OPINION: HEALTH RISKS FROM NUCLEAR ACCIDENTS – FACT OR FICTION?

No source of energy is risk-free – coal-fired power stations produce a variety of toxic agents that cause a number of detrimental health effects, and, incidentally, emit three times as much radiation as nuclear power stations in normal operating circumstances

In October 2014, the energy company EDF received the go-ahead to build a new nuclear power station at Hinkley Point in Somerset, the UK's first new nuclear reactor in 30 years. Public perception of the dangers of radiation have been partly responsible for this long hiatus. Professor Gerry Thomas, Professor of Molecular Pathology at Imperial College London, thinks that the perceived health risks of exposure to radiation from nuclear power plant accidents are vastly overestimated.

Professor Gerry Thomas

I was born in the 1960s, and grew up believing that the word 'radiation' meant something that was infinitely dangerous. Back then, we were led to believe that nuclear weapons would lead to the extinction of our species, and that to be bitten by a radioactive spider would confer supernatural powers! I was therefore sceptical about the use of nuclear power. It was not until 1992, when I started to study the health effects of the accident at the Chernobyl nuclear power station in 1986, that I began to question whether my understanding of the health effects of radiation came more from science fiction than scientific fact.

Let's start with some facts. We are a successful species inhabiting a naturally radioactive world and must have evolved protective mechanisms to deal with the effects of natural radiation – or we would not be here. All of us will be exposed to between 2 and 3mSv (milliSievert*) for each year of our life from our natural environment. Individuals seem to accept the use of higher levels of radiation when they can associate it with a direct beneficial effect – such as the use of radiation in medical tests and therapies. However, there appears to be less acceptance of the risk associated with any radiation level when the possibility of exposure to often much lower doses results from emissions from the nuclear industry.

So where does our evidence for the effect of radiation on health come from? Most of our understanding stems from epidemiological studies of the survivors of the atomic bombs that landed on Hiroshima and Nagasaki in the 1940s, from cohorts of workers who were exposed to radiation in the workplace, such as the radium dial painters in the early years of the 20th century, and, more recently, from the nuclear power plant accidents at Chernobyl and Fukushima. Each of these is a slightly different scenario, involving different types of radiation and different routes of exposure – factors that we now know influence health aspects.

Many things can affect our health; many agents or our environment can lead to the development of cancer. There are no biomarkers that enable us to distinguish a cancer caused by radiation from a cancer caused by any other carcinogen. To put this into some context, it is estimated that the number of cancers that may have resulted from exposure to radiation from the Chernobyl accident by 2025 may be as many as 41,000 – consisting of 16,000 thyroid cancers and 25,000 other cancers (the calculations are based on extrapolation from the data from the World War II atom bomb survivors) – compared with several hundred million from other causes over the same time period.

Herein lies a problem – our epidemiological evidence shows that the effect of radiation exposure on public health is dwarfed by the effects of everything else that affects our health. It is rather like looking for the needle in a haystack. Even in the largest studies, it has been difficult to produce good data to categorically show the health effects of radiation at individual doses below 100 mSv.

All toxins, including radiation, show a relationship between the dose to which we are exposed and the magnitude of their effect on health. Working out the dose delivered to a particular tissue in someone exposed to radiation is complicated and requires understanding of physics, chemistry and biology. The physical half-life of a radioactive isotope determines how much radioactivity will be released over a given period of time.

Our bodies exist in equilibrium with our environment; we are constantly taking in and releasing chemicals. The amount of time an individual chemical substance, such as a radioactive isotope, stays within our tissues is termed the biological half-life. This is governed by the chemistry of our bodily tissues – some of our tissues have developed biological pumps to concentrate particular chemical entities within a tissue and mechanisms to store complexes of these chemicals. In general, where biological half-life is greater than physical half-life, the dose of radiation to a given tissue will be higher, and therefore the health effects are likely to be greater.

Our evidence from the Chernobyl accident shows that the only radiobiological consequence for the general population has been a rise in thyroid cancer caused by exposure to radioiodine, with a physical half-life of eight days and biological half-life of a hundred days, in those who were young at exposure and received the highest doses to the thyroid gland. The doses from exposure to other radioactive isotopes, such as Caesium-137, with a physical half-life of 30 years and a biological half-life of 70 days, have been much lower – in the majority of cases equivalent to that of a single CT scan (around 10 mSv). Recent evidence from the United Nations Scientific Committee on the Effects of Atomic Radiation suggests that the fear of the possible health effects of radiation exposure and the consequent stress and anxiety have caused more harm to health than the radiation dose itself – to both the Chernobyl and Fukushima populations.

Modern society needs reliable energy sources. No source of energy is risk-free – coal-fired power stations produce a variety of toxic agents that cause a number of detrimental health effects through poor air quality, and, incidentally, emit three times as much radiation as nuclear power stations in normal operating circumstances. Yes, there are risks from nuclear energy, but the health risks have been overestimated by some sectors of the scientific community, the press and the public. The potential benefits in terms of climate change, for example, far outweigh any radiobiological risks from accidents.

Surely it is time to put scientific fact before science fiction?

BIOGRAPHY

Professor Gerry Thomas is Professor of Molecular Pathology at Imperial College London and has spent most of her career researching the health effects of exposure to radiation from the Chernobyl accident. In 2011, she was asked to explain the likely health effects of the accident at the Fukushima Daiichi power station by the media and her colleagues in Japan.

* A Sievert *represents the equivalent biological effect of the deposit of a joule of radiation energy in a kilogram of human tissue – a milliSievert is a 1,000th of a Sievert.*