Lung Cancer in South Africans and British Immigrants

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Dr David Eastcott of New Zealand is the originator of comparative epidemiological studies of lung cancer in locally-born and immigrant populations (Eastcott 1956). Studies in this field of epidemiology have also been carried out by Rakower (1957), Mancuso & Coulter (1958), Haenszel (1961) and others. My own interest in this field arose soon after my arrival in South Africa in 1947 but it was not until some ten years later that I was able to start my first study. The main finding of this study (Dean 1959) was that British male immigrants to South Africa who died between the ages of 45 and 64 had a much higher lung cancer rate than either white South African-born men or male immigrants from other countries of the same age group. This was followed by a further study in which I tried to trace relatives of all the 1,109 men born in South Africa or the United Kingdom who had died of lung cancer in South Africa aged 45–64 during the years 1947–56 and of a matched control group; the purpose was to obtain information about the smoking habits of those who had died. The main additional conclusions of this study (Dean 1961) were:

(1) Lung cancer was clearly associated with smoking, especially of cigarettes.

(2) Nevertheless, the lung cancer mortality rates of South African-born white men living in rural areas and smoking 1–20 cigarettes a day were only a little higher than those of non-smokers. This result was confirmed in a third study that I carried out in South Africa (Dean 1962*a*).

(3) British male immigrants increased their smoking after arrival in South Africa and yet had lower lung cancer rates than men in Britain.

The conclusion that British immigrants had higher lung cancer mortality rates than locally-born white men was found also in a study that I subsequently carried out in Australia (Dean 1962*b*). The same characteristic is to be found in the Channel Islands from about 1959 onwards ($P<5\%$). During the years 1952–8, the lung cancer mortality rates of locally-born men in the Channel Islands exceeded those of United Kingdom-born immigrants. Since 1958 this trend has been halted in Jersey and reversed in Guernsey, Alderney and Sark where the lung cancer mortality rates of United Kingdom-born immigrants now exceed those of locally-born men ($P<1\%$). The figures supporting these conclusions are summarized in Table 1.

Table 1

Comparison of age-standardized lung cancer mortality rates per 100,000 per annum of locally-born and United Kingdom-born men in South Africa, Australia and Channel Islands compared with England and Wales. (Numbers of deaths in brackets)

	Mortality rate per 100,000 per annum		
	Locally born	*UK-born immigrants*	*England and Wales*
South Africa, white men aged 45–64, 1947–56	51 (844)	106 (265)	135
Australia, men aged 40+, 1950–8	53 (4,934)	94 (1,801)	154
Channel Islands, men aged 35+:			
Jersey			
1952–8	145 (87)	104 (33)	139
1959–63	199 (86)	209 (54)	185
Guernsey, Alderney & Sark			
1952–8	131 (76)	69 (13)	139
1959–63	130 (55)	238 (34)	185
Total:			
1952–8	138 (163)	90 (46)	139
1959–63	165 (141)	221 (88)	185

The characteristic that I found in South Africa of men emigrating from Britain, apparently increasing their levels of smoking and yet having lower lung cancer mortality rates than men in Britain has been observed in other countries. The following summary illustrates this feature of lung cancer mortality in South Africa, Australia and the United States of America (Todd, personal communication, 1962):

(1) British male immigrants to *South Africa* aged 45 and over had an age-standardized lung cancer mortality rate of 125 deaths per 100,000 per annum during the years 1947–56, compared with the rate of 159 deaths per 100,000 in England and Wales. The men emigrating thus had a mortality rate 21% lower than the men they left behind. On the other hand, the daily cigarette consumption by men in approximately these age groups in 1947–56 was about 75% higher in South Africa (24 cigarettes daily per UK-born man aged 45–64) than in the United Kingdom (13·5 cigarettes, daily per man aged 35–59).

(2) Both male and female British immigrants to *Australia* aged 40 and over during the years 1950–8 had lower lung cancer mortality rates than men and women in England and Wales. The age-standardized mortality rate for male immigrants

to Australia was 94 per 100,000 per annum compared with a rate of 154 per 100,000 per annum in England and Wales (=39% less). The corresponding rates for females were 14 per 100,000 per annum for immigrants to Australia and 22 per 100,000 per annum for residents of England and Wales (= 34% less). The consumption of manufactured plus hand-rolled cigarettes per head in Australia (1,325 per annum in 1930, 3,417 in 1960) was slightly lower before the war and increasingly higher since the war than in the United Kingdom (1,408 per annum in 1930, 3,014 in 1960).

