

CANCER IN COKING PLANT WORKERS

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A review of death certificates, received in connexion with a funeral benefit scheme, suggested to the officials of the National Union of Mineworkers that there seemed to be an unduly high proportion of deaths due to cancer among workers in coking plants. At the request of the National Joint Consultative Council, a special study was made of the mortality experience of the industry. Its methods and results are reported below.

Apart from an unpublished report by Sir Thomas Oliver in 1930, little has been written about the health of workers in the coking plants of this country; and Oliver's study is impressionistic rather than factual in its approach. Indeed it is usual for coke-workers to be taken together with gas workers in the Registrar-General's account of occupational mortality. The basic processes in the production of metallurgical coke and of gas for industrial or domestic use are, of course, similar, and strong suggestions of an increased liability of gas workers to cancer of the skin and bladder (Henry, Kennaway, and Kennaway, 1931) and of the lung (Kennaway and Kennaway, 1947; Doll, 1952) are relevant to our problem. Thus we note that in Table 1 skilled gas workers had, at all ages over 35, higher death rates from cancer than males of the same social class.

TABLE 1

CANCER DEATH RATES IN SKILLED GAS WORKERS AND MALES OF SAME SOCIAL CLASS*
(REGISTRAR-GENERAL'S DECENNIAL SUPPLEMENT ON OCCUPATIONAL MORTALITY 1930-32)

Group	Age					
	35-	45-	55-	65-	70-	75-
All males in social class IV	0.5	1.6	4.7	8.9	11.8	15.1
Skilled gas workers	0.6	2.6	7.0	19.3	18.6	20.3

*Rates per 1,000 per annum.

These results apply to makers of gas and coke in general, but there are differences between coking

plants and gas works—in the type of coal and the methods of its treatment—which may affect the production of carcinogenic agents and the resultant cancer mortality. A special enquiry in coking plants was clearly required.

Conduct of Survey

Through the cooperation of the Carbonization Department of the National Coal Board and the Cokemen's Area of the National Union of Mineworkers, a complete record was obtained of the occupational histories of all men dying while still on the books of N.C.B. coking plants during the period 1949-54 inclusive. The cause of death in each case was ascertained either by reference to claims made on the Union's funeral fund, which had to be supported by a copy of the death certificate, or by a special search at the General Register Office. During the period of review, the average number of men employed in N.C.B. coking plants was about 8,000. A special census taken in 1952 gave a breakdown of this total by present job and age. At the same time a quasi-random sample was selected by taking every tenth man on the alphabetical lists of employees on the weekly payroll of each coking plant. For this 10% sample of the men employed a more detailed history was obtained of the nature and duration of different jobs done while working in the plants.

Information was also available from the funeral fund on the causes of deaths among individuals dying after their retirement from the plants, but no record had been kept of the number and age distribution of all such former employees, living or dead. For those dying within the period 1949-54, however, the past occupational history was obtained from the coking plants.

Method of Analysis

To the total number of man-years of exposure over the period 1949-54, divided according to the age and job distribution given in the special census in 1952, have been applied the cause and age-specific

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TABLE 2
COMPARISON OF OBSERVED DEATHS ACCORDING TO LAST JOB WITH DEATHS EXPECTED AT OTHER INDUSTRIAL RATES

Cause of Death	Oven Workers		By-product Workers		Maintenance						Total	
	Observed	Expected	Observed	Expected	Labourers		Workers		Foremen		Observed	Expected
					Observed	Expected	Observed	Expected	Observed	Expected		
Cancer of respiratory tract	4	5	3	3	2	6	10	7	2	1	21	23
All cancer	24	16	9	9	10	21	22	24	6	3	71	73
Other causes	50	49	29	26	57	60	95	72	14	9	245	216
Total, excluding cancer of respiratory tract..	74	65	38	35	67	81	117	96	20	12	316	289

death rates prevailing in the period 1950-54 in a large industrial organization. These rates were similar to those found in the General Post Office during a corresponding period but were more useful in that they extended beyond the usual retiring age of 60 for civil servants. Sick leave arrangements and the period of retention on the books during prolonged illness were similar in the two industrial groups. (National death rates make a less suitable standard of comparison since they derive from all male deaths including those of chronically incapacitated men.) The application of these standard age-specific rates to the corresponding age groups of men in different jobs gave a total of expected deaths which could be compared with those actually reported in the coking plants. Since no population data were available, only proportional death rates could be calculated for ex-employees.

