Prevalence of three major risk factors in random sample of men and women, and in patients with ischaemic heart disease

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SUMMARY A random sample of 283 men and 250 women between the ages of 30 and 69 years has been investigated for the three coronary risk factors—smoking, hyperlipoproteinaemia, and hypertension, and 146 men and 87 women with ischaemic heart disease have undergone a similar investigation.

Smoking and hyperlipoproteinaemia are significantly more common in both men and women in ischaemic heart disease groups but hypertension is not substantially different. The prevalence of any one of these three risk factors is the same in the random sample and ischaemic heart disease groups, but the prevalence of two or more factors is significantly greater in the ischaemic heart disease groups. The absence of all three risk factors is commoner in the random sample.

The prevalence of smoking is far greater in men with ischaemic heart disease than in the equivalent female patients, whereas the prevalence of hyperlipoproteinaemia is significantly greater in women.

Young men in the random sample have a significantly greater prevalence of all three factors than young women, but in the whole age range cigarette smoking is the only factor significantly greater in men than in women. In the whole random sample 24 per cent of men and 9 per cent of women have two or more risk factors.

In men the combination of smoking with either of the other two factors is significantly more common in the ischaemic heart disease group, but the combination of hypertension plus hyperlipoproteinaemia is not. In women, however, hypertension plus hyperlipoproteinaemia is the commonest combination and is significantly more common in the ischaemic heart disease group. In the random sample the combination of cigarette smoking with one or both of the other two factors is 7 times more common and smoking plus hypertension 25 times more common in men than in women.

Types IIa and IV hyperlipoproteinaemia are more common in both men and women with ischaemic heart disease than in their random samples, but Type IIb is significantly increased only in women with ischaemic heart disease.

It is suggested that reporting the prevalence of a single risk factor without knowing what other factors are present can be misleading. Our data suggest that a substantial part of the preponderance of ischaemic heart disease in men relates to their greater prevalence of major risk factors in the younger age range, and particularly to the greater prevalence of moderately heavy cigarette smoking in combination with one or more of the other factors.

Men suffer from ischaemic heart disease at least 5 times more often than women (Armstrong *et al.*, 1972). Much work has been done on risk factors but as yet the precise aetiology of ischaemic heart disease has not been established (Doyle *et al.*, 1959; Dawber *et al.*, 1962; Keys *et al.*, 1963; Morris *et al.*, 1966; Stamler *et al.*, 1969; Tibblin, 1970). The factors most frequently investigated have been

hypertension, hyperlipidaemia, and smoking, but there have been relatively few studies in women. Prospective and retrospective prevalence studies on risk factors appear to show similar findings (Friedman *et al.*, 1966; Medalie *et al.*, 1968; Mulcahy *et al.*, 1969).

As the incidence of ischaemic heart disease varies between countries (Keys *et al.*, 1963) we have investigated the prevalence of hyperlipoproteinaemia, hypertension, and smoking in a random sample of

subjects taken from one general practice, and have similarly investigated a group of male and female patients with known ischaemic heart disease from a local hospital. We thus have four groups for comparison.

Bengtsson *et al.* (1973) have referred to the difficulty of obtaining meaningful data in women with ischaemic heart disease because of the scarcity of cases. (Publication of our female results has been delayed because of the relatively small number of cases with ischaemic heart disease in women that we had collected by 1973, when the male results were published (Dick and Stone, 1973).) The purpose of this paper is to report our findings for women and by examination of our 4 groups to show how the predominance of ischaemic heart disease in men may to some extent be explained.

Subjects

The subjects of this investigation were inhabitants of Leigh, an industrial town of 46 000 people with a hospital catchment area of 100 000. It is a relatively static population concerned mainly with the manufacture of cotton, artificial fibres, and electrical cable; in addition, there is some coal-mining, general engineering, and agriculture.

