for avoiding. Moreover, it is impracticable to eliminate all air pollution in the sense of all foreign matter released into the air from industrial processes. Therefore the problems are those of defining the actual pollutants that are harmful in specific ways and of devising economic ways to eliminate those pollutants; or, if they cannot be eliminated, to dilute them or keep them away from centres of population.

I think those are the main questions I would put before you. You see I have done what I was asked: I have asked some questions but have answered none of them, although I have put before you an unsubstantiated speculation for which, I suppose, scientifically, I ought to apologize.

Chairman: Looking down some of the consultation registers of the 17th century I saw mentioned the scab, the itch, the scurf, the plague, fever, the gout, the pox, the flux, and measles, but nowhere did I see bronchitis. In this century, the College of General Practitioners and others have shown in surveys that 26 consultations per 1,000 are for bronchitis, and that eight out of every 100 beds in general hospitals are occupied by bronchitic patients. There is a widespread failure, we know, to take seriously the report on the subject of the Royal College of Physicians, based, as Bertrand Russell said, on the conjugation of the verb: I think you are obstinate and that he is pig-headed! However, I will now ask Dr Holland to discuss the natural history of chronic bronchitis.

THE NATURAL HISTORY OF CHRONIC BRONCHITIS

W. W. Holland, M.D., B.Sc. (*Reader, Department of Clinical Epidemiology and Social Medicine, St Thomas's Hospital Medical School, London, S.E.1.*)

I am very grateful to you for inviting me to talk on this subject, particularly as on this occasion you have at least labelled my talk, " The Natural History of Chronic Bronchitis ". On the last occasion when I spoke on this subject I was introduced as someone who was going to talk about an ' English ' disease, and I was followed by a consultant venereologist. I am afraid that I disappointed my audience, who thought they would have a whole afternoon devoted to venereal disease. The description of chronic bronchitis as ' an

English disease' is, however, a far more apt description than that description would be for venereal diseases.

Figures of mortality rates for different countries throughout the world have been prepared by the World Health Organization (figure 1). They show that at least as regards bronchitis this country leads the world. There are, of course, problems about such mortality figures. However, we can obtain some clues on the aetiology and history of diseases by looking at such figures.

If we look at the death rate in this country by age and sex, we find that mortality rates begin to rise steeply after age 45 and are greater in females than males (table I).

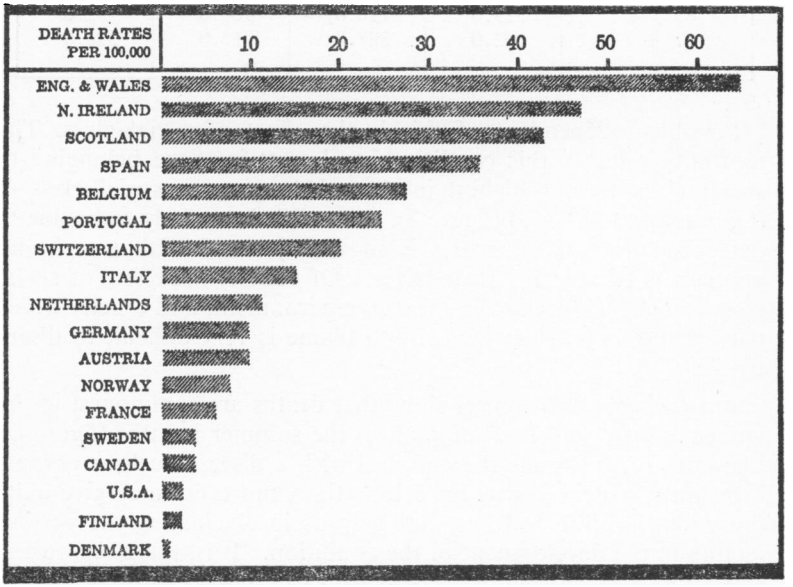


Figure 1

Death rates from bronchitis per 100,000 population
W.H.O. Report of Epidemiological and Vital Statistics Section, 6:321, 1953

If we look at mortality according to area, we find that this disease in this country is concentrated particularly in the north-west of England, in the Midlands, in South Wales, in the north-east of England and in London; and there is a broad agricultural belt in the eastern part of England and in the south-west that is relatively free from this condition (figure 2). To examine the effect of area more closely, one can examine the mortality rates according to the size of area. The mortality is far higher in the industrial conurbations

and in the urban areas than it is in the rural areas, which appears to give some indication that the type of area in which one lives may play a part (Reid 1956).

