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OCCUPATIONAL MORTALITY: CANCER

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THIS PAPER reviews the cancer statistics of the occupational mortality tables based on the 1961 Census. A general system such as that based on the certification of cause of death is in itself not sufficient for a detailed study of environmental effects; it is necessary to augment such a system by planned studies, both retrospective and prospective. The most useful advance in the general systems of statistics would be the introduction of a system of linking certain individual records.

The General Register Office Classification of Occupations (GENERAL REGISTER OFFICE, 1960) conforms as far as possible with the International Standard Classification of Occupations. It is based on 27 occupational orders divided into over 200 unit groups. The classification is in places industrial rather than occupational. As is usual, occupations have been grouped into 5 social classes using the additional information of employment status. It should be noted that the division into classes in some respects different from that of previous censuses, even though broadly speaking the definitions are similar. For example, the proportion of men in Social Class V is about 8.9 per cent compared with 12.1 per cent in 1951, and the change of proportions in the various classes has resulted in an increase of the mortality gradient.

How does one examine such a surfeit of data? One view of the overall cancer statistics is shown in Table 1 and, in addition. I will discuss some general aspects of the officially published tables. The table shows a mortality index for each site of cancer for each main group of males, i.e. the 26 so-called occupational orders. The statistic chosen is the standardised proportional mortality ratio* for ages 25–75 (standardised in 10-year age groupings). Statistical significance is marked with +, ++ and −, −− signs (at $P < 0.05$ and $P < 0.01$ levels).

As in the previous studies of occupational mortality there is an undetermined amount of discordance between numerators and denominators: in this 1961 study the situation is aggravated by the fact that the denominator is itself based on a 10 per cent sample. The PMR could be misleading if the death rates in the particular occupation from causes other than the one being examined varied sufficiently from the average. For example, in labourers the overall SMR is high, and the respiratory diseases have especially high rates; this situation may tend to reduce the PMR of a specific cancer. Contrarywise if overall death rates are low a specific PMR may be spuriously enhanced; for example, as is well known the numerators (i.e. recorded deaths) are obviously inflated, spuriously, in the category company directors and in the armed forces.

* The Proportional Mortality Ratio (PMR) and the Standardised Mortality Ratio (SMR) are both shown as percentages, i.e. average for the population is 100. The SMR is based on the population of persons at risk, whereas the PMR is calculated on death records only.

For the purposes of the present paper I have examined the published tables and also the proportional mortality ratios at ages 16-45 as well as at ages **65–74.** Those occupations with significantly high (or low) **SMRs** were selected and if the **PMR** is also high (or low) this was used as basis for discussion.

If one dredges the tables using a significance test then, of course, there will be mistakes of two kinds: some figures will appear to be significant by chance and some that are really significant will be left out. The notes in the published work point out the difference between using a significance test for ***a priori*** and ***a posteriori*** situations; in our present exercise ***(a posteriori)*** we capitalise on extreme values. As well as indices and significance levels there is a choice of age groupings and occupational groupings; the observed difference from the expected number may well depend on which grouping is chosen. The position is different if one has ***a priori*** reason to examine a particular occupation in respect of a particular hazard.

Sites of cancer are considered below in **ICD** order (the **ICD** number is shown in brackets):

Lip (140): farmers, foresters, fishermen and also labourers show high rates, possibly in response to sunlight.

Tongue **(141):** high rates for labourers and for service, sport and recreation workers.

Mouth **(143, 144):** this cancer is much more common in men than in women. There is a gradient of rates between social classes, high in **V.** Men have high rates in 8 occupational orders or groups: coal mine-face workers; gas, coke and chemicals makers; glass and ceramics makers; textile workers; transport and communications workers; publicans, innkeepers; armed forces (British and foreign).

Mortality from cancer of the lip and mouth has been falling over the years **(OFFICE** OF **POPULATION CENSUSES AND SURVEYS, 1972,** and in press); cancer of the lip since the **1930's;** mouth cancer rates show a reducing cohort effect since the last century. **A** possible explanation is that treatment has improved the survival for lip cancer. while oral cancers have diminished in response to the reduction of pipe smoking and alcohol in successive generations.