RANDOM SAMPLE

A random sample was taken from a general practice of about 2800 subjects who had registered with one of us (M.C.S.). The 'practice' had been under the care of this same general practitioner for 16 years at the time the study was begun.¹ Alternate record envelopes were selected and marked at a single session from the complete record files of the practice, thereby a 1 in 2 sample of the practice records was obtained.

The records of those subjects who had not reached their 15th birthday on the day of selection were rejected, leaving 480 men and 534 women. Of those 1014 subjects there were 627 subjects (322 men and 305 women) between the ages of 30 and 69 years, and of those subjects 283 men (88%) and 250 women (82%) completed the standardised examination described below. This group is referred to as 'the random sample'. The remaining

39 men and 55 women either refused examination, left the area, or died before they could be examined.

The male random sample contained 26 subjects (9.2%) known to have ischaemic heart disease; 8 subjects (2.8%) were found to have abnormal electrocardiograms classified as definite or probable ischaemic heart disease, but were otherwise in good health. A further 4 subjects had previously had severe chest pain likely to be the result of ischaemic heart disease, but had normal cardiograms when examined. The data from the male random sample reported in this paper include these 38 subjects. The female random sample contained 12 subjects (4.8%) thought to have coronary disease; 9 had angina and 3 had had infarcts. Seven other women (2.8%) with abnormal electrocardiograms classified as definite or probable ischaemic heart disease had had no symptoms of ischaemic heart disease at any time. These 19 subjects are included in the random sample.

Clearly, a general practice sample is not necessarily representative of the entire population. However, in men the degree to which the sample represents the whole U.K. male population was assessed by comparing the frequency distribution of 16 socioeconomic groups (General Register Office, 1966) in the sample, with that found in the 1966 U.K. sample census (General Register Office, 1969). These socioeconomic groups are reported in some of the census tables as 7 categories. We have compared the frequency distribution of these 7 categories in all men aged 15 years and over in our sample with that in the 1966 U.K. sample census by calculation of χ^2 on the original numbers. We found no significant difference ($P > 0.10$) between the distributions.

ISCHAEMIC HEART DISEASE GROUP

This contained 146 men and 87 women. All were inhabitants of Leigh and all cases had been under the care of one of us (T.B.S.D.). All available cases in this group were selected provided they conformed with the criteria given below. Cases of myocardial infarction included in this group had a typical history with changing pattern of serial electrocardiograms (see later). No case without typical electrocardiographic abnormality was included. Each author took the history independently where patients had angina, and only cases with a classical history on each occasion were included. Postinfarction angina was excluded from this subgroup. For the purpose of this survey, in every case of ischaemic heart disease, investigations were carried out not less than 3 months after an acute infarct. Both the random sample and ischaemic heart disease groups had been on a normal diet for

¹For those readers who are unfamiliar with the British scene, a U.K. general practice consists of people who have placed themselves under the care of a specific general practitioner in the area in which they live, and have registered this fact with the National Health Service Administration for the area. Record envelopes, within which are recorded details of any illness suffered by the subject, are held in alphabetical order in the record files of their general practitioner. The record is sent to him when he first accepts responsibility for the subject, though the latter may not suffer from any illness and may not have consulted him.

at least 4 weeks before the lipoprotein analysis was performed, and had not taken any lipid lowering medication. The two subcategories were—myocardial infarction (110 men, 62 women) and angina pectoris (36 men, 25 women).

Methods

Subjects from all groups were investigated in an identical way.

