

CORONARY HEART DISEASE IN TRANSPORT WORKERS

A PROGRESS REPORT*

BY

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During 1949 and 1950 we set out to record all the cases of coronary heart disease, as they occurred and were recognized, among the drivers and male conductors aged 35 to 64 years, of the red buses, trams, and trolleybuses of London Transport Executive, and to relate these cases to the population at risk. Some 15,500 drivers and 9,500 conductors were observed for the two years (and for as long in 1951 as was necessary to complete the information about 1950). The cases were ascertained by various established means: for example, drivers and conductors who have been off sick for any period on account of disease certified as cardiac, or for more than 28 days from any cause, are routinely identified in their garages and sent for examination to the Medical Department before returning to duty. In addition, there was a special cross-check in the Central Record of Staff Statistics for the purposes of the present enquiry to ensure that all "possible", as well as definite, cases came under scrutiny in the Medical Department. It is reasonably certain that few of the relevant cases were missed, and that sufficiently accurate diagnoses were made. A copy of the death certificate was obtained for all deaths, including those that occurred without previous sickness absence.

Because in any occupation a man may retire after his first clinical "episode", or "attack" of coronary heart disease, it was necessary to concentrate on these. The rate of first attack per 1,000 men is called the "incidence" of the disease. During the two years 1949-1950, 111 first attacks were recognized and satisfied the diagnostic criteria adopted. Of these cases, 32 occurred in conductors and 79 in drivers. When age standardized rates were calculated it was found that the incidence at 35 to 64 years was 2.0 per 1,000 men per year in the conductors but 2.7 in the drivers. Moreover, the distribution of type of presentation differed in the two occupational groups. The conductors had more

angina of effort, a relatively benign manifestation of the disease; 38% of their cases presented in this way compared with 13% among the drivers. On the other hand, the conductors had only half the "immediate mortality" (deaths within three days of onset of the first attack) that occurred in the drivers, 0.4 per 1,000 men compared with 0.9. There was a suggestion, also, that the disease presented at a rather later age in the conductors. When the fate of those who did not die immediately was followed to the end of the first three months of the clinical disease, the rate of coronary mortality in the conductors was again half that of the drivers, 0.2 and 0.4 respectively, making the total in the three months 0.6 per 1,000 in conductors against 1.3 in drivers.

A Three-year Follow-up

Clearly it was necessary to enquire whether the apparent advantage of the conductors continued beyond these early months of the first clinical attack. A follow-up study of those conductors and drivers who survived the first three months was therefore carried out, and we are now reporting on the next three years, covering all the men who had their first clinical attack in 1949-50. Some of the survivors are of course still working with London Transport. Others who had retired on age or medical grounds, or resigned, were traced by administrative methods—such as their continuing pensions—or by personal search. This latter was kindly undertaken by Dr. L. G. Norman, Chief Medical Officer of the Executive, as an exercise in what might be called "shoe-leather epidemiology".

Of the original 111 cases, 64 survived the first three months: 23 conductors and 41 drivers. All were traced. Up to the end of the three years' follow-up, 13 more died of coronary heart disease: four deaths occurred among the conductors and nine among the drivers. (A driver who died from another—cardiovascular—disease has been excluded from further consideration.) The standardized rate

*Presented by P. A. B. Raffle to the Association of Industrial Medical Officers at their Provincial Meeting, July, 1954.

TABLE

INCIDENCE AND MORTALITY FROM CORONARY HEART DISEASE IN DRIVERS AND MALE CONDUCTORS OF CENTRAL BUSES, TRAMS, AND TROLLEYBUSES OF THE LONDON TRANSPORT EXECUTIVE

