

Paper published in *Radiation Research*^s

“Skin Cancer Incidence among Atomic Bomb Survivors from 1958 to 1996”

Hiromi Sugiyama, Munechika Misumi, Masao Kishikawa, Masachika Iseki, Shuji Yonehara, Tomayoshi Hayashi, Midori Soda, Yukiko Shimizu, Ritsu Sakata, Eric J. Grant, Fumiyo Kasagi, Kiyohiko Mabuchi, Akihiko Suyama, Kotaro Ozasa

Radiat Res 2014 (May); 181(5):531–9

(doi: 10.1667/RR13494.1)

Study Findings

Researchers observed that exposure to radiation is associated with a significant risk of developing basal cell skin cancer, with a dose-response threshold of 0.63 Gy and risk increasing as the age at exposure decreases.

Commentary

1. Objective

Researchers have reported a clearly increased risk of skin cancer, especially basal cell cancer, in association with exposure to ionizing radiation, based on studies of A-bomb survivors, workers in the field of radiation medicine, and individuals with a history of radiation treatment. The Radiation Effects Research Foundation (RERF) previously reported radiation risks for skin cancer based on cases diagnosed during the period from 1958 to 1987 in the Life Span Study (LSS) population. In the present study, the observation period was extended for 9 years, and radiation risks for skin cancer according to histological type as well as the effects of ultraviolet radiation on radiation risks were investigated.

2. Methods

The subjects of this study were 80,158 of the 120,321 individuals in the LSS population who were alive in 1958, when both local cancer registries in Hiroshima and Nagasaki began operations, and whose radiation dose was estimated by the latest dosimetry system (DS02). Pathological review was conducted on potential skin tumors diagnosed from 1958 to 1996 to estimate radiation risks for first primary cancers by histological type. A Poisson regression model was used for the analysis.

3. Results

(1) Radiation risks for basal cell cancer

With regard to basal cell cancer (123 cases), the best fit was a linear-threshold model with a threshold dose of 0.63 Gy (95% confidence interval [CI]: 0.32, 0.89); the excess relative risk at 1 Gy of exposure (ERR_{1Gy}) was estimated to be 0.74 (95% CI: 0.26, 1.6) for those age 30 at

exposure. The risk was estimated to increase by 11% with each one-year decrease in age at exposure; thus the ERR_{1Gy} was estimated to be about 7 after exposure at age 10. On the other hand, attained age did not significantly affect radiation risks.

(2) Relationship between ultraviolet radiation and radiation risks for basal cell cancer

The ERR_{1Gy} of basal cell cancer on skin areas likely to be exposed to ultraviolet radiation, such as the face and hands, was estimated at 0.6 (95% CI: <0, 2.1), and the ERR_{1Gy} of areas unlikely to be exposed to ultraviolet radiation, such as the trunk and extremities except for hands, was estimated as 2.3 (95% CI: 0.61, 6.7). Although there was no statistically significant difference between the two ($P = 0.15$), the results suggest that radiation risks were higher for the areas unlikely to be exposed to ultraviolet radiation.

(3) Radiation risks for squamous cell cancer *in situ* (Bowen's disease)

When a linear model was used, the ERR_{1Gy} of squamous cell cancer *in situ* (64 cases) was 0.71 (95% CI: 0.063, 1.9). However, by city, the ERR_{1Gy} of squamous cell cancer *in situ* (Bowen's disease) in Hiroshima (56 cases) was not significant, at 0.28 (95% CI: <0, 1.9), whereas that in Nagasaki (8 cases) was extremely high, at 17.6 (95% CI: 3.0, 149); and a statistically significant difference existed between the two ($P < 0.001$). However, the number of cases in Nagasaki was small, and there may have been a difference between Hiroshima and Nagasaki in the diagnosis of squamous cell cancer *in situ* and in the rate of reporting to local cancer registries. Therefore, it was difficult to draw a conclusion about whether any significant dose-response relationship existed.

(4) Radiation risks for other histological types

There was no significant dose response relationship for malignant melanoma (10 cases), squamous cell cancer (114 cases), Paget disease (10 cases), or other skin cancers (15 cases). The null result for malignant melanoma with regard to radiation dose is especially notable since that is the most serious form of skin cancer.

The results of this study show that a linear dose-response relationship with a threshold dose of 0.63 Gy exists between basal cell cancer and A-bomb radiation, and that the lower the age is at exposure, the higher the radiation risk. There was no significant relationship between radiation exposure and malignant melanoma, squamous cell cancer, or Paget disease.

The Radiation Effects Research Foundation has studied A-bomb survivors and their offspring in Hiroshima and Nagasaki for more than 60 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.

[§]***Radiation Research***, which is an official monthly journal of the Radiation Research Society, publishes original, peer-reviewed papers and review articles on radiation effects and related issues in the fields of physics, chemistry, biology, and medicine. (Impact factor in 2013: 2.445)