Oesophagus (150): this cancer is related to consumption of alcohol. Among males, some 15 groups have high rates and **4** low rates. Among these, occupations in which one can imagine a possible occupational hazard are aerographers and paint sprayers (this high rate is based on only **8** cases) and the older textile workers.

Stomach (151): one of the more frequent cancers with a considerably higher mortality rate in men than in women, and higher in urban than in rural areas: there is a marked gradient of rates between the social classes among men, among married women, and among single women. Above age **65** the difference between the classes (judged by PMR) is less.

Because of the marked difference between classes, a large number of occupations also show significant differences from the average; broadly speaking a number of manual and unskilled occupations have high rates and non-manual. professional. technical workers and artists low rates.

Among occupation orders with high rates are—glass and ceramics makers: engineering and allied trades workers; and textile workers. Among the single women clothing workers also have high rates as do the group of single women classified as "service, sport and recreation workers".

TABLE 1. STANDARDISED PROPORTIONAL MORTALITY RATIOS (ALL MALES 100) FOR MALIGNANT NEOPLASM OCCUPIED AND RETIRED MALES AGED 15 TO 74 IN OCCUPATION ORDERS 1959 63 ENGLAND AND WALES

The figures are shown in italics when the numbers of cases observed are less than 4.

ICD No.	Site	Occupation Order	Farmers, foresters and fishermen	Miners and quarrymen	Gas, coke and chemicals makers	Glass and ceramics makers	Furnace, forge, foundry and rolling mill workers	Electrical and electronics workers	Engineering and allied trades workers n.e.c.	Woodworkers	Leatherworkers	Textile Workers	Clothing workers	Food, drink and tobacco workers	Paper and printing workers	Makers of other products	Construction workers	Painters and decorators	Drivers of stationary engines, cranes, etc.	Labourers n.e.c.	Transport and communications workers	Warehousemen, storekeepers, packers, bottlers	Clerical workers	Sales workers	Service, sport and recreation workers	Administrators and managers	Professional, technical workers, artists	Armed Forces	Inadequately described occupations
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII
140	Lip		**366	83	196	*372	40	40	51	93	0	0	0	111	69	0	92	34	183	**169	93	86	-29	62	72	63	61	0	268
141	Tongue		74	82	134	95	83	89	70	107	54	127	43	127	94	102	125	58	121	**130	101	86	89	101	*127	91	98	175	*207
142	Salivary gland		**178	70	227	218	50	136	117	76	148	136	161	45	126	169	54	40	54	87	60	-31	133	101	111	114	115	150	162
143, 144	Mouth		128	84	185	221	96	48	90	37	74	145	81	62	82	167	98	48	80	100	101	127	110	84	108	90	*142	167	130
145	Oral mesopharynx		79	55	70	0	87	116	100	90	28	124	30	27	124	*253	50	37	110	101	81	98	*148	105	121	129	99	**343	194
146, 148	Rem. pharynx		109	65	93	102	93	65	99	85	46	107	88	95	49	40	94	90	89	114	112	96	100	97	122	92	98	*170	154
150	Oesophagus		**137	-73	105	107	92	95	83	90	81	110	92	**134	96	95	101	99	102	*110	110	87	89	97	98	95	94	**176	138
151	Stomach		**109	**125	**128	100	108	95	**106	100	105	**115	91	97	92	99	**112	*110	**114	**116	**108	*107	74	85	-91	-75	70	-73	-58
152	Small intestine with duodenum		83	64	87	*280	65	116	95	70	80	85	113	23	87	173	103	62	56	87	121	*149	**150	108	87	111	*147	27	43
153	Large intestine except rectum		108	-83	112	104	99	102	103	100	91	106	*121	110	98	102	90	95	88	-79	97	95	*107	106	96	**137	**143	87	-60
