Ischaemic heart disease in the elderly

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Studies were made for evidence of heart disease on 501 people aged 65 and more living at home; 22.4 per cent had clinical and/or electrocardiographic evidence of ischaemic heart disease. The prevalence of ischaemic heart disease increased with age, and was slightly greater in men than women.

The frequency of ischaemic heart disease increased with increasing current cigarette consumption and with total cigarette consumption. There was no increase in relation to any of the following possible risk factors: systolic and diastolic blood pressure, blood glucose, serum cholesterol, skinfold thickness, percentage of ideal body weight.

The survival over a 5-year period of all subjects with ischaemic heart disease did not differ significantly from that of all subjects together, but the mortality of subjects with ischaemic heart disease and an abnormal electrocardiogram was 1.5 to 2 times that of subjects in whom ischaemic heart disease was diagnosed on the basis of angina pectoris or past cardiac infarction, the electrocardiogram being normal.

The majority of studies of ischaemic heart disease in old age have been concerned with the modes of presentation of acute cardiac infarction (Rodstein, 1956; Pathy, 1967), and the detailed and extensive reports on the 'risk factors' for the disease (see Kannel and Dawber, 1974; Joint Working Party, 1976; Reid *et al.*, 1976) barely consider these in relation to the elderly, even though ischaemic heart disease is the commonest single cause of death in old age (Caird and Kennedy, 1976). Of the many 'risk factors' identified with varying degrees of certainty, none, except possibly high blood pressure (Kannel, 1976), has been shown to carry with it an excess risk of ischaemic heart disease in old age (Elmfeldt *et al.*, 1976). Apart from studies of the survival of elderly patients admitted to hospital with acute cardiac infarction (Björck *et al.*, 1958; Librach *et al.*, 1976), and of the excess mortality associated with a variety of electrocardiographic abnormalities (Caird *et al.*, 1974), there is little information on the natural history and prognosis of ischaemic heart disease manifest late in life.

The present study was undertaken to establish the prevalence of ischaemic heart disease in a random sample of the elderly population, to identify factors related to this prevalence, and to investigate the survival of old people with respect to the presence or absence of clinically diagnosable ischaemic heart disease. The study is part of a detailed clinical, laboratory, and nutritional survey of old people living at home.

Methods

Two stratified random samples, totalling 501 subjects, were drawn from people aged 65 and over living at home, the first from the whole elderly population of the town of Kilsyth (Andrews *et al.*, 1971), the second from six general practices in north Glasgow, as described by McLennan *et al.* (1973). The findings in the two samples were virtually identical, and they have, therefore, been combined for the purposes of the present investigation.

A full medical history, supplemented where appropriate by reference to general practitioner and hospital records, and including details of current drug therapy, was taken from each participant. It also included standard questionnaires on angina pectoris (Rose and Blackburn, 1968) and smoking habits (Medical Research Council, 1966). Total cigarette consumption was estimated by multiplying the number of cigarettes smoked by the number of years for which each subject admitted to smoking cigarettes. Subjects who smoked both pipe and cigarette tobacco were included in respect of their cigarette consumption.

A clinical examination was carried out, and in all except 14 subjects (3%) a standard 12-lead electrocardiogram was recorded, the tracings being classified by two observers according to the Minnesota code (Rose and Blackburn, 1968; Kennedy and Caird, 1972). In all subjects except those whose condition necessitated examination at home rather than at a clinic a standard six-foot posteroanterior

chest radiograph was taken, and height and weight recorded.

The percentage of the subject's ideal weight was calculated from the nomogram of Anderson (1948). The thickness of skinfolds over the right subscapular region and right triceps were recorded using Harpenden calipers, and the arithmetic sum in mm of the two measurements taken as 'skinfold thickness'. Blood was taken by venepuncture between 11.00 a.m. and 2.00 p.m. for measurement of glucose by Autoanalyser as 'true glucose' and cholesterol by the method of Annan and Isherwood (1969). Risk factors with continuous frequency distributions (i.e. systolic and diastolic blood pressure, blood glucose, serum cholesterol, skinfold thickness, and percentage of ideal weight) were analysed by dividing the subjects into tertiles of the frequency distributions, after exclusions as detailed in Table 1. Table 2 gives the inclusive ranges of the middle tertiles of these continuous distributions.