TABLE I

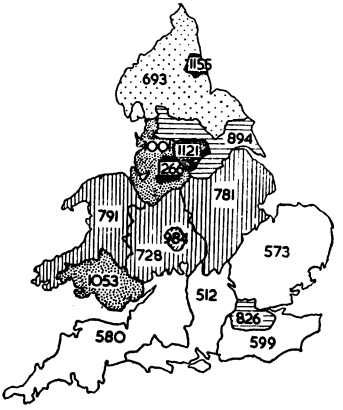
DEATH RATES PER 100,000 POPULATION AT CERTAIN AGES BY SEX, 1959–1960
ENGLAND AND WALES

Ages (years)	*1959*		*1960*	
	M	*F*	*M*	*F*
25—44 ..	3.3	1.9	3.5	1.5
45—64 ..	107.0	21.0	99.0	18.0
65—74 ..	513.0	116.0	466.0	92.0
75+ ..	962.0	388.0	916.0	328.0

Possibly independent of this is the effect of social class. The mortality rates of this condition are lowest in those belonging to social class I, and highest in those belonging to social class V (Goodman *et al.* 1953) (figure 3). That this is unlikely to be due to the occupation of the males is shown by the fact that a similar gradient is present for their wives. Of course, the effect of social class can also be partly the effect of environment, and exactly which part of the social class factor is to blame is very difficult to disentangle.

Finally, mortality figures show that deaths are commonest in the winter months and less common in the summer months (figure 4). Mortality is, however, the end and with a disease such as chronic bronchitis, which persists for a long time, mortality may give quite the wrong answer and may not help us in elucidating the various factors in the development of the condition. It is, therefore, necessary to look at morbidity. There are various ways of doing this.

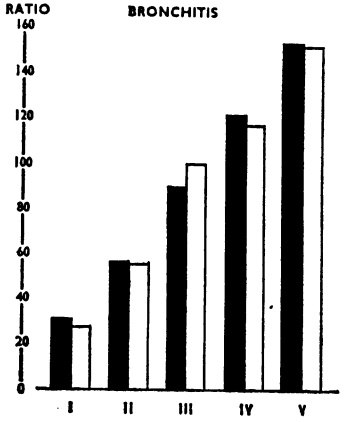
One example is a study by Reid (1958), in which he examined the wastage rates of postmen and the sickness-absence rates of postmen in different areas of this country. He used Post Office workers deliberately, since these all occupy approximately the same position in society in whatever area they live. Therefore, he was able to examine more closely the effect of such environmental factors as fog frequency, population density and domestic overcrowding. Bronchitis distinguished itself from cancer of the lung and from pulmonary tuberculosis and from influenza in that the factor most correlated with bronchitis morbidity and bronchitis mortality was fog frequency. Population density and domestic overcrowding played far lesser a role than, for example, in influenza.



—Bronchitis mortality in England and Wales. Rates per million, 1950.

Figure 2

Bronchitis mortality in England and Wales. Rates per million, 1950.



Distribution of deaths from bronchitis . . . according to social class, 1930–2. Ages 20–65 years. The mortality for all men (black columns) or all married women (open columns) is represented by 100.[8]

Figure 3

Distribution of deaths from bronchitis . . . according to social class, 1930–2. Ages 20–65 years. The mortality for all men (black columns) or all married women (open columns) is represented by 100[8].