154	Rectum		**112	97	101	94	110	104	104	112	112	97	88	103	91	119	107	101	92	91	100	100	100	101	98	106	100	90	78
155	Biliary passages and liver stated primary		101	94	86	83	94	105	104	85	79	61	64	88	96	99	102	94	106	99	102	95	87	109	109	119	*122	96	63
156	Liver secondary and u.s		119	86	63	48	91	88	102	120	93	121	102	83	109	90	74	142	115	86	109	91	87	97	117	132	91	116	127
157	Pancreas		101	92	96	79	112	100	99	96	92	90	**143	113	100	119	102	91	90	86	94	102	101	109	102	**143	114	112	63
158, 159	Peritoneum and u.s digestive-organs		**150	52	93	89	127	117	82	103	42	92	115	95	0	135	99	41	105	86	89	120	118	111	103	**206	125	59	33
160	Nose		*142	82	163	126	88	105	114	**191	59	80	96	93	74	163	140	152	73	105	101	48	77	66	120	66	94	62	50
161	Larynx		84	64	95	69	12:	118	102	81	89	101	86	116	91	134	100	80	122	*115	103	107	100	100	-124	69	70	96	*173
162, 163	Lung, bronchus and trachea		78	71	**115	**117	**123	**111	**112	**107	102	69	94	**114	103	108	**130	**135	**107	*102	**109	**108	90	100	102	93	-77	-79	-66
164	Mediastinum		118	63	134	131	30	134	80	46	0	66	196	192	101	0	113	48	65	97	115	99	76	135	74	*198	117	60	0
170	Breast		119	78	112	0	124	46	98	95	49	108	107	135	42	56	106	120	90	96	96	91	92	138	94	87	72	214	**420
177	Prostate		**126	72	89	86	91	116	100	113	85	93	82	106	114	78	108	99	90	-93	96	-84	96	**113	96	-116	**121	116	66
178	Testis		**149	70	84	93	81	108	93	113	61	64	59	119	111	106	130	64	80	70	97	117	101	120	62	123	*185	146	29
179	Other and u.s male genital organs		116	106	99	126	130	53	108	99	29	94	31	*183	97	99	140	128	116	122	83	108	77	77	97	81	88	60	96
180	Kidney		85	85	66	60	82	**138	*112	86	121	66	110	89	94	106	101	89	91	-78	95	98	111	**118	106	**137	**123	**145	41
181	Bladder and other urinary organs		82	77	**161	89	112	109	105	98	112	96	82	93	118	104	101	108	90	92	**116	*113	105	107	94	97	98	**138	74
190	Melanoma of skin		121	73	115	182	-19	148	83	99	101	43	105	143	**208	87	91	48	122	-66	104	78	*131	126	90	**163	**150	93	75
191	Other MN of skin		**157	99	110	84	46	54	87	100	71	140	116	93	31	157	119	138	97	100	112	121	79	70	106	67	117	175	123
193	Brain and other n.s		**124	77	62	95	86	117	105	*121	85	82	91	*122	**143	120	103	100	80	72	84	96	103	115	92	**142	**150	*133	74
194	Thyroid gland		*148	50	105	68	158	142	75	60	0	69	138	113	80	175	91	100	68	85	109	64	120	117	94	134	135	135	160
196	Bone		118	78	143	50	130	118	97	135	107	98	128	107	58	100	101	129	122	98	*123	76	89	84	91	104	117	111	35
197	Connective tissue		141	99	121	58	57	145	107	115	0	79	126	167	*208	57	137	87	71	57	116	87	92	106	77	128	135	46	41
200	Lymphosarcoma and reticulosarcoma		111	80	103	55	88	104	101	101	71	68	*158	69	117	120	115	88	99	75	102	104	105	110	107	134	**130	151	70
201	Hodgkin's disease		115	74	115	103	68	*129	105	93	101	133	76	*135	126	58	78	93	-70	-70	102	80	130	121	93	128	**142	124	-35
202	Other lymphoma		103	38	77	149	73	59	*142	162	113	162	0	131	90	148	101	84	126	97	102	59	66	125	85	108	131	33	0
203	Multiple myeloma		107	69	95	92	85	123	93	108	102	65	150	139	72	133	101	126	100	-76	106	76	108	113	90	*134	**162	110	44
204	Leukaemia		**133	81	96	109	95	105	99	103	102	95	123	99	108	80	88	94	86	75	98	95	107	114	68	**130	**144	98	39
	All MN		97	-83	**112	104	**110	**107	**106	*104	98	87	98	**109	102	106	**114	**115	101	98	**105	**104	**94	102	101	103	94	84	64
All causes SMR			82	114	92	96	105	102	99	91	109	116	107	107	83	82	92	103	98	144	106	101	98	90	118	70	75	150	30

** significantly higher than average $P < 0{\cdot}01$.
* significantly higher than average $P < 0{\cdot}05$.
- significantly lower than average $P < 0{\cdot}5$.
-- significantly lower than average $P < 0{\cdot}1$.

