



# USES OF EPIDEMIOLOGY

BY

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## PREFACE

This book is addressed to students of both clinical and preventive medicine, and in it I have tried to indicate how epidemiology can serve as a means of bringing these together. Illustrations are given of the usefulness of epidemiology to clinicians and laboratory workers, and of the possibilities that epidemiology offers for enlarging the traditional field of public health. This is not, therefore, a textbook in the ordinary sense, and there is no attempt to be comprehensive. Thus only passing reference is made to the infections, and a more accurate title would be *Some Uses of Epidemiology in the Study of Non-communicable Diseases*. Moreover, I have chosen often to illustrate from work with which I have myself been connected in the belief that the reader would prefer generalisations so derived.

I am glad of this opportunity to express my indebtedness to colleagues, past and present, in the Social Medicine Research Unit and to friends who have helped me so generously with ideas and examples. One at least I must mention by name, my teacher, Professor A. Bradford Hill, who has placed a whole generation of medical research workers under obligation. I am very grateful to the Editor of the *British Medical Journal* (in whose columns a brief account of the *Uses of Epidemiology* first appeared) and the Editor of *The Lancet*, both of whom have allowed me to republish much material from their pages. My thanks for a similar service are due to the Editors of the *British Journal of Industrial Medicine*, *British Journal of Preventive and Social Medicine*, *Medical Officer*, *Proceedings of the Royal Society of Medicine*. I much appreciate also the kindness of several friends, and the Editors of the publications concerned, for permission to reproduce work of theirs. My debt to many others is great, and I have been able to acknowledge only part of it by reference. I hope that the omissions will be forgiven.

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J. N. MORRIS.

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## INTRODUCTION

Until about 1900 death rates during middle-age in England and Wales were high (Fig. 1, *a*) but about the turn of the century sanitary reform began to show results in this age group. Mortality rates for both men and women began to fall, and they continued to fall until the 1920's. Then, rather abruptly, there

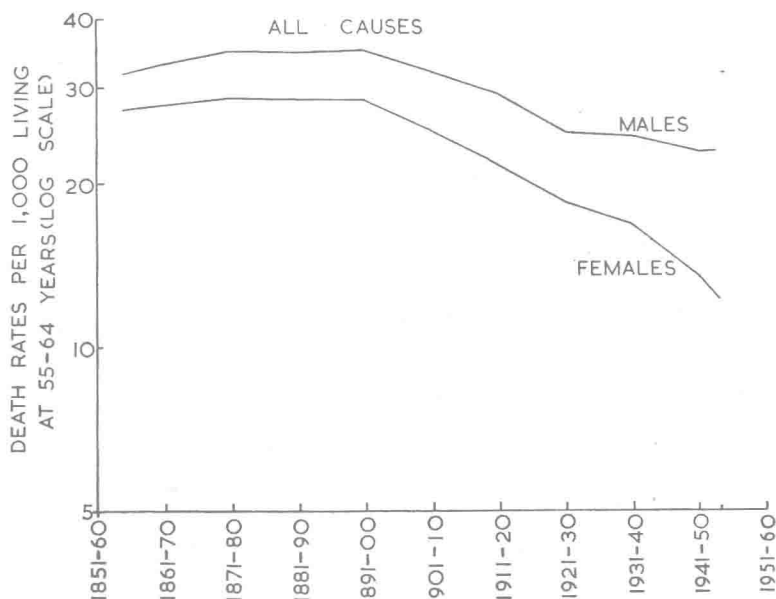


FIG. 1, *a*

Mortality in middle-age during the last 100 years. England and Wales. All Causes.<sup>18</sup>

was a change. Female mortality kept its downward course; but the reduction of male mortality has slowed and almost stopped. As one result of this, the death rate among men aged 55 to 64 which was about 10 per cent higher than for women a hundred years ago, and about 33 per cent higher after the first world war, is now about 90 per cent higher. That is to say, the situation is approaching when for every woman who dies in her



