

# Current research evidence about health problems from radiation

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## Executive Summary

- Even at low doses of radiation there is clear evidence of increased risk of cancer and cardiovascular disease. There is no safe lower dose.
- The risk of increased cancers has been clearly shown in studies with very large numbers of people: Workers in the nuclear industry, children having CT Scans, survivors of Nagasaki and Hiroshima, mine workers and householders exposed to raised levels of radon gas and in unborn children when their mothers had had abdominal X-rays.
- The risk of death from cardiovascular diseases is similar to that of dying of cancer, and the role of radiation causing other types of illness is currently being researched. As a result the overall excess risk of dying from exposure to low doses of radiation may be twice (or more) than that currently assumed from cancer alone.
- The trend in research over the last couple of decades, as each bit of new evidence emerges, is that the risks are greater than previously thought. There is now clear evidence that low dose exposures are harmful, and the greater the exposure the greater the risk.

## Nuclear Industry Workers

In June 2005, the British Medical Journal published a review of the risk of cancer from low doses of ionising radiation to workers in the nuclear industry in 15 countries which demonstrated a definite excess risk of cancer<sup>1</sup>.

**407,391 workers** were individually monitored for external radiation with a total follow-up of 5.2 million person years. The excess relative risk for cancers other than leukaemia was 0.97 per Sv (i.e. 97% increase- almost double per Sievert). The excess relative risk for leukaemia excluding chronic lymphocytic leukaemia was 1.93 per Sv (i.e.193% or almost triple per Sievert).

On the basis of these estimates, 1-2% of deaths from cancer among workers in this cohort may be attributable to radiation. These estimates, from the largest study of nuclear workers ever conducted, are higher than the risk estimates used for current radiation protection standards. **The results suggest that there is a small excess risk of cancer, even at the low doses and dose rates typically received by nuclear workers in this study (90% of workers received cumulative doses less than 50 mSv).**

**These results indicate that a cumulative exposure for adult workers of 100 mSv – the current recommended 5 y occupational dose limit – would lead to a 10% increase in mortality from all cancers, and a 19% increased mortality from leukemia (of types other than chronic lymphatic leukemia).** While the fact that the risk from low level radiation exposure may be 'small' in any particular individual, **when this risk is translated across populations, the increase in numbers of cancers can be considerable.**

## Medical Tests in Children (CT Scans)

In May 2013 a study in the British Medical Journal examined the cancer risk in children and adolescents following exposure to low dose ionising radiation from computerised tomography (CT) scans<sup>2</sup>.

The records of 10.9 million children and adolescents were identified between 1985 and 2005. Of these, **680,211 individuals** had a CT scan at least one year before a cancer diagnosis.

**Overall cancer incidence was 24% greater for exposed than for unexposed people.** These included brain tumours, many solid tumours (eg bowel, melanoma, female genital and thyroid), leukaemia and lymphoid cancers. **The risks increased for those exposed at younger ages.** The increased rates of cancer were continuing in the later years of follow up. There was no follow up after the trial concluded, so the total lifetime risk of cancer cannot be determined.

The average dose of radiation per person was 4.5 mSv, and **the average follow up after exposure was 9.5 years**. This large study confirms that low dose ionising radiation has significant adverse health effects. The follow up time is short- more cancers are likely as these kids get older.

## **Hiroshima and Nagasaki Survivors**

This report from 2012 covers deaths 1950-2003, so represents very long term follow up of events in 1945<sup>3</sup>. **86,611 people** are included in this cohort. There were **17% more cancer deaths in those exposed**, and these were **especially in those aged less than 10 at the time of the bombing with 58% more deaths in that group**. **This study shows there is an increased risk of dying of cancer throughout life**, and this risk increases proportional to radiation dose as the group ages. **The dose response is approximately linear** – i.e. twice the exposure dose = twice the risk, four times the exposure dose = four times the risk.

