

# X-rays linked to increased childhood leukemia risk

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Diagnostic X-rays may increase the risk of developing childhood leukemia, according to a new study by researchers at the University of California, Berkeley's School of Public Health.

Specifically, the researchers found that children with acute lymphoid leukemia (ALL) had almost twice the chance of having been exposed to three or more X-rays compared with children who did not have leukemia. For B-cell ALL, even one X-ray was enough to moderately increase the risk. The results differed slightly by the region of the body imaged, with a modest increase associated with chest X-rays.

The new findings, published in the October 2010 issue of the [International Journal of Epidemiology](#), come from the Northern California [Childhood Leukemia](#) Study, a population-based case-control study that includes 35 counties in the northern and central regions of the state.

While the relationship between high doses of radiation and cancer is well known, significant debate still surrounds the health impacts from the low doses of radiation typical of conventional X-rays, or radiographs.

Natural sources of ionizing radiation are ubiquitous, from the air we breathe to the soil we walk on. Government sources say that, on average, each American is exposed to 360 millirems of radiation a year from both natural and manmade sources, including radon, air travel and diagnostic X-rays. (A rem is the standard unit of measurement of absorbed ionizing

radiation in living tissue.)

Ionizing radiation is known to cause cancer in humans, whereas non-ionizing radiation, such as exposures associated with radio signals, microwaves and electric power lines, is not. The dose of ionizing radiation from a single chest X-ray is roughly equivalent to the amount one would get from natural surroundings in 10 days, which is still considered low.

"The general clinical impression has been that the level of radiation a child would be exposed to today from a conventional X-ray would not confer an additional risk for cancer," said Patricia Buffler, UC Berkeley professor of epidemiology and principal investigator of the Northern California Childhood Leukemia Study. "The results of our study were not what we expected."

Leukemia is a cancer of the white blood cells, the soldiers in the body's immune system responsible for detecting and destroying disease-causing agents. According to the American Cancer Society, it is the most common childhood cancer, accounting for nearly a third of all cancers among children younger than 15 years old.

Nearly all cases of childhood leukemia are acute, with 80 percent being acute lymphoid leukemia (ALL), characterized by the overproduction of abnormal B- or T-cell lymphocytes, and 20 percent being acute myeloid leukemia (AML), in which granulocytes are overproduced.

The study included 827 children up to age 15 diagnosed with either ALL or AML. The children with leukemia were each compared with other children randomly selected from the California birth registry who were matched by factors such as age, gender, ethnicity and maternal race.

Interviews were conducted with mothers within four months of the

diagnosis of leukemia, and the mothers were asked to report on the number of X-rays received by the child at least 12 months or more before the leukemia diagnosis. Mothers were also asked about their exposures to X-rays during pregnancy and the year prior to pregnancy.

The researchers noted that dental X-rays were not considered because they are so common and deliver such a low dose of radiation that exposure to those radiographs would not discriminate between individuals with high and low levels of radiation exposure.

The study found an increased risk from X-rays for ALL, but not for AML or T-cell leukemia, and there was no association with age at first exposure. Furthermore, there was no increased risk associated with prenatal exposure to X-rays or maternal X-rays occurring before pregnancy, although these exposures were uncommon in this study population.

The study authors emphasized that health care providers are already cautious in their use of X-rays in children, and use them only when necessary to diagnose potential problems such as respiratory illnesses, broken bones and fractures.

"X-rays are a valuable tool, and our findings indicate that their use should continue to be judicious," said Karen Bartley, doctoral student in epidemiology and first author of the study. "Of greater concern, perhaps, is the use of newer imaging technologies, which are becoming more common and which produce far higher doses of radiation."

Computed tomography (CT) scans, for instance, produce a 3-D image by compiling together multiple "slices" of 2-D images that were taken as the scanner moved along. A 2009 study from the National Cancer Institute projected that the 72 million CT scans received by Americans in 2007 would lead to 29,000 excess cancers. The number of scans in the United

States has increased over recent decades, going from 3 million scans in 1980 to more than 70 million a year today.

"The findings about increased leukemia risk certainly warrant further investigation," said UC San Francisco radiologist Dr. Rebecca Smith-Bindman, who was not part of the X-ray study. "If even plain film X-rays are associated with an increased risk of [leukemia](#), then one has to wonder about CT scans, some of which can generate 500 times the dose of radiation of an X-ray."

Dr. Smith-Bindman is in the process of characterizing the ionizing radiation exposure to children from CT scans as part of a study funded by the National Cancer Institute. She noted that two-thirds of the imaging procedures children undergo are conventional X-rays, accounting for about 20 percent of their exposure to radiation from medical imaging. In contrast, CT scans make up only 10 percent of the medical imaging tests children undergo, but they account for two-thirds of their ionizing radiation dose.

"The bottom line is we have to be very cautious about the use of any medical imaging techniques," said Dr. Smith-Bindman. "They can be enormously helpful for making accurate diagnoses, but tests that deliver [ionizing radiation](#) are associated with small – but real – risks of future complications related to the radiation exposure, and thus they should be used judiciously."

Provided by University of California -- Berkeley

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