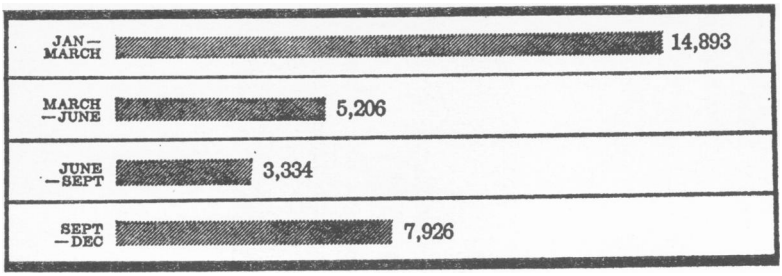


Figure 4
Deaths from bronchitis 1961

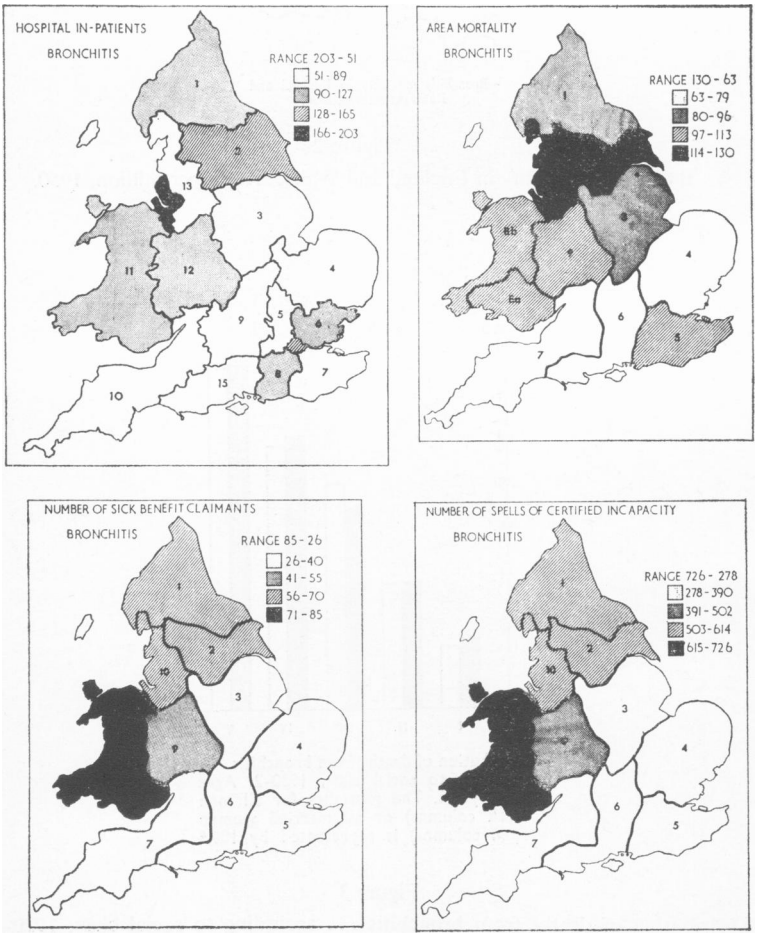


Figure 5
The geographical distribution of bronchitis by source of vital statistical data

Using another source of morbidity data Holland *et al.* (1961) studied the effect of various meteorological conditions on emergency bed service admissions to London hospitals. The applications for respiratory conditions in London are highest in the winter months; lowest in the summer months. Similarly, in the winter months temperature is low, whereas in the summer months temperature is high. This does not necessarily mean that because it is cold in the winter we have high mortality or morbidity rates from the conditions; because, similarly, we play a lot of football in the winter months and little in the summer months, and such correlations could then be used to show that the high admission rates of chronic bronchitic patients in the winter months is due to playing football. In order to try to disentangle such seasonal factors, therefore, it is necessary to look at the deviations from the mean; that is, to look at the deviations within a month. One could look at, for example, a warm winter January and a cold winter January and see whether in the cold January admissions were higher or lower than in the warm one. Similarly, one can look at the admissions in a warm summer month as opposed to admissions in a cold summer month. Using this type of investigation, one can show that, of the various factors that make up our weather, there are only two that independently affect emergency admission rates to London hospitals—atmospheric pollution, as measured by sulphur dioxide or smoke, and temperature. Humidity, rainfall and sun hours appear to have no effect.