Subjects in the first (Kilsyth) sample were followed up for 5 years, and those in the second (Glasgow) sample for 3 years after their initial examination, and their survival status, and if dead their date of death, determined. Survival curves were constructed by life table methods (Merrell and Shulman, 1955).

Diagnostic criteria

Ischaemic heart disease was diagnosed on the basis of positive answers to the questions on angina pectoris (in the absence of evidence of significant aortic valve disease), and/or a documented history of cardiac infarction, and/or an electrocardiogram showing codable Q/QS items according to the Minnesota code. Table 3 shows the diagnostic cri-

teria in the 112 subjects in whom ischaemic heart disease was diagnosed.

Hypertensive heart disease was diagnosed in the presence of an electrocardiogram showing 'probable left ventricular hypertrophy' (i.e. both voltage and ST-T changes; Kannel *et al.*, 1970; Kennedy and Caird, 1972; Campbell *et al.*, 1974) and either an arterial blood pressure of 180/110 mmHg or

Table 1 Subjects excluded from individual analyses

	Reason for exclusion	Number
Smoking	Not recorded	4
Blood pressure	Antihypertensive therapy	58
	Not recorded	27
Blood glucose	Known diabetes	11
	Thiazides	44
	Total	82
Serum cholesterol	Not recorded	51
Skinfold thickness	Not recorded	102
Per cent of ideal weight	Not recorded	54

Table 2 Range of middle tertile of continuous variables

Sex	M		F	
Age (y)	65-74	75+	65-74	75+
Systolic blood pressure (mmHg)	155-170	155-180	160-185	165-195
Diastolic blood pressure (mmHg)	85-100	85-100	89-105	95-105
Blood glucose (mmol/l)*	4.9-6.1	5.3-6.1	4.9-6.1	5.4-6.3
Serum cholesterol (mmol/l)*	5.9-6.9	5.6-6.6	6.9-8.2	6.5-7.9
Skinfold thickness (mm)	17-27	17-22	23-33	17-29
Per cent of ideal weight	97-115	94-104	101-119	101-118

*For conversion from SI units to traditional units: glucose: 1 mmol/l $\approx$ 18 mg/100 ml; cholesterol: 1 mmol/l $\approx$ 38.6 mg/100 ml.

Table 3 Diagnostic criteria for ischaemic heart disease

Manifestation	Electrocardiogram	M	F	M + F
Angina*	No electrocardiogram	3	2	5
	Electrocardiogram normal	10	10	20
	Q/QS items†	5	2	7
	Other codable abnormality†	11	13	24
	Total	29	27	56
Cardiac infarction*	Electrocardiogram	3	4	7
	Q/QS items†	4	4	8
	Other codable abnormality†	2	6	8
	Total	9	14	23
No symptoms	Q/QS changes†	7	26	33
	No electrocardiogram	3	2	5
	Electrocardiogram normal	13 (31%)	14 (22%)	27 (25%)
All	Q/QS items†	16 (38%)	32 (49%)	46 (43%)
	Other codable abnormality†	13 (31%)	19 (29%)	32 (30%)
	Total	45	67	112

*From questionnaire.

†See text for definition.

more, or a lower blood pressure when antihypertensive drugs were being taken. Conventional criteria were used for the diagnosis of valvular heart disease (Bedford and Caird, 1960); pulmonary heart disease was diagnosed when the electrocardiogram showed right ventricular hypertrophy (Goodwin and Abidin, 1959) and there were symptoms and signs of severe chronic respiratory disease. 'Mixed' heart disease was considered present when criteria for more than one form of definite heart disease were met in an individual subject. 'Definite unclassifiable' heart disease was diagnosed when there was no doubt of cardiac abnormality (e.g. left bundle-branch block or atrial fibrillation) but the available evidence did not allow a convincing diagnostic classification. Heart disease was described as 'doubtful' when evidence of cardiac abnormality was not beyond doubt (e.g. T wave flattening, or a minor increase in cardiothoracic ratio on the chest radiograph).

