

TABLE 4
CAUSES OF DEATH AMONG MALE ASBESTOS WORKERS
COMPARED WITH MORTALITY EXPERIENCE OF ALL
MEN IN ENGLAND AND WALES

Cause of Death	No. of Deaths		Test of Significance of Difference between Observed and Expected (Value of P)
	No. Observed	Expected on England and Wales Rates	
Lung cancer*: with mention of asbestosis ..	11	—	<0.000001
without mention of asbestosis	0	0.8	
Other respiratory diseases (including pulmonary tuberculosis) and cardiovascular diseases: with mention of asbestosis ..	14	—	<0.001
without mention of asbestosis	6	7.6	
Neoplasms other than lung cancer	4	2.3	>0.1
All other diseases†	4	4.7	
All causes	39	15.4	<0.000001

* Including one case with pulmonary tuberculosis.

† Including two cases (benign stricture of oesophagus and septicaemia) in which asbestosis was present but was not thought to have been a contributory cause of death.

an increased mortality from lung cancer, other respiratory diseases and cardiovascular diseases, in association with asbestosis, but that their mortality from other diseases was close to that expected.

Four explanations of the findings are possible: (1) that all the men who had died of lung cancer were recorded because of interest in the condition, but that some of the records of other men dying of other diseases or still alive were omitted, with consequent underestimation of the expected number of deaths; (2) that lung cancer was incorrectly and excessively diagnosed among the asbestos workers; (3) that lung cancer was insufficiently diagnosed among the general population of England and Wales; or (4) that the asbestos workers studied suffered an excess mortality from lung cancer.

It certainly cannot be claimed that the records of the Personnel Office were necessarily complete, but they were believed to be complete and no deficiency on this score would account for the total excess of deaths unless it were so gross that more than half the defined population had been omitted. Moreover, the number of deaths due to conditions unrelated to asbestosis was close to the estimated number and this is unlikely to have happened unless the population had been estimated approximately correctly and the deaths from all causes fully reported.

All the 11 deaths attributed to lung cancer were confirmed by necropsy and histological examination so that the excess number cannot be attributed to incorrect diagnosis among the group of asbestos workers. Some of the excess may well be due to an underestimation of the expected deaths since part of

the increase in mortality attributed to lung cancer over the past 30 years is certainly due to improvements in diagnosis and in therapy (Doll, 1953). Even, however, if it were postulated that the whole of the recorded increase between 1931 and 1951 was spurious and that the real mortality from the disease throughout was that ascribed to it in 1951, the expected number of deaths is increased to only 1.1 and the observed excess is still grossly significant. For the actual number of lung cancer cases to be so little in excess of the expected as to be reasonably attributable to chance, it would be necessary for the expected cases to be 6.2, that is 5.6 times the number estimated on 1951 rates. In other words, it would be necessary to postulate that in 1951 (and throughout the previous 20 years) there was 5.6 times as much cancer of the lung as was recognized in 1931, which would mean that the condition would have to have been present and capable of detection in over 20% of all men at death. Moreover, even if this were so, it would still not account for the fact that all the cases of lung cancer were found in association with asbestosis.

It is, therefore, concluded that the fourth explanation is the most reasonable one and that the asbestos workers who had worked for 20 or more years in the "scheduled areas" suffered a notably higher risk from lung cancer than the rest of the population.

To test if the risk has altered since the 1931 regulations were introduced, it is not only necessary to make allowance for duration of employment before the end of 1932, but also to allow for the men's ages and for the total durations of their employment in the "scheduled areas", since the men employed in the earlier periods can also have been employed longer and lived to be older. On the other hand, there is no need to consider the changing incidence of lung cancer in the total population of England and Wales since the non-industrial risk has been shown to be small in comparison with the industrial one. The data required for comparing the risks among men employed for under 10 years, for 10 to 14 years, and for 15 years and over in the pre-1933 conditions are shown in Table 5. The ages shown are the ages at death of the men who have died and the ages in mid-1953 for the men who are still alive. The expected numbers of men in each pre-1933 employment group found to have asbestosis or asbestosis and lung cancer are estimated by multiplying the numbers in each age, total employment, and pre-1933 employment subgroup by the proportions of men with asbestosis or with asbestosis and lung cancer in the same age and total employment group for all lengths of pre-1933 employment combined. For example, three out of the nine men aged 50 to 54 years who had