The prevention of coronary heart disease in general practice

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SUMMARY. Four hundred and eighty-one (75 per cent) of the male patients between 35 and 55 years of age in a health centre group practice were screened for risk factors for coronary heart disease. An attempt was made to alter these factors and the effectiveness of the intervention was later assessed. We consider that where there is an attached health visitor a screening programme can be carried out as part of general practice without too great an increase in workload for the general practitioner. The continued surveillance of those at risk and the alteration of the risk factors is more arduous. We think the assistance of the other health care professionals such as the area health education officer and dietician is essential in such a programme.

Introduction

CORONARY heart disease is now the chief single cause of death in Britain. In men aged 45 to 54 years, 52 per cent of all deaths in 1973 were due to cardiovascular disease and more than three quarters of these were due to coronary heart disease. This compares with 26 per cent which were due to cancer and seven per cent from accidents. The mortality from coronary artery disease in younger men has doubled in the last 20 years (OPCS, 1975). Despite all the advances of modern medicine, life expectancy for a man who reaches the age of 40 is very similar to what it was at the turn of the century. The prevention of coronary heart disease is thus one of the major challenges in medicine today.

It has long been recognized that there are some factors which increase the risk of coronary heart disease (Dawber *et al.*, 1962; Epstein, 1968; Stamler and Epstein, 1972; Blackburn, 1974; Kannel, 1977). The cardinal risk factors are cigarette smoking, hypertension, hyperlipidaemia (particularly elevated low density lipoprotein cholesterol (C-LDL), while diabetes, obesity, a family history of coronary heart disease, a lack of physical activity, type A personality, hyperuricaemia, and the Pill are lesser risk factors. The risk increases with the number of cigarettes smoked, the levels of blood pressure and cholesterol, and the number of risk factors involved. In the United States between 1964 and 1975 there was a decline in mortality from coronary heart disease, particularly in men in the 35 to 55 year age group (27 per cent; Walker, 1977). In this period there was also a 25 per cent decrease in the amount of tobacco smoked (US Bureau of Health Education, 1975), a decline in the consumption of animal fats with a small but significant fall in the mean serum level of cholesterol in the general population (Stamler and Gill, 1977), and a considerable improvement in the detection and treatment of hypertension (Stamler *et al.*, 1976). In contrast, in the British Isles during this same period the mortality from coronary heart disease continued to rise (*British Medical Journal*, 1977), although there is some evidence that the mortality rate has started to decline within the last two or three years (Florey *et al.*, 1978).

It is generally accepted that acute coronary care, the coronary ambulance, and coronary artery surgery cannot bring about a major reduction in the burden of coronary heart disease, and that this must come from preventive measures such as a reduction in risk factors. The Joint Working Party of the Royal College of Physicians and the British Cardiac Society (1976) stated in their report that the prevention of coronary heart disease in the community is predominantly the role of the general practitioner, who is best situated to identify and advise those at high risk. But is the detection and screening of patients for risk factors of coronary heart disease part of general practice? If so, how should this be carried out? It may be possible to bring about a reduction in risk factors involving an alteration in behaviour in hospital, as part of a major research project (Stamler, 1971), but is it possible in everyday

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general practice? If so, what is involved? How is it best achieved and is extra help required?

Method

Each male patient between 35 and 55 years in a group practice of 7,500 patients situated in a health centre was sent a letter inviting him to attend fasting for a check-up at a given time on a Wednesday or Friday morning. Twenty patients were booked for each session. We were fortunate to have a health visitor especially seconded to our practice for four mornings per week to organize the survey. She was assisted by our two attached health visitors.

