



NCRP Commentary No. 32: *Evaluation of a Sex-Specific Difference in Lung Cancer Radiation Risk and Approaches for Improving Lung Cancer Radiation Risk Projection (with a Focus on Application to Space Activities)*

National Council on Radiation Protection and Measurements

NCRP Commentary No. 32, *Evaluation of a Sex-Specific Difference in Lung Cancer Radiation Risk and Approaches for Improving Lung Cancer Radiation Risk Projection (with a Focus on Application to Space Activities)*, examines the risk of lung cancer in populations exposed particularly to chronic (protracted or fractionated) radiation. A main objective is to assess whether or not there is a sex-specific difference in lung cancer risk from chronic radiation exposure to the lungs such as experienced by astronauts during extended space missions.

Key Points:

1. Lung cancer, and its dependence on sex, in populations exposed to chronic radiation was examined based on a review of relevant radiation-related lung cancer epidemiologic and experimental studies.
2. No firm conclusion on whether or not there is a sex-specific difference in radiation risk for lung cancer from chronic exposure could be supported based on the evidence available to date.
3. Recommendations include additional or expanded epidemiologic studies [that include males and females, and concentrate on nonsmokers, chronic radiation exposure, and (when possible) exposure to high linear-energy transfer radiation] as well as further experimental studies and enhanced risk models.

The main motivation for the lung cancer risk assessment stems from the National Aeronautics and Space Administration (NASA) current operational model for astronaut radiation-induced cancer risk. The current NASA radiation-induced cancer risk model for astronauts relies on data from the Life Span Study (LSS) of Japanese atomic-bomb survivors. The LSS has demonstrated that the risk of radiation-related lung cancer is the largest contributor to the total fatal cancer risk. LSS results show that the radiation-induced lung cancer risk for the acute exposure experienced by the Japanese atomic-bomb survivors is nearly three times greater for females than for males on a relative scale (similar for both mortality and incidence).

Two main questions arise:

1. Based on the available data, is there a clear difference between radiation-related lung cancer risk in males and females for chronic exposure?
2. Is there a need to modify the existing NASA lifetime risk projection model for lung cancer and, if so, how?

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The Commentary addresses the above questions *via* a review of epidemiologic and experimental studies relevant to radiation-related lung cancer and examines the biological plausibility of a sex-specific difference in radiation-related lung cancer risk. It then evaluates the model that NASA currently employs to project lifetime risk of lung cancer mortality together with the associated uncertainties.

The Commentary contains in-depth discussions of human and animal studies as well as modeling and provides specific recommendations on future approaches for:

- Epidemiologic studies of lung cancer risk and female-male differences.
- Biological data and animal experiments to assess female-male differences in lung cancer risk.
- Modeling lung cancer risk projections for astronauts.



NASA spacewalker Kayla Barron is pictured during a 6 h and 32 min spacewalk to replace a failed antenna system on the International Space Station's Port-1 truss structure. <https://www.flickr.com/photos/nasa2explore/51732390695/>

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