The risk of cancer mortality increased significantly for most major sites, including stomach, lung, liver, colon, breast, gallbladder, oesophagus, bladder and ovary. An increased risk of other diseases including the circulatory, respiratory and digestive systems was observed, but more research is needed to show this is from radiation. **Most significantly is that there is no safe lower dose- even low dose exposure showed increased risk.**

## **Cardiovascular Disease( mostly strokes and heart attacks)**

This 2012 review drew on eligible research papers published since 1990 looking at cardiovascular disease<sup>4</sup>. It looked at individuals who had low dose whole body exposures (cumulative average less than 0.5 Sv whole-body exposure, or exposures at a low dose rate (i.e., less than 10 mSv/day). They were all either atomic bomb survivors or occupationally exposed. The estimates of risk of increased deaths from circulatory disease are similar to those for radiation-induced cancer. **The overall excess risk of dying after exposure to low doses or low dose rates of radiation may be about twice that currently assumed due to radiation-induced cancers alone.**

## **Radon gas exposure**

**Worldwide everyone is exposed to radon gas naturally, but levels vary widely from place to place. Radon is known as a lung carcinogen.** Radon is a naturally occurring radioactive gas which can accumulate in enclosed places, including houses and other buildings. Uranium ore releases radon gas. Protective gear and ventilation reduces exposure in mines.

In 2006, with particular reference to radon (and especially relevant to uranium miners), **new studies found direct evidence of a lung cancer risk from the presence of radon gas in many homes, prompting a revision of safety levels**, according to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)<sup>5</sup>. **UNSCEAR reports ample evidence of carcinogenic effects of radiation not only in the occupational dose range (up to 20mSv/annum) but also in the overall lesser residential dose range (of 1-10mSv per annum depending on where in the world you live)**. In fact, for the first time, studies have measured increases in lung cancer in the general public from radon mainly in their homes (previously, the risk was extrapolated from the old data from uranium mining where the doses were very high).

It finds that despite all the problems with such research, there is now remarkably strong similarity in the evidence from both types of exposure. This shows that with increasing exposure to radon gas there are increased rates of lung cancer with rates varying between 9.4 % and 18% increased risk per 100 Bq/m<sup>3</sup>

Additionally, the UNSCEAR paper predates the doubling of the radon lung cancer risk that the ICRP (International Commission on Radiological Protection) has recommended. The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is currently surveying workers' exposures at Olympic Dam uranium mine to update previous studies done in 1990. **With the new radon risk levels, it is possible that some of the highest exposures might even exceed the occupational**

limits even in open pits, if weather conditions (inversion layers which keep gas close to the surface) occur to trap the radon.

## **Risk of childhood cancer from X-ray before birth**

Initially reported in 1956, many studies have since confirmed that low dose ionising radiation increases risk of childhood cancer<sup>6</sup>. This 1996 paper by Doll and Wakeford reviewed the evidence and found that one abdominal X-ray of a fetus increased the risk of childhood cancer by 40%. More recently doses of radiation from X-rays have reduced. However **there was no lower dose threshold that has been shown to be safe**. The evidence has been supported by both a dose response relationship (i.e. as the exposure increases the risk of cancer increases) and by animal models.

## **Confirmation that there is no “safe” low dose or irradiation**

In 2006 a comprehensive review of the effects of exposure to low levels of ionizing radiation, BEIR VII was published<sup>7</sup>. The BEIR (Biological Effects of Ionizing Radiation) reports are a series of publications by the National Academy of Sciences in the USA. The BEIR committee reviewed recent epidemiologic studies of the atomic bomb survivors, as well as recent studies of populations exposed to radiation from medical studies, from occupational exposures and from exposure due to releases of radioactive materials into the environment. **BEIR VII reconfirmed that the linear no threshold model (i.e. there is no safe lower dose, and the higher the dose the higher the risk of adverse health effects) is the most practical model to estimate radiation risks, especially for radiation protection purposes.**

### References

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