Clinical, smoking, and family histories were taken. Any patient who had stopped smoking within the last three years was considered still at risk and was included as a smoker. Pipe smokers were also included unless they smoked less than 1 oz of tobacco per week and did not inhale. Those with a parent, uncle, aunt, or sibling who had died of myocardial infarction or cerebrovascular accident under 60 years of age were considered to be at risk because of a family history of premature cardiovascular disease. Measurements carried out included height, weight, and blood pressure. The patient's relative weight was calculated using tables (United States Bureau of Health Education, 1975). A patient was considered to be at risk if he was 10 per cent or more overweight. The diastolic blood pressure was taken using the fourth phase or muffing of the sounds. Blood was withdrawn for fasting cholesterol and sugar. A resting electrocardiogram was recorded in each case. The electrocardiograms were interpreted according to the Minnesota code (Rose and Blackburn, 1968). The last 227 patients, who were mostly in the younger age groups, had a Masters double two step using leads AVF and V5 only; an abnormal result consisted of ST depression of at least 1 mm.

Participants were informed of the dangers of cigarette smoking and on the advisability of taking regular exercise and maintaining ideal weight. Where appropriate, patients were given diet sheets. Health education literature relating to the risks of coronary heart disease was distributed to all participants. All patients were then seen by one of us who looked at their past medical histories, checked their clinical histories and blood pressures if these were over 100 mm diastolic, reinforced what the health visitor had already told them, and advised them that they would get a written report.

If a patient had a diastolic blood pressure over 100 mm Hg at initial examination, he was subsequently recalled for at least two further readings and treatment was begun if the diastolic blood pressure was persistently above 100 mm Hg. If the serum cholesterol was over 7·0 mmol/l (270 mg/100 ml) at initial examination he was recalled for a full lipid analysis. If he was more than 20 per cent overweight he was given an appointment to attend a clinic in the health centre run by the dietician and the local community medical officer.

After six months those who were smoking at the time of screening were sent a questionnaire with a stamped addressed envelope for its return. The smokers were asked in the questionnaire to state whether they still were smoking, how many cigarettes they were smoking, whether they were smoking a milder cigarette, and whether they were prepared to attend an anti-smoking clinic. Later in the survey, the health visitors visited the homes of those most at risk, namely those with four or more risk factors, and invited them to attend an anti-smoking clinic in the health centre. This clinic consisted of five two-hour sessions attended by the two health visitors and the area health education officer. Those whose blood pressures were initially 100 mm Hg or over and those whose repeat serum cholesterols were over 7 mmol/l (270 mg/100 ml) were reviewed. Those in the early part of the survey were reviewed after 12 months and those in the latter half after six months. Those patients 20 per cent overweight, who attended the dietician, were kept under regular review by her.

Results

Six hundred and forty-two patients were sent letters. Three hundred and eighty-nine patients (61 per cent) attended on the first invitation. The non-attenders were sent a further invitation and 92 (36 per cent) of these attended. Four hundred and eighty-one patients (75 per cent) attended altogether. The attendance rate was similar in each age group.

The number of patients with the various risk factors is shown in Table 1. Two hundred and sixty-five patients (55 per cent) were smokers, 71 (15 per cent) had a diastolic blood pressure of 95 mm Hg or over, while 45 (10 per cent) had a diastolic blood pressure of 100 mm Hg or over. Forty-seven patients (10 per cent) had an initial fasting blood cholesterol over 7·0 mmol/l (270

Table 1. Risk factors identified.

	Number	Percentage
Smokers	265	55
Diastolic blood pressure 95 mm Hg or over	71	15
Diastolic blood pressure 100 mm Hg or over	45	10
Cholesterol more than 7.0 mmol/l	47	10
Weight		
Ideal	270	56
0 to 9 per cent overweight	77	14
10 to 19 per cent overweight	92	19
More than 20 per cent overweight	41	9
Family history positive	87	18
Major electrocardiographic changes	30	6
Number of patients screened	481	100

Table 2. Effect on smoking habits.

	Number	Percentage
Patients currently smoking	231	*100*
Questionnaires returned	80	*35*
Agreed to attend anti-smoking clinic (smokers)	43	*19*
Had stopped smoking at review	7	*3*

mg/100 ml). This was confirmed in 32 of them (seven per cent) with a full lipid analysis.

