CORONARY THROMBOSIS AN ENVIRONMENTAL STUDY

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This study was made at the request of the Cheshire County Council's Health Committee on considering the County Medical Officer's Annual Report for 1956, in which it was stated (a) that coronary thrombosis was the certified cause of death of 447 males and 111 females, resident in Cheshire, who had died in that year between the ages of 45 and 64 years, and (b) that the percentage of deaths of persons between the ages of 45 and 64 years certified to have been due to coronary thrombosis was 22.4 in that year, and that this percentage had increased in successive years since 1950.

Morris *et al.* (1953) found a negative association between the incidence of coronary heart disease and physical activity at work. Doll and Hill (1956) ascertained that mortality from coronary thrombosis reveals a slight but significant relationship with smoking. Keys (1957) reported that diet, through its fat content, particularly of saturated fat, plays an important part in the development of coronary heart disease, affecting the serum cholesterol level and influencing atherogenesis and the tendency to develop thrombosis. Logan (1959), referring to his analysis of mortality in the five years 1949-53, showed that coronary disease among men under 65 years displayed its well-recognized predilection for social classes I and II (analogous to socio-economic groups 1, 3, 4, and 5). Friedman and Roseman (1959) remarked on the fact that men manifesting an intense sustained drive for achievement and continually involved in competition had a much higher incidence of coronary artery disease than men who showed the opposite sort of behaviour pattern. Thomas (1959), discussing familial patterns in hypertension and coronary heart disease in relation to parents and grandparents of students at Johns Hopkins University, stated that coronary heart disease (and hypertension) are familial disorders, at least in part.

The object of this study was to relate these findings to the population of a large English county (900,000) and to ascertain, if possible, any other environmental factors affecting the incidence of coronary thrombosis, by a comparison between information received concerning Cheshire residents who had died from coronary thrombosis ("subjects") and information under the same headings from a random control sample ("controls").

For the purposes of this paper the general term "coronary thrombosis" includes myocardial infarction, angina pectoris, and myocardial ischaemia as well as coronary thrombosis, but not such causes of death as cardiac muscle failure.

Method of Study

Two groups of subjects were studied. The larger one was composed of all those Cheshire residents whose deaths from any cause were recorded by the registrars of births and deaths as taking place between the ages of 45 and 64 years during the three and a half years from June, 1956, to December, 1959, and this group was used

solely for the study of the occupations followed by the deceased persons (see Table III).

The second group consisted of those persons who had died from coronary thrombosis between 45 and 64 years of age, from June 1, 1958, to August 31, 1959. The medical history, daily routine, and habits of these were compared with similar information from living persons, in the same five-year age-groups and chosen at random (see Table IV).

A series of questions was devised, and the nearest surviving relative of each subject was asked to receive an interviewer who put the questions. A similar series of questions was posed to controls in the same way.

The names and addresses of surviving relatives were discovered in the nominal roll of the Executive Council for the Health Services in Cheshire, and, failing this, the subject's family doctor usually gave the information. The names and addresses of controls were also supplied by the executive council, who gave, when the name, address, and age of each successive subject were submitted, the same information for the first three persons in the alphabetical nominal roll, of the same sex and five-year age-group as the subject, starting at the beginning of the names of persons whose surname's initial letter alphabetically followed the initial letter of the subject's surname. The first of each series of three was approached as a control, followed by the second and third if the approach proved abortive. Each name supplied by the executive council was noted so that it could not be used again. As 97% of persons in Cheshire are on the nominal roll the controls formed a cross-section of the county's population taken at random.

The family doctor was informed of the intention to interview the surviving relatives of each subject and asked to give any relevant information. The interviewers were four trainee mental-welfare officers selected from over 80 applicants.

During the period of the inquiry the deaths were reported of 657 persons (497 males and 160 females) aged between 45 and 64 certified as due to coronary thrombosis. Inquiry forms were completed for 536 of these (409 males and 127 females).

The names and addresses of 1,880 possible controls were received from the executive council; 819 of these people were approached and 642 interviewed (483 males and 159 females). The reasons why some were not interviewed are given in Table I.

TABLE I.—Reasons for Failure to Interview

	Relatives of Subjects	Controls
Interview refused	42	59
Unable to contact or left district	23	109
No known relatives	50	—
Stated not to have died from coronary thrombosis	3	—
Name duplicated	3	—
Too ill to interview	—	9

The result was a mass of information which was analysed with the help of the accounting machines in the County Treasurer's department at County Hall.

Scope of Inquiry

Questions were asked under the following headings: (a) place and manner of death, whether post-mortem examination was made or not; (b) marital state, occupation, spouse, and children, parents, parents-in-law, and lodgers living in the household; (c) illnesses, medicines

prescribed by doctor, self-medication; (d) home particulars, amenities, and holidays; (e) type of work, travel to and from work, hours of work, working week, and work strains; (f) height, weight, personal characteristics; (g) meals, favourite foods, drinks; (h) tobacco and alcohol habits; (i) leisure activities in and outside the home; and (j) hereditary factors. Answers were shown by the interviewing officer ringing the number opposite one of a series of possible answers given, on the inquiry form, for each question.

