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“Radiation Effects on Cognitive Function among Atomic Bomb Survivors Exposed at or after Adolescence”

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Study Findings

We analyzed longitudinal cognitive decline data spanning two decades from atomic bomb survivors exposed in or after adolescence. Radiation exposure was not significantly associated with late-life pre-dementia cognition level or age-associated cognitive decline.

Explanation

Cognitive function was evaluated in medical examinations performed every other year from 1992 through 2011. The effects of radiation exposure on longitudinal pre-dementia cognitive decline were estimated after adjustment for age, sex, education level, and occurrence of dementia during follow-up.

1. Study purpose

The objective was to investigate what effects radiation exposure in or after adolescence has on late-life cognitive function by estimating longitudinal cognitive decline in the participants who did and in those who did not develop dementia during follow-up.

2. Study methods

To observe longitudinal pre-dementia cognitive decline, cognitive function was assessed in medical examinations of 1,844 participants in the Hiroshima Adult Health Study (AHS) who were exposed to atomic bomb radiation at or after the age of 13 and, in 1992, were between 60 and 80 years of age and free of dementia. The Cognitive Abilities Screening Instrument (CASI), a standardized survey of cognitive ability, was used to evaluate cognitive function. Of that total, 313 participants developed dementia during follow-up from 1992 through 2011. A mixed-effects* model was used to analyze changes over time in pre-dementia cognitive scores.

*Mixed-effects model: This statistical model is useful for analyzing repeated measurements over time. It factors in both fixed and random effects (hence its name).

3. Study results

(1) Cognition level was significantly lower in participants who were older, had a low level of

education, or developed dementia but was unrelated to radiation dose or sex.

(2) Cognitive decline accelerated with age, dropping particularly rapidly in participants who had developed dementia. Tendencies in age-associated cognitive decline were unrelated to radiation or education.

(3) Radiation dose did not significantly affect cognition level or tendencies in age-related cognitive decline in the participants who did and in those who did not develop dementia.

Study Significance

Interest is growing in the effects of radiation exposure on cognitive function as more patients survive malignancies. Research on survivors of cancer radiation therapy has shown cognitive decline many years after exposure in younger patients exposed to high doses. But the effects of high radiation therapy doses for cancer treatment are not easily distinguished from the effects of the underlying cancer and chemotherapy. The effects of moderate and lower radiation doses or in patients undergoing radiation therapy at relatively older ages, moreover, have not been sufficiently studied. In this study, we evaluated cognitive function in elderly atomic bomb survivors exposed once to a moderate or lower dose (≤ 4 Gy) in or after adolescence. We did not find that radiation exposure significantly affected cognition. A similar cognitive study has been carried out since 2011 of AHS participants who were 12 years or younger at the time of the A-bombings. Upon completion of the four-year cross-sectional study, those data will be analyzed.

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.

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