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“Typical doses and dose rates in studies pertinent to radiation risk inference at low doses and low dose rates”

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Study Findings

This review paper examined the radiation doses and dose rates in various experimental studies in radiobiology and radioepidemiological studies of exposed human populations and compared them to those of the Japanese atomic bomb survivors in the RERF Life Span Study (LSS).

Explanation

To estimate risk from radiation exposures that are of interest in radiation protection, which generally occur at low dose rates (<1 mGy/minute averaged over 1 hour) and amount to low doses (<100 mGy), it is necessary to extrapolate downward from results obtained at higher doses and dose rates. This paper reviews the doses and dose rates in a variety of relevant studies in experimental radiobiology (cell cultures, animals) and exposed human populations, and compares them to the doses and dose rates experienced by the atomic bomb survivors studied by RERF, as the latter are often considered to be a “gold standard” in radiation risk estimation. Dr. Cullings, Chief, Department of Statistics, RERF, collaborated in this study by providing and explaining relevant details of the doses received by the atomic bomb survivors as estimated by the dosimetry system, DS02, used at RERF.

Results

The experimental studies in cells and animals often involved doses and dose rates much higher than those of interest for radiation protection of human populations, and it was advised that the radiation-induced effects seen in such studies need to be extrapolated with care for use in radiation protection at lower doses and dose rates. On the other hand, the low-dose-rate epidemiological studies in human populations that were reviewed for this paper were found to have dose rates directly relevant to radiation protection and therefore to provide a valuable complement to the A-bomb survivor studies, which involve very high dose rates.

Study Significance

This study was put together by Task Group 91 of the International Commission on Radiation Protection (ICRP) to provide information to researchers around the world about the doses and dose rates of the studies that the said ICRP task group is considering in its new review, which is aimed at reconsidering the “dose and dose-rate effectiveness factor” (DDREF) that the ICRP previously recommended for use in radiation protection to “extrapolate radiation risks at high doses and high dose rates, where an abundance of data are available, down to low doses and low dose rates, where there is much less human data.” That extrapolation is a key step in using the information from the higher-dose and higher-dose-rate studies to establish standards for radiation protection at lower doses and dose rates.

The Radiation Effects Research Foundation has studied A-bomb survivors and their offspring in Hiroshima and Nagasaki for around 70 years. RERF’s research achievements are considered the principal scientific basis for radiation risk assessment by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and for recommendations regarding radiation protection standards by the International Commission on Radiological Protection (ICRP). RERF expresses its profound gratitude to the A-bomb survivors and survivors’ offspring for their cooperation in our studies.

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