reasonable at 56%. There is a current perception that the medical profession is suffering from increased stress, but most of the attention has been focused on junior doctors and their excessive hours of work. This study shows that senior doctors also suffer from considerable amounts of stress and perhaps more than expected. The inclusion of senior managers in the study, however, has shown that there seems to be an equivalent amount of stress in that group, and this should widen the debate. Stress is not the sole property of the medical profession.

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Predictive value of continuous ambulatory electrocardiographic monitoring in elderly people

I J Räihä, S J Piha, A Seppänen, P Puukka, L B Sourander

Abstract

***Objective*—To determine the predictive value of findings on continuous ambulatory electrocardiographic monitoring in elderly subjects.**

***Design*—Retrospective cohort study. Ten year follow up of randomly selected elderly subjects who participated in ambulatory electrocardiography study in 1982. Mortality data derived from official registers.**

***Setting*—Turku, Finland.**

***Subjects*—480 people aged 65 or older in 1982 who were living in the community, of whom 72% agreed to participate.**

***Main outcome measures*—Mortality from cardiac and non-cardiac causes during 10 year follow up.**

***Results*—In the univariate analysis adjusted for age, risk of death from cardiac causes was increased among those with ventricular ectopy of more than 100 beats during the day (odds ratio 2·6; 99% confidence interval 1·4 to 6·1) or at night (3·3; 1·1 to 9·8) and in those with multifocal ventricular ectopic beats during the day (2·3; 1·0 to 5·0) or night (3·0; 1·3 to 7·1) compared with those with no ventricular ectopy. Sinoatrial pauses exceeding 1·5 seconds during the day (4·5; 1·8 to 11·1) were also associated with excess mortality from cardiac causes. None of the findings on ambulatory electrocardiography predicted death from non-cardiac causes. A further study of explanatory variables in the stepwise logistic regression analysis showed that sinoatrial pauses exceeding 1·5 seconds (4·0; 95% confidence interval 1·8 to 8·9) and night time multifocal ventricular ectopy (2·7; 1·2 to 5·9) predicted excess mortality from cardiac causes independently of age or clinically evident heart disease.**

***Conclusion*—Daytime sinoatrial pauses exceeding 1·5 seconds and night time multifocal ventricular ectopy in the ambulatory electrocardiogram predict increased mortality from cardiac causes independently of clinically evident cardiac diseases in unselected elderly subjects.**

Department of Geriatrics, University of Turku, Kunnallissairaalantie 20, FIN-20700 Turku, Finland
I J Räihä, *senior lecturer*
L B Sourander, *professor*

Research Centre of the Social Insurance Institution, Peltolantie 3, FIN-20720 Turku, Finland
S J Piha, *senior lecturer*
A Seppänen, *senior lecturer*
P Puukka, *statistician*

Correspondence to:
Dr Räihä.

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Introduction

The prevalence of various cardiac arrhythmias increases with advancing age. Ventricular ectopy occurs in 64-100% of apparently healthy elderly people,[1-3] but only 40-50% of young or middle aged people.[4,5] Supraventricular ectopy and atrial fibrillation also increase with age.[3,6] In a population study of elderly people frequent ventricular ectopy on ambulatory electrocardiographic monitoring was associated with clinically evident cardiovascular disease.[6] Sinoatrial pauses also occurred more commonly in subjects with evidence of heart disease.

Frequent and complex ventricular ectopy in patients with ischaemic heart disease[7,8] or previous acute myocardial infarction[9,10] has been found to predict increased mortality from cardiac causes. Reduced variability in heart rate has also been shown to be associated with increased mortality from cardiac causes.[11] Nevertheless, frequent ventricular ectopy in healthy subjects is commonly accepted as a benign phenomenon without prognostic importance.[12,13] Frequent or repetitive ventricular ectopic beats induced by an exercise test did not predict increased morbidity or mortality from cardiac disease during a mean follow up period of 5·6 years in apparently healthy subjects of all ages.[14]

Other studies, however, have reported an adverse outcome in apparently healthy people with frequent ectopy. Hinkle *et al* found that ventricular arrhythmias were associated with sudden death in asymptomatic middle aged men.[15] In a five year follow up study elderly people with more than 10 ventricular ectopic beats an hour had about double the mortality of those with less frequent ectopy.[16] It is difficult to distinguish between physiological and pathological ventricular ectopic activity since ectopy in apparently healthy subjects may be related to underlying silent ischaemic heart disease. This difficulty probably explains the conflicting results in these studies.