Conductors							Drivers						
Age of Men in 1949-1950 (Years)	Number of Men Observed	Incidence—First Clinical Episodes—of Coronary Heart Disease	Mortality Rates per 1,000				Age of Men in 1949-1950 (Years)	Number of Men Observed	Incidence—First Clinical Episodes—of Coronary Heart Disease	Mortality Rates per 1,000			
			First 3 Days	First 3 Months	First 3 Years					First 3 Days	First 3 Months	First 3 Years	
					No. of Deaths	Rate						No. of Deaths	Rate
(1)	(2)	(3)	(3)	(1)	(2)	(3)	(3)						
35-39	2955	0.0	0.0	0.0	0	0.0	35-39	3179	0.3	0.0	0.2	1	0.2
40-44	1856	0.0	0.0	0.0	0	0.0	40-44	3002	1.0	0.3	0.3	2	0.3
45-49	1438	1.7	0.4	0.4	1	0.4	45-49	3213	2.2	0.8	0.9	8	1.2
50-54	1322	2.3	0.8	1.1	4	1.5	50-54	2636	2.9	1.0	1.3	10	1.9
55-59	1199	5.0	0.4	0.8	4	1.7	55-59	1892	5.3	1.9	2.9	12	3.2
60-64	813	5.5	1.2	1.8	4	2.5	60-64	1442	7.6	2.1	3.8	14	4.9
Standardized Rate at 35-64 Years		2.0	0.4	0.6	0.8		Standardized Rate at 35-64 Years		2.7	0.9	1.3	1.6	

The incidence includes all first clinical episodes of coronary heart disease that were recognized and recorded in these men in 1949 and 1950. The mortality rates are cumulative: (2) includes (1) and (3) includes (2). Since they result from the cases occurring in two years the denominators used are *twice* the "numbers of men observed". This conforms with the idea of an annual incidence, and shows the number of deaths which occurred (within the specified time) amongst the new cases arising in any one year amongst 1,000 men.

Mortality rates are standardized for age on the civilian male population of England and Wales in 1949.

Details of populations and methods of recording sickness absence and deaths are given in *The Lancet* (1953) 2, 1053.

of mortality from four months to three years was 0.2 (conductors) and 0.3 (drivers) and this adds up to a total mortality in the three years of 0.8 and 1.6 respectively.

The advantage in the conductors' experience over the drivers' is thus apparent at 0 to three days, four days to three months, and four months to three years. But there is an indication that with the passage of time the advantage is becoming smaller. Eventually, it is reasonable to anticipate, the coronary mortality among these men will approximate to the incidence—2 per 1,000 in the conductors and 2.7 in the drivers—an overall superiority in the conductors of about 35%, compared with that of 125% in the "immediate mortality" reported above.

Forty per cent. of the conductors and 60% of the drivers who had a first attack in 1949 and 1950 died within three years. The Table gives details of the results and Fig. 1 summarizes them.

An Hypothesis

Nearly all the conductors' work is on double-decker vehicles. On the basis of the above observations, and others, an hypothesis has therefore been stated as a guide to future investigation:

That men in physically active jobs have a lower incidence of coronary heart disease in middle age than men in physically inactive jobs. More important, the disease is not so severe in physically active workers, tending to present first in them as angina pectoris and other relatively benign forms, and to have a smaller early case fatality and a lower early mortality rate.

It should be emphasized that the hypothesis is not advanced in any exclusive sense—that differences in their physical activity at work is the only factor relevant to the differences in coronary disease described or, necessarily, the main one. But if progress is to be made questions must be narrowed down, and they are often best dealt with one at a time.

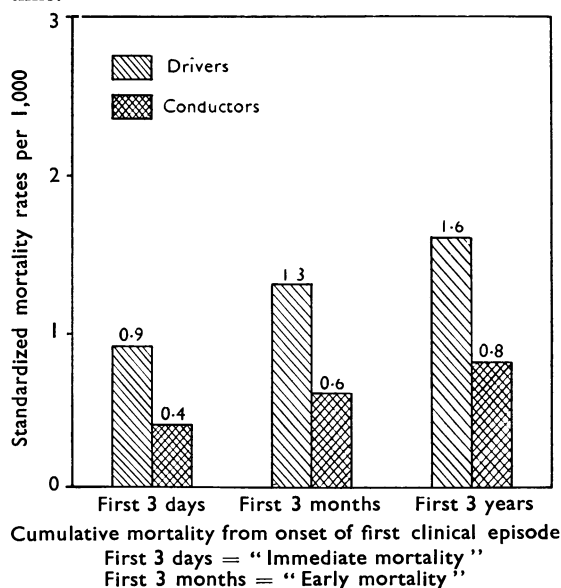


FIG. 1.—Mortality from coronary heart disease in male drivers and conductors, 35 to 64 years of age, working on central buses, trams, and trolleybuses of the London Transport Executive.

