Intracellular reactive oxygen species[1] level in blood cells of atomic bomb survivors is increased due to aging and radiation exposure

With increased age and radiation dose in atomic bomb survivors more than 60 years after the bombings, decreased immune function and increased inflammation-related biomarkers have been observed. However, the association of reactive oxygen species (ROS) levels in immune-related cells with age and radiation dose is still unclear. In this study, RERF investigated the association between ROS levels in blood cells and serum iron,[2] ferritin,[3] and C-reactive protein[4] (CRP) levels in 2,495 Hiroshima A-bomb survivors who underwent health examinations in the RERF Adult Health Study during 2007–2012, in an attempt to examine the relationship between such changes and age and radiation dose.

After adjusting for the effects of gender, age at examination, smoking and drinking habits, body mass index, and blood sampling time, RERF carried out analysis using sophisticated statistical techniques. As a result, superoxide anion[5] (one kind of ROS) levels in monocytes, granulocytes, and T cells[6] (intracellular) tended to be higher in survivors exposed to higher radiation doses. In addition, serum iron, ferritin, and CRP levels were suggestively associated with intracellular ROS levels. CRP levels were also higher in older and more heavily exposed study participants, as observed in previous RERF studies.

When divided into three groups according to blood CRP level, the intracellular superoxide anion levels in blood cells were higher in survivors exposed to higher radiation doses, and this was most prominently observed in the group with the highest CRP levels. The results suggest that increased intracellular ROS levels might be associated with inflammatory conditions such as increased CRP levels and decreased serum iron, especially after radiation exposure. In this study, RERF observed a tendency toward higher levels of oxidative stress[7] — a situation marked by decreased immune function and increased inflammation — in the blood cells of older A-bomb survivors who had been exposed to higher doses of radiation.

Notes

[1] Reactive oxygen species (ROS):
A type of oxygen molecule in the atmosphere that has been converted into a more reactive compound. These highly reactive oxygen molecules play important roles in immune responses. Excessive ROS production and accumulation might enhance the risk of development of cancer and lifestyle-related diseases.

[2] Serum iron:
An iron component that binds to proteins and is transported in serum, a liquid component of blood. This component is involved in the production and breakdown of free radicals (one type of ROS).

[3] Ferritin:
A type of protein that binds to iron and is stored in the cells of living organisms. This protein plays a role in preventing the production of iron-induced free radicals.

[4] C-reactive protein (CRP):
A relatively large protein synthesized by liver cells that appears in the blood when an inflammatory reaction or tissue destruction occurs in the body.

[5] Superoxide anion:
One type of ROS. This negatively charged molecule contains an oxygen molecule with an excess of one electron and is highly reactive.

[6] T cells:
Immune cells are activated in the body to fight infection, and T cells, a type of white blood cell, act to manage the immune response to such disease. T cells are mainly produced in the thymus, from which the letter “T” is derived.

[7] Oxidative stress:
Production of active oxygen and antioxidant defense mechanisms are ordinarily balanced in the body. Oxidative stress occurs when the production of active oxygen becomes excessive and the antioxidant defense mechanism is overwhelmed.

doi.**10.1126/science.abg2365**
(Doi are permanent, content-specific numbers assigned to most digital information and, in this case, can be used to link to published abstracts and/or full papers.)

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.