Results

PREVALENCE OF HEART DISEASE

The prevalence of the various forms of heart disease diagnosed in the 501 subjects is shown in Table 4: 112 subjects (22.4%) had ischaemic heart disease, 11 of whom also fulfilled the criteria for hypertensive heart disease. Four men and 24 women had only hypertensive heart disease as defined. Three men and 19 women had valve disease; of these, 5 had mitral regurgitation of uncertain origin, 5

rheumatic mitral stenosis and regurgitation, 11 aortic stenosis with or without regurgitation, and 1 'isolated aortic regurgitation' (Bedford and Caird, 1960). Three men had pulmonary heart disease. Fifty-three subjects (11%) had 'definite unclassifiable' heart disease as defined, and 28 (6%) had 'doubtful' heart disease. In all, 43 per cent had definite heart disease, the proportion being slightly greater in men than in women, and increasing with age. Of those with definite heart disease as defined, 51 per cent had ischaemic heart disease.

Table 5 shows the prevalence of ischaemic heart disease by age and sex in greater detail. It was present more often in men (25%) than in women (21%), the male/female prevalence ratio being 1.1 between the ages of 65 and 74, and 1.2 over the age of 75. Ischaemic heart disease increased in frequency with age in both sexes.

RISK FACTORS FOR ISCHAEMIC HEART DISEASE

Of subjects who had never smoked, 17 per cent had ischaemic heart disease, as compared with 29 per cent of current cigarette smokers, 26 per cent of ex-cigarette smokers, and 23 per cent of current smokers of pipes or cigars (Table 6). The difference between current smokers and those who have never smoked is significant at the 2.5 per cent level. There is also a statistically significant trend in the prevalence of ischaemic heart disease in relation to total cigarette consumption (Table 7).

Fig. 1 to 3 show the prevalence of ischaemic heart

Table 4 Prevalence of heart disease

Age (y) Sex	65-74 M	F	75+ M	F	Total
No. of subjects	102	167	79	153	501
Ischaemic	21	29	20	31	101 (20%)
Hypertensive	1	9	3	15	28 (6%)
Valvular	0	8	3	11	22 (4%)
Pulmonary	2	0	1	0	3 (0.6%)
Mixed ischaemic and hypertensive	1	3	3	4	11 (2%)
Unclassifiable	14	8	14	17	53 (11%)
Total definite heart disease	39 (38%)	57 (34%)	44 (56%)	78 (51%)	218 (43%)
Doubtful heart disease	10	4	1	13	28 (6%)
No heart disease	53 (52%)	106 (64%)	34 (43%)	62 (61%)	255 (51%)

Table 5 Prevalence of ischaemic heart disease by age and sex

Age (y) Sex	65-69 M	F	70-74 M	F	75-79 M	F	80-84 M	F	85+ M	F	All subjects M+F
No. of subjects	58	85 (1)	44 (1)	82 (4)	47 (4)	80 (1)	21 (1)	46 (2)	11	27	501 (14)
No. with ischaemic heart disease	12	20 (1)	10	12 (1)	14 (3)	19	6	8	3	8	112 (5)
% with ischaemic heart disease	21	24	23	15	30	24	28	17	27	30	22

Numbers in brackets are subjects without an electrocardiogram.

Table 6 Frequency of ischaemic heart disease and current smoking habits

Sex	M No.	%	F No.	%	M+F No.	%
Never smoked	2/16	13	44/249	18	46/265	17
Current smokers:						
Cigarettes/day 1-14	10/46	22	12/24	50	22/70	31
15+	9/31	29	4/20	20	13/51	26
All	19/77	25	16/44	36	35/121	29*
Ex-cigarette smokers	9/39	23	6/19	32	15/58	26
Pipe smokers	9/39	23	—	—	9/39	23
Ex-pipe smokers	1/5	—	—	—	1/5	—

*Significantly different from subjects who never smoked: $\chi^2=6.12$, d.f. = 1, $P < 0.025$.