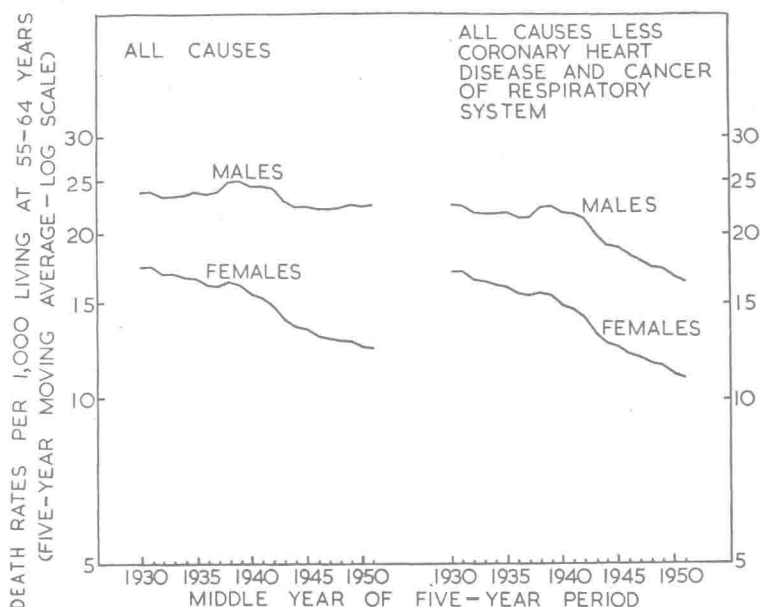


FIG. 1, b

Mortality in middle-age, 1928-53. The contribution of coronary heart diseases and lung cancer. England and Wales.<sup>18, 177</sup>

late fifties and early sixties two men will die. What has been happening? As we now know, many strange things are reflected in these vital statistics. The most important is the emergence of three diseases from obscurity to become exceedingly common, diseases which particularly affect men and are very frequent in middle-age: duodenal ulcer, cancer of the bronchus and "coronary thrombosis". The first of these mainly produces ill-health and inefficiency; but the other two have become major causes of death, killing annually over 20,000 middle-aged men. Fig. 1, b shows the record of mortality for 1928-53, and the contribution of "coronary thrombosis" and lung cancer. The trend among men is very different without them.

Figs. 1, a and 1, b illustrate one "use" of epidemiology—in historical study. But first let me explain that what I am writing of is *the study of health and disease of populations and groups*,

the epidemiology of which Farr, Snow and Goldberger are the modern masters. By contrast with clinical medicine, the unit of study in epidemiology is the *population* or *group*, not the *individual*. Deaths, or any other event, are studied only if information can be obtained, or inferred, about the population in which the events occurred. This "population" may be of a whole country, or any particular and defined section of it. The clinician, therefore, deals with *cases*. The epidemiologist, in studying disease, is concerned with *cases as they occur in their population*: he may start with a population and seek out the cases in it, or start with cases and refer them back to a population, or what can be taken to represent such. Always, the epidemiologist ends up with some estimate of  $\frac{\text{cases}}{\text{population}}$ ,

or, to be more precise,  $\frac{\text{all the cases}}{\text{population}}$ .<sup>\*</sup> In consequence, he can sometimes ask questions which the clinician also asks, and get different (maybe better, maybe worse) information in reply. Often, the epidemiologist may ask questions that cannot be asked in clinical medicine at all. He can, for example, calculate the frequency, or rate of occurrence, of phenomena in the population—such as the deaths from all and from particular causes, per thousand persons of a particular age, at one period of time and another—to make possible the kind of comparison shown in Figs. 1, *a* and 1, *b*.

In this book I am concerned mainly with epidemiology as a way of learning, of asking questions and getting answers that raise further questions: that is, as a *method*. Seven "uses" of epidemiology are described, different if overlapping applications of the method, ways of looking at epidemiological data.

<sup>\*</sup> *E.g.*, 18, 19, 29, 31, 37, 44, 60, 61, 62, 63, 67, 68, 74, 79, 92, 96, 98, 100, 104, 118, 123, 129, 137, 138, 140, 157, 176, 180, 183, 184, 186, 198.

## I

## HISTORICAL STUDY

The historical statements commonly made in medicine are, by definition, "epidemiological": they refer to the frequency of some event among populations at different points in time. The decline of infections, for example, or of nutritional deficiencies, are described, and the main trends are usually very obvious—such as have transformed clinical pædiatrics (or orthopædics, or dermatology) in a single generation. Table I

TABLE I

*Mortality from Heart Disease* \* 18, 141, 148, 177

Ages 5–14 years

M. and F. Combined

Rates per 100,000

(Averages)

Population		(1) 1929–33	(2) 1946–49
<i>England and Wales</i>	County Boroughs .	13.4	4.1
	Urban Districts .	11.2	3.7
	"Rural" Districts .	7.9	2.7
<i>South Wales</i>	County Boroughs .	17.9	4.2
	Urban Districts .	20.1	5.5
	"Rural" Districts .	18.8	3.9

\* Excluding congenital.