- (1) *A history* in relation to previous illnesses and smoking habits was obtained.
- (2) *Examination* of the heart, lungs, and casual blood pressure was made in every case by the same examiner (T.B.S.D.). Casual blood pressure was taken in a private cubicle using a mercury sphygmomanometer with a 12.7 cm cuff, with the subject lying down. These readings were made to the nearest 5 mm. The diastolic pressure was defined as that at which all sounds ceased. The first reading only in each subject was recorded. The recording was made after at least 3 minutes rest in a recumbent position.
- (3) *12-lead electrocardiogram* (Cambridge Instrument Company) was taken, all tracings being coded according to the Minnesota code (Blackburn *et al.*, 1960) by one of us (T.B.S.D.) without knowledge of the clinical state in subjects from the random sample, but with this knowledge in cases of ischaemic heart disease.
- (4) *Definition of ischaemic heart disease*
Definite ischaemic heart disease—the subject had a classical history with electrocardiograms coded as I.1, IV.1, V.1.
Very probable ischaemic heart disease—classical history with coding I.2, IV.2, V.2, VI.1 or 2, VII.1 or 2, emphasis being made on serial electrocardiograms and changing patterns.
- (5) *Lipoprotein analysis*

For at least 4 weeks before their lipoprotein analyses all subjects had been taking their accustomed diet, were not losing weight, and were not on any lipid lowering medication. Blood was drawn after a 14-hour overnight fast and the concentrations of lipoprotein fractions were estimated from the results of 'MNC analyses' (membrane filtration, nephelometry, and cholesterol estimation (Stone *et al.*, 1970). The concentrations of three lipoprotein fractions—LDL (low density lipoproteins, beta lipoproteins, S_f 0–20); VLDL (very low density lipoproteins, pre-beta lipoproteins, S_f 20–400), and chylomicrons (S_f 400)—were calculated from the nephelometric measurement and the value of serum total cholesterol.

TERMINOLOGY AND LIPOPROTEIN CLASSIFICATION

In this publication we have used only the World Health Organisation's recommended classification for lipoprotein fractions (Beaumont *et al.*, 1970). The types of lipoprotein pattern reported in this paper, i.e. types IIa, IIb, and IV, correspond to types S (IIa), SM or MS (Type IIb), and M or ML (Type IV) in our earlier publication (Stone and Dick, 1973). The limits used to define 'abnormal' concentrations of lipoprotein fractions correspond to the 99th centile level found in healthy young subjects, none of whom is included in the present study. These limits are set at the following lipoprotein concentrations:

- (a) LDL—550 mg/100 ml for both men and women.
- (b) VLDL—240 mg/100 ml for men and 210 mg/100 ml for women.

A Type IIa pattern would, therefore, have an LDL > 550 mg/100 ml, and a VLDL < 240 mg/100 ml for men or < 210 mg/100 ml for women. A Type IV pattern would have VLDL > 240 mg/100 ml in men, or > 210 mg/100 ml in women; with LDL < 550 mg/100 ml in both sexes. We have calculated that a Type IIa or IIb pattern could occur only if total cholesterol exceeds 7.0 mmol/l (270 mg/100 ml), and Type IV or IIb only if triglycerides exceed 2.3 mmol/l (200 mg/100 ml) for men and about 1.9 mmol/l (170 mg/100 ml) for women.

(6) Statistical analysis

The significance of difference in prevalence in the various tables was estimated by the calculation of χ^2 .

Results

SECTION I—PREVALENCE OF CORONARY RISK FACTORS IN RANDOM SAMPLE AND ISCHAEMIC HEART DISEASE GROUPS

(a) Single risk factors in women

In Table 1 the prevalence of hyperlipoproteinaemia is seen to be significantly increased in the female ischaemic heart disease group as compared with the equivalent random sample in each age range ($P < 0.001$). The prevalence of smoking in the 50 to 69 year age range is the only other prevalence significantly increased in the ischaemic heart disease group, though in the 30 to 69 year total group both diastolic blood pressure and smoking have a higher prevalence in the ischaemic heart disease group. The separate lipoprotein patterns are shown; Types IIa, IIb, and Type IV are all increased in the ischaemic heart disease group compared with the random sample. This difference is very striking for Type IIb.