Male subjects dying in their first recognized heart attack were regarded as a specially important group and were compared with controls matched for occupational groups by taking the same number of controls as subjects in each socio-economic group (Table II). The controls and subjects used for this comparison were the latest ones to be interviewed in each socio-economic group.

TABLE II.—Scheme of Analyses and Comparisons

	Subjects			Controls		
	M	F	Total	M	F	Total
Total number of interviews ..	409	127	536	483	159	642
Cause of death confirmed at necropsy ..	141	50	191	—	—	—
Subjects dying in first recognized heart attack ..	195	75	270	195	—	—
Subjects dying less than one day after fatal attack began ..	238	83	321	—	—	—
Persons having had no medical treatment for three years ..	73	15	88	201	44	245
Males in socio-economic groups 3, 4, and 5 (professional, managers, and shopkeepers) ..	118	—	118	182	—	182
Males in socio-economic groups 9, 10, 11, and 12 (foremen, skilled, semi-skilled, and unskilled manual workers) ..	211	—	211	204	—	204
First controls ..	—	—	—	381	128	509

"Persons having had no medical treatment" were those for whom medicaments had not been prescribed by their doctor in the three years before the onset of the fatal attack or the date of inquiry. They were put in a special category as they were presumed to have been well before their fatal "heart attack."

The controls showed a larger proportion of persons in socio-economic groups 3, 4, and 5 than had been anticipated, thus introducing a social bias. This was corrected by making separate analyses for (a) total male subjects and controls matched for socio-economic groups in the same way as was done for males dying in their first recognized heart attack; (b) for males in socio-economic groups 3, 4, and 5; and (c) for males in socio-economic groups 9, 10, 11, and 12.

Summary of Findings

It would be impossible to give all the statistics in such a paper as this. A brief summary must suffice, with extracts from the analyses where these show important differences. The full figures (which so far as the random controls are concerned give an account of general conditions and habits of life among a cross-section of men and women of middle age in Cheshire) are available. Throughout this paper the term "significant" is used strictly in its statistical sense. P values are given where appropriate.

Occupation (Males Only)

The figures for "expected deaths" in column 3 of Table III were calculated by taking the proportion of the total actual deaths of males reported (5,481) which the percentage of persons in each socio-economic group

TABLE III.—Expected and Actual Deaths of Men Aged 45 to 64 Reported from June, 1956, to December, 1959, From All Causes and From Coronary Thrombosis According to Socio-economic Groups

Socio-economic Group* (Males Only)	Estimated Percentage of Male Pop. of Cheshire Aged 45-64 at Mid-1959	Deaths from All Causes			Deaths from Coronary Thrombosis		
		Expected (Based on Percentage of Pop.)	Actual	Actual 4-3 Expected (%)	Expected	Actual	Actual 7-6 Expected (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Farmers ..	3.45	189	139	73	53	26	49
2. Other agric. workers ..	4.50	247	174	70	70	31	44
3. Higher professional ..	4.94	271	247	91	76	94	124
4. Other professional, managers, etc. ..	13.81	757	738	97	214	262	122
5. Shopkeepers ..	5.96	327	328	100	92	93	101
6. Clerks ..	5.59	306	400	131	87	149	171
7. Shop assistants ..	2.86	157	169	108	44	50	114
8. Personal service ..	1.68	92	117	127	26	27	104
9. Foremen, charge hands ..	4.52	248	270	109	70	88	126
10. Skilled manual workers ..	28.79	1,578	1,454	92	446	380	85
11. Semi-skilled manual workers ..	9.46	519	576	111	146	139	95
12. Unskilled workers ..	14.42	790	869	110	223	209	94
	100	5,481	5,481		1,547	1,548	

* Registrar-General (1952).

In reporting 142 deaths during this period no occupation of the deceased was given by the registrars.

bore to the total male population of Cheshire between the ages of 45 and 64, inclusive, according to figures supplied by the Registrar-General—for example, 3.45% of males in Cheshire aged 45 to 64 were farmers, so that the expected deaths of farmers, if death rates were the same in all socio-economic groups, would be 3.45% of 5,481=189. The figures shown in column 6 were arrived at in the same way from the total deaths from coronary thrombosis (1,547) during the same period and of the same age-group.

Actual deaths of farmers from all causes were significantly lower than expected ($P<0.01$), as also were those of other agricultural workers ($P<0.01$), but those of clerical workers were significantly higher ($P<0.01$). The comparisons between expected and actual deaths from coronary thrombosis among these three socio-economic groups showed the same pattern but wider differences, which were in each case statistically significant. Farmers and other agricultural workers had, therefore, the lowest mortality, whether from all causes or from coronary thrombosis, and clerical workers had the highest.

