

# Cancer incidence and cancer mortality in a cohort of semiconductor workers: an update

T Sorahan, D J Pope, M J McKiernan

In 1985 a report was published on incidence of cancer and cancer mortality among a cohort of 1807 workers from a semiconductor factory.<sup>1</sup> For the total study cohort, observed numbers of deaths (and incident cases) for all cancers were close to those expected. For incidence of melanoma, three cases were observed and 0.68 were expected. This excess was of borderline significance at the 5% level and was not associated with either duration of employment in the plant or duration of employment in the photo-masking process—a process that involves potential exposure to ultraviolet light. This report provides results from a further seven years of follow up—namely mortality data to the end of 1989 and data on the incidence of cancer to the end of 1988.

## Materials and methods

The study cohort has been described before.<sup>1</sup> By the closing date of the study (31 December, 1989) the National Health Service Central Register (NHSCR) of the Office of Population, Censuses, and Surveys (OPCS) had traced 107 subjects who had died, 11 who had emigrated, and 1636 survivors. The 53 subjects who were untraced at the NHSCR were traced by other means. Thirteen of these were on the current electoral register, one was still employed with the company, and 39 were traced alive on 31 March, 1982 by the central offices of the Department of Social Security (DSS). Copies of death certificates were supplied by the NHSCR for the 107 employees known to have died, with the underlying cause of death classified according to the 8th revision of the International Classification of Diseases (ICD).

The OPCS also supplied details of cancer registrations from the National Cancer Registration Scheme. A computer search of the main index files of the West Midlands Regional Cancer Registry (WMRCR)

provided a further source of cancer registration data.

Expectations for mortality and incidence of cancer were calculated as described before.<sup>1</sup>

## Results

Table 1 shows the observed and expected numbers of deaths from principal causes. Compared with the general population of England and Wales, this cohort experienced very low overall mortality (standardised mortality ratio (SMR) = 72). In particular, low levels of mortality were found for cancer of the breast (SMR = 54), cancers of the genitourinary system (SMR = 21), diseases of the circulatory system (SMR = 70), and a remainder category (SMR = 38). Findings for skin cancer were close to expectation (expected (E) = 0.8; observed (O) = 1). No significant excess was found for any site of cancer (individual three digit ICD categories).

The deficit for mortality from all causes in the total study population is likely to be due, at least in part, to selection effects—namely, the “healthy worker effect” and the “survivor population effect”. Evidence exists for a healthy worker effect in the census population (759 employees in employment on 1 January, 1970) with SMRs increasing with duration from first employment (0–9 years, O = 7, SMR = 47; 10–19 years, O = 25, SMR = 60; ≥20 years, O = 41, SMR = 108). This effect was not seen in the entry cohort (1048 employees first employed in the period 1970–9) (0–9 years, O = 19, SMR = 76; 10–19 years, O = 15, SMR = 51).

Table 2 shows the observed and expected numbers of cancer registrations for the total study population. For all employees, the observed number was close to expectation (standardised registration ratio (SRR) = 96). The deficit for women (SRR = 87) and the excess for men (SRR = 140) are not statistically significant. The excesses shown for cancers of the skin (SRR = 159), reticuloendothelial neoplasms (SRR = 179), and the remainder category (SRR = 158) are also not statistically significant.

The findings for skin cancers relate to melanoma and other skin cancers. For melanoma, there were three cases compared with 1.50 expected. This difference is not statistically significant. Subtracting

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Department of Public Health and Epidemiology,  
University of Birmingham, Edgbaston,  
Birmingham B15 2TJ, UK  
T Sorahan, D J Pope  
Lucas Industries plc, Great King Street,  
Birmingham B19 2XF  
M J McKiernan