Table 1 *Prevalence of single coronary risk factors in women*

Risk factors	30-49 years		50-69 years		30-69 years	
	Random sample (N=134) %	Ischaemic heart disease (N=16) %	Random sample (N=116) %	Ischaemic heart disease (N=71) %	Random sample (N=250) %	Ischaemic heart disease (N=87) %
Diastolic BP ≥ 95 mmHg	11.2	25.0	44.0	33.8	26.4	32.2
Smoking ≥ 15 cigarettes/day	21.0	18.8	7.1	19.7*	14.8	19.5
All hyperlipoproteinaemias	13.4	62.5‡	26.7	60.6‡	19.6	60.9‡
<i>Lipoprotein patterns</i>						
Type IIa	9.7	25.0	12.9	18.3	11.2	19.5†
Type IIb	0	12.5	2.6	23.9‡	1.2	21.8‡
Type IV	3.7	25.0†	11.2	18.3	7.2	19.5†

*P < 0.05, †P < 0.01, ‡P < 0.001.

Table 2 *Prevalence of single coronary risk factors in random sample*

Risk factors	30-49 years		50-69 years		30-69 years	
	Women (N=134) %	Men (N=145) %	Women (N=116) %	Men (N=138) %	Women (N=250) %	Men (N=283) %
Diastolic BP ≥ 95 mmHg	11.2	20.7*	44.0	39.9	26.4	30.4
Smoking ≥ 15 cigarettes/day	21.4	48.3‡	7.1	47.8‡	14.4	48.1‡
All hyperlipoproteinaemias	13.4	22.1	26.7	16.7	19.6	19.4
<i>Lipoprotein patterns</i>						
Type IIa	9.7	6.2	12.9	5.8	11.2*	6.0
Type IIb	0	2.1	2.6	2.9	1.2	2.5
Type IV	3.7	13.8†	11.2	8.0	7.2	10.9

*P < 0.05, †P < 0.01, ‡P < 0.001.

Table 3 *Prevalence of single coronary risk factors in patients with ischaemic heart disease*

Risk factors	30-49 years		50-69 years		30-69 years	
	Women (N=16) %	Men (N=61) %	Women (N=71) %	Men (N=85) %	Women (N=87) %	Men (N=146) %
Diastolic BP ≥ 95 mmHg	25.0	29.5	33.8	43.5	32.2	37.7
Smoking ≥ 15 cigarettes/day	18.8	72.1*	19.7	61.2‡	19.5	65.8‡
All hyperlipoproteinaemias	62.5	47.5	60.6*	35.3	60.9*	40.4
<i>Lipoprotein patterns</i>						
Type IIa	25.0	14.8	18.3	10.6	19.5	12.4
Type IIb	12.5	4.9	23.9‡	4.7	21.8‡	4.8
Type IV	25.0	27.9	18.3	20.0	19.5	23.3

*P < 0.05, ‡P < 0.001.

(b) *Single risk factors in men*

These data have been published previously (Dick and Stone, 1973; Stone and Dick, 1973) and in order to save space the male random sample and ischaemic heart disease groups are not compared here in a separate table. However, the male random sample data for single risk factors are shown in Table 2 and the ischaemic heart disease data in Table 3.

From these data it can be seen that there is an increased prevalence of hyperlipoproteinaemia in all three age ranges (P < 0.01), but there is an important difference now as compared with Table 1.

The prevalence of smoking in the male ischaemic heart disease group is significantly greater in two of the age ranges (P < 0.05), and there is also an increase in smoking in the 50 to 69 year age range, though this is not significant at the 5 per cent level. As in women, the prevalence of hypertension is greater in the ischaemic heart disease group but not at a significant level. Examination of the lipoprotein patterns suggests that men with coronary disease have a rather greater prevalence of Type IV hyperlipoproteinaemia than the equivalent women who have more Type IIa and significantly more Type IIb.