The many types of worker in a coking plant seem to fall naturally into four main groups. The first of these consists of men who operate the coking ovens, driving the ram, filling the oven, clearing the hydraulic main, etc. The second group consists of men working on the recovery of by-products such as tar, ammonia, and benzole, while the last two include labourers—whose duties and contacts vary greatly—and another broad group of maintenance men and craftsmen who from time to time are in contact with the processes. Foremen, who have a roving supervisory commission, may also be separated out. These are the occupational groups used in the analysis.

Summary of Results

Cancer in Present Employees.—Table 2 shows the numbers of deaths, both from cancer and from all other causes, in each occupational group observed and expected at standard rates. In total there is no excess in the number of cancer deaths, and the slight excess in deaths from other causes suggests that there has been no serious under-reporting of deaths in coking plant staff. This excess of deaths from other causes comes entirely in the maintenance group which may have contained a number of men doing lighter tasks because of indifferent health. Of particular importance is the complete lack of any excess in cancer of the respiratory tract among men working on the ovens where exposure to fumes might be expected to be greatest.

“Present job” may not, however, be the best indicator of past occupational exposure in the coking industry. From the sample survey of occupational histories the frequency of having worked either on the ovens or in the by-product section of the plant was computed for men in each age and each “present job” group. The application of the same standard death rates as used before gave the expected numbers of deaths, which are compared in Table 3 with the numbers reported. There is close agreement between expectation and observation in those who have at any time worked in the by-product sections. This suggests that by-product process work is not associated with any excessive cancer risk. Among the oven workers, past and present, there is some apparent excess in the number

TABLE 3
COMPARISON OF OBSERVED AND EXPECTED DEATHS ACCORDING TO OCCUPATIONAL EXPOSURE

Cause of Death	Men Employed at Any Time as Oven Workers		Men Never Employed as Oven Workers		Men Employed at Any Time as By-product Workers		Men Never Employed as By-product Workers	
	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected
Respiratory cancer	14	10	7	13	4	6	17	17
All cancers	40	32	31	41	16	18	55	55
Other causes	71	95	174	121	46	53	199	163
Total, excluding cancer of respiratory tract..	111	127	205	162	62	71	254	218

of deaths due to cancer and four out of the seven extra cases died from cancer of the respiratory system. This excess is small and might well have occurred purely by chance. It should be pointed out, however, that past histories for the dead men may not be as reliable as the occupational records available for those still employed in the industry, and that the frequency of oven exposure among the former may be understated. Table 3 certainly does show an excessive number of deaths from other causes among the "never employed" groups but there is no corresponding excess in the cancer deaths which might be masking a real occupational hazard.

Cancer in Former Employees.—Since we do not know the age distribution of men who have retired from work in the coking plants, we cannot make the same type of comparison between the number of deaths from cancer and other causes observed among them with the number to be expected at standard rates. We can only assume that if the death rate from other causes is the same in groups of men who had done different jobs in the coking plants any serious excess in cancer death risk will be reflected in a high proportion of the total number of deaths in a particular occupational group being due to cancer. The first section of Table 4 shows

the number of deaths among former coking plant employees divided according to the job done before retirement; the second section gives the proportional death rates for all types of cancer (as a percentage of all deaths) and for lung cancer (as a percentage of all cancers) in each of those occupational groups. As Table 4 shows, these proportional death rates do not differ greatly between the groups. In view of the small numbers on which the rates are based, such differences as there are might well be due to chance; and there is certainly no suggestion that either of the proportional cancer death rates is unduly high among former oven workers.

These deaths have been arranged according to the last job in the coking plant, but because of failing health in their later years some men may have changed their job in the plant before final retirement. The deaths and proportional death rates, calculated as above, are given in Table 5 for groups of men who have worked for some time on either the ovens of the by-product sections and for the remainder of the plant staff in each case.