Table 1 Expected (E) and observed (O) deaths 1970-89, total study population

Cause of death	ICD 8th revision	Men			Women			Total		
		E	O	(SMR)	E	O	(SMR)	E	O	(SMR)
Cancers of the:										
Buccal cavity and throat	140-149	0.2	1	(526)	0.4	0	(0)	0.6	1	(159)
Digestive system	150-159	3.6	4	(111)	9.2	7	(76)	12.8	11	(86)
Respiratory system	160-163	5.0	6	(121)	6.9	6	(87)	11.9	12	(101)
Skin	172-173	0.1	0	(0)	0.6	1	(155)	0.8	1	(130)
Breast	174	0.0	0	(0)	12.9	7	(54)	12.9	7	(54)
Genitourinary system	180-189	1.4	0	(0)	8.3	2(*)	(24)	9.7	2(**)	(21)
Reticuloendothelial system	200-207	0.8	2	(250)	2.6	2	(78)	3.4	4	(118)
Other cancers	Rem 140-209	1.3	3	(231)	5.0	5	(100)	6.2	8	(129)
All cancers	140-209	12.4	16	(129)	45.9	30(*)	(65)	58.3	46	(79)
Diseases of the:										
Circulatory system	390-458	21.3	15	(70)	34.0	24	(71)	55.3	39(*)	(70)
Respiratory system	460-519	4.3	3	(70)	7.1	3	(42)	11.4	6	(53)
Digestive system	520-577	1.1	4	(352)	3.6	3	(84)	4.7	7	(149)
Genitourinary system	580-629	0.4	0	(0)	1.2	2	(166)	1.6	2	(123)
Accidents	800-949	1.3	0	(0)	2.7	2	(75)	4.0	2	(51)
Suicide	950-959	0.7	0	(0)	2.0	1	(49)	2.7	1	(37)
All other causes		2.3	0	(0)	8.2	4	(49)	10.5	4(*)	(38)
All causes		43.8	38	(87)	104.7	69(***)	(66)	148.5	107(***)	(72)

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001; ( ) indicates deficit.

Table 2 Incidence of cancer 1970-88, total study population

Site of Cancer	ICD 8th revision	Men			Women			Total		
		E†	O	(SRR)	E†	O	(SRR)	E†	O	(SRR)
Buccal cavity and throat	140-149	0.4	1	(286)	1.0	0	(0)	1.3	1	(78)
Digestive system	150-158	4.4	7	(159)	12.3	10	(81)	16.7	17	(102)
Respiratory system	160-163	5.4	6	(111)	5.9	5	(85)	11.3	11	(97)
Skin	172-173	2.1	2	(95)	8.0	14	(176)	10.1	16	(159)
Breast	174	0.0	0	(0)	25.9	20	(77)	26.0	20	(77)
Genitourinary system	180-189	2.6	0	(0)	17.4	9(*)	(52)	20.0	9(**)	(45)
Reticuloendothelial system	200-207	0.9	3	(323)	2.9	4	(136)	3.9	7	(179)
Other cancers	Rem 140-209	1.4	5*	(357)	6.3	7	(111)	7.6	12	(158)
All cancers	140-209	17.2	24	(140)	79.7	69	(87)	96.9	93	(96)

\*p < 0.05; \*\*p < 0.01; ( ) indicates deficit.

†Expectations for the period 1970-7 calculated from incidence rates in *cancer incidence in five continents volume IV*<sup>2</sup> and expectations for the period 1978-88 calculated from incidence rates in *cancer incidence in five continents volume V*.<sup>3</sup>

these results from those reported in the previous paper<sup>1</sup> the new information on incidence of melanoma (1982-8) is zero cases found compared with 0.82 expected. Thus no new evidence exists for any excess risk of melanoma in this study population. For skin cancers other than melanoma, 13 cases were observed compared with 8.58 expected. This difference is not statistically significant. Only one of these cases had a histology of squamous cell carcinoma. New information on the incidence of these cancers—obtained in the same manner—comprised eight observed cancers and 4.65 expected. This difference is also not statistically significant.

Analyses for cancer registrations were also carried out for all individual sites of cancer (three digit ICD categories). No statistically significant excesses were found.

## Discussion

The follow up of this cohort is still at an early stage, because among the entry cohort no subject has been followed up for more than 20 years from first

employment. Nevertheless, the new information for incidence of melanoma is reassuring, and the likelihood that an occupational factor has increased the risk of melanoma among this cohort is much reduced. We are not aware of other cohort studies relating to a similar group of workers.

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- 1 Sorahan T, Waterhouse JAH, McKiernan MJ, Aston RHR. Cancer incidence and cancer mortality in a cohort of semiconductor workers. *Br J Ind Med* 1985;42:546-50.
- 2 Waterhouse JAH, Muir C, Shanmugaratnam K, Powell J, eds. *Cancer incidence in five continents. Vol 4*. Lyon: International Agency for Research on Cancer, 1982. (IARC sci publ No 42.)
- 3 Muir C, Waterhouse JAH, Mack T, Powell J, Whelan S, eds. *Cancer incidence in five continents. Vol 5*. Lyon: International Agency for Research on Cancer, 1987. (IARC sci publ No 88.)