- illustrates from rheumatic heart disease; it complements the story of "coronary thrombosis" to provide a miniature of modern cardiology. Historical statements about the possible increase of disorders are often quite another matter. There is little difficulty about some conditions, such as road-vehicle accidents, barbiturate poisoning, industrial dermatitis, salmonella food poisoning and sonne dysentery, infective hepatitis, paralytic poliomyelitis (or retrolental fibroplasia). But questions often put—"Have disk syndromes become commoner?"—are bedevilled by uncertainty about nomenclature in the past and about the level of diagnosis over the years, and by the lack of quantitative estimates of frequency at any time: how many cases occurred annually, per 1000 men aged x, in the 1930's and in the early 1950's? (Or, more correctly, how many *new* cases arose, or were discovered, which gives the "incidence", the base line of epidemiology.) Consider these sickness figures,<sup>94</sup> from certificates given by doctors about other doctors, and only fifteen years apart:

	1937	1952
	No. of cases	
Rheumatism (and gout)	18	7
Fibrositis . . . . .	17	11
Lumbago and Sciatica .	47	29
Prolapsed disk . . . .	0	35
	—	—
Total . . . . .	82	82
	—	—

(One does not need to believe that "disks" are a consequence of man's upright posture . . .)

In such problems as the frequency of functional disorders or of the psychoneuroses, historical questions, which are often asked, are hopeless of direct answer and useful information is more likely to come from the novelist and the social historian. But even in disorders like leukæmia, urinary cancer or cerebral tumour, subarachnoid hæmorrhage, dissecting aneurysm, and

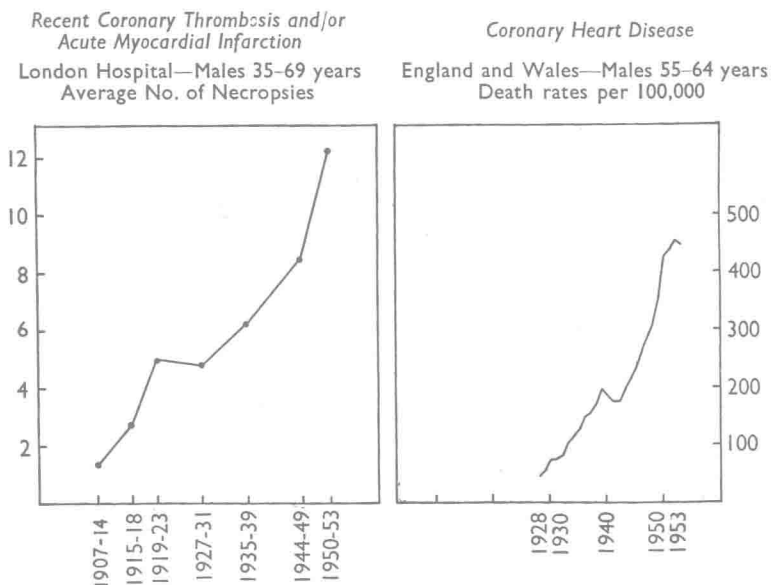


FIG. 1, c

Two indicators of the increase of coronary heart disease in middle-age. 18, 140, 177

various collagen diseases, it is exceedingly difficult to estimate how much the recent apparent increase reflects a true rise in incidence. Each civilisation, it has been said, makes its own diseases; but it has several ways of going about this, and an apparent increase may be the product merely of changing fashions in nomenclature and classification ("myocardial degeneration" has recently become unpopular in the middle-aged, "senility" is less often written on the death certificates of the old); of improving recognition and diagnosis (carcinoidosis will inevitably be described oftener, and hypertension due to pyelonephritis become "commoner"; "cancer of the pancreas" is certified more as the cause of death nowadays and "cancer of the liver" less); of demographic changes (as in the growing number of old people eligible to suffer dementia, cataract and otosclerosis); and of various combinations of such factors

(certainly accounting for part of the apparent increase of "coronary thrombosis" and lung cancer and of some rarer disorders such as cervical spondylosis or giant-cell arteritis). These questions about whether an increase is real or not clearly matter, since the role of environmental influences and of recent social change in the ætiology, arises. It will be interesting to observe the development of the story of infantile hypercalcæmia now that there is so much awareness of these problems. As a result of much study it must today be accepted as working hypothesis and guide to environmental researches that there has been some true increase of duodenal ulcer,<sup>110</sup> cancer of the bronchus<sup>59</sup> and "coronary thrombosis"<sup>140</sup> (Fig. 1, c).

