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A proportional mortality study of a group of newspaper workers

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Greenberg, M. (1972). *Brit. J. industr. Med.*, **29**, 15-20. **A proportional mortality study of a group of newspaper workers.** In investigating an anecdotal report of a high incidence of bladder cancer at a London newspaper printing factory, death certificates for 670 workers relating to the years 1954-66 were studied. While an increased incidence of carcinoma of the urinary organs could not be demonstrated, the total of all malignancies was greater than predicted and carcinoma of the bronchus accounted for much of the excess. Only death by suicide occurred to excess among causes of death other than malignancy.

The smoking habits of subjects are not known but if tobacco habit contributed to bronchial carcinoma it had no observable effect on the incidence of chronic bronchitis and ischaemic heart disease in early middle age.

It is concluded that a prospective study would be required if occupation is to be implicated as a hazard.

During the latter part of the nineteenth century the printing trade was considered to be an occupation unhealthful beyond average. This contention was borne out by statistics collated in Berlin and America from such sources as insurance companies and Union Sick Funds (Silberstein, 1908; Hamilton and Verrill, 1917). Compared with other occupational groups, printers showed a high sickness ratio and death rate. Pulmonary tuberculosis accounted for one-half to one-third of all deaths in printers (Silberstein, and Sommerfield quoted by Silberstein, 1908). However, by the beginning of this century, when tuberculosis was being brought under control, the lowering of the death rate for tuberculosis was greater for printers than for men in the general population (Hamilton and Verrill, 1917). In 1902 Aschoff remarked that printers appeared to have a low mortality from malignant disease, about one-eighth that of agricultural workers. Young and Russell (1926), studying all cancers, found an excess of bladder cancer in printers for the years 1910-12 at a time when lung cancer represented 1·06% of all cancer deaths, but this was not found by Henry, Kennaway, and Kennaway (1931), who examined the Registrar General's data for 1921-28.

Kennaway and Kennaway (1947), studying cancer of the lung and larynx in relation to occupation, observed 61 cases of lung cancer in printers as against 59·7 expected in the years 1921-32 and observed 116 cases as against 88·8 expected in the years 1933-8.

Ask-Upmark (1955) in Sweden reported a high incidence of bronchial carcinoma in typographers, by which he appears to mean all printing workers. A prospective survey in California was started in 1950 by Dunn and Weir (1968) and showed an inexplicable deficit of lung carcinoma in printing workers to 1960, but by June 1965 this deficit was no longer apparent. The Registrar General's statistics for printers in England and Wales in recent years have not indicated any abnormal mortality pattern (Registrar General, 1951).

Goldstein, Benoit, and Tyroler (1970), studying the effect of exposure to oil mist, followed a population of about 460 pressmen at a newspaper factory for over 15 years. Seven hundred compositors

formed a control group. They concluded that there was no evidence that exposure to oil mist influenced mortality due to respiratory disease in pressmen. Three pulmonary carcinomas were reported in the pressmen and six in compositors.

The different conclusions reached by these authors may be based either on disparate population samples, variation in diagnostic criteria, or non-comparable types of printing exposure. If there were in recent years a special risk in newspaper printing, and newspaper printers represented a small proportion of the national total of printing workers, then this group would be swamped in the larger industrial groups (regional or national) studied.

The present paper originated as an investigation of anecdotal reports of a high incidence of bladder cancer among workers at a London newspaper printing factory. A preliminary communication published in the Annual Report for 1969 of H.M. Chief Inspector of Factories (Cmnd 4461, page 57) reported an excess of carcinoma of the bronchus. Enquiries subsequently showed that the printers forming the subject of this study comprised workers at Factory A in the report by Moss, Scott, and Atherley (1972).