Little attention has been focused on the prognostic value of arrhythmias in elderly subjects. Few longitudinal studies with sufficient follow up times exist,[13,16] and it remains unclear whether certain arrhythmias predict poor outcome independently of clinically evident heart disease. We conducted a follow up study to determine the prognostic value of various findings on ambulatory electrocardiographic monitoring in unselected elderly subjects.

Subjects and methods

In 1982 we carried out a comprehensive survey of the health of elderly people in the city of Turku, Finland. We selected a random sample of 480 people aged 65 or older who were living in the community from the register of the Social Insurance Institution. Before selection the population data were stratified into four age groups (65-69, 70-74, 75-79, and 80 years and older) and according to sex. The only exclusion criterion was living in an institution. The participation rate in the study was 72%, giving a total 347 subjects (184 men and 163 women).

A clinical history was obtained by personal interview. As well as continuous ambulatory electrocardiography all patients had a full clinical examination, including standard electrocardiography, chest radiography, routine biochemical analysis, and measurement of blood pressure, body mass index, and serum lipid concentration. Serious cardiovascular disease was established on the basis of the history and clinical evaluation. Ischaemic heart disease was diagnosed if the subject had a standard history of angina pectoris.[17] Previous acute myocardial infarction was recorded if Q wave abnormalities described in the Minnesota code were seen in the electrocardiogram.[18] Congestive heart failure was diagnosed on the basis of findings on chest radiography. Cerebral artery disease was diagnosed if there was evidence of focal neurological symptoms or signs. Patients receiving treatment for diabetes or with a fasting serum glucose concentration over 6·4 mmol/l were considered to have diabetes. The diagnosis of hypertension was based on the entitlement to free prescriptions (see below) rather than a single measurement of blood pressure at the clinical examination. We also asked about smoking habits in the personal interview.

Additional information on diseases was obtained from the national health insurance documents of the subjects. These documents include information on entitlement to free prescriptions because of common chronic diseases. To get this entitlement a patient must have a complete clinical evaluation. If a subject was eligible for free drugs because of diabetes, hypertension, ischaemic heart disease, or congestive heart failure that diagnosis was recorded as present.

Twenty four hour continuous ambulatory electrocardiographic monitoring was done with a portable two channel tape recorder (Oxford Medilog, Oxford). The electrodes were placed in order to obtain modified V1 and V5 lead readings. The recordings were analysed with a replay unit (Oxford PB-2 Replay, Oxford), an analysis unit (Pathfinder, Reynolds Medical Equipment, Hertford), and a computer. The subjects were encouraged to continue normal everyday activities during recording and asked to record their symptoms in a diary. The mean duration of the recordings was 23 hours. Electrocardiographic monitoring taking place when subjects were in bed according to the diary was considered night time monitoring and the rest was considered daytime monitoring. If the diary did not contain sufficient information monitoring between midnight and 8 am was defined as night time monitoring. Day and night recordings were analysed separately.

Ventricular arrhythmias were described as unifocal, multifocal, ventricular couplets (two consecutive ventricular premature depolarisations), ventricular tachycardia, or R on T phenomena. All other arrhythmias were defined by standard electrocardiographic criteria.[18] Criteria for abnormalities on ambulatory electrocardiographic monitoring were set immediately after the recordings were made in 1982. The limit of the extent of ventricular and supraventricular ectopy, however, was set in 1992 by someone who was unaware of the mortality data. The criteria were as follows: the extent of ventricular ectopic beats (≤ 100, > 100 beats), multifocal ventricular ectopic beats (yes, no), couplets (yes, no), ventricular runs (yes, no), R on T phenomena (yes, no), supraventricular ectopic beats (≤ 100, > 100), supraventricular tachycardias (yes, no), atrial fibrillation (yes, no), pauses $\geq 1{\cdot}5$ s (yes, no).