#### FUTURE POPULATION TRENDS

For some the main interest of history is the light it can throw on the future. Vital statistics is better placed than most disciplines to forecast because, for example, the whole population of old people of the second half of the century are already born and leading their lives under the conditions we know. Fig. 1, *a* can be projected ahead, if only with wide margins of confidence. What seems to be keeping the male death rate in middle-age even as moderately satisfactory as it is now, is the balancing of those diseases which are increasing (such as "coronary thrombosis") by those which are declining (tuberculosis and other infections).<sup>\*</sup> If the decline of the infectious diseases is halted before the modern epidemics are brought under control, and if the conditions which are relatively stationary (cancer of the stomach, cerebrovascular disease, for example) do not show improvements in the meanwhile, the overall middle-aged male death rate will actually begin to rise. This may already be happening in Scotland where the position is in several respects less favourable. The average death rates in that country since the first world war have been:

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<sup>\*</sup> See note on p. 9.

## SCOTLAND

	<i>Men</i>	<i>Women</i>
1921-30 . . .	26.4	21.1
1931-40 . . .	24.9	19.1
1941-50 . . .	24.5	15.9
1951-54 . . .	25.7	14.5

(Per 1000. Ages 55 to 64 years. All causes.<sup>167</sup>)

One consequence of these trends if they persist would be that the population of old people in the future will consist more and more of solitary old women, whatever the increasing popularity of marriage during recent years. Already, about a third of men reaching 35 years of age die before 65 compared with about 20 per cent of women. This current trend of mortality in middle-aged men (less marked at 45 to 54 and at 65 to 74 years of age) is the most disquieting feature of Western vital statistics.<sup>159</sup> Geographically—another kind of epidemiological comparison that will be considered again later—the situation is better in Scandinavia than in the English-speaking (!) world as illustrated by figures like these:

*Death rates per 1000 aged 55 to 64 from all causes, 1952-53.\**

	<i>Men</i>	<i>Women</i>
Scotland, England, Wales, Canada, U.S.A.		
New Zealand, Australia, S. Africa . . .	22.7	12.5
Denmark, Norway, Sweden . . . . .	14.4	10.7

Not only are the male rates lower in Scandinavia, but the sex ratio is smaller and it has been changing little in recent years. Searching questions need to be asked in this kind of situation. There is no ready answer in terms of living standards, animal or vegetable fat consumption, industrialisation, urban living, economic advance, tempo of social change.

\* Mean of rates for separate countries. U.S.A., Whites; New Zealand, excluding Maoris; S. Africa, Europeans, estimated. <sup>159, 177, 200</sup>

\* There seems to have been an analogous situation vis-a-vis cerebrovascular disease 200 years ago:

The yearly sum of the deaths ranged under the heads of apoplexies, suddenly, planet-struck, lethargies and palsies, fluctuates without any constant increase or decrease, till the beginning of the present century: from which time this sum has been perpetually increasing. Is this difference [increase] only an apparent one, arising from the placing of some deaths under these in the later Bills [of mortality] which formerly came under other articles? There seems no reason for such a suspicion. If the increase be real, is it owing to any alteration in our manners, or diet? And what is that alteration? The practice of drinking spirituous liquors must, probably, answer for some part of this; and it might be of public use, if some attention were paid to the finding out of the other causes.

But there does not appear to be any increase in the distempers just mentioned, or in any other, which is not likely to be abundantly made amends for, by the decrease in the numbers destroyed by the small-pox, which may be hoped for from the practice of inoculation. Heberden, W. 1759. Preface to *A Collection of the Yearly Bills of Mortality*, London.



## II

### COMMUNITY DIAGNOSIS

Epidemiology provides the intelligence service of Public Health. The nature and relative size of health problems can be described, and various indications given of their social importance. For example, the 16 million male industrial workers of the country had 4,625,000 "spells" of sickness and injuries in 1953-54 which lasted four or more days, and totalled just over 200 million lost days.<sup>156</sup> Ten per cent of this certified incapacity to work was ascribed to "bronchitis" (20 million days lost), and "asthma" accounted for a further 3 million days; rheumatism, arthritis, sciatica, etc., were responsible for 17 million days; gastric and duodenal ulcer for 6 million days, other unspecified "gastric" and "duodenal" ailments for a similar figure; psychoneurosis, anxiety and the like for 10 million; industrial accidents for 16 million lost days. It is not possible to estimate the additional time lost in absences of one, two or three days.<sup>92</sup> Such facts may be sketchy and very general. How accurate the diagnoses are and what may be behind them cannot be at all readily assessed; practitioners, for example, are understandably unwilling to certify cancer when it is the cause of disability. More generally, the physician's social as well as personal responsibility in certifying fitness or unfitness for work may present difficult clinical problems. These figures do nevertheless provide some indicators of the people's health and capacity to work, and of the load of illness—all matters of high consequence now that the promotion of health and the vast network of medical care facilities are prime concerns of social policy. For the clinician they provide background and perspective to his work, some idea of the quantitative importance in the community as a whole of the cases he does and does not meet. Table II A, p. 12, tries to express some of this with an