Details of population and method of study

The death certificates of 670 male printing workers who died in the years 1954-66 were available for examination. These certificates had been submitted by next of kin in support of an application for a grant. All active or retired workers at the newspaper printing factory, skilled, semi-skilled or unskilled, belonged to its pension scheme and they nominated a relative to receive a sum of money on death. It is not known if this was a complete set of certificates. There is no reason to suppose that there was anything unrepresentative about the group of certificates submitted in support of the death grant for the years 1954-66. Nearly all subjects studied would have spent the whole of their working lifetime in the printing industry. Some of the skilled workers were employed on shift work at more than one factory. The organization of the newspaper printing industry and printing unions is such that, although printers in the London area occasionally change employers during their lifetime, they remain in the industry. That this is true of the skilled workers is not surprising, but questioning of workers, supervisors, and managers indicates that it also applies to the unskilled. Occupational history records do not exist for the group studied. The group defined as newspaper workers was restricted to:

1. linotype operators and compositors
2. stereotypers, bench hands, engineers, and process operators
3. printers, assistant printers, machine minders, assistant machine minders and reel hands
4. readers and correctors
5. packers and warehousemen
6. electricians, engineers, carpenters, maintenance workers, and labourers.

Although it would be desirable to study these groups separately to see if mortality patterns vary this would have been unrealistic. In the course of a lifetime, individual workers may experience a variety of conditions at a number of factories and indeed in the same factory. Even in the larger printing works separation of processes is neither complete nor uniform. For example, in one factory packing and despatching is carried out in a separate department whereas in another it is close to the printing machines, so that printers, packers, and despatchers are subject to the same environment. Furthermore, where it was possible to check particulars given on the death certificate the occupation given was often misleading or imprecise. The lack of precision of occupational classification was not peculiar to this study, thus the Registrar General (1951) comments: 'Printing machine minders and their assistants, printers and machine rulers form a group of occupations within which there appears to have been considerable incorrect reporting of occupations and little reliance can be placed on SMRs for individual occupations.' No personnel records were available to carry out an age profile study or an accurate departmental analysis. Although a proportional mortality study presents problems of interpretation resulting from the varying mortality experience related to social class, smoking habits, the peculiar characteristics of the group studied, and the geographically associated variations in mortality patterns, this was the only method available in the present study. All subjects had worked in Greater London though many had retired to or resided outside the Greater London area in the dormitory areas of south-east England. Taking the Registrar General's mortality data for Greater London for comparison presented a more severe criterion for comparison of observed figures with predicted figures for certain diseases in that the SMR for neoplasms, suicide, degenerative heart disease and bronchitis was higher for Greater London than for the South Eastern Region, while that for ischaemic heart disease was lower. Using Greater London figures in the Registrar General's Statistical Review of England and Wales for the years 1954 to 1966, prediction of numbers of deaths for each disease group was made for each age group in each year.

The prediction formula used was $E = \frac{X}{Y} \times y$.

where E = predicted deaths due to specified cause for a specific group and year
X = all print worker deaths in that age group and year
Y = all Greater London male deaths in that age group and year
y = deaths due to the specific cause in males in the Greater London conurbation in that age group and year.

The statistical significance of the results for each cause was determined by comparison of the sums of all predicted values and the total of observed deaths from that cause.

Results

All malignant neoplasms (I.C.D. 140 to 205)

These are listed in Table 1 and the first point of interest is the 195 observed deaths due to malignant

TABLE 1

DEATHS DUE TO MALIGNANT NEOPLASM (I.C.D. 140 TO 205) 1954-66 FOR PRINTING WORKERS (ALL AGES)

Disease (I.C.D.)	*Observed (O)*	*Expected (E)*[1]	*Age standardized ratio O/E × 100*	$\frac{(O-E)^2}{E}$	*P*
All malignancies (140–205)	195	163·13	119·53	6·231	<0·02
Ca. lung and bronchus (162, 163)	93	69·99	132·87	7·559	<0·01
Ca. stomach (151)	29	20·48	141·61	3·545	<0·10
Leukaemia (204)	4	3·29	121·58	0·154	<0·70

