

Health effects of radiation

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1. Acute Exposure

Acute exposure is exposure to a large, single dose of radiation, or a series of doses, for a short period of time. Large acute doses can result from accidental or emergency exposures or from special medical procedures (radiation therapy). In most cases, a large acute exposure to radiation (above 1 sievert) can cause both immediate and delayed effects. For humans and other mammals, acute exposure, if large enough, can cause rapid development of radiation sickness, evidenced by gastrointestinal disorders, bacterial infections, hemorrhaging, anemia, loss of body fluids, and electrolyte imbalance. Delayed biological effects can include cataracts, temporary sterility, cancer, and genetic effects. Extremely high levels of acute radiation exposure can result in death within a few hours, days or weeks. Because radiation affects different people in different ways, it is not possible to indicate what dose is needed to be fatal. However, it is believed that 50% of a population would die within thirty days after receiving a dose to the whole body, over a period ranging from a few minutes to a few hours, between 3500 to 5000 mSv. This would vary depending on the health of the individuals before the exposure and the medical care received after the exposure.

These doses expose the whole body to radiation in a very short period of time (minutes to hours). Similar exposure of only parts of the body will likely lead to more localized effects, such as skin burns.

2. Chronic Exposure

Chronic exposure is continuous or intermittent exposure to low levels of radiation over a long period of time. Chronic exposure is considered to produce only effects that can be observed some time following initial exposure. These include genetic effects and other effects such as cancer, precancerous lesions, benign tumors, cataracts, skin changes, and congenital defects.

Low doses-less than 100 mSv- spread out over long periods of time (years to decades) don't cause an immediate problem to any body organ. The effects of low doses of radiation, if any, would occur at the level of the cell, and thus changes may not be observed for many years (usually 5-20 years) after exposure.

Genetic effects and the development of cancer are the primary health concerns attributed to radiation exposure. The likelihood of cancer occurring after radiation exposure is about five times greater than a genetic effect (e.g., increased still births, congenital abnormalities, infant mortality, childhood mortality, and decreased birth weight). Genetic effects are the result of a mutation produced in the reproductive cells of an exposed individual that are passed on to their offspring. These effects may appear in the exposed person's direct offspring, or may appear several generations later, depending on whether the altered genes are dominant or recessive. Although radiation-induced genetic effects have been observed in laboratory animals (given very high doses of radiation), no evidence of genetic effects has been observed among the children born to atomic bomb survivors from Hiroshima and Nagasaki.

3. Risks of Health Effects

All people are chronically exposed to background levels of radiation present in the environment. Many people also receive additional chronic exposures and/or relatively small acute exposures. For populations receiving such exposures, the primary concern is that radiation could increase the risk of cancers or harmful genetic effects.

The probability of a radiation-caused cancer or genetic effect is related to the total amount of radiation accumulated by an individual. Based on current scientific evidence, any exposure to radiation can be harmful (or can increase the risk of cancer); however, at very low exposures, the estimated increases in risk are very small. For this reason, cancer rates in populations receiving very low doses of radiation may not show increases over the rates for unexposed populations.

For information on effects at high levels of exposure, scientists largely depend on epidemiological data on survivors of the Japanese atomic bomb explosions and on people receiving large doses of radiation medically. These data demonstrate a higher incidence of cancer among exposed individuals and a greater probability of cancer as the level of exposure increases. In the absence of more direct information, that data is also used to estimate what the effects could be at lower exposures. Where questions arise, scientists try to extrapolate based on information obtained from laboratory experiments, but these extrapolations are acknowledged to be only estimates. For radon, scientists largely depend on data collected on underground miners. Professionals in the radiation protection field prudently assume that the chance of a fatal cancer from radiation exposure increases in proportion to the magnitude of the exposure and that the risk is as high for chronic exposure as it is for acute exposure. In other words, it is assumed that no radiation exposure is completely risk free.

Health Risks Arising From Low Doses of Ionising Radiation		
Effect	Risk	Normal Incidence
Risk of cancer from 1 mSv of radiation	1 in 17,000*	57 in 17,000**
Risk of severe hereditary effect from 1 mSv of radiation	1 in 77,000	1,770 in 77,000

* Age standardized lifetime probability for whole population.

**Age standardized incidence rate for whole population (not necessarily fatal).

The risk of obtaining cancer from 1 mSv of radiation exposure is equivalent to the risk of getting cancer from smoking approximately 100 cigarettes.

4. References

1. Recommendations of the International Commission on Radiological Protection, ICRP Publication 60. Annals of the ICRP 21, p22 (ICRP 1990).
2. SOURCES AND EFFECTS OF IONIZING RADIATION, UNSCEAR 2000 REPORT Vol. I, http://www.unscear.org/unscear/en/publications/2000_1.html

http://www.arpansa.gov.au/rad_health.htm

<http://www.bt.cdc.gov/radiation/>

<http://www.hpa.org.uk/radiation/default.htm>