Table 4 *Prevalence of combinations of risk factors in women*

Risk factors	30-49 years		50-69 years		30-69 years	
	Random sample (N=134) %	Ischaemic heart disease (N=16) %	Random sample (N=116) %	Ischaemic heart disease (N=71) %	Random sample (N=250) %	Ischaemic heart disease (N=87) %
None	60.5	25.0	35.3*	15.5	48.8‡	17.2
Any one	34.3	43.8	51.7	52.1	42.4	50.6
Any two	4.5	31.3‡	12.9	31.0†	8.4	31.0‡
All three	0.8	0	0	0	0.4	0

*P < 0.05, †P < 0.01, ‡P < 0.001.

Table 5 *Prevalence of risk factor combinations in the random sample*

Risk factors	30-49 years		50-69 years		30-69 years	
	Women (N=134) %	Men (N=145) %	Women (N=116) %	Men (N=138) %	Women (N=250) %	Men (N=283) %
None	60.5†	33.8	35.3	23.9	48.8‡	29.0
Any one	34.3	45.5	51.7	49.3	42.4	47.3
Any two	4.5	16.6†	12.9	25.4*	8.4	20.9‡
All three	0.8	4.1	0	1.5	0.4	2.8

*P < 0.05, †P < 0.01, ‡P < 0.001.

Table 6 *Prevalence of risk factor combinations in patients with ischaemic heart disease*

Risk factors	30-49 years		50-69 years		30-69 years	
	Women (N=16) %	Men (N=61) %	Women (N=71) %	Men (N=85) %	Women (N=87) %	Men (N=146) %
None	25.0	9.8	15.5	10.6	17.2	10.3
Any one	43.8	39.3	52.1	50.6	50.6	45.9
Any two	31.3	42.6	31.0	27.1	31.0	33.6
All three	0	8.2	0	11.8†	0	10.3†

†P < 0.01.

(c) Combinations of risk factors

The data for women are presented in Table 4 and, as explained above, the data for men in the random sample can be seen in Table 5, and for the male ischaemic heart disease group in Table 6. It can be seen from these tables that the prevalence of both men and women who have none of the three risk factors is greater in each age range of the random sample. The possession of any one risk factor is not materially different between the random sample and ischaemic heart disease groups for both men and women, whereas the possession of any two risk factors is significantly more common in the ischaemic heart disease groups. A noteworthy point of difference between the men and women is that out of 283 men in the random sample, 8 had three risk factors, whereas only 1 female subject among

250 had three risk factors. Of 146 male patients with ischaemic heart disease, 15 had three risk factors compared with none in the 87 female patients.

These Tables show that the prevalence of each of the three factors is more common in men and women in the ischaemic heart disease group, and these data suggest that the possession of two or three factors is a more adverse finding for both men and women than the absence of factors or indeed the presence of only one.

SECTION 2—COMPARISON OF MEN AND WOMEN IN ISCHAEMIC HEART DISEASE GROUPS

(a) Single risk factors

In Table 3 our ischaemic heart disease cohorts are compared and show that in the female ischaemic

heart disease group there is an increase of prevalence of hyperlipoproteinaemia as compared with the male ischaemic heart disease group, which is significant in two of the age ranges and shows a similar trend in the 30 to 49 year range. In particular, Type IIb shows a distinct increase in prevalence in women with ischaemic heart disease compared with men. In the male group with ischaemic heart disease, however, there is a pronounced increase in the prevalence of smoking which is statistically significant in all three age ranges. There is no significant difference in the prevalence of hypertension.

(b) *Combination of risk factors*

In Table 6 the ischaemic heart disease groups are again compared. Since both groups have ischaemic heart disease, it is perhaps not surprising that there is little difference between the two groups in the prevalence of risk factor combinations, with the exception that three factors occur only in men. The fact that there are 15 men with three risk factors and no women with three reflects the higher prevalence of smoking in men since the prevalence of hypertension is about the same, and that of hyperlipoproteinaemia is greater in women.