Socio-economic groups 3, 4, and 9 had similar mortality rates from all causes and also from coronary thrombosis. Groups 10, 11, and 12 separately had approximately the same mortality rates from coronary thrombosis, but each of these groups had a lower mortality rate than each of groups 3, 4, and 5 to a significant extent ($P<0.01$).

Socio-economic groups 1 and 2 taken together had a significantly lower mortality rate from coronary thrombosis between 45 and 64 years than socio-economic groups 10, 11, and 12 ($P<0.01$), groups 10, 11, and 12 had a significantly lower mortality from coronary thrombosis than groups 3, 4, and 9 ($P<0.01$), and groups 3, 4, and 9 had a significantly lower mortality than group 6 ($P<0.01$).

Mortality from coronary thrombosis among males aged 45 to 64 therefore increases from agricultural workers to manual workers, from manual workers to professional men and managers, and from professional men and managers to clerks.

These figures are comparable with those given by the Registrar-General (1954).

A summary of the more important results of the inquiry are given in Table IV. Findings on the various headings follow.

Home Circumstances and Holidays

Inquiries regarding the proportions of subjects and controls who were single, separated, or divorced yielded no information of any significance. Similarly, there was no material difference whether children were still living with the family, the number of children who had been born, the presence of parents, parents-in-law, or lodgers in the household, or, in the case of men, whether the wife was working or not.