In 1992 we obtained information on the death of subjects and causes of deaths from the mortality statistics. The mortality data were assessed blind to the results of ambulatory electrocardiography.

STATISTICAL ANALYSIS

We used the SAS program, version 6, for statistical analysis. Data collected in 1982 were used as the explanatory variables in the univariate analysis for death rates from cardiac and non-cardiac causes. These explanatory variables were findings on ambulatory electrocardiography and several background factors (sex, body mass index, cholesterol and high density lipoprotein cholesterol concentration, smoking, diabetes, hypertension, coronary artery disease, congestive heart failure, previous acute myocardial infarction, and exercise tolerance). The relative risks adjusted for age (odds ratios with 99% confidence intervals) for deaths were calculated by the logistic (SAS/LOGIST) procedure. We used 99% confidence intervals in the univariate analyses in order to reduce the overall type I error in multiple comparisons. To study the independent risk of arrhythmias we did a stepwise logistic regression analysis simultaneously using the findings on ambulatory electrocardiography and those background factors that were associated significantly with death from cardiac disease in the univariate analysis.

Results

By 1992, 184 (53%) of the subjects had died and 163 were still alive (table I). Seventy six subjects died of cardiac disease, of whom 35 had cardiac disease confirmed at necropsy. Table II gives the causes of death. Ambulatory electrocardiography had been successful in 162 of the subjects who were alive in 1992, 87 who had died of cardiac disease, and 105 who had died of non-cardiac causes.

The age adjusted univariate analysis of the background variables showed that coronary risk factors such as male sex and smoking predicted death from cardiac disease (table III). Hypertension, obesity, and low concentrations of high density lipoprotein cholesterol were not associated with death from cardiac disease. High serum concentrations of total cholesterol were associated with low mortality. Clinically evident cardiac diseases such as coronary artery disease, previous acute myocardial infarction, and congestive heart failure were powerful predictors of death from cardiac causes. Seriously impaired exercise tolerance also correlated with high mortality. Smoking was the only background variable that was associated with death from non-cardiac causes in the univariate analysis.

Several findings on ambulatory electrocardiographic

TABLE I—*Study population and mortality during 10 years according to age at entry*

Age (years)	No of subjects 1982			No of deaths		
	Women	Men	Total	Cardiac cause	Non-cardiac cause	No alive in 1992
65-69	50	49	99	7	13	79
70-74	46	52	98	26	32	40
75-79	38	46	84	25	28	31
≥80	29	37	66	18	35	13
Total	163	184	347	76	108	163

TABLE II—*Causes of death*

	No of subjects
Non-cardiac (n=108):	
Carcinoma	37
Alzheimer's-type dementia	16
Cerebral event	25
Other vascular event	8
Trauma	10
Infection	6
Miscellaneous	6
Cardiac (n=76):	
Myocardial infarction	26
Suspected myocardial infarction	10
Previous myocardial infarction	9
Ischaemic heart disease	11
Sudden cardiac death	13
Other	7

monitoring were associated with death from cardiac disease (table IV). Ventricular ectopy of more than 100 beats or multifocal ventricular ectopic beats during the day or night predicted death from cardiac causes, but ventricular tachycardia and supraventricular ectopies were not associated with increased mortality. Sinoatrial pauses exceeding 1·5 seconds during the day were strongly associated with increased mortality from cardiac causes. None of the arrhythmias was associated with excess mortality from non-cardiac causes.

A further analysis of explanatory variables in the logistic regression model showed that sinoatrial pauses of more than 1·5 seconds and night time multifocal ventricular ectopy predicted increased cardiac mortality independently of clinically evident heart disease (table V). The highest risk of death was associated with previous acute myocardial infarction. When relative risks were calculated for non-cardiac causes of death in the logistic regression analysis with the same explanatory variables as for cardiac causes, age, heart failure, and daytime atrial ectopy predicted increased mortality (table VI).

