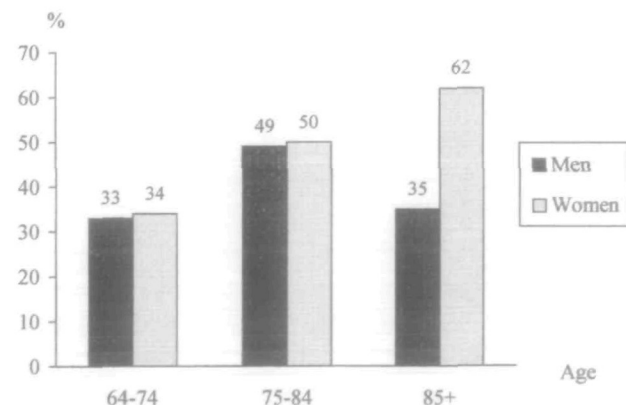


Figure 2. Prevalence of coronary heart disease by age for men (■; n = 488) and women (□; n = 708).

Dyspnoea of grades II–IV was seen in 29% (95% CI: 21.9–35.1) of men with CHD and 13% (9.5–17.2) of men without the disease; the figures for women were 26% (20.9–31.3) and 12% (8.6–14.8) respectively. Very few CHD patients had a diagnosis of current asthma or chronic obstructive pulmonary disease: six men (3%) and 15 women (5%) had current asthma while 16 men (9%) and seven women (2%) had chronic obstructive pulmonary disease. Obesity (defined as a body mass index ≥ 30 kg/m²) was seen in 25% (18.7–31.3) of men with CHD and 17% (12.9–21.4) without the disease; the figures for women were 32% (26.8–37.4) and 33% (28.8–37.9) respectively.

The logistic regression analysis among men showed a higher prevalence of CHD to be associated with increasing age and a history of having smoked previously (Table 3). OR was low among men who had worked in the manufacturing industry or construction. Among women, a higher prevalence of CHD was associated with increasing age and a lower educational level.

Discussion

The prevalence of CHD rises with increasing age in women. A similar tendency occurs in men, but is less pronounced in the oldest age group of men (aged 85 years and over) than in those aged 75–84 years. Similar trends in the prevalence figures have also been seen in other population-based studies [1, 2]. The reason for the lower prevalence in men is probably the higher incidence and mortality from CHD among middle-aged men. CHD is usually more severe in nature in men than in women and a greater proportion of men have suffered MI or have typical AP. Also, the number of female patients who are current or ex-smokers is low, which is one reason why more women with CHD have survived longer than men.

In men aged 70–89 years, the survivors of the Finnish cohorts of the Seven Countries Study, the total prevalence of CHD was 45% [19], whereas the figure in our study was 49% in men aged 75–84 years. In the 'Mini-Finland Health Survey', the figures for CHD-related ECG findings were somewhat different from those reported here, possibly due to the different criteria used [20]. In our study, the figures for ECG evidence of MI were higher and those for minor ECG changes lower. The total prevalence of CHD in Lieto is higher than elsewhere in Scandinavia [21] or in Europe [22]. Various studies from USA [2, 23], Australia [1] and Asia [24, 25] have also reported lower prevalence figures in elderly subjects.

As yet no consensus has been reached among epidemiological surveys on the criteria for CHD applicable to elderly people. Any comparison of findings is difficult because of the variable criteria. Some studies report the overall prevalence figures of self-reported disease rather than using criteria based on

electrocardiography [22]. In some studies the age of those surveyed has differed from ours. Our results, however, support the conclusion that CHD morbidity is high among the elderly population of Finland.

To present our ischaemic ECG findings, we used the same Minnesota codes that were used in the Whitehall studies, which were carried out in middle-aged people [14]. Woo *et al.*, in their studies of an elderly Chinese population, used the 'Whitehall criteria' in defining ischaemia [24], and their ECG findings suggesting possible ischaemia were lower than ours. In some studies, the only ECG evidence of CHD has been a pathological Q wave with a duration of 0.04 second or longer [23] or a major Q wave [25]. In the Cardiovascular Health study, the diagnosis of CHD was partly based on 'cardiac injury' and the system of scoring it with age [2].

The Minnesota codes are useful in population studies [7], but attention must be given to the effect of age on the ECG, (especially in populations with high prevalence of CHD [26]), ST and T wave changes (particularly the digitalis effect) and right and left ventricular hypertrophy patterns. The use of digitalis is common in elderly Finns, and this may have induced part of the ST depression changes in our study: 26% of men and 33% of women with CHD were using digitalis. In addition, hypertension was also common in the CHD patients. However, the Q/S patterns, the ST–T patterns, including T wave flattening as well as inversions, and the voltage changes of left ventricular hypertrophy in elderly subjects cannot be disregarded or taken merely as a sign of ageing [27]. Recent studies have shown the prognostic value of increased left ventricular mass for CHD [28] and *vice versa*: repeated ischaemia in dogs may induce left ventricular hypertrophy [29].

Some researchers have accepted atrial fibrillation as one of the diagnostic criteria for CHD but, despite its association with CHD and old age, valvular diseases, congestive heart failure, hypertension and diabetes mellitus are independent risk factors for the development of atrial fibrillation [30]. Furthermore, hyperthyroidism, alcohol intoxication and the use of cholinergic drugs are also risk factors [31]. Although we did not accept atrial fibrillation as a criterion for CHD, the association between atrial fibrillation and CHD is seen in our study.