Diseases for which regional tables are not available

Ca. oesophagus (150)	2	Ca. bladder (181·0, 8)	4
Ca. bowel (153, 154)	20	Ca. kidney (180)	2
Ca. pancreas (157)	9	Ca. tonsil (145)	2
Ca. biliary tract (155·1)	3	Melanoma	2
Ca. prostate (177)	10	Unknown primary (199)	8

Single cases

Ca. maxillary antrum	Reticulosis
Ca. testis	Hodgkin's disease
Ca. pharynx	Neuroblastoma
	Glioma

[1]Based on Registrar General's figures for Greater London 1954–66.

neoplasm compared with the predicted value of 163·13 (the age standardized ratio is 119·53 and $P < 0·02$).

A major part of the excess is accounted for by *carcinoma of bronchus, trachea, and lung* (I.C.D. 162 and 163) with a total of 93 deaths observed against 69·99 predicted (the age standardized ratio is 132·87 and $P < 0·01$).

Carcinoma of the stomach (I.C.D. 151) Twenty-nine deaths observed against 20·48 predicted gives an age standardized ratio of 141·61 but $P < 0·10$.

Leukaemia (I.C.D. 204) with 4 observed deaths as against 3·29 expected was statistically unremarkable.

Carcinoma of the urinary organs There are no tables for cancer of the urinary organs in the Greater London conurbation. All that is available for regional comparison are tables prepared by the Registrar General dealing with cancer registration and deaths for the four Metropolitan Hospital Regions for the years 1963-66. For the earlier years of the study a gap exists in the tables. Calculations were also made using national figures for prediction and comparison of cancer of the urinary organs.

Between 1954 and 1966 six deaths due to carcinoma of the urinary organs (I.C.D. 180 and 181) were certified: of these only three related to the years 1963-66 for which regional tables were available for comparison; 3·20 cases were predicted ($P < 0·70$). Using national rates for prediction in the years 1954-66, six cases were observed and 8·67 were predicted ($P < 0·50$). Clearly, a longer period would be required to confirm or refute the suspicions concerning a significantly raised incidence of bladder cancer at the factory studied.

Carcinoma of the tonsil (I.C.D. 145) This was a cause of death in two printers. Using national figures, 0·26 was the predicted number ($P < 0·001$).

Non-neoplastic causes of death

These are listed in Table 2 and it is of interest to observe that the historical scourge of *tuberculosis* (I.C.D. 002) accounted for only two deaths compared with 6·29 predicted; the deficit is not significant ($P < 0·10$).

Suicide (I.C.D. 970 to 979) This presents the only cause of a significant excess of deaths in this group with 14 observed as against 7·73 expected, giving an age standardized ratio of 181·11 ($P < 0·05$). The explanation for this is not obvious: further study would be required to substantiate the hypothesis that there is a self-selection of persons with the personality traits productive of social problems who enter an industry that involves night work inimical to a normal social existence and exacerbating the situation.

TABLE 2

DEATHS DUE TO CAUSES OTHER THAN MALIGNANCY (ALL AGES)

Disease (I.C.D.)	*Observed (O)*	*Expected (E)*	*Age standardized ratio* $\frac{O}{E} \times 100\%$	$\frac{(O-E)^2}{E}$
Hypertension (440–447)	22	20·32	108·26	0·140
Peptic ulcer (540, 541)	5	9·43	53·02	2·080
Rh. heart disease (410–416)	5	7·57	66·05	0·873
Cerebrovascular accident (330–334)	64	59·96	106·73	0·270
Suicide (970–979)	14	7·73	181·11	5·091
Arteriosclerotic and degenerative heart disease (420–422)	186	189·01	98·40	0·057
Chronic bronchitis and emphysema (502)	46	60·71	75·77	3·563
Pneumonia and bronchopneumonia (490, 491)	42	34·93	120·24	1·432
Pulmonary tuberculosis (002)	2	6·29	31·79	2·926

Diseases for which regional tables are not available

Parkinsonism (350)	3	Pulmonary embolus (465)	13
Heart failure (434·1, 434·4)	7	Dissecting aneurysm (451)	6
Aortic valve disease (421·1)	8	Spontaneous pneumothorax (520)	3
Asthma (241)	4	Prostatic hypertrophy (610)	2
Chronic nephritis (592)	5	Accidents and operations (E 800–970, E 979–990)	8

Miscellaneous single cases 20

Peptic ulcer (I.C.D. 540, 541) As a cause of death this was certified on five occasions compared with 9·43 expected, giving an age standardized ratio of 53·02 ($P < 0·20$). From this it would appear that whatever the effect of shift work on the production of peptic ulcer it had no effect on mortality.