Discussion

In a study using heart catheterisation Kostis *et al* found that ventricular ectopy exceeding 100 beats/24 h was associated with cardiac disease.[19] In our unselected sample of elderly subjects more than 100 ventricular ectopic beats during the day or night, multifocal ventricular ectopy during the day, and couplets during the night predicted death from cardiac disease. This effect was associated with clinically evident cardiac disease at the time of ambulatory electrocardiographic recording. Ventricular tachycardias and R on T phenomena were not associated with mortality from cardiac

TABLE III—*Relative risks adjusted for age for mortality from cardiac and non-cardiac causes according to risk factors and known cardiac disease*

Risk factor	No of subjects alive (n=163)	Cardiac cause of death (n=76)			Non-cardiac cause of death (n=108)		
		No of subjects	Odds ratio (99% confidence interval)	P value	No of subjects	Odds ratio (99% confidence interval)	P value
Sex:							
Female	91	29	1·00		43	1·00	
Male	72	47	2·37 (1·05 to 5·34)	0·0061	65	1·86 (0·91 to 3·82)	0·026
Body mass index:							
≤25	72	37	1·00		54	1·00	
26-30	62	33	0·88 (0·38 to 2·01)	0·68	36	0·70 (0·32 to 1·53)	0·24
>30	25	5	0·47 (0·12 to 1·96)	0·18	14	0·83 (0·29 to 2·39)	0·64
Cholesterol:							
≤5·0	10	16	1·00		12	1·00	
5·1-6·5	64	33	0·33 (0·09 to 1·19)	0·033	52	0·62 (0·17 to 2·26)	0·34
6·6-8·0	61	22	0·24 (0·06 to 0·70)	0·007	28	0·42 (0·12 to 1·58)	0·09
>8·0	28	5	0·09 (0·02 to 0·53)	0·0006	9	0·22 (0·04 to 1·07)	0·014
High density lipoprotein cholesterol:							
<1·2	54	43	1·00		46	1·00	
1·2-1·7	69	16	1·80 (0·66 to 4·87)	0·13	37	1·03 (0·41 to 2·59)	
>1·7	40	16	0·45 (0·14 to 1·39)	0·06	22	0·76 (0·30 to 1·89)	0·93 0·43
Smoking:							
No	103	37	1·00		48	1·00	
Stopped	42	32	2·73 (1·14 to 6·58)	0·0032	41	3·10 (1·33 to 7·20)	0·0006
Yes	16	6	2·01 (0·45 to 8·91)	0·23	16	3·82 (1·16 to 12·53)	0·0037
Diabetes	16	18	2·45 (0·85 to 7·05)	0·029	18	1·60 (0·55 to 4·60)	NS
Hypertension	36	13	0·90 (0·34 to 2·39)	0·78	17	0·86 (0·35 to 2·12)	0·66
Ischaemic heart disease	18	29	5·85 (2·22 to 15·41)	0·0001	15	1·16 (0·40 to 3·35)	0·72
Previous myocardial infarction	4	16	13·39 (2·82 to 63·53)	0·0001	10	2·77 (0·50 to 15·42)	0·13
Heart failure	8	22	5·80 (1·76 to 19·14)	0·0002	20	2·82 (0·82 to 9·66)	0·031
New York Heart Association grade:							
1	94	20	1·00		49	1·00	
2	43	13	1·21 (0·40 to 3·67)	0·65	21	0·70 (0·28 to 1·74)	0·31
3-4	20	39	7·24 (2·67 to 19·65)	0·0001	36	2·18 (0·85 to 5·58)	0·033

Data missing on four patients for high density lipoprotein cholesterol and cholesterol concentration, on six patients for smoking, and on 12 patients for New York Heart Association grade.