If one examines the pattern of, for example, admissions to hospitals, mortality rates, sick benefit claims and spells of certified incapacity in this country, one would expect, that in areas where mortality was high, admission rates would be high and sickness-absence rates would be high. There are, however, certain problems (Holland 1965). In figure 5 we have collected figures comparing the age-standardized area mortality rates for bronchitis with hospital inpatient discharge rates for bronchitis and with the number of sick benefit claimants. It should be quite obvious to all of you from this figure that there are very wide differences that cannot be explained simply. This illustrates the problem of using such vital statistical data. Use of mortality statistics or morbidity statistics tells little about the personal habits of the individuals with the condition.

It is because of these various reasons that we have been concerned in the development of other methods. One of these is the use of a standardized questionnaire (Medical Research Council 1960). Use of standardized questions in a condition such as chronic bronchitis enables one at least to define somewhat more clearly, as Professor Scadding said, people with different symptoms and levels of symptoms. This helps one to get round the difficulty that doctors in different areas may use quite different criteria for diagnosis.

It also enables one to question the individual himself, who will know what his symptoms are, and relate them to the various environmental and other conditions which may play a part in the genesis of the condition. The use of the questionnaire and other simple objective tests, as for example sputum collection and ventilatory function methods, can be done in defined populations in order to unravel the effect of environmental and other factors (Holland 1963).

One example of such a study is one that has been done on Post Office and telephone workers in different areas of this country. (Holland and Reid 1965) and in the United States by Holland *et al.* (1965). We used Post Office and telephone workers because we wanted to equate as nearly as possible social and environmental factors other than such personal habits as cigarette smoking and levels of environmental air pollution. The three areas that we chose were London, three country towns in England (Peterborough, Norwich and Gloucester), and three towns in the United States (Westchester (New York), Baltimore, and Washington (D.C.)). We examined all men aged between 40 and 59 who were Post Office or telephone van drivers in each area and between 96 per cent and 98 per cent of all men doing this type of work were examined. In each area the men were asked the same standard questions; we collected a sample of sputum from them all in respect of the first hour after getting up the next day, and we did a simple test of ventilatory function (Peak Expiratory Flow Rates (Wright and McKerrow 1959); or Forced Expiratory Volume (McKerrow and Edwards 1961)).

To try to answer one of Professor Scadding's questions on the relative role of cigarette smoking and of environmental air pollution. As you will see symptom prevalence was uncommon in non-smokers in any area, but was very common in smokers of 25 cigarettes or more per day within each of the areas. In addition, within each smoking category symptoms were commoner in London and least common in the United States. In between were the country workers (figure 6).

That these differences are probably real was demonstrated by the results obtained from sputum collection in that very few non-smokers brought up more than 2 ml. of sputum a day, whereas quite a high proportion of smokers (certainly a much higher proportion than of non-smokers) brought up more than 2 ml. of sputum a day. In addition, expectoration of sputum was commonest in London and least common in the United States.

Finally, as regards one-second forced expiratory volume (figure 7), the ' A ' group are non-smokers, the ' E ' group are heavy smokers of 25 or more cigarettes a day. One-second forced expiratory volume is highest in the non-smokers within each area and lowest in the smokers within each area; so that smoking and where one lives appear

