Ionising Radiation

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A study of occupational exposure to ionising radiation in Canada.

Total radiation doses, weighted for biological activity, were recorded for 500,000 workers between 1969 and 1983. Employment records were used to correlate with the national cancer registry. Correlation was not 100% accurate.

The average cumulative dose for the cancer sub cohort was 6.64 milli Sv.

For comparison, the mean cumulative doses (milli Sv) in the main occupational categories were:

Occupational group	Mean occupational exposure (milli Sievert)*
dental	0.31
medical	3.95
industrial	4.78
nuclear	31.98

* regardless of cancer status.

The problem is, what risks, if any, are associated with the lower exposure groups?

The authors attempt to extrapolate from the higher exposure cohorts and arrive at the answer that the excess relative risk:

- For all cancers is 2.5 per Sv (90%CI 1.2,4.0).
- For all cancers but leukaemia; 2.3 per Sv (90% CI, 1.1,3.9)
- Rectum cancer 13.8 per Sv (90% CI 3.7,33.6)
- Lung cancer 3.0 per Sv (90%CI 0.5,6.8)
- Leukaemia 5.4 per Sv (90%CI 0.2,20.0)

Where CI = confidence interval.

Comment

A 90% confidence interval is more widely used in the ionising radiation arena. Adoption of this standard seems to indicate a more precautionary approach than is generally applied. Even so, the results for rectal cancer and leukaemia would seem to be of doubtful statistical significance.

Excess Relative Risk (ERR) is also an unusual measure. For the example of the case of all cancers; ERR = 2.5 per Sv (90%CI 1.2,4.0), this translates to mean that the relative risk is 1.025 at 10 milli Sv, 1.25 at 100 milli Sv. The UC ionising radiation regulations (1999) define effective dose limits of 20 milli Sv per annum. This would be equivalent to a relative risk of 1.05 f the value calculated here was accurate.

In general, any relative risk less than 1.5 is to be regarded with skepticism as it may very well be the result of confounding factors.

For the average nuclear worker with an exposure of 31.98 milli Sv the relative risk is calculated to be 1.08.

Previous reports of ERR calculations provide widely varying results many of which are of doubtful statistical significance. The value found here is at the high end of the spectrum and of some statistical significance.

The standard that appears to be applied to protection against cancer arising from exposure ionising radiation is not that of beyond reasonable doubt (RR≥20), the balance of probabilities (RR≥2) but that of any detectable risk. It is not yet clear (from this work) whether or not such a threshold has been defined.

A much more powerful study of 600,000 nuclear industry workers is now under way. This may help to solve the problem of extrapolation to low exposures.