TABLE IV—*Relative risks adjusted for age for mortality from cardiac and non-cardiac causes according to findings on 24 hour ambulatory electrocardiographic monitoring*

	No of subjects alive (n=162)	Cardiac cause of death (n=72)			Non-cardiac cause of death (n=105)		
		No of subjects	Odds ratio (99% confidence interval)	P value	No of subjects	Odds ratio (99% confidence interval)	P value
>100 Ventricular ectopic beats:							
During day	35	32	2·62 (1·35 to 6·06)	0·0030	28	1·20 (0·52 to 2·76)	0·58
At night	14	18	3·30 (1·12 to 9·78)	0·0046	13	1·18 (0·35 to 3·97)	0·72
Multifocal ventricular ectopic beats:							
During day	64	45	2·25 (1·01 to 5·02)	0·0095	56	1·71 (0·83 to 3·54)	0·06
At night	28	31	2·98 (1·25 to 7·13)	0·0013	29	1·96 (0·83 to 4·61)	0·045
Couplet:							
During day	29	25	1·77 (0·72 to 4·33)	0·10	28	1·30 (0·54 to 3·11)	0·43
At night	11	18	3·23 (1·04 to 10·03)	0·0077	10	1·05 (0·28 to 3·94)	0·93
Ventricular tachycardia:							
During day	10	13	2·33 (0·66 to 8·14)	0·08	7	0·82 (0·20 to 3·45)	0·72
At night	6	4	1·35 (0·22 to 8·27)	0·66	4	0·92 (0·15 to 5·59)	0·91
R on T-phenomena:							
During day	6	2	0·82 (0·09 to 7·76)	0·82	1	0·28 (0·02 to 5·43)	0·27
At night	3	2	2·18 (0·18 to 27·13)	0·43	0		
>100 Supraventricular ectopic beats:							
During day	26	22	1·85 (0·73 to 4·71)	0·09	29	2·06 (0·86 to 4·92)	0·034
At night	16	20	2·63 (0·93 to 7·43)	0·017	21	2·23 (0·80 to 6·23)	0·044
Supraventricular tachycardia:							
During day	58	31	1·23 (0·55 to 2·75)	0·50	38	1·03 (0·49 to 2·17)	0·93
At night	40	18	1·11 (0·45 to 2·76)	0·76	25	0·97 (0·42 to 2·24)	0·92
Atrial fibrillation	5	13	3·96 (0·88 to 17·74)	0·018	10	1·22 (0·25 to 6·06)	0·75
Pauses ≥1·5 s:							
During day	22	34	4·52 (1·84 to 11·11)	0·0001	23	1·22 (0·47 to 3·17)	0·60
At night	39	29	1·66 (0·72 to 3·85)	0·12	25	0·68 (0·29 to 1·61)	0·25

TABLE V—*Adjusted relative risks* for mortality from cardiac causes according to findings on 24 hour ambulatory electrocardiographic monitoring and known cardiac disease*

Explanatory variable	Odds ratio (95% confidence interval)	P value
Night time multifocal ventricular ectopic beats	2·67 (1·21 to 5·87)	0·015
Daytime pauses ≥ 1·5 s	4·03 (1·83 to 8·90)	0·0005
Previous myocardial infarction	16·21 (4·42 to 59·46)	0·0001
Heart failure	3·22 (1·08 to 9·57)	0·035
Age	1·15 (1·08 to 1·23)	0·0001

*Analysed by stepwise logistic regression model including age; ischaemic heart disease; acute myocardial infarction; heart failure; unifocal, multifocal, and repetitive ventricular ectopy; supraventricular ectopy; atrial fibrillation, and sinoatrial pauses exceeding 1·5 seconds as explanatory variables.

TABLE VI—*Adjusted relative risks* for non-cardiac causes of death according to presence of cardiac disease and findings on 24 hour ambulatory electrocardiographic monitoring*

Explanatory variable	Odds ratio (95% confidence interval)	P value
Heart failure	2·94 (1·14 to 7·54)	0·025
Daytime supraventricular ectopic beats	2·09 (1·07 to 4·08)	0·030
Age	1·17 (1·11 to 1·23)	0·0001

*Analysed by stepwise logistic regression model including the same explanatory variables as in table V.

disease. However, the number of subjects with these arrhythmias was small and conclusions should be drawn with caution.

