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**“Exposure to Atomic Bomb Radiation and Age-related Macular Degeneration in Later Life: The Hiroshima-Nagasaki Atomic Bomb Survivor Study”**

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**Study Findings**

Analyses adjusted for age, sex, city, smoking status, and other relevant factors in atomic bomb survivors indicated no significant association between the prevalence of age-related macular degeneration and prior radiation exposure.

**Explanation**

In age-related macular degeneration (AMD), the macula at the center of the retina (the light-sensitive lining of the eye) degenerates with age, which leads to visual impairment. AMD is the leading cause of vision loss among adults in many Western countries and constitutes an important societal issue as a major cause of vision loss in Japan, where an aging population and Westernized lifestyles have increased incidence of the disease. Age-related degeneration of the retina and choroid (the layer underlying the retina), genetic polymorphism, environmental factors, chronic inflammation, and ischemia each play important roles in AMD development. As they age, atomic bomb survivors may be at increased risk of AMD, but the relationship between AMD and radiation exposure has remained unclear.

1. Objective

The objective was to investigate the association between radiation exposure from the atomic bombings and the prevalence of AMD among atomic bomb survivors in Hiroshima and Nagasaki who have been followed by the Radiation Effects Research Foundation through biennial health examinations (Adult Health Study: AHS) since 1958.

2. Methods

The 2,153 participants in AHS ophthalmological examinations from 2006 to 2008 underwent a fundoscopic examination with a non-mydratric fundus camera (Topcon TRC-NW200, made in Japan). The resulting fundus images were used to grade the progression of lesions and classify the disease as early or late AMD. When lesion severity differed between the eyes, the eye with greater severity was considered. Eye doses determined with the DS02

dosimetry system were used in the analyses. Logistic regression models<sup>\*1</sup> were used to assess the association of radiation exposure and AMD prevalence, with adjustments made for relevant factors (e.g., age, sex, city, smoking status, body mass index, diabetes mellitus, hypertension, hyperlipidemia, white blood cell count).

<sup>\*1</sup> Logistic regression models: When a disease (A) is associated with multiple factors (B, C, D, E...) and the effect of B on A is to be determined, the effects on A of the factors other than B (i.e., C, D, E...) must be adjusted for. Logistic regression models are widely used in epidemiological research to adjust for such factors.

### 3. Results

Fundus images were gradable for AMD for 1,824 of the participants (84.7%). (The mean eye dose was 0.45 gray (Gy)). The prevalence of early AMD was 10.5%, and that of late AMD 0.3%. Analyses adjusted for age, city, and smoking status indicated no significant association between AMD prevalence and radiation exposure, resulting in adjusted odds ratio (95% confidence interval) per 1 Gy of 0.93 (0.75 to 1.15) for early AMD and 0.79 (0.21 to 2.94) for late AMD. The prevalence of small drusen<sup>\*2</sup> (diameter < 125 µm), which is a precursor to AMD, decreased with dose, but the difference was statistically insignificant.

<sup>\*2</sup> Drusen: Deposits of metabolic waste products under the retina.

### 4. Discussion

No association was observed between AMD prevalence and radiation exposure early in life. A lack of statistical power, however, cannot be ignored, because this was the first study to evaluate AMD prevalence using fundus images and very few participants had late AMD. Further follow up on AMD development and progression will be needed.

**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.

<sup>§</sup>*Investigative Ophthalmology & Visual Science (IOVS)*, published as ready online, is a peer-reviewed academic journal of the Association for Research in Vision and Ophthalmology (ARVO). IOVS features original research, mostly pertaining to clinical and laboratory ophthalmology and vision research in general. IOVS is regarded as a premier basic science journal for the field of ophthalmology. (Impact factor in 2013: 3.661)