Large intestine (except rectum) (153): in addition to high rates in orders "Administrators and managers" and "Professional, technical workers and artists", there are a number of occupations with high rates including the textile workers and clothing workers.

Rectum (154): no pattern is discernible. Medical practitioners have a very low rate (2 cases against 12 expected).

Biliary passages and liver (155): no pattern; a high rate among brewers, wine makers, and related workers is based only on 4 cases.

Nose, nasal cavities, middle ear and sinuses (160): as expected (ACHESON *et al.*, 1968), woodworkers have a high rate. Among the men with high rates are painters and decorators; transport and communications workers: police officers and men: publicans and innkeepers.

Larynx (161): social class trend, high in V. The rate among men is very much higher than in women. Among men there are high rates in a number of occupational orders and groups including brewers, wine makers and related workers; publicans, innkeepers: stevedores, and dock labourers; and barmen and barmaids. Low rates occur in farmers, foresters, fishermen; administrators and managers; professional, technical workers, and artists.

Lung, bronchus (162, 163): since this is the most frequent site of cancer, and is known to be related to cigarette smoking, it is not surprising to find that significant variations from the average rate are common. As is now well known there is a marked social gradient: the SMR of Social Class V is nearly three times that of I. Among some 50 groups of men with high rates it is not possible to attribute an occupational risk to any. Since the classification is in many aspects industrial rather than occupational, the effect of hazards which have been identified in surveys are lost in the industrial groupings. Because of this wide range of rates it would not be reasonable to suspect an industrial hazard simply on a mortality rate unless it was considerably above (say twice) the expected.

Knowing that this cancer is related to smoking, it is interesting to look at occupations in which people have low rates. The lowest are among the "Professional, technical workers and artists"; for example among men (SMR in brackets) university teachers (12); clergy, ministers, members of religious orders (17); legal profession (40); medical practitioners (47); teachers (34). In some instances the wives, also, have low rates (i.e. relative to other married women): for example, wives of teachers (64), wives of electrical engineers (9), while the engineers themselves have an SMR of 44. The wives of clergy have the same low relative rate as do their husbands (17). However, the wives of doctors and of university teachers do not have statistically significant low rates (80 and 67 respectively).

Prostate (177): high rates for both SMR and PMR at ages 15–64 appear among Proprietors and managers, food sales; and in deck and engineroom ratings, barge and boatmen.

Testis (178): four groups of men have high rates for both SMR and PMR: furnace, forge, foundry, rolling mill workers; commercial travellers, manufacturers' agents; professional, technical workers, artists; and armed forces (British and foreign).

Other and unspecified male genital organs (179): there are two groups with high rates: food, drink and tobacco workers; and labourers.

Scrotum (179 ***part):*** high rates appear in the order Engineering and allied trades workers. Machine tool setters have 5 cases with 1 expected at ages 15–64; and labourers also have a high rate.

Breast (170): no pattern that could be related to occupation emerges.

Cervix uteri (171): The main factors which have been found to be related to this cancer are intercourse at young age and numbers of partners. The figures shown in **this** study tell a social rather than occupational story; some groups of married women have an SMR and PMR above 200 while others have rates as low as 12-e.g. wives of members of religious orders. In general, wives of professional workers, technical workers, and artists have low rates; e.g. wives of medical practitioners (35); and of chemists, physical and biological scientists (17). There is a sharp gradient between social classes; among married women the **SMR** of Social Class I is **34** while that of **V** is 181.

Ovary, Fallopian tube and broad ligament (175): among the 10 groups of women with high rates are members of "Clergy, ministers, and members of religious orders", with SMR of ***230.***

Kidney (1 ***80):*** four groups have significantly high rates: shoemakers and shoe repairers; police officers and men; publicans, innkeepers; and electrical and electronic workers.