Night time multifocal ventricular ectopy predicted death from cardiac disease independently of clinically evident heart disease. Heart disease was diagnosed on the basis of careful non-invasive clinical assessment including history, clinical examination, standard electrocardiography, and chest radiography. An exercise test was not included in the study. We did not do ST segment analysis on the ambulatory electrocardiograms so ischaemic heart disease cannot be ruled out with certainty.

It has been suggested that unrecognised ischaemic heart disease is common in the elderly population, being present in a quarter of people aged over 45 years.[20] Multifocal ventricular ectopic activity during the night was therefore probably an early sign of underlying silent coronary artery disease. This finding is clinically important because ventricular ectopy in apparently healthy elderly people is usually not treated, and these patients do not normally have an exercise test. Our results suggest that these elderly patients are at risk of dying from cardiac causes and may not be being adequately evaluated and treated at present.

Subjects with a small increase in the daytime RR interval due to delayed sinoatrial conduction were also at increased risk of death from cardiac disease. Camm *et al* found that ventricular pauses and bradycardia were uncommon in elderly subjects,[21] in contrast to the pattern in young people.[4] In another study of a healthy elderly population only two out of 98 subjects had sinus pauses exceeding 1·5 seconds.[3] In our population daytime pauses of 1·5 seconds were found in 56 (23%) of the subjects. We suggest that a prolonged RR interval in the day is an abnormal phenomenon in elderly subjects, reflecting sinoatrial conduction disturbance rather than parasympathetic activation.

Night time RR intervals exceeding 1·5 seconds, however, were not associated with increased mortality. This might be expected since increased parasympathetic activation during sleep is known to cause bradycardia, although variation in heart rate tends to decrease with advancing age.[22] Sinoatrial pauses may also have resulted from unrecognised ischaemic heart disease. However, it is more likely that they are due to age related degeneration of the sinus node. Age related degeneration is consistent with daytime pauses being an independent risk factor for cardiac death.

NON-CARDIAC CAUSES OF DEATH

Smoking was the only predictor of death from non-cardiac causes. None of the arrhythmias was associated with excess mortality from non-cardiac causes in the univariate analysis. In the multivariate analysis, heart failure and atrial ectopy were weak predictors of death from non-cardiac causes. The association between heart failure and non-cardiac death could be explained by multiple diseases connected to heart failure. The relation between atrial ectopy and non-cardiac causes of death is difficult to explain, and it may be a chance finding.

High serum total cholesterol concentration was associated with low mortality from cardiac and non-cardiac causes. The highest mortality was associated with cholesterol concentrations below 5 mmol/l, but the differences were smaller between higher values. Low cholesterol concentration may be associated with underlying diseases such as cancer or heart failure, which would explain the high mortality.

CONCLUSION

In conclusion, daytime pauses exceeding 1·5 seconds and night time multifocal ventricular ectopy in the ambulatory electrocardiogram predicted increased mortality from cardiac causes independently of clinically evident cardiac disease in unselected elderly subjects. Patients with these findings should be evaluated for silent ischaemic heart disease and sick sinus syndrome, although the benefit of treating silent ischaemia in elderly patients is unclear.

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Clinical implications

- Complex ventricular arrhythmias after acute myocardial infarction are known to be associated with increased risk of cardiovascular death
- The importance of ventricular arrhythmias and conduction disturbances in healthy elderly people is unknown
- In this study ventricular ectopy and delayed sinoatrial conduction were associated with increased mortality from cardiac disease over 10 years
- Night time multifocal ventricular ectopy and daytime sinoatrial pauses above 1·5 seconds were independent predictors of death from cardiac causes
- Elderly people with these findings should be evaluated for silent ischaemic heart disease and sick sinus syndrome

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Back pain and risk of fatal ischaemic heart disease: 13 year follow up of Finnish farmers

Jyrki Penttinen

Kuopio Regional Institute of Occupational Health, PO Box 93, Fin-70701, Kuopio, Finland
Jyrki Penttinen, *researcher*

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In the early 1980s some authors found an association between cardiovascular risk factors, especially smoking, and back pain.[1] Quite recently Kauppila and Tollroth reported an association between history of back pain and atherosclerotic lesions of lumbar arteries in cadavers. They suggested that back pain could be an early symptom of atherosclerosis.[2] Prospective studies concerning mortality related to back pain have not been published previously. My purpose was to find out whether patients reporting back pain have an increased risk of dying of ischaemic heart disease when compared with those who have no back symptoms.