Table 7 Frequency of ischaemic heart disease and total cigarette consumption

Sex	M No.	%	F No.	%	M+F No.	%
Non-smokers	2/16	13	44/249	18	46/265	17*
Total cigarette consumption < 200 000	5/36	14	12/34	36	17/70	24*
> 200 000	26/91	29	8/27	30	34/118	29*

*Trend significant: $\chi^2=7.80$, d.f. 2, $P < 0.025$.

Fig. 1 Prevalence of ischaemic heart disease by tertiles of the frequency distributions of systolic and diastolic blood pressure in men, in women, and in both sexes together. There are no significant gradients of prevalence. L, M, U: lower, middle, and upper tertiles. Number of subjects in each group is shown above.

Fig. 2 Prevalence of ischaemic heart disease by tertiles of the frequency distributions of blood glucose and serum cholesterol, in men, in women, and in both sexes together. There are no significant gradients of prevalence. L, M, U: lower, middle, and upper tertiles. Number of subjects in each group is shown above.

Fig. 3 Prevalence of ischaemic heart disease by tertiles of the frequency distributions of skinfold thickness and percentage of ideal weight, in men, in women, and in both sexes together. There are no significant gradients of prevalence. L, M, U: lower, middle, and upper tertiles. Number of subjects in each group is shown above.

disease by tertiles of the frequency distributions of systolic and diastolic blood pressure, blood glucose, serum cholesterol, skinfold thickness, and percentage of ideal weight. In none is there any significant gradient of prevalence. In the case of serum cholesterol, prevalence in women is highest in the middle tertile.

SURVIVAL IN ISCHAEMIC HEART DISEASE

The survival of the whole group of subjects with ischaemic heart disease does not differ significantly from that of an age- and sex-matched sample of the whole group of subjects (Table 8), but the survival of subjects whose electrocardiograms were abnormal (i.e. showed either Q/QS or other items) was significantly less than that of subjects with normal electrocardiograms in whom ischaemic heart disease was diagnosed solely on the basis of a history of angina or a past cardiac infarct.

Discussion

The reasons for regarding the population studied as representative at least of the elderly in urban Scotland, and probably more widely, are discussed by McLennan *et al.* (1973).

The diagnostic criteria for ischaemic heart disease used in the present study are probably as realistic as can be achieved in elderly people. It is known that questions relating to the presence of angina may be answered in the affirmative at one examination and in the negative at a second examination (Rose, 1968); the true prevalence of angina in any group is therefore likely to be underestimated in a single cross-sectional study. It will be seen from Table 3 that the electrocardiogram showed no codable abnormality in 40 per cent of the subjects who gave a history of angina. It is of course possible that the exertional chest pain recorded as angina by the answers to the questionnaire was not in fact of cardiac origin in some cases. But the electrocardiogram was normal in 7 of the 23 (30%) in

whom the criterion for the diagnosis of ischaemic heart disease was a documented cardiac infarct. The findings of Kitchin *et al.* (1973) in the elderly are very similar. Of the 107 subjects in the present study in whom ischaemic heart disease was diagnosed and an electrocardiogram recorded, 43 per cent had Q/QS abnormalities, 30 per cent had other codable abnormalities, and 25 per cent had a normal electrocardiogram.

It is possible that some instances of 'definite unclassifiable' heart disease were of ischaemic origin and should, therefore, be so classified, but it would be unwarranted and unrealistic to consider them all to be so. Certainly many cases both of bundle-branch block and of atrial fibrillation in old age are unrelated to coronary artery disease (Davies, 1976; Pomerance, 1976). The frequency of hypertensive heart disease depends largely on the definition of hypertension employed. The prevalences recorded in the present study for valvular and pulmonary heart disease are in line with previous estimates (Beford and Caird, 1960; Pomerance, 1976; Campbell *et al.*, 1974).