So far, we have only been able to do little by way of testing the hypothesis in these transport workers. Following are the kinds of questions that arise :—

Is the Hypothesis True?—The difference between 2.0 and 2.7 in the incidence of the disease probably underestimates the real difference between the conductors and drivers. The excess of angina in the conductors may well be due simply to their physical activity evoking symptoms which in the less active drivers remained quiescent and undetected. That is to say, the figure of 2.0 in the conductors is very likely an inflated one relative to the 2.7 of the drivers.

We are, however, thinking of another possibility : that conductors, more than drivers, exclude themselves from conducting and weed themselves out of the population at risk, because of early or sub-clinical manifestations of coronary heart disease, such as fatigue or diminished exercise tolerance, which are brought on by physical effort. There is no evidence to support such a possibility, and it is not yet apparent how it may be investigated. If it were real it would of course be very important. (It should be remembered that men are unlikely to give up conducting for health reasons without reporting to the Medical Department, because of the efforts made to place such men in alternative employment, and because there may be an *ex gratia* benefit involved.)

If the Hypothesis is True, Is It Only Indirectly True?—This raises the big question of the other differences there are between conducting and driving, and the many differences there must be between conductors and drivers : *must be* because they have chosen such very different jobs. Are the mental strains of conducting less than those of driving? Do conductors have different kinds of constitution, or health histories, eat less, smoke less, have more active leisure pursuits? As a first approach to this kind of question, we have started an analysis of the size and shape of conductors and drivers, using their uniform measurements as an indicator. A first sample of about 1,000 men is promising : there are interesting similarities and differences in the measurements ; and, most interesting, these are as clear at 25 to 34 years of age, in the earliest years of conducting and driving, as at 55 to 64.

The alternative and better way to meet this possibility that in dealing with differences in physical activity of jobs we may, in fact, be dealing mainly with a partial correlation between physical activity and another factor, is to observe the operation of

physical activity in a wide variety of situations so that eventually it becomes the only constant factor. This has been attempted elsewhere, and similar differences in respect of coronary disease were identified between postmen and sedentary workers ; and between "heavy" workers, generally, and "light" workers.

If the Hypothesis is True, How is Physical Activity Effective?—An observation relevant to this problem is the substantial difference in severity of the disease among the two groups. It is interesting first to compare the mortality experience in relation to the mode of clinical presentation :

Type of First Episode	Total No.	No. Dying		% Surviving 3 Years
		First 3 Months	4 Months–3 Years	
As angina pectoris	22	1	1	91
As "coronary thrombosis" / myocardial infarction	89	46	12	35

This advantage to those who present with angina and (presumably) without major infarction was originally shown in the survey of medical practitioners. The present further evidence is strong, as it comes from a "prospective" study, the diagnoses having been made during the first episode in 1949–50 and not changed since then. Now it is known from general experience that many cases first coming to clinical notice with a major occlusion/infarction have previously had angina which was not particularly troublesome ; and, anyhow, had not led them to seek advice as a result of which the diagnosis was made. Conductors, of course, presented more commonly with angina than drivers. (Why this is so has already been briefly discussed : they would be less likely to ignore the pain.) The question therefore arises, Can it be that their detection of the disease at an earlier, or less serious, stage by the conductors and the subsequent adjustment of their way of living have helped to reduce their coronary mortality? It should be noticed that the fatality rate in the cases presenting as major occlusion/infarction was similar in the two groups ; the advantage of the conductors was that so many of their cases presented as angina. This question needs to be gone into in detail, and with much larger numbers than we have been able to study. It illustrates another kind of relation—between occupation and health—apart from the aetiological, with which we are mainly concerned at present.

However, it is unlikely that this mechanism can account for all the difference in mortality between

the two groups which has been observed. These are the numbers and distribution of first episodes in 1949-50 under 50 years of age :

	Total No. of First Episodes	Presenting as—		
		Angina Pectoris	"Coronary Thrombosis" with Early Mortality	Other "Coronary Thrombosis"
Conductors	5	1	1	3
Drivers	22	0	9	13

Clearly, there must be another factor in early middle age which produces the difference between the mortality of drivers and conductors. The cases of angina in the conductors which could have operated in the manner described in the preceding paragraph just did not occur.