Chronic bronchitis and emphysema (I.C.D. 502) This was certified as a cause of 46 deaths when 60·71 were expected. While there was a deficit (age standardized ratio 75·77) the significance was not of a high order ($P < 0·10$). Similarly, an excess from lobar and bronchopneumonias (I.C.D. 490 and 491) of 42 observed with 34·93 expected gave an age standardized ratio of 120·24 but with $P < 0·30$.

Social class and disease

So far comparison has been made on a regional basis and certain excess deaths have been described. It has been argued that the social class variations in mortality pattern might account for these results as the group studied was restricted to members of classes III, IV, and V. A proportional mortality study was carried out using the Registrar General's figures for 1959-63 for England and Wales in which nationally deaths from certain diseases are classified by age group and social group. A similar analysis is not available for Greater London.

In the formula $E = \frac{X}{Y} \times y$

E = predicted deaths due to a specific cause for a specific age group in males for a particular year, assuming social class III, IV or V

X = all print worker deaths in that age group and year

Y = England and Wales deaths in that age group and year for males in the specific social class

y = deaths due to the specific cause in England and Wales for males in that age group, year, and social class.

Calculations were made on the basis that the group studied was entirely composed of class III, IV or V and are presented in Table 3.

Even if one were to assume that the group studied fell exclusively into the social class having the greatest expectancy of the specific disease, there was still a significant increase of death from malignant disease and, in particular, from carcinoma of the bronchus.

In attempting to gain precision relating to social class one inevitably loses that precision obtained from regional comparison.

Smoking as an aetiological factor

If the smoking habit of newspaper workers was an important aetiological factor in the development of bronchial carcinoma then one might observe a parallel

TABLE 3

COMPARATIVE DEATHS FOR CERTAIN DISEASES ASSUMING PRINTERS EXCLUSIVELY CLASS III, IV OR V, BASED ON REGISTRAR GENERAL'S TABLES FOR ENGLAND AND WALES [1959-63] (AGES 15 TO 74)

	All malignant neoplasms (I.C.D. 140–205)			*Carcinoma of bronchus (I.C.D. 162, 163)*			*Chronic bronchitis (I.C.D. 502)*			*Arteriosclerotic and degenerative heart disease (I.C.D. 420–422)*		
	Social class			*Social class*			*Social class*			*Social class*		
	III	IV	V	III	IV	V	III	IV	V	III	IV	V
Observed no.	160	160	160	83	83	83	34	34	34	132	132	132
Expected no.	120·52	117·61	116·71	52·90	50·65	52·29	42·30	47·61	56·85	145·68	134·84	119·39
Age standardized ratio ..	132·8	136·0	137·1	156·9	163·9	158·7	80·4	71·4	59·8	90·6	97·9	110·6
χ^2	12·9327	15·2784	16·0569	17·1268	20·6618	17·7596	1·6286	2·7784	5·4956	1·2846	0·0597	1·3318
P	<0·001	<0·001	<0·001	<0·001	<0·001	<0·001	<0·30	<0·10	<0·02	<0·30	<0·99	<0·30

effect in the increased incidence of death from chronic bronchitis at all ages and death from ischaemic heart disease below the age of 45.