TABLE IV.—Summary of More Important Results of Inquiry

Number in sample	Males												Total	
	Total		Total Matched for Socio-economic Groups		Died in First Recognized Heart Attack		Had No Medical Treatment for 3 Years		Socio-economic Groups					
									3, 4, and 5		9, 10, 11, and 12			
	Subj. 409	Cont. 483	Subj. 371	Cont. 371	Subj. 195	Matched Cont. 195	Subj. 73	Cont. 201	Subj. 118	Cont. 182	Subj. 211	Cont. 204	Subj. 127	Cont. 159
Holidays—none away from home in last three years	30.6	27.1	30.5	27.8	33.6	29.2	32.9	25.9	17.8	12.6	35.1	25.7	28.3	26.4
Live in hilly area	54.8*	42.9	53.0*	42.6	57.9	47.2	61.3*	39.8	46.6	41.8	55.0*	39.8	44.9	43.4
Circumstances and type of work:														
Non-manual	36.9	41.8	38.0	35.6	31.3	29.2	38.4	43.3	75.4	78.6	10.8	11.8	—	—
Heavy	23.5	26.2	23.2	22.1	22.4	25.1	20.6	21.0	5.8	2.8	34.1	35.3	—	—
Incurs frequent overtime	15.9	21.7	—	—	16.4	18.5	16.4	23.4	22.0	28.0	13.7	16.1	—	—
Involved physical strain	15.2	14.9	—	—	16.9	13.3	8.2	13.4	3.4	4.4	20.9	23.5	—	—
Travelled over 6 miles to work ..	19.1	22.4	20.3*	21.8	16.9	15.9	15.1*	2.0*	33.1	35.2	12.3	12.3	—	—
Height and weight:														
Height over 5 ft. 9 in. (175 cm.)	35.5	33.9	36.9*	29.1	36.9	27.2	39.7	30.3	39.0	47.8	33.2*	22.3	7.1	1.3
Weight over 14 st. (90 kg.) ..	10.3	7.0	10.8	6.9	12.8	6.7	9.6	6.5	8.4	8.8	12.8*	3.9	8.7	3.9
Lost weight in last year	29.3	12.0	30.2*	13.2	26.2*	16.9	15.1	6.0	30.5*	13.7	30.2*	10.3	42.5*	21.4
Main leisure activities:														
Gardening	38.1*	53.8	—	—	37.9*	50.8	37.0*	50.7	42.4*	61.5	33.2*	51.0	21.3	26.4
Joinery, "do it yourself"	39.6	45.0	—	—	40.0	45.6	44.3	47.3	38.1	47.3	40.3	48.0	—	—
Walking	13.9	19.3	—	—	14.4	16.9	9.6	18.0	14.4	22.0	16.6	20.1	10.2*	26.4
Voluntary work, "council"	13.7	18.4	—	—	10.8	13.8	9.6	18.4	15.2	22.4	8.5	7.8	19.7	27.0
Sport and games	17.1	18.2	—	—	16.4	15.4	20.5	23.4	23.7	18.1	13.3	19.6	5.5	2.5
Play bowls regularly	9.8*	15.1	9.4*	16.2	9.2*	18.5	6.8	17.4	6.8	11.5	12.3	16.7	—	—
Regular spectator at organized games	26.9	21.3	27.2	22.9	25.1	24.1	27.4	21.9	23.7	16.5	28.4	27.5	—	—
Visit club or hotel more than thrice weekly	13.2	12.2	13.2	12.9	11.8	9.2	16.4	12.9	10.2	9.9	16.1	14.7	4.7	1.9
Radio or T.V. more than five times weekly	48.9	47.8	48.8	48.0	46.7	48.7	—	—	—	—	—	—	61.4	55.3
Tobacco:														
Never smoked cigarettes	10.5	14.1	10.5	13.2	9.7	13.3	6.8	12.4	13.6	12.6	8.5	13.2	59.8	59.7
Smoked cigarettes until last illness (or inquiry)	72.6*	61.9	73.0*	63.3	73.8*	62.1	76.7	67.7	61.0	56.6	79.1*	64.7	33.1	30.2
Smoked pipe until last illness ..	20.0	21.5	20.2	19.9	17.9	20.0	13.7	16.0	21.2	24.2	17.1	15.7	—	—
Stopped smoking more than one year ago	16.4	19.5	16.4	19.7	13.8	21.5	15.1	18.9	30.4	25.8	10.0	16.4	3.9	6.9
Medical attendance and treatment:														
None in last three years	17.8*	41.5	17.5*	41.0	29.2	38.5	—	—	18.7	41.8	17.1*	35.8	9.4	16.4
Complained of shortness of breath in last 6 months	50.6*	17.6	50.4*	19.4	41.0*	20.5	—	—	46.6*	22.0	55.4*	11.8	50.4*	17.0
Having medical treatment in last week of life (or before inquiry)	65.3*	20.5	64.2*	22.4	46.2*	20.5	—	—	64.4*	18.1	73.1*	23.0	73.2*	28.9
Confined to bed for more than 28 days in last three years ..	40.3*	13.0	40.7*	14.8	24.6*	13.8	—	—	39.0*	13.2	39.3*	12.7	40.2*	14.5
Had had treatment for more than 6 months before death (or inquiry)	58.2*	17.7	58.2*	19.7	39.4*	19.7	—	—	55.9*	16.5	59.2*	18.1	61.4*	28.9
Food and drink:														
Ate bacon at breakfast more than 3 times weekly	30.3*	40.1	29.9	39.1	33.3	36.4	31.9	38.3	37.3*	51.6	27.5	27.1	23.6	23.9
Said to be "fond of fat and fried food"	45.0*	55.7	43.7*	55.8	48.7	54.9	45.2	59.2	49.1	54.9	45.0	56.4	48.8	42.8
Use lard for frying	35.7*	44.1	34.2*	46.9	39.0	47.7	35.6	46.3	30.5	38.5	43.1	48.0	43.3	33.3
Fat not taken	38.4	27.4	39.1*	28.0	35.9	23.6	37.0*	24.4	33.1	23.6	38.4	28.4	32.3	37.1
Abstainers from alcohol	16.9	14.1	17.5	14.3	19.5	17.4	15.1	10.9	20.3*	8.8	15.2	18.1	37.0	26.2
Alcohol taken more than three times weekly	14.9	17.6	15.1	17.8	12.3	13.8	16.4	18.4	17.8	18.1	14.7	18.6	9	3.8
Took more than 10 cups of tea daily	14.2	11.2	15.1	12.7	17.9	12.8	19.2	11.9	13.3	9.6	19.9	17.0	11.8	9.4
Took 1-5 cups coffee daily	28.5*	45.1	26.2*	38.8	26.0*	41.3	23.1*	42.5	48.0*	59.2	18.3*	30.4	26.4*	49.6
Personal characteristics:														
Absorbed attitude to work	27.6	24.0	27.0	21.3	19.0	20.3	21.9	23.4	50.0*	35.2	19.4	12.3	—	—
Had "job worries"	33.5	21.5	—	—	30.3	16.9	32.9	14.3	47.5	31.9	25.1	16.7	—	—
Not "fussy"	51.1	54.0	—	—	55.9	54.9	46.6	58.2	49.1	48.4	52.6	61.3	44.9	47.2
"Good mixer"	79.7	89.0	80.6	87.3	80.1	85.6	83.6	90.0	87.3	90.1	76.8	82.8	78.0	83.0
Number in sample	239	273	—	—	125	118	39	115	66	106	125	115	68	92
Personal characteristics:														
"Quiet and steady"	51.5*	65.2	—	—	61.1	62.3	64.1	74.8	45.5	60.4	51.2	60.8	33.8	47.8
"Worrying and introspective" ..	27.2*	16.5	—	—	19.8	21.1	17.9	8.7	37.9*	20.8	23.2	16.0	38.2	27.2
Heredity:														
One or more parents died from coronary thrombosis	26.8*	14.7	—	—	22.4*	11.0	15.4	17.3	27.3	16.0	28.0	13.9	17.6	19.6
One or more sibs died from coronary thrombosis	16.7*	7.7	—	—	16.8	4.2	7.7	8.7	13.6	7.5	19.2	6.1	16.2	5.4

* Statistically significant difference between subjects and controls.