Bladder and other urinary organs (181): among the groups of men with high rates are both divisions of Order III: gas, coke and chemicals makers, the highest rate being among the chemical production process workers. The other group in this order, furnacemen (coal gas and coke ovens) also have a high rate (SMR 225, PMR 150) and in addition the labourers classified as coke ovens and gas workers have a high rate. Older ceramic formers have a PMR of 175 (but this is based only on 7 cases). Workers in rubber have SMRs 170 and 175. Among older single women the paper and printing workers have high rates, as also do 3 unit groups: spinners, doublers, winders, reelers; maids, valets and related services; launderers, dry cleaners and pressers (the numbers are few, respectively 4, **24,** ***6).***

Skin, malignant melanoma (191): there is no apparent pattern: high rates occur among electrical and electronic workers; food, drink and tobacco workers; deck and engineroom ratings, barge and boatmen: vehicle drivers: and in the wives of administrators and managers.

Skin (n.e.c.) (191): High rates are found in farmers, foresters and fishermen: stevedores and dock labourers; as well as older men in transport and communications. These high rates are consistent with the evidence that the cancer is related to exposure to sunlight.

Among single women aged 65–74, clothing workers have high rates in both ICO groups 190 and 191.

Brain and other parts of the nervous system (193): high rates occur in professional, technical workers and artists, in each of the three populations, males, wives and single women.

Thyroid gland (194): high rates appear among orders farmers, foresters and fishermen : and transport and communications workers.

Bone (196): high rates for farmers, foresters and fishermen; furnace, forge, **foundry.** rolling mill workers; labourers (n.e.c.); deck and engineroom ratings, barge and boatmen.

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DISCUSSION

DR. KIPLING, commenting on Dr. Adelstein's statement that Dr. Waterhouse's people might have cancer of the stomach as well as scrotal cancer because of their poverty. overcrowding and general uncleanliness, said that his own experience of these people was that they lived in "middle class" circumstances and were well paid. so he did not think this could be a factor. He might. however, be absolutely wrong.

Dr. J. MCLINTOCK (Deputy Chief Medical Officer. National Coal Board) said that Dr. Adelstein's cynical attitude towards SMR was one he shared in respect of some occupations. It was the convention, as Dr. Adelstein said. that the person registering death should give the deceased's last occupation. This rule was not always followed. In fact, was it reasonable to follow it in respect of certain occupations? Policemen commonly retired between 45 and 50 and usually took up some other occupation. as perhaps firemen did also. Coal miners leaving the mines at ages over 50 commonly did not return. and might take up some other occupation. There was quite a possibility of SMRs being weighted. Would Dr. Adelstein care to comment on the possible inaccuracies in SMRs which might be derived from the recording on death certificates of (a) the present occupation, even if short-term, and (b) the previous occupation. if socially important?

Dr. ADELSTEIN said that he was not sure that he could distinguish the two. The best one he had come across was the wives of "company directors". At censuses "garage proprietor" would be filled in, where appropriate but after a death a woman would become the widow of a "company director". These certificates seemed to play a bigger part in the life of families than was immediately apparent. Recently he had attended a wedding at which people were examining the registration certificate, which gave the occupation of the father. He happened to know the occupation of this particular individual and it had been enhanced on the form! There might be a good deal of this kind of enhancing in some occupations. The use of the term "company director" had distorted the social class published mortality rates in 1961. because some people dying in Social Class 2 had been Coded as Social Class 1. The women concerned appeared as the wives of company directors instead of garage proprietors.

There were also errors in regard to coal mining. He did not know what motive impelled the wife of a coal miner to have her husband classified as a face worker. Perhaps she felt that he would in that way be more likely to get compensation if he had pneumoconiosis. Perhaps. there was an added status. or the woman might recall her best times as having been when her husband was a face worker. Looking through the book of occupational mortality it was possible to pick out what appeared to be abnormally high SMRs and low PMRs, and to see which kinds of occupations were doing it. It did not detract from the value of the book as a whole, but there were certainly a number of occupations in respect of which this kind of thing happened.

The **CHAIRMAN (Dr.** Glover) said that anyone in South Wales who had been a coal miner for even a short period would put it down in the hope of getting compensation.

Dr. J. M. HARRINGTON (TUC Central Institute of Occupational Health), commenting on Dr. Adelstein's statement that registrars put the last known occupation on death certificates, said that in his experience local registrars seemed to talk in terms of the main occupation.

Dr. A. M. ADELSTEIN said that this was incorrect. It was absolutely clearly written in the book of rules as the *last* full-time occupation.