Tooth enamel ESR doses and cytogenetic doses of Nagasaki atomic-bomb survivors in comparison with DS02R1 doses

There are two methods to investigate radiation doses to which the atomic bomb survivors were exposed. One involves a dose estimation system based on physical measurements (currently: DS02R1[*1]). With such a system, doses can be calculated based on distance from the hypocenter and shielding conditions including walls and roofs of buildings. The other comprises examination of biosamples, such as blood, provided by the survivors. For the latter method, chromosomes[*2] in blood cells are generally used but teeth[*3] also can be studied. Measurements using teeth are more accurate than those using chromosomes, but one disadvantage of calculations with teeth is that A-bomb survivor donations of teeth extracted for medical reasons are rare.

With biosamples provided by 24 A-bomb survivors in Nagasaki, this study investigated whether a disparity existed between results using chromosomes and teeth, and whether the biologically estimated doses agreed with the doses estimated by physical methods applied in epidemiologic studies. The study showed that these results were in close agreement.

The observed results lend support to the conclusions from large-scale chromosome studies for dose estimation conducted in the past.

[*1] DS02R1

DS stands for dosimetry system, based on which radiation exposed dose can be estimated. Information concerning A-bomb survivors such as their distance from the A-bomb's hypocenter and angle from the blast, shielding situation, orientation to the bomb blast, posture, and so on, can be used to calculate individual A-bomb survivor doses. The DS system was created in 1986 (DS86) and revised in 2002 (DS02), reflecting progress made in computer technology. The latest version is known as DS02R1, which is a revised version of DS02.

[*2] Chromosome method

Radiation can break chromosomes, but cells have the ability to repair the damage. However, occasionally, such broken ends can mistakenly fuse with other broken ends that were different from the originals. By investigating the frequency of such abnormal chromosomes, the amount of radiation exposure can be estimated.

[*3] Tooth method

When radiation hits a material, radicals (unstable atoms or molecules) can be formed. Radicals disappear rapidly in aqueous solution but can persist for a long time in solid material. Since radicals formed in tooth enamel remain for many years, the amount of past radiation exposure can be estimated by measuring the number of these radicals. This method is known as "Electron Spin Resonance (ESR)."

RERF's objective with this brief outline is to succinctly explain our research for the lay public. Much of the technical content of the original paper has been omitted. For further details about the study, please refer to the full paper published by the journal.