Questions were asked about holidays, whether a holiday had been taken away from home in the previous three years, the number of holidays taken, and whether a holiday had been taken at all. There was no difference between subjects and controls noted in any of the comparisons made. Times of rising and of going to bed were proportionally the same for subjects as for controls. The presence or absence of such household amenities as television, a motor-car, or domestic help was immaterial, as also was whether the house and furniture appeared to be well kept or not.

Configuration of Area

Certain parts of Cheshire are hilly and undulating, and this demarcation is not related to socio-economic groupings. In all comparisons, a greater percentage of subjects than controls lived in hilly districts, and the difference was significant in the case of total males ($P<0.01$), males matched for socio-economic groups ($P<0.01$), males having had no medical treatment for three years ($P<0.01$), males who had died in their first recognized heart attack ($P<0.05$), and those in socio-economic groups 9, 10, 11, and 12 ($P<0.01$).

Circumstances and Type of Work

The answers gave no indication that work, whether it was indoors or out of doors, light manual, heavy manual, or non-manual, or whether it involved frequent travel, overtime working, night work, or physical strain, created any liability to death from coronary thrombosis.

Subjects in socio-economic groups 3, 4, and 5 who had an absorbed attitude to work were significantly in excess of controls in the same groups ($P<0.05$). Furthermore, 73.6% of subjects in these three socio-economic groups as against 56.6% of controls in the same groups were said to have mental strain at work (significant, $P<0.01$). Both these observations were subjective in character and therefore unreliable, but were confirmatory of Friedman and Roseman's (1959) observations.

Method of travel to and from work and the distance involved, whether travelled by bus, train, motor-car, bicycle, or on foot, were immaterial so far as mortality from coronary thrombosis was concerned, but it was noticed that only 2% of controls who had had no medical treatment for three years, compared with 22.4% of total male controls, travelled more than six miles in each direction between home and work (significant, $P<0.01$). Shift work, the length of the working week, times of work, and frequent changes of job were not associated with any difference between subjects and controls.

Height and Weight

A significant excess of subjects, both men and women, had lost weight during the past year. While this could possibly be due to so many of the subjects already being ill or reducing food intake on medical advice, it is noteworthy that the percentage of subjects who had had no medical treatment for three years who had lost weight was 15.1% as against 6% of similar controls (significant, $P<0.05$).

While generally a greater proportion of subjects were over 14 st. (90 kg.) in weight, the differences were significant only in the comparison involving male manual workers, socio-economic groups 9, 10, 11, and 12 ($P<0.01$). As regards males in socio-economic groups 3, 4, and 5, the percentage of controls over 14 st. (90 kg.) in weight was very slightly in excess of that of subjects.

The samples were too small for any useful comparisons between weights of persons at various heights.

Leisure Activities

The specific leisure activities regarding which questions were asked included housework (for men), gardening, joinery, "do it yourself," reading, radio and television, music, cycling, walking, motoring, voluntary and "council" work, sport of various kinds, and visits to club and hotel.

A significantly higher proportion of controls in the analyses for (a) total males ($P<0.01$), (b) professional and managerial groups ($P<0.01$), and (c) manual workers groups ($P<0.01$) gave gardening as one of their two principal leisure activities, thus extending the physical activity hypothesis of Morris *et al.* (1953) to leisure activities.

Walking was more popular among controls, and in the case of women significantly so ($P<0.01$).

More subjects than controls regularly watched organized games and more controls than subjects performed voluntary work. Participation in sport and games was not associated with any difference between subjects and controls, but it was observed that in the comparisons between men dying in their first heart attack and matched controls, and those who had had no medical treatment for three years, a significant excess of controls played bowls ($P<0.05$).

No other leisure activity showed any material difference between subjects and controls.

Tobacco

In all comparisons involving males only, more subjects than controls smoked cigarettes up to their last illness (or the inquiry). In the case of total males the difference was significant ($P<0.01$), as also with males in socio-economic groups 9, 10, 11, and 12 ($P<0.01$) and males dying in their first recognized heart attack ($P<0.05$). There was no significant difference between female subjects and controls.

There was a higher percentage of pipe smokers among controls in all comparisons save one, but the excess of all smokers (whether of pipe or cigarettes) among male subjects was such as to be significant ($P<0.05$). Although fewer subjects had never smoked the difference was by no means significant.

Medical Attendance and Treatment

Subjects in all comparisons had had much more illness than had controls. Comparing subjects with controls matched for socio-economic groupings, 17.8% of subjects had had no medical treatment for three years compared with 41.2% of controls ($P<0.01$), 50.4% of subjects had complained of shortness of breath and 19.4% of controls ($P<0.01$), 64.4% were having medical treatment in the last week of life compared with 22.4% of controls taking medicaments prescribed by their doctor in the week before the inquiry ($P<0.01$), and 58.2% of subjects had been under treatment for more than six months but only 19.7% of controls ($P<0.01$). The same comparisons showed statistically significant differences in all other analyses. It would indeed seem likely that in about 40% of cases death from coronary thrombosis was the terminal point of a chronic illness.

