

Trends in Urban Air Pollution in the United Kingdom in Relation to Lung Cancer Mortality

by P. J. Lawther* and R. E. Waller*

The substantial reduction in air pollution, and particularly in components such as benzo[a]pyrene in urban areas of the United Kingdom during the past few decades has presented an opportunity to consider further the possible role of carcinogens in the air in relation to lung cancer. While the overall trends in lung cancer mortality have undoubtedly been dominated by changes in smoking, the marked contrasts that at one time existed between these death rates in urban and rural areas have gradually diminished. This may indicate that air pollution contributed appreciably to the urban/rural differences in lung cancer at one time, but it is still difficult to disentangle any effects it may have had from those of changing smoking habits.

The most important long-term effects on health of air pollution from the combustion of fossil fuels are probably those related to the development of chronic bronchitis. Death rates attributed to this cause have always been high in the United Kingdom as compared with those in other countries, and there has been a large contrast in rates between urban and rural areas (1). At the same time, pollution by products from the combustion of fossil fuels (notably coal smoke and SO₂) has also been a severe problem in urban areas of the United Kingdom, particularly in the first half of the present century. There were doubts originally about whether these considerations really indicated an association between bronchitis and air pollution, because of international and local differences in nomenclature of this disease, but the results of many careful epidemiological studies during the past two decades have confirmed that at least part of the difference in prevalence indicated by the mortality figures is real, and that there are contrasts between urban and rural areas that appear to be related to local levels of smoke and/or sulfur dioxide.

The question to which attention is being drawn in the present discussion is, however, the possible re-

lationship between exposure to general air pollution and cancer. Within that field, the main concern is with the presence of potentially carcinogenic polycyclic aromatic hydrocarbons as components of smoke in relation to the development of lung cancer. It was the astute observations of the late Percy Stocks, on trends in lung cancer in the United Kingdom some 40 years ago, and on the differences that then existed in death rates between urban and rural areas (2), that led to the more detailed investigations of the roles of air pollution and smoking which were started about 1947. As a result, the dominant part played by cigarette smoking was displayed, and studies on the benzo[a]pyrene content of urban air showed that domestic coal fires were important contributors, and there was a tendency for concentrations to be highest in large towns (3, 4). There was no reason to believe, however, that the rising incidence of lung cancer was related directly to the amounts of this carcinogen in the air, for the indications were that, as assessed from smoke measurements, concentrations had been declining in the large towns of Britain during the present century (5). That decline was accelerated by the Clean Air Act, 1956, and results of a series of benzo[a]pyrene measurements in London show that concentrations are now of the order of one-tenth of those that existed from 25 years ago (Table 1).

*MRC Environmental Hazards Unit, St. Bartholomew's Hospital Medical College, Charterhouse Square, London, EC1M 6BQ, England.

Table 1. Concentrations of benzo[a]pyrene in air at sites in Central London, 1949-73, based on 24-hr samples aggregated for yearly periods.

Period	Sampling site	Benzo[a]pyrene, $\mu\text{g}/1000 \text{ m}^3$
1949-51	County Hall	46
1953-56	St. Bartholomew's Hospital	17
1957-64	County Hall	14
1972-73	St. Bartholomew's Hospital Medical College	4

The contrast in concentrations of benzo[a]pyrene that at one time existed between large cities, smaller towns, and rural areas was the key to the interest shown in its possible relationship with lung cancer mortality, but these contrasts have become very small, and it is of interest therefore to consider whether urban/rural differences in lung cancer mortality are diminishing at all.

It is clear now that in the United Kingdom as a whole, trends in lung cancer mortality have been influenced largely by changes in smoking habits some 30 years earlier. Thus the death rates among men appear to have reached a maximum, reflecting the "saturation" level of cigarette smoking attained in the late 1930's and the wartime period, while among women and the death rates at most ages are still rising. When differences in mortality between urban and rural areas are being considered, it is then of fundamental importance to know whether there have been differences in smoking habits between such areas. Unfortunately there is relatively little information on this point, particularly in detailed categories by age and sex as well as by locality.

If the trends in lung cancer are considered carefully in different types of area, some interesting developments can be seen. Table 2 shows an extract

Table 2. Lung cancer: age specific death rates for males aged 60-64 in greater London and rural districts of England and Wales.

Year of death	Year of birth	Deaths per 100,000 ^a	
		Greater London	Rural districts
1951-55	1891	350	170
1956-60	1896	420	240
1961-65	1901	450	270
1966-70	1906	405	295
1973	1911	370	290

^aThese rates are approximate, being interpolated from tabulations in broader age ranges. Figures for the single year 1973 are given as an indication of those in the most recent quinquennium, and these are subject to revision.

from a large table that has been prepared (as the basis for a cohort study) contrasting trends in Greater London with those in rural districts of England and Wales. This extract is confined to men in one narrow age range, and among them maximum lung cancer mortality appears to have been reached in the early 1960's in London and in the late 1960's in rural districts. The pattern is consistent in other age ranges, and, in general, the highest death rates are among men born soon after the turn of the century, with the trends in rural districts lagging just a few years behind those in London. One result of this "phase-difference" is that the ratio of London to rural rates is changing gradually. On the basis of figures in Table 2, it has fallen from 2.1 to 1.3 over the past 20 years. It is not clear whether the gap between the London and rural rates will narrow still further, but at the present time a small "urban excess" remains.

It is difficult to interpret these trends, for they may in part be related to differential changes in smoking habits between urban and rural areas or to selective migration, with a tendency for men suffering from respiratory complaints to leave large cities such as London. It is of interest to consider changes in air pollution in this context. There has certainly been a large reduction in smoke concentrations in London and in other large cities in the 20 years since the introduction of the Clean Air Act. In relation to possible effects on the development of lung cancer, we may however have to look even further back, and there is evidence, both from the limited range of measurements made earlier this century and from the known changes in the use of coal, that in many cities a decline in pollution by smoke began much earlier. Reductions in the concentrations of benzo[a]pyrene are likely to have been at least as great as those in smoke, since the polycyclic hydrocarbons are associated particularly with grossly inefficient combustion and there has been a continued tendency to improve efficiency as far as possible. These large changes in pollution in the United Kingdom may ultimately help to resolve the problem as to how far carcinogens in the air have been responsible for differences between urban and rural lung cancer death rates, but at the present time it is still difficult to disentangle any effects from those of changing smoking habits.

Although much of the concern to date has been with the polycyclic aromatic hydrocarbons associated with the incomplete combustion of coal or oil, there may be other potentially carcinogenic substances in town air, and their number is likely to increase as the products of industry become more diverse. There may be good cause to consider this field to merit the more intense scrutiny.

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