Subjects, methods, and results

The basic population consisted of 8816 Finnish farmers who participated in a postal survey in November 1979 to January 1980. Those 3842 women and 3648 men who did not report any cardiovascular disease in the questionnaire (except haemorrhoids or varices) and who were 30-66 years old in 1980 were selected for the follow up study.

I included back pain and sciatica in the year before follow up as dichotomous variables. Sciatic pain was included only if the subject had had back pain. Smoking was included as one of three categories (current smoker, former smoker, and never smoked), body mass index (weight (kg)/(height (m)^2)) as a continuous variable, and social status as one of three categories on the basis of the size of the farm. Mortality between 1 February 1980 and 31 January 1993 was determined from the register of the Social Insurance Institution of Finland. Copies of death certificates were obtained from the Finnish Statistics Bureau. The code numbers 410-414 of the *International Classification of Diseases*, ninth revision (ICD-9), were used for ischaemic heart disease as a cause of death. Other cardiovascular causes included the ICD-9 codes 390-459, excluding 410-414. I carried out cross tabulation analysis using the χ^2 test or Fisher's exact test. The adjusted relative risk was calculated by logistic regression analysis (EGRET).

The cross tabulation showed that men who were 30-49 years old and reported back pain during the preceding year at the beginning of follow up had a significantly increased risk of dying of ischaemic heart disease during the 13 years of follow up when compared with those of the same age with no symptoms (table). This result remained after adjustment for age, smoking, body mass index, and social status. The relative risk was 4·6 (P=0·04, 95% confidence interval 1·06 to 19·6) in the logistic model. The association between back pain and death from ischaemic heart disease was similar in those with and without sciatica. The risk of dying of other cardiovascular diseases was no higher in the group with back pain. For men aged 50 and over back pain did not precede death from ischaemic heart disease or any other particular disease during follow up. Smoking was significantly related to risk of death from ischaemic heart disease in men of every age. Body mass index or social status did not correlate with ischaemic heart disease at any age. In women no association between back pain and any vascular disease was found.

Age specific mortality (per 1000 people and 13 years) of men according to history of back pain

	Age (years) at beginning of follow up					
	30-49			50-66		
Cause of death	Back pain (n=1274)	No back pain (n=586)	P value*	Back pain (n=1212)	No back pain (n=576)	P value*
Ischaemic heart disease	18·1	3·4	0·02	54·5	72·5	0·15
Stroke	0·8	0·0	0·68	7·4	8·1	0·99
Other cardiovascular disease	3·9	5·1	0·49	22·3	26·2	0·74
All causes	56·5	44·4	0·32	169·6	203·6	0·10

*χ^2 test or Fisher's exact test.

Comment

Mechanical reasons and disc degeneration have been proposed as the main causes of back pain. My results support the hypothesis that back pain in some cases may be an early manifestation of atherosclerosis. Anything causing or worsening local ischaemia of the lumbar region may cause back pain. In a recent study of fire fighters in New York a strong association between smoke and first episode of back pain was found.[3] So called unspecific back pain may often have a vascular basis, which may be atherosclerosis or any other defect causing temporary ischaemia.

According to a recent study back pain may be related to work in the same sense as angina pectoris is. The association between smoking and back pain has been found to depend on the job of the subject. There seems to be an association between smoking and back pain, however, only in physically demanding jobs.[4] One should, however, be cautious in interpreting the observed association between smoking and back pain because, for example, pain in the extremities is more clearly associated with smoking than back pain.[4]

I found no relation between back pain and death from ischaemic heart disease in older men. One