(3) Men and women emigrating from England and Wales to the *United States* who died in 1950 had a lower lung cancer rate than residents of England and Wales. According to Haenszel's (1961) figures, the reduction was 46% for men and 10% for women. In 1950, cigarette consumption per adult in the United States (3,250 cigarettes per annum) was 50% higher than in the United Kingdom (2,160 cigarettes per annum).

Cigarette consumption has long been higher in the Channel Islands than in Britain, but during the years 1952–8 the lung cancer rates of British immigrants to the Channel Islands were less than those of residents of England and Wales (Table 1). Since 1959, however, the lung cancer mortality rate of United Kingdom immigrants to the Channel Islands has exceeded the corresponding rate in England and Wales. In Jersey the difference was not statistically significant ($P>10\%$), but in Guernsey, Alderney and Sark the difference was significant ($P<5\%$).

The evidence, however, seems indisputable that men can emigrate from Britain to several areas, increase their cigarette consumption level considerably and yet have lower lung cancer rates than the men they leave behind. The emigrants are a selected group. Haenszel (1961) wrote:

'Since migrants were presumably subject to selection by health status, socio-economic class, locality, &c., there is no assurance that comprehensive national data from countries of origin would be truly comparable with those for their migrants to the United States. Also, for sites with strong urban-rural differentials, comparisons of predominantly urban groups of migrants with composite urban-rural groups in the home country would be imprecise.' Todd (1962, personal communication) has commented as follows: 'As regards the first point made by Haenszel, even if migrants from the United Kingdom were healthier than the average of the population and if this meant that they had greater than average resistance to the causes of lung cancer, it still remains true that this more than averagely healthy section of the United Kingdom population experienced in the United States a considerably higher lung cancer rate than men and women born and dying in the United States. Haenszel's second point only heightens the contrast between the lung cancer mortality rates of United Kingdom residents and the United Kingdom emigrants if it should be true that the latter lived in urban areas of the United Kingdom to a greater extent than the former.'

On the other hand, it is true that UK-born male immigrants to South Africa dying of lung cancer aged 45–64 in 1947–56, in so far as they could be classified according to their occupations before death in South Africa, came from a higher social class on the average than the male population of England and Wales in 1951, as shown in Table 2.

Table 2

Social class distribution, where classifiable, of male population of England and Wales and of United Kingdom-born male immigrants to South Africa

		South Africa	
		UK-born male immigrants, aged 45–64, 1947–56	
	England & Wales: Males, all ages,	*Lung cancer*	*Control*
Social Class	1951 %	*deaths* %	*deaths* %
I	3	7	6
II	15	21	21
III	53	67	66
IV	16	4	6
V	13	1	1
	100	100	100

If, however, the United Kingdom-born immigrants to South Africa dying of lung cancer are re-weighted according to the social class of the male population of England and Wales, the average lung cancer mortality rate of the former is reduced by only about 4%.

In the report of my second study in South Africa (Dean 1961), in order to illustrate the basic differences between the lung cancer mortality rates of South Africa and the United Kingdom, I estimated the number of lung cancer deaths that would have occurred among men in the United Kingdom aged 45–64 in 1958 if they had been subject at each level of smoking to the lung cancer mortality rates of South African-born men living in rural areas of South Africa. On this basis, lung cancer among United Kingdom men would have been about 20–25% of its actual level.

In the light of evidence available at that time, I came to four conclusions:

(1) That differences between the United Kingdom and South African smoking habits were unlikely to account for these differences.

(2) That when combined with smoking, exposure to air pollution may have more than additive effect.

(3) That the elimination of air pollution from urban areas would substantially reduce the incidence of lung cancer, as long as cigarette consumption did not increase.

(4) That the adverse air conditions in the United Kingdom could reflect the effect of climate and respiratory infections as well as air pollution.

Table 3
Smoking characteristics of men aged 40–69 in United Kingdom and South Africa

	United Kingdom	*South Africa*
Estimated length smoked of cigarettes:		
Plain	47 mm	52 mm
Filter-tipped	51 mm	58 mm
Average number of puffs per cigarette	12·7	13·8
Proportion of cigarette smokers inhaling moderately or deeply	74%	89%
Average age of starting to smoke	18 years	17 years

Since 1961, when I wrote, further evidence has become available on all four points. At my suggestion, the Tobacco Research Council in London arranged for comparable surveys of cigarette smoking characteristics in the United Kingdom, South Africa and Australia to be carried out. The results have been published (Todd 1963). The main conclusions reached in this report were:

(1) Until 1951, the manufactured cigarettes smoked in the United Kingdom and South Africa were very similar. They were very largely of the same type (plain and not filter-tipped), of the same length and, with the exception of a moderate use of air-cured tobacco in South Africa, the cigarettes were broadly similar in blend.

