Do occupational exposures in nuclear refineries contribute to mortality from brain cancer?

Editor—Mortality from brain cancer has been found more often than expected in several nuclear processing plants.1 Exposure to chemicals and radiation were examined, one by one, but each alone was not the causative agent of the disease.2,4 The possibility of an association between brain cancer and exposure to electromagnetic fields has been examined in several recent studies, but definite conclusions about a causal relation have not yet been reached.

Brain cancer was noticed to occur more frequently than expected for workers in Ontario (observed 5, expected 1-12, standardised mortality ratio (SMR) 446, 95% confidence interval (95% CI): 147 to 1054). This finding was unexpected. These 1190 men were included in a larger study of underground uranium miners to find out whether exposure to uranium dust in the mills could have increased mortality from kidney disease. The SMRs for all causes, all cancer, and most of the specific cancer sites were below 100 for the uranium mill workers. No brain cancers were found (expected = 1-51) in men who worked in other mills in Ontario where ores such as gold were processed. Nor was an excess of brain cancer found in Ontario uranium miners (observed 14, expected 23-72, SMR 59). An excess of mortality from brain cancer has also been found in men who worked in tank houses where nickel is electrolytically refined (observed 8, expected 2-19).6

Two of the deaths from brain cancer in the Ontario uranium mill workers occurred between the ages of 35 and 44. The other three occurred in men over 55. Two of the cancers were glioblastoma multiforme, one a glioma, one a medulloblastoma, a rare tumour occurring in children and young adults, and the other brain tumour was unspecified. The work histories available to us were not detailed enough to identify characteristics in which the workers who died of brain cancer differed from the whole cohort. The six men who died of brain cancer did not work elsewhere in the mining industry in Ontario. One worked underground in a uranium mine and another was a painter for 28 months and gold mill worker for 141 months. Employments in the uranium mills ranged from four months to 74 months for these five men. Four of the five deaths from brain cancer occurred less than 10 years after the men last worked in the uranium mines, and the other man died of brain cancer was not recorded on the death certificate for two men and ranged from two months to 6-5 years before death for the other three men.

Exposure records for external γ radiation have been included in the National Dose Registry5 since the routine monitoring of the radiation exposures of uranium mine and mill workers was begun in 1981. We obtained exposure records from the National Dose Registry for 92% of the 1190 Ontario uranium mill workers. The average lifetime exposure to radon from all occupational sources was 20 working level months and the average cumulative external γ radiation exposure between 1981 and 1995 was 17 mSv. All of the men who died of brain cancer began working in the Ontario uranium mills in the late 1950s before external γ exposures to radon were routinely measured and recorded in the National Dose Registry. Exposure levels for all workers exposed to radiation in Canada have decreased since the 1950s but deciding which levels exposed for the uranium millers is difficult. In any case, the uranium millers’ low levels of exposure to external γ radiation reflect the low levels of radioactive elements in the uranium ores mined in Ontario. Exposure to radon has not been associated with brain cancer,5 but several studies have shown an association between brain cancer and exposure to γ radiation.6 However, no association between brain cancer and exposure to radiation has yet been found in the survivors of the atomic bombings of Nagasaki and Hiroshima.

The exposure to electromagnetic fields around some heavy duty electrical machinery used in the mining industry was between 1 and 10 μT and levels of electromagnetic fields in the electrolytic nickel refinery were reported.3 A recent United States study found a significant excess of brain cancer in workers in the highest exposure category. Exposure to magnetic fields two to 10 years before death was most strongly associated with mortality from brain cancer, the relative risk increasing by 1-94/μT-year.10 This suggests that magnetic fields may act as a tumour promoter. A Canada-France collaborative study found a non-significant increased risk of brain cancer in workers whose cumulative exposure to magnetic fields was above 157 μT-years (odds ratio 1-95, 95% CI 0-76 to 5-0).11

The question of whether or not the increased risk of brain cancer in nuclear processing plants is due to occupational exposures remains unanswered. It is unlikely that exposure to radon is directly related to the development of brain cancer as no excess has been found in uranium miners and the exposures in the uranium mills were much lower than in the uranium mines. Neither do the exposures to γ radiation seem to be large enough to produce an excess of brain cancer. The exposure to electromagnetic fields, however, may be larger than those found in other studies, in which excesses of brain cancer have been found. The case-control method should be used to investigate exposures that might be associated with brain tumours in nuclear processing plants and electrolytic metal refineries. Electromagnetic fields, radon progeny, γ radiation, and exposure to chemicals, including solvents, can be considered in the same study. Large populations would need to be combined to get one large enough for a valid statistical analysis.