SECTION 3—COMPARISON OF MEN AND WOMEN IN RANDOM SAMPLE

In Table 2 our random samples are compared. It can be seen that there is an increase in prevalence in all three risk factors for men in the age range 30 to 49 years though this is statistically significant

for smoking and diastolic hypertension only, the prevalence of hyperlipoproteinaemia almost reaching significance at the 5 per cent level. It can be seen that the prevalence of smoking in men is significantly increased for each age range, whereas taking the whole 30 to 69 year range there is no significant difference in the prevalence of hyperlipoproteinaemia or raised diastolic blood pressure between the two groups. These findings appear to give support to the view that smoking is the most important factor.

From Table 5 it can be seen that having no risk factors is significantly more prevalent in the female random sample than in the male, whereas the possession of one risk factor shows no difference in prevalence between the two groups. There is a significantly greater prevalence of men with two or more factors in all three age ranges, and it is evident that this, in large measure, must relate to the greater prevalence of smoking in men, as hyperlipoproteinaemia and hypertension are almost equally prevalent in both random samples.

SECTION 4—KNOWN RISK FACTOR COMBINATIONS

In men the specific risk factor combinations (Fig.) suggest that those in which smoking is one of the factors may carry a greater degree of risk than combinations which do not include it. The combination of hyperlipoproteinaemia and diastolic blood pressure ≥ 95 mmHg is the least common in men and appears to carry the least risk, as the

Fig. Prevalence of risk factor combinations in the random sample and ischaemic heart disease (IHD) groups. HLP, hyperlipoproteinaemia; DBP, diastolic blood pressure ≥ 95 mmHg; smoking, smoking ≥ 15 cigarettes per day.

prevalence of this combination is virtually the same in the ischaemic heart disease and random groups. In women, however, hyperlipoproteinaemia and a high diastolic blood pressure is the commonest combination and its prevalence is significantly greater in the ischaemic heart disease group, as is the combination hyperlipoproteinaemia and smoking. However, the combination of a high diastolic blood pressure and smoking in women occurs less frequently than the other two combinations in both the random sample and ischaemic heart disease groups. It is noteworthy that the combination high diastolic blood pressure and smoking in the random sample is 25 times as great in men as it is in women.

Discussion

Our random sample of men and women contains subjects we regarded as having ischaemic heart disease, but we would not have a satisfactory random sample unless they were included, and any statistical relation seems to us to err on the side of caution when associating the prevalence of the three risk factors hyperlipoproteinaemia, smoking, and diastolic hypertension with ischaemic heart disease. However, we have repeated the calculations after excluding these subjects from the random sample and find that the statistical relations are either the same or show a minimal increase of the degree of significance in the relation of the three factors to ischaemic heart disease.

We find the prevalence of diastolic hypertension greater in the ischaemic heart disease cohorts but not at a statistically significant level; it may be that some permanent lowering of blood pressure has occurred in the ischaemic heart disease group as a result of infarction. The prevalence of diastolic hypertension is higher in the random sample groups than would be expected from published data (Hamilton *et al.*, 1954) and from our own semibasal levels (T. B. S. Dick and M. C. Stone, 1972, unpublished data). Diastolic pressure was the first reading taken at the first interview in the lying position after a brief rest and though this standardisation procedure resulted in a relatively high prevalence of diastolic hypertension, it in no way invalidates the comparison between the groups. The conditions were similar to those encountered in the average outpatient clinic, and it is difficult to record comparable levels in any other way. The difficulty of assessing the blood pressure levels as between examiners and between countries has been stressed (Keys, 1970).

When male and female random samples are compared with the equivalent ischaemic heart disease cohorts, it appears that in general an increased

prevalence of all three factors is associated with ischaemic heart disease and at first glance there is relatively little difference between the sexes except for the increased prevalence of smoking in young males. It seems evident from our data that the prevalence of both male and female subjects with no risk factors is significantly greater in the random sample than in the ischaemic heart disease group, whereas the possession of one factor shows no difference in prevalence between the two groups. The prevalence of those with two or more factors in both men and women is significantly greater in the ischaemic heart disease groups. However, in Tables 3 and 6 where the men and women with ischaemic heart disease are compared, we find a significantly greater prevalence of smoking in men and a much higher prevalence of hyperlipoproteinaemia in women.