If the Hypothesis is True, What are the Implications for Preventive Medicine?—The question arises at once of the amount and nature of physical activity outside work. Do conductors and drivers differ? More specifically, for example, have the drivers who do not develop coronary heart disease more active leisure interests than those who do?

Natural History

Several features of the natural history of coronary heart disease may be illustrated from the present material. For example, the curve of mortality in the clinical disease is a peculiar one, very much like that of infant mortality, the greatest danger being in the first days, and diminishing steeply thereafter. Fig. 2 shows that of the 60 coronary deaths in the three years of observation, 31 occurred in the first three days of the first clinical episode, a further 16 in the

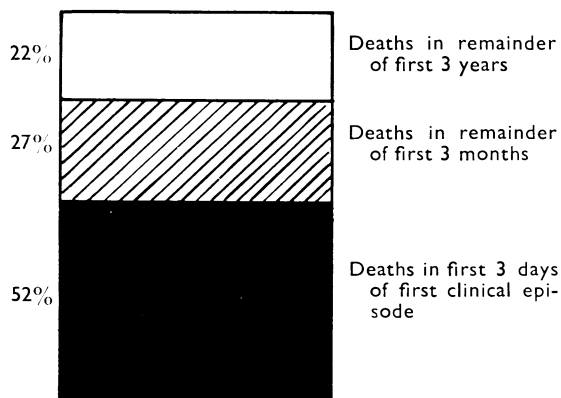


FIG. 2.—Deaths from coronary heart disease in relation to first clinical episode.

remainder of the first three months, and 13 in the next 33 months. This distribution is similar to the experience of the medical practitioners previously studied. However, the prognosis after the early weeks of the first clinical episode is not so good among these transport workers as among the doctors. This may be a reflexion of difference in social circumstances, or in treatment, and it should be investigated further.

Employment History

A brief analysis was made of the 50 men who were still alive at the end of three years. Sixteen (six conductors and 10 drivers) are still working in London Transport. Not one is in the job he held in 1949-50: one man who had been a driver was now working as a conductor; the other 15 were mostly employed as telephone operators, messengers, and queue pointsmen—jobs considered to be within their various physical capacities. The consensus of opinion in industrial medicine is that once a driver has demonstrated he has ischaemic heart disease, he can no longer be considered fit to drive passengers in a public service vehicle. In general, conducting is beyond the physical capacity of a man who has had an overt attack of coronary heart disease, though there are exceptions. Five of the 16 men still working with London Transport have already had further absences from work attributable to coronary heart disease. (Of course, others of the three-month survivors had been placed in alternative employment within the organization after recovery from their first clinical episode, and subsequently died or retired. Five conductors and six drivers come into this category, making 27 in all, of the 64 three-month survivors who had returned to work in the organization.)

Of the 34 (13 conductors and 21 drivers) who survived the first three months and were still alive when traced at three years, but not working with London Transport, 23 were under 65 years of age; and of these 23, 13 were known to be in some form of employment.

In brief, therefore, there were 43 three-year survivors who were under 65 years of age and 29 of these are known to be working, 16 with the Executive and 13 elsewhere. At a later stage we may be able to make some report on the employment experience of those who left the Executive.

Comment

Two points may be made. Of the 111 men first presenting with coronary heart disease in 1949 and 1950, about 45% survived for three years or more. Many of these are in active employment as described

above. There is urgent need for more systematic study of the needs and capacities of the tens of thousands of men who have "had a coronary" and subsequently returned to work. Careful follow-up studies are required of these men over the years, comparing their experience under different medical and occupational régimes. Finally, it may be noted that this type of enquiry deals with a general relationship between work and health, in contrast to the specific occupational hazards with which industrial medicine has been obliged to be so much concerned in the past. The industrial medical officer working in the field is well placed to study such questions; and occupational medicine may

have a great contribution to make in this way towards the elucidation of major problems of the aetiology and natural history of disease, and of the rehabilitation of the sick, by using its every-day opportunities for the observation of men at work.

We are very grateful to our colleagues in the Social Medicine Research Unit, particularly Mr. J. A. Heady, and in London Transport Executive, particularly Dr. L. G. Norman, Mr. F. H. Spratling, and Mr. F. J. Lloyd, for much help.

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