Table 1 shows that 270 (56 per cent) were of ideal weight, 77 (16 per cent) were less than nine per cent overweight, 92 (19 per cent) were between 10 and 19 per cent overweight and 41 (nine per cent) were more than 20 per cent overweight. Eighty-seven patients (18 per cent) had a family history of premature cardiovascular disease, and 30 (six per cent) had major electrocardiographic changes, indicative of a poor prognosis. Six patients had electrocardiographic evidence of definite left ventricular hypertrophy, that is, increased R waves in the left praecordial leads with deep S waves in the right praecordial leads associated with ST depression and T wave flattening or inversion, often with left axis deviation more than −30° and a prolongation of ventricular activation of at least 0·05 sec. Eleven patients had possible left ventricular hypertrophy (the above findings without the ST or T wave changes). Thirteen had generalized T wave changes suggesting ischaemia. These changes were commoner in the older age groups. Other ECG changes were axis deviation, interventricular block arrhythmias, and minor T wave changes the prognostic significance of which are not clearly defined. The post-exercise Masters test was normal in all cases. There were 71 patients (15 per cent) with three or more risk factors and 22 (4·6 per cent) with four or more risk factors.

The effect of our advice was assessed at least six months after initial examination. The response from the smokers to the postal questionnaire is given in Table 2. Of the 80 (35 per cent) of those who replied to the questionnaire, only seven (three per cent) stated that they had given up cigarettes on our advice and were still not smoking at the time of review, 43 (19 per cent) stated they would attend an anti-smoking clinic, and 12 (55 per cent) out of the 22 who were most at risk and who were invited to attend the anti-smoking clinic actually attended. Six months after attendance at the anti-smoking clinic four (33 per cent) out of the 12 are still not smoking.

Forty-five patients had diastolic blood pressures 100 mm Hg or more. In 21 patients the blood pressure settled (at least two subsequent readings were under 100 mm Hg) and did not receive treatment. This left 24 requiring treatment, including 10 who were known to be hypertensive and under treatment, and five other known hypertensives under treatment whose diastolic blood pressure was below 100 mm Hg at the time of screening. Fourteen of these 29 patients (48 per cent) were discovered by this screening to have blood pressure persistently over 100 mm Hg requiring treatment (Table 3). This group included three severe hypertensives, who had stopped treatment unknown to us. At review there was an improvement in the diastolic blood pressure in 22 of the 24 patients, the average pressure improving from 108 to 91 mm Hg, a fall of 13 mm Hg.

Of the 32 patients with raised blood cholesterols, all of whom were treated by diet alone, 15 were checked 12 months after the initial reading and the remaining 17 after six months. Thirty-one patients (96 per cent) had a lower cholesterol at review than at initial examination. Within this group the average cholesterol was lowered from 7·82 to 6·69 mmol/l, a 14 per cent reduction.

Two hundred and ten patients were overweight and they were all given a reducing diet sheet and where appropriate were advised to take more exercise. The 41 patients who were more than 20 per cent overweight were given an appointment to attend the dietician. The 23 who attended lost an average of 2·8 kg (6·3 lbs) (three per cent) during an average period of attendance at the clinic of between four and five months.

Discussion

The 75 per cent response rate to the invitation for screening was considered reasonably good, particularly since these sessions were held during working hours, causing many patients to lose a half or whole day at work. This contrasted with a very poor response to an earlier invitation for cervical screening. Patients in other practices in the health centre asked to be screened and doctors in other practices reported that more patients attended them for a check-up during the survey period, showing the general interest that was created in the community. It is hoped that non-attenders will be persuaded to undergo screening when next they attend the surgery.

We were fortunate in having a health visitor attached part time to our practice to help conduct the survey. The initial screening was completed over a five-month period but could easily have been performed over a longer period by our attached health visitors as part of

Table 3. Effects on blood pressure.

	Number	Percentage
Diastolic blood pressure persistently 100 mm Hg or over	24	*100*
Diastolic blood pressure improved at review	22	*92*
New hypertensives discovered/total number in practice	14/29	*48*

their service commitment. We also consider that it is not essential for the patients to be seen at the initial examination by a doctor. Those discovered to have abnormalities by the health visitor could later have been referred by the health visitor to their own doctor.