There was no evidence that self-medication was any more common among subjects than among controls.

Food and Drink

Under this heading the times, types, and regularity of breakfast, midday meal, afternoon tea, evening meal, and supper; habits and preferences as regards consumption of fat, alcohol, tea, and coffee; favourite items of food and the use of sugar, salt, and condiments were investigated. Only a very brief selection of figures can be given in Table IV. As many of the questions concerned preferences, the comparisons cannot be regarded as statistically reliable, but they are sufficient to show that expectation of death from coronary thrombosis between the ages of 45 and 64 years is not affected by meal-times, by types or regularity of meals, or by a person's preference for certain items of food.

Significantly fewer subjects than controls matched for socio-economic groups ate bacon for breakfast more than thrice weekly ($P<0.05$), were stated to be "fond of fat and fried food" ($P<0.01$), or used lard for frying ($P<0.01$), and more subjects than matched controls did not take fat ($P<0.01$). A significantly smaller percentage of subjects in socio-economic groups 3, 4, and 5 had bacon for breakfast more than thrice weekly ($P<0.01$), and more subjects who had not had medical treatment for the three previous years than controls were said not to take fat ($P<0.05$). While it could not be said that these statistics are reliable, as they concern preferences and not hard facts, it would nevertheless be reasonable to deduce from them that death from coronary thrombosis, so far as the samples were concerned, was not associated with consumption of fatty foods.

33.7% of subjects and 43.1% of controls matched for socio-economic grouping took dinner as their evening meal (significant, $P<0.05$).

Abstinence from or consumption of alcohol, whether beer, wine, or spirits, made no difference, and no significant results accrued from inquiries regarding tea drinking. To enjoy highly seasoned food, to take extra salt or condiments, or to be a "heartier eater" did not affect the percentages.

There is some social significance in coffee drinking, shown by the significantly higher percentage of coffee drinkers in socio-economic groups 3, 4, and 5 than in groups 9, 10, 11, and 12 ($P<0.01$). The percentage differences between subjects and controls who drank one to five cups of coffee daily were significant for all comparisons, and in each case coffee drinkers were more frequent among controls.

Answers to questions about favourite items of food consumed, such as roast meats, made-up dishes, eggs, fruit, salads, fish, bread, and potatoes, showed no differences between subjects and controls.

The results of this inquiry do not support Keys's (1957) findings on the role of fats in the development of coronary disease. The statistical and inquiry method adopted in this paper has weaknesses, however, which are discussed below.

Personal Characteristics

All information in this group of answers must be regarded as under suspicion as the questions were highly subjective. They dealt with unfavourable home attitudes and circumstances such as the effect of money difficulties, job worries, and the care of sick persons in the home, fussiness about clothes, tidiness, punctuality, etc., ability to mix freely with other people, and certain broad temperamental characteristics.

Significantly more males in the professional and managerial groups had an absorbed attitude to work ($P<0.05$) and a significant excess of subjects over controls in all analyses were said to have "job worries" (total male subjects $P<0.01$, males who had had no medical treatment for three years $P<0.01$, and males in socio-economic groups 3, 4, and 5, $P<0.05$); more controls than subjects were said to be "good mixers" (significant for total males $P<0.01$); "quiet and steady" types predominated among controls ($P<0.01$); and in the comparison between total subjects and controls there was a significantly higher proportion of "worrying and introspective" men among the subjects ($P<0.05$).

As stated by Friedman and Roseman (1959) there would seem to be an association of a behaviour pattern with mortality from coronary artery disease.

Heredity

Questions of heredity were added while the inquiry was in progress, so that samples were smaller. The excess of total male subjects one or more of whose parents were said to have died from coronary thrombosis is significant ($P<0.05$), as is that of subjects one or more of whose sibs had died from the same cause ($P<0.01$). The same result was observed in the case of males dying in their first heart attack. Women showed no difference between subjects and controls for parents dying from coronary thrombosis, but when sibs were considered the excess of subjects was significant ($P<0.05$). Inquiry was not made into the deaths of total first-degree relatives from coronary disease, nor was information obtained particularly about parents and sibs who had died between the ages of 45 and 64. These results are in accordance with Thomas's (1959) findings.

Discussion

The method of study adopted has certain manifest defects, the main one being that in the case of subjects the information was derived from surviving relatives, and, as regards controls, mainly from the controls themselves. It was thought there would be fewer obstacles to getting information direct from the controls than from their spouses or other relatives. The aim was to get few refusals, and therefore samples as representative as possible. In the event, only 6% of persons approached refused information about subjects and 7% of controls declined to be interviewed; great interest was evinced, and the interviewers were received in a very friendly manner.