ROBERT KUSIAK
Health and Safety Studies Unit, Occupational Health and Safety Branch, Ontario Ministry of Labour, 400 University Avenue, Toronto, ON M5G 1E6

PATRICK ASHMORE
National Dose Registry, Radiation Protection Bureau, Health Canada, 775 Brookfield Road, Ottawa, Ontario K1A 1C1

DALSU BARIS
Radiation and Environmental Protection Branch, Atomic Energy Control Board, 280 Slater Street, Ottawa, Ontario K1P 5S9

Correspondence to: Dr R Kusiaik, Occupational Health Studies Unit, 400 University Avenue, 7th Floor, Toronto, Ontario M5A 1T7, Canada.
Incidence of lung cancer in Danish asbestos cement workers employed during periods when chrysotile only was used

<table>
<thead>
<tr>
<th>Number of cases of lung cancer</th>
<th>Obs</th>
<th>Exp</th>
<th>SIR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed 1929-44:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>12</td>
<td>6.48</td>
<td>1.9 (0.96-3.2)</td>
</tr>
<tr>
<td>Women</td>
<td>0</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Employed 1980-4:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>0</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>0</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>

Lung cancer in asbestos cement workers in Denmark

Editor—This paper is a tribute to Edith Raffin and Elsebeth Lynge who have been involved in all three analyses of mortality and cancer morbidity in this Danish asbestos cement worker population, and to Johannes Clemmesen, father of their Cancer Register. The history of studies of asbestos cement workers tends to follow a pattern. When the health of the population studied is found to be perfect or its excess mortality not significant, there has been a tendency to leave well alone. (The asthma epidemiologists, after conducting a preliminary analysis that seems to show that asbestos exposure was good for you, would decline to proceed further until they had verified the integrity of the population. But that is another story.)

The attraction of studying asbestos cement workers (and for that matter asbestos textile workers) was the possibility of being able to evaluate the toxicity of chrysotile. In the event, when excess cancer mortality was found, it would be recalled that for a period there may have been exposure to amphibole.

This population of Danish asbestos cement workers overall, had the potential for mixed chrysotile and amphibole exposure, but it does include a subset of workers employed exclusively before the introduction of amphibole. Could the authors inform us whether analysis of this valuable group casts any light on the hazards of exposure purely to chrysotile asbestos?

MORRIS GREENBERG
74 North End Road
London NW1 7SY


If you wish to order, or require further information regarding the titles reviewed here, please write or telephone the BMJ Bookshop, PO Box 295, London W1X 9TE. Tel: 0171 383 6244, Fax: 0171 383 6662. Books are supplied post free in the UK and for British Forces Posted Overseas addresses. Overseas customers should add 15% for postage and packing. Payment can be made by cheque in sterling drawn on a UK bank, or by credit card (MasterCard, VISA, or American Express) stating card number, expiry date, and your full name. (The price and availability are occasionally subject to revision by the Publishers.)

BOOK REVIEWS

Book review editor: R L Maynard


Smog Alert: Managing Urban Air Quality is a useful introductory book on urban air pollution. The style is apocalyptic and the author delights in providing, especially in the early chapters, details of appalling population growth and worsening air quality in the rapidly expanding cities of the countries in transition from an agricultural to an industrial economy. The author has provided extensive footnote references, which I like, to the "grey literature" but almost no references to the original scientific literature. This is by contrast with his book Atmospheric Pollution: A Global Problem which provides detailed referencing. The author has included a wide range of government reports in his footnotes: again, I like this, but use of the secondary literature alone makes it difficult to check statements made in the text.

Does the book provide a balanced account? Looking closely at those areas with which I am familiar, I am afraid that it does not. For example, the section dealing with asthma and air pollution leaves the impression that the worldwide, rising tide of asthma is caused by air pollution. A secondary source not quoted by the author is the Department of Health Report on Asthma and Outdoor Air Pollution. This report made clear, by a detailed examination of the primary literature, that links between air pollution and the prevalence of asthma were far from established. This point has also been made in a recent report of an International Programme of Chemical Safety Workshop on Environmental Chemicals and Respiratory Hypersensitisation. The prevalence of asthma is increasing in the United Kingdom and yet the trend in pollution levels in the United Kingdom urban areas has not been dramatically upward during the past 10 or so years. Other sections of the book also
Do occupational exposures in nuclear refineries contribute to mortality from brain cancer?
R Kusiak, P Ashmore and D Baris

*Occup Environ Med* 1997 54: 142-143
doi: 10.1136/oem.54.2.142-a

Updated information and services can be found at:
[http://oem.bmj.com/content/54/2/142.2.citation](http://oem.bmj.com/content/54/2/142.2.citation)

**These include:**

**Email alerting service**
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

**Notes**

To request permissions go to:
[http://group.bmj.com/group/rights-licensing/permissions](http://group.bmj.com/group/rights-licensing/permissions)

To order reprints go to:
[http://journals.bmj.com/cgi/reprintform](http://journals.bmj.com/cgi/reprintform)

To subscribe to BMJ go to:
[http://group.bmj.com/subscribe/](http://group.bmj.com/subscribe/)