The prevalence of any two risk factors in both ischaemic heart disease groups is not significantly different, but the possession of three risk factors occurs only in the men. The fact that there is a greater prevalence of hyperlipoproteinaemia in the female ischaemic heart disease group compared with the male is presumably balanced by the increased prevalence of smoking in the male group, so that the prevalence of any two factors is the same or nearly so in the two groups. As coronary disease is much more common in men, does this then suggest that smoking is more important than hyperlipoproteinaemia as a risk factor?

Our results suggest that the high prevalence of smoking in men is a major factor in causing a significantly higher prevalence of ischaemic heart disease in men and that two or more risk factors, whether in men or women, significantly increase the risk whereas the absence of factors is associated with a lower risk.

Epidemiological studies have concentrated on men, and we must, therefore, turn to our own random sample and compare male and female groups to see if there is support for this view. In Tables 2 and 5 where random men are compared with random women, there is a significant increase in the prevalence of smoking in men in all age ranges. In young men, in particular, there is an increase in prevalence of all three factors as compared with young women. When we examine the distribution of known combinations of two risk factors (Fig.) the most surprising finding is that in men the combination of hyperlipoproteinaemia and a diastolic blood pressure ≥ 95 mmHg has virtually the same prevalence in the random sample and ischaemic heart disease groups. Reid *et al.* (1976), in their report on British civil servants, found that in those who developed coronary disease, smoking

was an important independent risk factor, and they also found that in non-smokers the risk of having the two factors, hypercholesterolaemia and hypertension, hardly increased the risk at all above that of the average risk for the population. In smokers, however, they found the risk of having either of these factors was much greater, and this agrees with our findings.

In our women, the combination of hyperlipoproteinaemia and hypertension is significantly higher in the ischaemic heart disease group, the number with this combination being slightly greater than in the two smoking groups combined. We feel it is very important to note that in the random sample the combination of cigarette smoking with one or both of the other factors is 7 times as common in men as in women, and that a high diastolic blood pressure and smoking is 25 times greater in men.

Consideration of the total prevalence of any one factor does ignore the possible synergistic effects of the other two factors occurring with it, and also where any two unknown factors are combined the significance of certain specified combinations is concealed. We drew attention to this in an earlier publication (Dick and Stone, 1973). The possession of two factors is significantly more common in ischaemic heart disease, but it is important to know which two factors, because in men and possibly in women also, if smoking is a factor, the risk appears to be greater.

It is important to bear in mind that age itself is a factor and the immediate problem is why there has been such a striking increase in ischaemic heart disease in men below the age of 50 in the past few decades. There has been a great increase in cigarette smoking over the past 50 years (Wald, 1976) but we have no evidence that there has been much change in the blood pressure or lipid levels in the community during this time.

Oliver (1974a) says that ischaemic heart disease is increasing in young women and that we still do not understand the reasons why ischaemic heart disease occurs so much less commonly in young women than in young men. He also states in the same paper, 'Arguments have been developed to suggest that the difference in sex ratio of IHD is the result of male excess rather than infrequency of the disease in young women. Both may apply but if the male excess were the sole explanation one might expect a high prevalence of major risk factors in healthy men compared with healthy young women'. Our own results suggest that there is indeed a considerable difference in the possession of risk factors as between men and women of the random sample. In a recent study the incidence of ischaemic

heart disease was found to be 3 times more common among young men in Edinburgh than young men in Stockholm (Oliver *et al.*, 1975). The most clear-cut difference between these populations was the significantly greater number of smokers in Edinburgh and also the greater number of subjects with two or more 'high value' risk factors in Edinburgh.