Male sex is a most important risk factor for ischaemic heart disease in the young and middle aged (Joint Working Party, 1976), but, as Table 5 shows, this is not so in the elderly, in whom the prevalence rate in men exceeds that in women by only 10 to 20 per cent (Kitchin *et al.*, 1973).

Analysis of other risk factors shows a significant association between ischaemic heart disease and cigarette smoking, which is demonstrable in both sexes and whether current or total cigarette consumption is considered (Tables 6 and 7). Kitchin *et al.* (1973), whose study of old people at home closely resembles the present investigation, failed to find such an association, but prospective data from the Framingham survey, reported by Kannel (1976), suggests that cigarette smoking retains its place as a risk factor for ischaemic heart disease in old age. Kannel also stresses the importance of high blood pressure as a risk factor for ischaemic heart disease in old age, but this is not confirmed either by Kitchin *et al.* (1973) or by the present study; both of these include many subjects over the age of 75 years. Neither blood glucose nor serum cholesterol level are associated with the presence of ischaemic heart disease (Fig. 2) as Kannel (1976) has also shown. In the case of serum cholesterol level, prevalence of ischaemic heart disease is highest in women in the middle tertile of the range, and it is of interest that Carlson and Böttiger (1972) in a prospective study found the highest incidence of episodes of ischaemic heart disease in elderly men whose serum cholesterol was in the middle of the frequency distribution.

Table 8 Survival of subjects with ischaemic heart disease

	No.	Survivors % ($\pm$ SE) at years				
		1	2	3	4	5
All cases	112	92 $\pm$ 3	88 $\pm$ 3	74 $\pm$ 4	65 $\pm$ 5	56 $\pm$ 5
Expected*		93	86	78	71	65
Electrocardiogram						
normal	32	100	100	91 $\pm$ 5	79 $\pm$ 8	79 $\pm$ 8
Q/QS items	46	89 $\pm$ 5	87 $\pm$ 5	67 $\pm$ 7	67 $\pm$ 7	50 $\pm$ 10
Other abnormality	29	86 $\pm$ 6	72 $\pm$ 8	61 $\pm$ 9	48 $\pm$ 10	37 $\pm$ 10

*Expected mortality of all subjects, adjusted for age and sex.

Obesity is not of great importance as a risk factor for ischaemic heart disease in middle age (Epstein, 1973; Joint Working Party, 1976), and it is thus not surprising to find no association between either measure of obesity and ischaemic heart disease in old people (Fig. 3); indeed the gradient of prevalence is negative (i.e. ischaemic heart disease is commoner among the thinner subjects).

It seems clear, therefore, that cigarette smoking is the only one of the commonly demonstrable risk factors for ischaemic heart disease which can be positively identified in the elderly. Two possible explanations for the discrepancy between the findings in the middle-aged and in the elderly suggest themselves. It may be that those most exposed to risk factors in early and middle life do not survive into old age, or that all the risk factors continue to operate in old age, but each individually to a less than significant intensity, so that it is the duration of exposure to all factors together that comes to predominate. If this were so, it might well be that in old age no single risk factor could be shown to be significantly associated with the presence of ischaemic heart disease.

It is somewhat surprising that no excess mortality can be shown in old age for ischaemic heart disease when all subjects are taken together (Table 8). However, abnormality of the electrocardiogram, rather than the symptom of angina with a normal electrocardiogram, is shown to carry an excess mortality, as has been previously shown (Caird *et al.*, 1974). The difference in mortality between those with an abnormal electrocardiogram and that expected for the whole group of subjects is of the same order (1.5 to 2 fold) as was found by Björck *et al.* (1958) and Librach *et al.* (1976) for elderly people discharged from hospital after a myocardial infarct, and is much less than for young or middle-aged patients with ischaemic heart disease.

This study shows clearly a substantial number of differences between ischaemic heart disease in middle and in later life. In old age the male predominance is very much smaller, the risk factors except cigarette smoking much less obvious, and the outlook for survival relative to other people of the same age much less unfavourable.

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