Dead persons were used as subjects because particulars of their ages, occupations, marital state, and cause of death could be readily secured from the registrars of deaths and their records, and therefore the sample was as complete as could be obtained—far more so than if information had been sought about living persons who had suffered and survived an attack of coronary thrombosis. In the event, the statistical material obtained covered 82% of all Cheshire residents who had died from coronary thrombosis within a period of 17 months.

Indeed, the method used seemed the only practical one, with all its disadvantages. The number of relatives of subjects and controls who acknowledged strains and admitted "fussiness" and a more than average liking for tobacco and alcohol raises a presumption that the questions were answered to the best of their knowledge. On the other hand, second persons may well have a different idea of others than those others may have of

themselves, particularly about habits and attitudes. They cannot be expected to know as much about events and strains away from home, and their recollection of facts may well be inaccurate; they may have an exaggerated idea of them or may not realize that they occur.

The control sample included a higher proportion of males in socio-economic groups 3, 4, and 5 than the subjects. This was corrected by comparing subjects in the full male sample with controls matched for socio-economic groups and by making separate analyses for these groups as representing the Registrar-General's social classes I and II. Socio-economic groups 9, 10, 11, and 12 were separately analysed as being composed of manual workers (including charge hands and foremen). A separate analysis was made of "first controls"; the results were similar to those for the total sample of controls.

The samples could of course have been bigger and the inquiry pursued further, but one and a half years were taken up by the interviews, and this was thought sufficient.

The method of selection of controls seemed to be the most random one available, as the aim was to get as representative a cross-section of the Cheshire community as possible. Even so, the objection could be raised that such Welsh names as Davies, Parry, and Vaughan are alphabetically at the beginning of the surnames beginning with D, P, and V, so that, in a county with perhaps a greater proportion of Welsh names than most, there could just conceivably be a slight Welsh bias.

It must be remembered that the actual interviews were carried out by non-medical men and that the subjects' relatives who were questioned were asked to search back in their memory for small details in the life of some other person. Questions therefore had to be as simple as possible, and medical terms had to be avoided so that an answer could be furnished in every case. Questions, with certain obvious exceptions—for example, mode of death—were identical for subjects and controls, and to facilitate machine analysis replies were shown by ringing one or perhaps two numbers indicating possible answers. There was therefore little scope for showing degrees of, say, frequency, severity, or quantity in the answers without adding considerably either to the questions or to the possible answers. As interviews lasted an average of one hour, and almost half of these were with bereaved persons, while some others were themselves not in good health, it was not desired to prolong them unduly.

Certain parts of the inquiry yielded reliable factual information, such as length of illness, occupation, meal-times, size of family, etc., but information based on opinions and impressions such as that on strains, attitudes, and traits of character can only be regarded as unreliable. Such information could also be different when given by a person about himself from when given by a second person. Nevertheless, in producing an environmental record information on such strains and attitudes was important, although due regard must be had to its fallibility. The sections on food habits, tobacco, alcohol, and leisure activities come between these two limits of factual and subjective.

When such matters as "strains" were being asked about there could be no question of accurate definition; the everyday meaning of the term had to be accepted, hoping that bias of underestimation or overestimation on the part of the control or subject's relative would be more or less equal on either side.

With all these difficulties and serious disadvantages in mind, the inquiry does afford a means of comparison between the daily lives of 536 persons whose cause of death was certified to be coronary thrombosis and 642 of the same proportionate sex distribution and age-group chosen by a random method out of a population of approximately 900,000. A rigid selection of material had to be made from the great bulk of figures obtained in order to reduce this paper to manageable size.

The subjects and controls in the category "no medical treatment during the last three years" were those regarding whom no medicament had been prescribed by a doctor during that period. They could have had an injury or an examination for some extraneous purpose.

Confidentiality has been strictly observed, but the records and punched cards (no names or addresses) are still in existence to furnish, if necessary, the basis of further analyses, and copies of the tables are available. As no names or addresses were kept it was impossible to go back and obtain further information on any answer from a person who had been interviewed.

One of the difficulties was to decide on which deceased persons should come within the classification "coronary thrombosis" and therefore be investigated as subjects. The final decision, which once the inquiry had started could not be altered, was to include all those men and women with a Cheshire home address between 45 and 64 years of age, inclusive, whose death certificates as reported by the registrars of deaths bore the words "coronary thrombosis," "myocardial infarction," "angina pectoris," or "myocardial ischaemia" in part 1 of the certificate, whether they had died within or outside the administrative country.

The most likely explanation for the significant variation in mortality from coronary thrombosis between the socio-economic groups would seem to be that those occupations which are indoors, mainly sedentary, and do not involve walking to any great extent—and clerical work is the outstanding example of this kind of job—predispose to coronary disease. An agricultural worker's job is in the open air, is physically strenuous, and involves much walking; the comparative mortality then rises through the socio-economic groups in accordance with the amount of sitting involved, and, inversely, with the amount of walking and open-air life associated with the occupations. This is supported by the significantly higher proportion of controls who gave gardening as one of their principal leisure activities. While walking was a commoner leisure activity of controls than of subjects, walking to work was equally common in both subjects and controls, perhaps because it can involve the element of hurry, and to live in a hilly district involves physical strain, particularly in those persons who are not in good health.

