Health effects of radiation

At every minute of our life we are exposed to both natural and artificial radiation. Radioactive materials with the characteristic of ionizing radiation are present in our vicinity, both in nature and in living organisms, as well as in our own bodies.

There are two sources of natural radiation: the cosmos and the Earth's crust. Cosmic radiation (derived from the Sun and deep space) as well as radiation from the Earth's crust were effective before the birth of life. Humankind developed and is continuously developing in a radiation field. The presence of natural radioactive materials is inevitable. They can be found in the soil, construction materials, air, food and drinking water, as well as in our own bodies.

Several billions of the atoms that make up our body are radioactive. Regarding operation of cells and organs, these radioactive atoms behave in the same way as the stable atoms of the same elements. Radioactivity is the ability of the nuclei of certain element to release ionizing radiation during their decay. In a human body about 16 million decays (decay of atoms of cells and materials absorbed with air and food uptake) occur every hour. On the other hand, due to this internal plus the external radiations, every second about 75,000 ionizing particles reach our bodies.

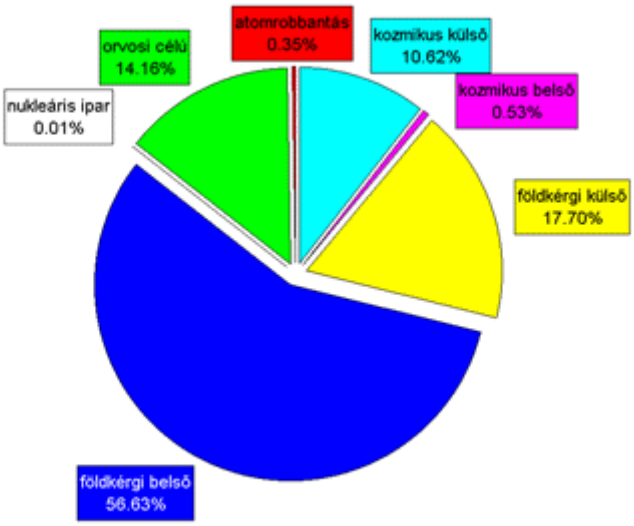
Our life is impacted by these internal and external doses from our conception to the grave. This natural radiation dose does not spell any danger, it is a natural and inseparable part of our life.

Our natural dose derives from inevitable sources of natural radioactivity and its quantity shows relatively insignificant differences regarding the majority of the Earth's population. These differences stem from different properties of human habitats and are determined mostly by geological and geographical variances, moreover the characteristic local building structures, living standards and average time spent indoors. For example, the radiation dose derived from cosmic radiation is somewhat higher among inhabitants of higher mountain regions than sea-level populations, since the radiation absorbing capacity of the atmosphere (it is relatively denser at sea level) decreases with increasing altitudes.

According to a United Nations survey recorded in 1988, each inhabitant of the Earth is exposed to an average 2.4 mSv radiation dose per year.

Sv (sievert) is the unit of the effect of radiation dose that a living organism obtains.

Internal sources provide two-thirds of our radiation dose, one third of it derives from external radiation. While internal sources originate abundantly from the Earth's crust, it accounts for a slight majority of external sources.



Natural	(2.4 mSv/év)
External cosmic	0.3 mSv
Internal cosmic	0.015 mSv
External crustal	0.5 mSv
Internal crustal	1.6 mSv
Artificial	(0.4 mSv/év)
Nuclear industry	0.0002 mSv
Medical	0.4 mSv
Nuclear explosions	0.01 mSv

Main sources and average values of radiation dose of the Earth's population

It can be observed that crustal origin internal dose is one hundred times higher than the cosmic origin internal radiation dose, while the cosmic origin external dose is only twenty times higher than the internal one.

The natural radiation dose for an average Hungarian citizen is 3 mSv/year. That is about 20 % higher than the worldwide average because we spend a bit more time in buildings. The majority of the Earth's population, living in tropical regions mostly in open-air conditions, have a lower radiation dose, while people in northern countries can be exposed to twice the worldwide average dose.

The biggest part of our radiation dose stems from the inhalation of a radioactive radon isotope, which originates from uranium and which is always present in rocks, building materials, soil etc., and from other airborne radioactive materials.

The more we stay in badly ventilated, ground-level or even subterranean rooms, the more the dose due to radon. This is why it is very important to frequently air all the rooms we stay in for longer time. This should be done for a few minutes every one or two hours, and thoroughly with drawn before sleeping.