Chronic bronchitis (Tables 2 and 3) was not certified as a cause of death to excess in printers: the deficit that occurs is of little significance. For deaths from arteriosclerotic and degenerative heart disease below the age of 45 there was no significant excess (observed 3, expected class III—2·20, class IV —2·04, class V—1·53). However, it may be that while the effect of excess smoking is registered as an increase in frequency of carcinoma of the bronchus its effect on the incidence of bronchitis and, under 45, ischaemic heart disease is of too small an order to be noticeable in a sample of this size.

Age distribution

Table 4 a and b shows that there is no gross disparity between the mortality of printers of different ages and other persons dying in Greater London.

Discussion

In the nineteenth century and early this century surveys of industry gave the following reasons for the high morbidity and mortality of printers:

1. Lead, by lowering resistance, was important as a cause of sickness rather than a primary cause of death;
2. Gravitation of the 'weak' to a sheltered occupation;
3. Exposure to antimony, carbon monoxide, petroleum, coal tar volatiles, turpentine, aniline oil, wood alcohol, and carbon tetrachloride.

The current standard of handling lead and its dross in general has improved and there is now no risk. There is no evidence that points to a special selection for the printing trade of recruits who are predisposed to developing specific disease (other than suicide in in this group).

In addition to the volatile substances mentioned by the older writers as a general health hazard, which hazard must have been increased by the centrifugal force of the higher speed rotary machines, there will be an increased atmospheric pollution by lubricating oils, metal derived from machinery, and paper fly. Until the smoking habits of printers can be related to morbidity from cancer of the bronchus, it would be wrong to speculate that the petroleum derivatives present as lubricants and ink components *might* have carcinogenic properties or that the dust

TABLE 4

(a) NUMBERS OF DEATHS IN AGE GROUPS 1954–66

Year	*15–*	*25–*	*45–*	*55–*	*65–*	*75+*	*Total*
1954	0	2	2	12	11	13	40
55	0	1	2	9	12	12	36
56	0	0	4	8	15	13	40
57	0	0	11	11	13	10	45
58	0	2	7	12	20	14	55
59	0	1	6	13	16	15	51
60	0	0	3	8	18	13	42
61	1		5	9	15	19	49
62	0	1	7	25	22	8	63
63	1	0	2	8	26	22	59
64	0	1	5	13	22	15	56
65	0	0	6	9	24	18	57
66	0	2	8	23	28	16	77
Total	2	10	68	160	242	188	670

(b) MORTALITY BY AGE GROUPS OF PRINTERS IN THE STUDY AND DEATHS IN GREATER LONDON MALES (1967): PERCENTAGES

	15–	*25–*	*35–*	*45–*	*55–*	*65–*	*75+*
Printers ..	0·3	0·1	1·4	10·1	23·8	36·3	28
Greater London (1967) ..	1·2	1·2	2·8	8·4	22·8	29·9	33·7

and metal derived from the machinery might act as co-carcinogens.

It must be stressed that results obtained in this survey are not comparable with other studies of printers reported any more than those are comparable with each other. Ask-Upmark investigated the occupations of a number of Swedes who died of carcinoma of the bronchus in the years 1931-50. In his series of 125 cases of bronchial carcinoma, eight were printers. At the time of his investigation there were 1 500 printing workers at risk in his catchment area which contained 13 200 men above the age of 40. He felt that the figures (an incidence of bronchial carcinoma in printing workers 18 times that for the average population) were even more impressive if it was considered that of the total 1 500 printers only one-third were exposed to printing ink: all the eight carcinomas occurred in the latter group. Ask-Upmark (1955) cited experimental work by Steinbruch (1929) in which of 16 mice whose necks were painted with printing ink, five developed carcinoma of the lung and skin and three developed neoplastic tissue in lymph nodes, liver, and spleen.

Conclusion

Even when allowance is made for geographical and social factors, a small group of newspaper workers had a statistically significantly raised proportion of deaths from malignant neoplasm and from bronchial carcinoma in particular. In view of the important rôle played by smoking in the incidence of bronchial carcinoma a prospective study of smoking habits and mortality patterns of newspaper printers would be required if occupation is to be implicated as a hazard.

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