Again there is no important difference in the proportional rates in the four contrasting groups. This constancy in proportional rates suggests that they are not being unduly affected by the differences in the death rates from other causes, which is the

TABLE 4
DEATHS AND PROPORTIONAL DEATH RATES BY FORMER OCCUPATION IN RETIRED EMPLOYEES

Cause of Death	Oven Workers	By-product Workers	Labourers	Maintenance Workers	Foremen	Total
<i>Deaths and Previous Occupation</i>						
Respiratory cancer	3	4	4	3	1	15
All cancer	12	12	11	12	4	51
Other causes	43	25	42	30	8	148
Total, excluding respiratory cancer . .	55	37	53	42	12	199
<i>Proportional Death Rates and Previous Occupation</i>						
Respiratory cancer	25	33	36	25	25	30
All cancer						
All cancer	22	32	21	23	33	26
Total deaths						

TABLE 5
DEATHS AND OCCUPATIONAL HISTORY

Cause of Death	Men Employed at Any Time as Oven Workers	Men Never Employed as Oven Workers	Men Employed at Any Time as By-product Workers	Men Never Employed as By-product Workers
Respiratory cancer	5	10	4	11
All cancer	23	28	15	35
Other causes	64	84	30	118
Total, excluding respiratory cancer . .	87	112	45	153
<i>Proportional Death Rates and Occupational History</i>				
Respiratory cancer	22	36	27	31
All cancer				
All cancer	26	25	33	23
Total deaths				

usual source of their unreliability. Indeed, the indications given by these rates are remarkably consistent with the age-standardized comparisons already made for the employed men in suggesting that there is no grossly excessive cancer death risk in any particular occupational group.

The increase in respiratory cancer in men who have worked on the ovens can be further studied by taking duration of exposure into account. The number of years of employment in the coking industry and the number of years spent working on the ovens for 20 of the men dying from respiratory cancer while still on the books, for whom detailed histories were available, are compared in Table 6 with similar durations for men of similar age still alive and selected at random from those included in the occupational sample survey. There is no suggestion apparent in these data that the occupational history of the men dying from respiratory cancer differs appreciably from that of a random sample of coking plant employees of the same age.

TABLE 6
DURATION OF EMPLOYMENT IN RESPIRATORY CANCER DEATHS AND SAMPLE EMPLOYEES

	Respiratory Cancer Deaths	Sample
Oven work	16.3	16.7
Total in coking plant	23.0	25.3

Cancer of the Bladder.—In view of the suggestions that gas workers have an excessive mortality rate from cancer of the bladder, the national age-standardized cancer of the bladder death rates for the years 1949-54 inclusive (Case, 1953) have been applied to the N.C.B. coking plant population. The deaths upon which the rates tabulated by Case are based will include deaths occurring among men removed from the books of firms after prolonged absence from work. Despite this, there is a close agreement between the numbers expected at these national standard rates (five) and the numbers actually reported (four) in the N.C.B. coking plants during the period of the survey.

Discussion

The results obtained seem to imply that as far as recent experience in the coking industry goes, there is no great excess in cancer mortality in general nor in respiratory cancer in particular, even among the men who have worked on the ovens. This finding differs from the results of earlier work on the mortality of workers in the gas industry (Kennaway and Kennaway, 1947; Doll, 1952) which suggested a twofold increase in respiratory cancer among men in that industry.

The agreement between observation and expectation for other causes of death suggests that the methods of collecting population data, the reporting of deaths, and the application of standardized rates were reasonably efficient. With the numbers involved in this study we could anticipate being able to detect as large a difference as a twofold increase in respiratory cancer. That the excess is apparently now less than this may be due to several factors. Quite apart from differences in plant siting or operation, present conditions in the coking industry may be quite different from those prevailing in the gas industry a generation ago; and previous mortality studies were based on the experience of the earlier generation. Of greater importance, however, is the great change in the prevalence of cancer of the lung in the general population: the crude death rate in males increased fivefold in 20 years.

If this increase is due to a universal habit like cigarette smoking the effect of occupational exposure to industrial air pollutants may be submerged. For these reasons, we may conclude that, relative to current risk in the population at large, the mortality in the coking industry from cancer in general and cancer of the lung in particular, is not as excessive as had been feared, and may in fact be negligible. To give a more precise answer, large-scale follow-up studies, such as the one now in progress in the gas industry, would be required.

Summary and Conclusions

The number of deaths from cancer and other causes in the coking plants of the National Coal Board during 1949-54 inclusive have been compared with numbers expected on the basis of the mortality experience of another large industrial organization. No general excess of deaths from cancer was found either in the coking plant population as a whole or in particular occupational groups. An excess in the number of cancer of the lung deaths among men who had worked on the ovens was not paralleled by any increase in proportionate cancer of the lung death rates among retired oven workers nor by any difference in occupational exposure between 20 men dying from cancer of the lung and other employees still at work and of the same age.

The reasons for this apparent divergence between past experience in similar industries and present experience in N.C.B. coking plants are discussed.

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