There are parts of the world where the natural background dose is five to ten and even fifty times higher than in Hungary, due the increased amount of radioactive material (mainly thorium compounds) in the crust. Such areas can be located, for example, in India (in Kerala State) and Iran (Ramsar), moreover in France, Madagascar and Nigeria. Despite thorough medical and epidemiology examinations, which have been going on for decades with tens of thousands of the population of these regions, no signs of health damage have been observed.

Since the end of the 19th century, human beings have been exposed not only to a natural but also an artificial (derived from human activities) radiation load. Among these, X-ray radiation is the most predominant. X-rays were the first artificial radiation. They were described in 1887 by Wilhelm Konrad Röntgen and reached worldwide application – predominantly in the medical sciences – within a relatively short time. Medical applications account for the main proportion of the artificial radiation dose of the population.

	man.Sv
Medical radiation	2,000,000
Of nuclear explosions	50,000
Glowing clock faces	2,000
Nuclear industry professionals	5,000
Nuclear industry civilians	1,000

Collective radiation dose of the Earth's population due artificial sources

There is no real reason to fear or reject X-ray medical examinations. X-ray imaging provides invaluable information about existing illnesses or developing disorders. Thus the possible damage caused by a medical radiation dose is dwarfed by the value of the X-ray results regarding appropriate prevention and treatment of illnesses.

The dose exposure due to artificial radiation sources is less than 20 % of the total natural dose (considering the population both of the Earth and of Hungary). An abundant contributor to the artificial radiation is medical radiation, resulting in a 0.4 mSv/year dose to a person.

The population is also exposed to some extra radiation as an effect of previous experimental military A-bomb explosions and the nuclear industry. However, the amount of this is negligible: less than half of one per cent of our dose from the natural background.

Medical radiation accounts for 97 % of the collective radiation dose of the Earth's population due to artificial sources. It is hard to believe but (according to worldwide measurements and calculations) the collective radiation dose of civilians from the nuclear industry, including the dose derived from the Chernobyl reactor accident, is lower than the dose coming from glowing clock faces. Even the collective radiation dose of nuclear industry professionals (uranium miners, workers of NPPs and uranium breeding facilities) is only two and a half times higher than the dose from those clock faces.
(The collective radiation dose is the radiation dose of certain populations exposed to certain radiation sources. It can be calculated with multiplication of the number of the given population by the average radiation dose from the given source. Its unit is man.Sv)

There are no measurement data supporting the overreaching fears and condemnations regarding nuclear power plants. This is especially valid in the case of Hungary, a country with restricted energy sources, where Paks Nuclear Power Plant provides almost half the country's energy production – without any detectable extra radiation dose affecting the civilians. While inhabitants of Hungary suffered a radiation dose equivalent to one month of the yearly natural radiation as an effect of the Chernobyl disaster, people living in the region of the Paks NPP have an extra dose the equivalent of two hours of the annual natural radiation. Compared to the dose derived from the annual 8,760 hours of inevitable natural radiation, this is such a low quantity that no detrimental health effects can be contributed to it.

Reactor accidents indisputably lead to higher levels of danger, as has been proven by reactor disasters with casualties. However, the number of occurrences of such accidents is extremely low. The probability of a serious reactor accident resulting in the release of a substantial amount of radioactive material with the risk of individual health damage (severe radiation damage or radiation sickness, or even more detrimental outcomes) is extremely low: such a serious accident occurs every 2,000 years for 500 operating reactors – in view of our recent knowledge and safety systems.

Assuming the future enhancement of reactor safety systems and the reduction of the possibility of NPP disasters resulting from human error or failed decisions (like the Chernobyl disaster in 1986), even the total prevention of them is a natural and justified assumption. There is little chance of a repetition of the Chernobyl accident. Such old type, obsolete reactors have not been installed in the past two decades.

Nowadays NPPs are far safer than traditional fossil power plants and even hydroelectric ones (the breaking of dams has its own probability). According to the statistics, the probability of casualties in fossil plants is 500 to 1,000 times higher than in NPPs. Nevertheless, public opinion still overestimates the dangers of the nuclear industry. The widest difference between real and assumed risks occurred in the case of NPPs according to the risk analyses and assessments accomplished between 1989 and 1991.

While smoking, traffic accidents and fossil power plants shorten the average lifespan by 2,000, 200 and 24 days, respectively, NPPs reduce it by only 0.04 of a day. In comparison, civilians estimated this latter value as 250 days. The risk in relation to lifespan shortening is fifty thousand, twenty thousand, five thousand and one thousand times higher with smoking, obesity, car accidents and suffocation, respectively, than the risk determined by nuclear power plants.

Dr. Turai István: Környezeti sugáregészségügyi ismeretek című munkája alapján