There was insufficient evidence to connect mental strain with the incidence of coronary thrombosis. Socio-economic groups 3 and 4, with a high comparative mortality, are commonly associated with mental strain and additional responsibilities, but farmers, with a low mortality, are also subject to mental strain and carry considerable responsibility. Although the subjective nature of the questions concerning mental strain must be strongly stressed, a pattern does emerge in that a higher proportion of subjects were said to have job worries, were not "good mixers," or were "worriers." Psychological factors therefore may influence the death rate, and this aspect is worthy of future study.

Food and drink habits—with one significant exception, coffee drinking—appear not to influence mortality from coronary thrombosis. To be fond of fat and fried foods, pastry, puddings, suet, and chips, or to use lard did not affect the death rate; neither did tea drinking nor consumption of alcohol. The fewer subjects in proportion to controls who ate bacon for breakfast more than three times weekly could have been due to restriction of diet because of illness.

The higher proportion of subjects who had not stopped smoking cigarettes—and incidentally the answers showed that the number of cigarettes smoked was immaterial—was within the bounds of significance, but the analyses did not show that pipe smoking was in any way associated with mortality from the disease.

The answers relating to heredity showed a significant excess of subjects one or both of whose parents had died from coronary thrombosis. This group of answers is difficult to evaluate: although almost all controls knew the cause of their parents' death many of the nearest relatives of subjects did not; the difference between subjects and controls might therefore have been greater. It was desired to exclude all other cardiac causes of death except coronary thrombosis, so the question was asked, "Did either of your parents die from coronary thrombosis?" Such causes as "sudden heart failure" were not accepted, and of course there was no chance of seeing the death certificates or getting copies from the registrars. It did not seem useful to particularize about the deaths of parents from coronary thrombosis having taken place between the ages of 45 and 64, as many persons interviewed were not certain of the age of their parents at death. Unless the interviewee could state with certainty that a parent had died from coronary thrombosis the answer "none" was ringed. It would be safe, therefore, to assume that heredity is an influence but the extent could not be determined.

Summary

The object of the study was to ascertain, if possible, any environmental feature influencing the death rate from coronary thrombosis between the ages of 45 and 64 years.

Records were taken of the age, sex, and occupations of persons normally resident in the administrative county of Cheshire who died between these ages from June, 1956, to December, 1959, and an inquiry was carried out over a period of 17 months into the medical history and environmental particulars of 536 persons who had died aged 45 to 64 years from coronary thrombosis, and the results were compared with similar information from 642 controls of the same sex and age-groups taken at random.

The answers received indicate that approximately three-fifths of those who had died had been receiving medical treatment, though not necessarily for a cardiac condition, for longer than six months.

There was no evidence to establish that family circumstances, holidays, consumption of fat, alcohol, or tea, times of meals or of rising or going to bed, participation in sport or games, visits to club or hotel, employment (in the case of women), addiction to radio or television, overtime or night working, and whether the job was manual or not, heavy or light, affect the likelihood of death from coronary thrombosis.

Only a very small percentage (2%) of men controls who had not received medical treatment in the past three

years travelled more than 6 miles (9.6 km.) in each direction between home and work.

The death rate among farmers and agricultural workers was much lower in middle age than that of any other socio-economic group, whether from general causes or from coronary thrombosis. Work involving walking, and gardening in leisure, lessened liability to death from coronary thrombosis. The death rate was highest among sedentary workers, particularly clerks. To hold a position of responsibility at work does not carry an increased risk.

There was a higher death rate from coronary disease among smokers, but no evidence to suggest an association between death from coronary disease and pipe smoking.

Evidence suggested that overweight among manual workers is associated with increased liability to death from coronary thrombosis.

There were significantly fewer deaths among coffee drinkers.

A number of observations, based on subjective evidence and therefore subject to suspicion, raise the possibility that psychological and temperamental factors, particularly worry, may increase liability to death from coronary disease.

Heredity, so far as could be deduced from such an inquiry as this, is an influence.

The answers to the questions show that there is no need for a person to restrict himself or herself from those ordinary pleasures of life discussed in this paper in order to avoid death from coronary thrombosis.

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A preliminary draft British Standard for life-saving jackets has been prepared to meet the urgent need to provide increased safety both for amateur sailors, including ocean-racing yachtsmen, dinghy sailors, canoeists, and for people involved in work where water is an occupational hazard. The purpose is to guide manufacturers and those responsible for purchasing equipment for clubs, and for training children in seamanship, as to the essential performance requirements of a safe lifejacket. These requirements have been formulated by taking as a basis the needs of an unconscious man in the water. Copies of the draft standard may be obtained from the Director, British Standards Institution, 2 Park Street, London W.1.