It is difficult to compare the incidence of the various risk factors with other published studies as different authors have screened different age groups and used different cut-off points. Although 55 per cent of our patients were considered to be at risk because of smoking, 34 had actually stopped smoking during the previous three years, so that only 48 per cent were smoking at the time of screening. The 1976 General Household Survey (OPCS, 1978) showed that 46 per cent of men smoked compared with 52 per cent in the 1972 survey.

Comparative figures for blood pressure and cholesterol are given in Table 4. In South Wales Hart (1970) found seven per cent of 254 men aged 40 to 64 years in his practice to be hypertensive, that is, having a diastolic blood pressure sustained at 100 mm Hg or more over three readings. In another study from general practice (Coope, 1974) 7·6 per cent of 524 men aged 40 to 60 years were found to be hypertensive using the same criteria. These figures compare with 29 (six per cent) of our patients aged 35 to 55 years who were found to be hypertensive requiring treatment. Sixty-one per cent of Hart's hypertensive patients were previously undetected compared with 47 per cent in Coope's study and 48 per cent in our study.

Since 60 per cent of patients attend their doctor every year (General Register Office, 1958) it is suggested that if those patients at risk had their blood pressures taken when they came to the surgery, special screening clinics would be unnecessary. Despite our trying to do this in our practice, 48 per cent remained unknown. Nevertheless, we believe it is to be recommended for those without the resources for screening. The more alarming discovery was that at the initial examination only five of the 15 known hypertensives on treatment had diastolic blood pressures below 100 mm Hg. Furthermore, three patients who were known severe hypertensives were found at initial examination not to be taking treatment. We believe that much of the treatment in our practice has been inadequate and even yet needs improvement.

It is more gratifying that at review 22 out of 24 showed an improvement in the diastolic blood pressure, the average improving from 108 to 91 mm Hg. It appears from our figures and those quoted that the detection and treatment of hypertension is poorer in Britain than in the US, where a large nationwide study between 1973 and 1975 showed that only 36 per cent of men with hypertension were undetected and 28 per cent inadequately treated using 95 mm Hg diastolic as the criterion for hypertension and adequacy of treatment (Stamler *et al.*, 1976). We believe treatment could be improved in general practice if doctors held a hypertensive clinic once a month and followed up defaulters. This is foreign to general practice at present and since it puts the onus on the doctor rather than the patient, this may act as a deterrent.

The percentage of patients with raised serum cholesterol is higher in the US study quoted than in studies from Britain (Table 4). This is in keeping with the study by Keys (1975) who showed differences in the mean level of plasma cholesterol between various countries, with a strong positive relationship between the mean level of plasma cholesterol in the community and the incidence of coronary heart disease.

The value of an electrocardiogram is as a baseline record without which the changes of acute ischaemia may be difficult to interpret. Electrocardiographic changes can also be used as a lever to get unco-operative patients to improve their risk factors. The electrocardiogram is also an important prognostic indicator. The Framingham studies (Kannel *et al.*, 1970) have shown that the risk of sudden death is increased ten-fold where there is definite electrocardiographic evidence of left ventricular hypertrophy. Possible left ventricular hypertrophy is also linked with increased risk as is generalized T wave inversion (Ostrander, 1970). Some doctors feel insufficiently experienced at reading electrocardiograms. The Minnesota code (Rose and Blackburn, 1968) makes this considerably easier in this type of study. Electrocardiograms can now be read by computer and there are reports of health centres linked to computers in which doctors receive an immediate report (Hoyte, 1977). This development may help this type of work greatly. Post-exercise electrocardiograms, such as we did, using leads AVF and V5, should show 89 per cent of all abnormalities to be seen in the complete 12 lead electrocardiogram (Blackburn *et al.*, 1966) and

Table 4. Comparisons with other studies.