Bengtsson *et al.* (1973) did not find any important difference in serum cholesterol, serum triglycerides, or blood pressure between Swedish men and women in a population study, but he found that smoking 15 cigarettes a day or more was significantly more common in men than in women, which again agrees with our own findings for the age range 30 to 69 years.

Hagerup (1974) in a Danish population study in men and women aged 50 years found smoking more prevalent in men but the blood pressure levels were the same in the two sexes. Serum cholesterol levels tended to be higher in women than in men whereas triglyceride levels were higher in men.

Mann *et al.* (1975) studied the prevalence of six risk factors in 60 young women with ischaemic heart disease, and in a control group consisting of 173 hospital patients. The proportion of their control subjects with no risk factors (67%) was similar to that in our younger female random sample (61%). The prevalence of patients with two or more risk factors was almost five times as great in their ischaemic heart disease group as in their control group, which is similar to the sixfold difference which we found in our younger women (Table 4).

Oliver (1974b) has reported that in young women with ischaemic heart disease hyperlipoproteinaemia is a more common factor than smoking and this agrees with our own findings.

The prevalence of hyperlipoproteinaemias has been studied in men and women in the population and compared with men and women with ischaemic heart disease in two other U.K. studies (Patterson and Slack, 1972; Lewis *et al.*, 1974a, b). There are also a number of studies which have compared the prevalence of hyperlipoproteinaemias in men and women in the U.S. population (Wood *et al.*, 1972; Brown and Daudiss, 1973), or which have compared men with ischaemic heart disease and men from a population group (Leren and Haabrekke, 1971a, b; Werko, 1971; Dick and Stone, 1973), or in which women with ischaemic heart disease have been compared with healthy women (Mann and Thorogood, 1975), but we have found no random sample study of men and women comparable with our own, particularly in relation to the combination of known risk factors.

The prevalence rates for hyperlipoproteinaemia

in men found by Patterson and Slack (1972) in their control group are lower than in the other population studies which we have examined, but their prevalence rates for women are similar to ours and to most of the published studies. Lewis *et al.* (1974b) examined 276 subjects, including both men and women, aged 20 to 69 years, from a healthy working population and found hyperlipidaemia in 17 per cent of men and 8 per cent of women. They also examined 123 men and 20 women with ischaemic heart disease (Lewis *et al.*, 1974a) and found hyperlipoproteinaemia in 56 per cent of men and 55 per cent of women.

Our results agree with most of the above population studies in the U.S. and U.K., in finding that the Type IV lipoprotein pattern is more common in men than in women, and that Type II has a similar prevalence in both sexes in younger subjects, but is commoner in older women than in older men. Most of the studies agree in finding a higher prevalence rate in ischaemic heart disease subjects for both Types IIa and IV hyperlipoproteinaemia, but we found that in our ischaemic heart disease patients the Type IIb pattern was much more common in women than in men ($P < 0.001$). Examination of the data of Patterson and Slack (1972) shows a similar phenomenon in their ischaemic heart disease patients.

Conclusion

Our study supports the view that the preponderance of ischaemic heart disease among men relates to the fact that they have more risk factors, smoke more heavily, and in particular that young men have a greater prevalence of all three factors than women.

It appears from our results that smoking added to either of the other two factors is of great importance in men, and it may be in women also, though this is not yet clear. If an increase in smoking among young women gives rise in the comparatively near future to an increase in the incidence of female ischaemic heart disease, it suggests that these assumptions are correct.

Current prophylactic therapy in ischaemic heart disease has yet to be proved of value, but the correction of hypertension and the abolition of smoking can be justified on grounds other than those of ischaemic heart disease. Whether the correction of hyperlipoproteinaemia is desirable, especially when mild and when it is the only factor present, is debatable. The most important prophylactic measure appears to be the cessation of smoking.

We acknowledge research grants from the Manchester Regional Hospital Board (T.B.S.D.), the

Medical Research Council (M.C.S.), and Imperial Chemical Industries Limited. We are grateful to Dr M. F. Oliver for his advice and criticism.

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