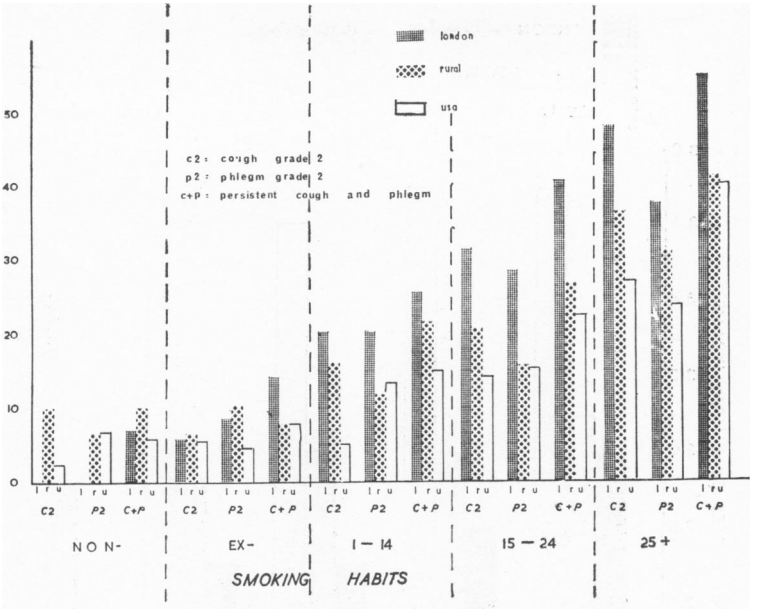


Figure 6
Symptoms and smoking and area of residence
(Cigarette equivalents/day)

to play a part in the level of symptoms, in the expectoration of sputum, and in levels of ventilatory function.

I have hesitated to say that the entire differences between these levels of symptoms and functions are due to levels of environmental air pollution. There were differences, particularly between the British and the American areas. There were also differences between the country towns and London, particularly in maximum levels of air pollution (Holland and Stone 1965). There were in addition undoubtedly certain differences in the living conditions, particularly between the British and the American workers. However, without any question, within each of the areas smoking played a very large role and in unpolluted areas such as the United States it appears to play the major, if not the only, role in the genesis of symptoms such as cough and phlegm production.

I cannot really answer Professor Scadding's question of the relative roles, although a very rough calculation, which I should not like you to believe in too much, indicates that smoking is a factor of five or six in symptoms compared to the factor of 1.2 for environment and air pollution. So I think that smoking plays a much greater role.

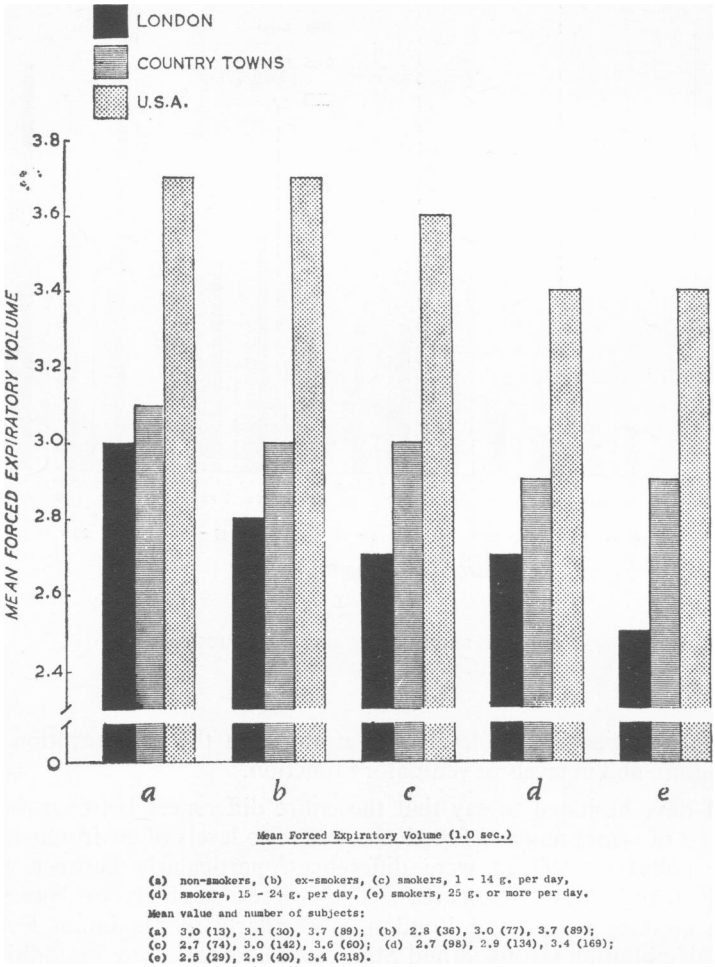


Figure 7

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