Authors	Age of men studied	Cholesterol	Percentage	Blood pressure	Percentage
Stamler and Epstein (1972)	30 to 59	>275 mg	*17.0*	>95 mm Hg diastolic phase	*19.0*
Dick and Stone (1978)	30 to 49	>270 mg	*8.3*	>95 mm Hg diastolic phase	*20.7*
Rose *et al.* (1977)	40 to 64	>260 mg	*10.0*	>160 mm Hg systolic phase	*12.5*
This study	35 to 55	>270 mg	*10.0*	>95 mm Hg diastolic phase	*15.0*

obviously take considerably less time to perform. Since the identification of abnormalities using the Masters double two step is so low it hardly seems worthwhile (Robb and Marks, 1964; Redwood and Epstein, 1972). Submaximal stress testing using a bicycle ergometer should give a higher yield, but in our opinion should be reserved for those with multiple risk factors.

The most convincing evidence that alteration in risk factors associated with coronary heart disease improves the prognosis comes from Chicago (Stamler, 1971). This study showed that the mortality from coronary heart disease was 75 per cent lower in a group of men initially at high risk who underwent a rigorous sustained attack over a seven-year period to alter their risk factors compared with a control group of the general population with average risk factors. Stamler and colleagues (1971) achieved a 15 per cent reduction in serum cholesterol from 307 mg to 260 mg, an average weight reduction of seven per cent, and an improvement in diastolic blood pressure from 101 to 92 mm Hg in those who completed the programme. It is encouraging that our results compared very favourably in these aspects—although we reviewed only those who were at least 20 per cent overweight. Stamler and colleagues reported that the majority of his volunteers changed from a sedentary living habit to one of light exercise, a change we also encouraged, but did not review.

In the Chicago study, of the 116 smokers at entry, 43 (37 per cent) stopped smoking. There is no doubt that counselling on a single occasion as we used is of little effect in stopping people smoking (Porter and McCullough, 1972). Only 12 of the 22 smokers invited to attend our anti-smoking clinic actually attended. Six months after completion of these sessions only four (33 per cent) had stopped smoking. There is no doubt that this type of approach is much more effective than single counselling, with reports suggesting at least a 20 per cent success rate on follow-up after one year (Schwartz, 1969). It is also clear that considerable time is involved in getting people to stop smoking. For these reasons we believe that an anti-smoking clinic can and should be run by non-medical staff in conjunction with a programme such as ours. Individual efforts at practice level would be helped by a national advertising programme on the dangers of smoking.

We see our efforts to modify the risk factors of our patients as a continuing programme. The question remains how often a patient should be checked. If normal blood pressure and serum lipids are found, when should the patient be examined again? We feel once in every three to five years should be adequate. Though the time and resources involved in screening are not great, the continued surveillance of those at risk and the alteration of their risk factors is more arduous. In our opinion the assistance of other health care professionals along the lines we have outlined is essential in any programme. The improvement in the mortality from coronary heart disease in the US gives encouragement to advocates of prevention. Our study suggests that a screening programme can be carried out as part of general practice and shows that an improvement in risk factors can be achieved.

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Addendum

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Exercise testing after myocardial infarction

The prognostic value of a limited treadmill exercise test performed one day before hospital discharge after acute myocardial infarction was studied in 210 consecutive patients who had no overt heart failure and had been free of chest pain for at least four days. No complications occurred. During a one-year follow-up period 28 of 43 patients (65 per cent) who had chest pain during the test reported angina, compared with 60 of 167 (36 per cent) who had no chest pain during the test ($p < 0{\cdot}001$). The one-year mortality rates were 2·1 per cent (three of 146) in patients without changes in the S-T segment during exercise and 27 per cent (17 of 64) in those with depression of the S-T segment ($p < 0{\cdot}001$). Sudden death occurred in one of the 146 (0·7 per cent) patients who showed no change in the S-T segment and in 10 of 64 (16 per cent) with depression of the segment ($p < 0{\cdot}001$).

Thus, a limited treadmill exercise test performed before hospital discharge after acute myocardial infarction is safe and can predict mortality in the subsequent year.

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