(2) The length of butt discarded by male smokers aged 40–69 of manufactured cigarettes in recent years was shorter in Britain than in South Africa, but notwithstanding this the actual length of tobacco smoked was less in Britain owing to the substantial change-over in South Africa to king-size filter-tipped cigarettes in the last ten years.

(3) South African male cigarette smokers aged 40–69 took more puffs per cigarette than the United Kingdom cigarette smoker.

(4) A higher percentage of male cigarette smokers aged 40–69 inhaled moderately or deeply in South Africa than in the United Kingdom.

(5) In all three countries, male cigarette smokers aged 40–69 had started to smoke about the same average age.

The figures are summarized in Table 3.

If these smoking characteristics and the number of cigarettes smoked had been the only factors contributing to lung cancer, it would not have been unreasonable to expect them to have led to higher lung cancer rates in South Africa than in Britain instead of *vice versa*.

My earlier conclusion that smoking and air pollution may have more than additive effect when combined seems to be confirmed by evidence that is emerging from a survey of environmental factors in relation to lung cancer and bronchitis on Tees-side. This survey was carried out at the request of the local Medical Officers of Health by the Health Surveys Division of AGB Research Ltd, who invited me to act as a consultant to them. The survey included Eston, which is an urban district adjacent to Middlesbrough and contains many inhabitants who lived close to, and were employed in, steel-making and other plants; it also included the rural districts of Croft, Northallerton, Richmond and Stokesley in north Yorkshire. Provisional lung cancer mortality rates per 100,000 men per annum are shown in Table 4.

Table 4
Lung cancer mortality rates per 100,000 per annum. Men aged 35+

	Mortality rates, 1952–60			*1960–62*
	Eston Urban District	*Stockton*	*Rural areas North Riding*	*Truly rural districts Northern Ireland*
Non-smokers	23	26	24	10
Cigarette only smokers:				
1–10 daily	115	127	30	20
11–22 daily	124	147	52	63
23+ daily	446	351	208	155
Mixed smokers	229	181	107	56
Pipe or cigar smokers	161	108	89	46
All smokers + non-smokers	151	147	69	44

Note: All figures are provisional

I have included in Table 4 some figures from a survey that I am carrying out in Northern Ireland with the co-operation of the Ministry of Health and Local Government, the Registrar General and the local Medical Officers of Health.

Other data from the Tees-side survey support the conclusion that the differences between the rural and urban mortality rates of smokers reflect effects of exposure to air pollution in both occupation and place of residence. While I believe that cigarette smoking contributes much more than any other controllable environmental factor to lung cancer, I still think that a substantial reduction in lung cancer would occur if air pollution in all its forms were to be eliminated.

Nevertheless, the contribution made by the British climate to lung cancer seems to have been seriously underestimated. An estimate has been made of what the lung cancer mortality rates for different levels of smoking would have been in England and Wales (Todd, personal communication 1964), by weighting certain figures published by Stocks (1958) so that as far as possible they applied to the country as a whole. These estimates for England and Wales may be compared with as nearly corresponding rates as possible for the Channel Islands and South Africa (Table 5).

Table 5

Lung cancer mortality rates per 100,000 per annum by smoking levels. All men in England and Wales: locally-born men in Channel Islands and South Africa

	England & Wales	*Jersey*	*Guernsey, Alderney & Sark*	*South Africa*
Age groups	35–74	35+	35+	45–64
Years covered				
from	Mid-1952	1952	1952	1947
to	Mid-1955	1956	1956	1956
Mortality rates				
Non-smokers	30	11	15	8
Cigarette smokers:				
1–22 daily	138	126	89	25
23+ daily	285	390	242	99
Mixed smokers	n.d.●	120	122	59
Pipe and/or cigar smokers	73	39	157	30
All smokers + non-smokers	132	126	115	50

● n.d. = not distinguished

Despite the differences between the coverage of the various sets of figures, it may be fair to draw broad conclusions. As has frequently been said, there is no air pollution problem in the Channel Islands. Yet the lung cancer mortality rates in the Channel Islands at each level of smoking are usually several times the South African rates and frequently of approximately the same order of magnitude as the estimated rates of England and Wales. It is therefore difficult to believe that the damp, cold climate and overcrowded living conditions of Britain and the Channel Islands, with the repeated respiratory infections that result, do not contribute very considerably to the differences between the lung cancer rate of these areas and South Africa. Finally, where England and Wales have had the effect of air pollution on their lung cancer rates, the Channel Islands have had longer experience of higher smoking levels.

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