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Incidence of Breast Cancer in the Life Span Study of Atomic Bomb Survivors: 1958–2009

Ionizing radiation is a well-known risk factor for female breast cancer. It is also well known that the younger the age at menarche becomes, the higher the risk of later breast cancer development in populations unexposed to radiation.

This latest breast cancer study conducted by the Radiation Effects Research Foundation (RERF) evaluated radiation effects on breast cancer incidence in 62,534 females, as well as in 42,910 males (for whom breast cancer is rare), in the RERF Life Span Study (LSS)* cohort of A-bomb survivors, followed since 1958. It looked at the LSS population through 2009 and is one of few studies to focus on breast cancer radiation risk in relation to female reproduction, including such factors as age at menarche**, number of full-term pregnancies, age at first full-term pregnancy, and menopause status. The previous RERF report on breast cancer in this population was published in 2007 and analyzed data through 1998.

In this new breast cancer paper, the number of female breast cancers in the study population since the previous analysis increased 37% (from 1,073), totaling 1,470 cases, with most new cases (75%) occurring among females exposed before the age of 20.

The study showed a continued strong relationship between the risk of female breast cancer and radiation dose that was linear in nature, meaning that breast cancer incidence increased in direct proportion to increased level of radiation dose, information that is well established.

Different from previous LSS research, however, this study found a strong relationship between radiation breast cancer risk and age at menarche: radiation risk was lower in women with greater age at menarche, for any given level of radiation dose and age at exposure (or, naturally, radiation breast cancer risk was greater in women with earlier menarche onset). Among females with the same age at menarche and radiation dose, the highest radiation risks were estimated for exposures occurring nearest the time of menarche.

For example, a 70-year-old female who experienced menarche at age 15 and also received 1 gray (Gy)*** of radiation at the same age had 2.40 times higher breast cancer risk than a 70-year-old unexposed female with similar menarche onset timing. For comparison, a 70-year-old female who experienced menarche at age 15 and was exposed to 1 Gy of radiation

at age 30 had 2.04 times higher risk than a comparable unexposed female, a considerably lower risk than the female exposed at age 15; see chart below. This is one of only few studies to conduct analysis of radiation risk by both age at menarche and age at exposure in a study population.

Gender	Age	Age at menarche	Age at exposure	Dose	Breast cancer relative risk (compared to unexposed)
Female	70	15	30	1 Gy	2.04
Female	70	15	15	1 Gy	2.40

This newest LSS breast-cancer study continues to show a strong dependence of female breast cancer risk on dose, and suggests increased breast-tissue sensitivity to radiation in females during puberty. These findings offer potential for greater insight into the mechanism by which breast cancer is related to age at radiation exposure, which should be of significant interest to the scientific community.

Notes

* RERF's LSS cohort—which provides the opportunity to study life span and cause of death in around 120,000 atomic bomb survivors with individual dose estimates—is unparalleled in size and follow-up duration, making it a unique opportunity to investigate breast cancer in terms of age and radiation effects.

** Onset of menstruation

*** Gray (Gy) is a unit used to measure radiation quantity; the average amount of radiation to which people are exposed each year from natural sources and human activity, not including medical irradiation, is estimated to be around 2.0 milligray (or, 0.002 Gy).

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Alina V. Brenner, Dale L. Preston, Ritsu Sakata, Hiromi Sugiyama, Amy Berrington de Gonzalez,

Benjamin French, Mai Utada, Elizabeth K. Cahoon, Atsuko Sadakane, Kotaro Ozasa, Eric J. Grant, and Kiyohiko Mabuchi

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