

Occupational radiation exposure and mortality: second analysis of the National Registry for Radiation Workers

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Abstract. The National Registry for Radiation Workers (NRRW) is the largest epidemiological study of UK radiation workers. Following the first analysis published in 1992, a second analysis has been conducted using an enlarged cohort of 124 743 workers, updated dosimetry and personal data for some workers, and a longer follow-up. Overall levels of mortality were found to be less than those expected from national rates; the standardised mortality ratio for all causes was 82, increasing to 89 after adjusting for social class. This 'healthy worker effect' was particularly strong for lung cancer and for some smoking-related non-malignant diseases. Analysis of potential radiation effects involved testing for any trend in mortality risk with external dose, after adjusting for likely confounding factors. For leukaemia, excluding chronic lymphatic leukaemia (CLL), the central estimate of excess relative risk (ERR) per Sv was similar to that estimated for the Japanese atomic bomb survivors at low doses (without the incorporation of a dose-rate correction factor); the corresponding 90% confidence limits for this trend were tighter than in the first analysis, ranging from just under four times the risk estimated at low doses from the Japanese atomic bomb survivors to about zero. For the grouping of all malignancies other than leukaemia, the central estimate of the trend in risk with dose was closer to zero than in the first analysis; also, the 90% confidence limits were tighter than before and included zero. Since results for lung cancer and non-malignant smoking-related diseases suggested the possibility of confounding by smoking, an examination was made, as in the first analysis, of all malignancies other than leukaemia and lung cancer. In this instance the central estimate of the ERR per Sv was similar to that from the A-bomb data (without the incorporation of a dose-rate correction factor), with a 90% confidence interval ranging from about four times the A-bomb value to less than zero. For multiple myeloma there was an indication of an increasing trend in risk with external dose ($p = 0.06$), although the evidence for this trend disappeared after omitting workers monitored for exposure to internal emitters. The second NRRW analysis provides stronger inferences than the first on occupational radiation exposure and cancer mortality; the 90% confidence intervals for the risk per unit dose are tighter than before, and now exclude values which are greater than four times those seen among the Japanese A-bomb survivors, although they are also generally consistent with an observation of no raised risk. Furthermore, there is evidence, of borderline statistical significance, of an increasing risk for leukaemia excluding CLL, and, as with solid cancers, the data are consistent with the A-bomb findings.

1. Introduction

Estimates of the risks from exposure to ionising radiation have, over the last few decades,

come mainly from epidemiological studies of the survivors of the atomic bombings of Hiroshima and Nagasaki and from certain groups exposed for medical reasons (BEIR 1990, ICRP 1991,

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