The present prevalence of AP among both men and women is lower than in previous studies in Finland [19, 20] and in the USA [2], with the exception of the Hawaii study [25]. Danish prevalence figures for AP among 70-year-old people [32] are similar to those obtained in our population aged 64 years and over. AP questionnaires are commonly used as tools in epidemiological studies on the prevalence of ischaemic heart disease. However, with increasing age the perception of pain during myocardial ischaemic episodes becomes muted, and this relationship remains significant even

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Table 3. Number of subjects and prevalence (%) of coronary heart disease by sex, age, history of smoking, previous occupation and education, and logistic regression analysis with age, social status, occupation, smoking, education, marital status and body mass index as related factors

	Men (n = 488)			Women (n = 708)		
	Cases/subgroup	%	OR (95% CI)	Cases/subgroup	%	OR (95% CI)
Age (years)						
64-74	106/322	33	Ref.	143/417	34	Ref.
75+	78/166	47	1.81 (1.20-2.73)	154/291	53	2.02 (1.48-2.77)
History of smoking ^a						
Non-smoker	52/148	35	Ref.	267/638	42	-
Ex-smoker	110/268	41	1.66 (1.06-2.59)	18/42	43	-
Smoker	22/72	31	1.25 (0.65-2.40)	11/24	46	-
Previous occupation						
Service sector/administration/teaching	32/58	55	Ref.	66/155	43	-
Manufacturing industry/construction work	78/262	30	0.34 (0.19-0.61)	61/167	37	-
Agriculture	74/168	44	0.62 (0.33-1.15)	125/287	44	-
Work in family	-	-	-	45/99	46	-
Education						
More than basic ^b	10/35	29	-	15/46	33	Ref.
Basic ^b	156/405	39	-	236/590	40	-
Less than basic	18/48	38	-	46/72	64	2.30 (1.37-3.86)
Hosmer-Lemeshow		P = 0.290			P = 0.211	

OR, odds ratio; CI, confidence interval; Ref., reference group.

^aIncomplete data on four women.^bCombined in the logistic regression analysis.

when the presence of medication and the severity of disease are controlled for [33]. In some studies, the presence of AP has been confirmed by a physician's interview rather than standardized questionnaires [2]. There are possible biases when the physician's interview is used for the diagnosis of AP or even when standardized questionnaires are used in epidemiological studies of AP [34]. The Rose questionnaire has turned out to be highly specific and fairly sensitive when compared with the physician's diagnosis of AP among men [35], but its validity among women remains uncertain [36].

At 26% for men and 28% for women, our prevalence figures for atypical chest pain are fairly high. This may be because we strictly observed the instructions of the Rose questionnaire when inquiring about the presence of AP. However, nearly half of men and slightly more than half of women with atypical chest pain had ischaemic ECG findings. Many people reported taking nitroglycerine and continuing walking without rest in spite of chest pain. Chest pain in women with CHD seemed to be more often atypical. The possibility of microvascular angina as a cause of chest pain with angiographically normal coronary arteries [37] should be remembered when evaluating atypical chest pain in elderly people.

Men showed an association between CHD and having smoked in the past. No such association was found between CHD and current smoking. The explanation might be that subjects had given up smoking when symptoms of CHD arose. In a cohort of Japanese-American men aged 65 years and over during a 12-year follow-up period, the CHD incidence rates increased progressively in individuals classified at baseline as never, former and current smokers, respectively [38]. Current cigarette smokers, especially men, have an increased risk of CHD death compared with non-smokers, ex-smokers or smokers of pipes and cigars [39]. The excess risk of death declined within 1–5 years of cessation of smoking. Due to the cross-sectional design of our study, smoking as a risk factor for CHD has been underestimated.

We found a relationship between a low level of basic education and CHD among women. This result is consistent with a recent Finnish finding: lower levels of education, occupation and income are associated with an increased cardiovascular risk in middle-aged men and women [40].

Men who have been working in the manufacturing industry and construction work have a low risk of CHD. This may be due to some sort of selection in the past: healthy men have probably chosen physically demanding work. Another explanation might be some protective effect of physical activity on CHD [41].

In conclusion, the prevalence of CHD in elderly Finns is high, with minor ECG changes (especially in the ST and T segments) frequent in this population. These findings are common not only in CHD but also

with ageing, in left ventricular hypertrophy and in digoxin users. Previous MI was a common finding in our study population. The prevalence of typical AP is fairly low, indicating that the clinical picture of CHD in elderly people may vary from severe symptoms to no symptoms. However, the proportion of people having some form of discomfort or pain in the chest on effort due to CHD is larger than the prevalence of typical AP derived from the Rose questionnaire. Atypical chest pain with minor ECG changes is common, especially among women.

Key points

- Atypical chest pain with ischaemic electrocardiographic changes is common in elderly people, especially among women.
- Minor electrocardiographic changes especially in the ST and T segments are common with ageing but these findings, combined with atypical chest pain or dyspnoea, may indicate the possibility of coronary heart disease.
- Coronary heart disease seems to be less severe in elderly women than men.

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