



Review

Health effects of the Chernobyl accident: fears, rumours and the truth[☆]

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Received 29 October 2002; received in revised form 13 November 2002; accepted 19 November 2002

Abstract

The impact of the world's worst nuclear disaster at Chernobyl in 1986 is reviewed within a framework of a triad of fear, rumour and truth. The scope of the accident, Soviet secrecy about it, and the lack of general awareness of, or disregard for, the effects of radiation created a fertile ground for persistent fears and rumours attributing any health problem to Chernobyl. Scientifically correct answers to health issues have been the means to combat disinformation, and to replace interconnected fears, misconceptions and rumours. To date, according to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2000 Report, based on a review of epidemiological and radiobiological studies, the main radiation-related effect of the Chernobyl accident is an increased risk of childhood thyroid cancer. In addition, the accident has had serious non-radiation-related psychological consequences on the residents of the contaminated territories, resettled populations and clean-up workers. Researchers in search of the truth through epidemiological reasoning are facing serious challenges which are reviewed within this article.

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Keywords: Chernobyl; Health effects; Thyroid cancer; Epidemiological research; Disease registries; Challenges

The Chernobyl disaster that took place on 26 April 1986 was not just an event. It is an ongoing process. It is a process that we are living with and living in. It is taking place in our lifetime and it will have an impact on the lives of millions.

“What kind of life will we and our children have in the future?”, ask people who are living in, or who have lived, in a radioactively contaminated environment. “What will be the health effects of Chernobyl?”—ask scientific researchers. These and similar questions must be asked and answered, but there are no simple answers. Life and health outcomes are often difficult to describe and measure.

Prelude

Years ago, I tried to picture what the world would be like without smoking. I envisioned a world with: no smoking-related diseases or their victims; no prognoses

on the catastrophic effects of smoking on the future of humankind; one less factor to be considered as a possible confounder or effect modifier; no company-paid scientists claiming the harmlessness of smoking; no intensive research to blame or bless smoking; no eye-catching ads touting new brands of cigarettes, no Marlboro man, no Joe Camel; no “separate” places in cafes and airports for smokers and non-smokers; different winners of the 1996 Ig Nobel Prize in Medicine [1]; and no need for dreams of a smoke-free society.

Today, the contradictions, paradoxes, passions, reactions of the public and media, and the conflicts of interest that are so clearly observable with research on smoking can also be found in issues related to the health effects of the Chernobyl accident. This review concentrates on some specific accident outcomes, within a framework of a triad of fear, rumour and truth.

1. The accident, immediate aftermath and affected populations

The accident stemmed from an experiment to test a safety procedure, specifically, whether it was possible

[☆] This review is based on a keynote lecture at the 24th Annual Meeting of the International Association of Cancer Registries held on 25–27 June 2002 in Tampere, Finland.

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to shut down reactions in the core in the event of a main power loss. The reactor's emergency core cooling system was intentionally switched off. Unfortunately, later, out of control, the reactor overheated, and was followed by the intense generation of steam and two explosions that destroyed the reactor core [2].

The explosions resulted in a fire, confusion, chaos, fear and the release of radioactivity into the environment. Intensive research was initiated. One investigator remarked that "Chernobyl research very soon became a fast growing international industry" [3].

The previously unknown name, "Chernobyl", became widely used and started to play an important role in the global language. A new meaning arose for the word "liquidator" to denote a person who participated in the environmental clean-up and related activities after the reactor accident. In addition, various synonyms of "liquidator" emerged, like "clean-up worker" (the name preferred here), "Chernobyl veteran", "emergency worker", "recovery operation worker", "accident recovery worker", "*ad hoc* worker" and "decontamination participant".

Radioactive fallout was mainly concentrated in three countries close to the nuclear power plant: Ukraine, Belarus and the Russian Federation. However, lower concentrations came down over much of the entire Northern hemisphere. Nuclear fallout from Chernobyl was detected on 2 May in Japan, 4 May in China, and 5–6 May in Canada and the USA [4].

To stop radioactive clouds moving towards Moscow with its 10 million people, a decision is believed to have been made to seed the clouds to cause precipitation [5]. In this way, a highly contaminated area in a rural Novozybkov district west of the city of Bryansk (the Russian Federation) was produced.

In the three most affected countries, contaminated areas (^{137}Cs soil deposition density $> 37 \text{ kBq/m}^2$) cover approximately $150,000 \text{ km}^2$, including so-called areas of strict control ($> 555 \text{ kBq/m}^2$) that cover approximately $10,300 \text{ km}^2$. In 1995, the size of the population in those areas was 5–6.7 million and 130,000–190,000, respectively [6,7].

From 1986 to 1990, around 600,000 persons [6] (estimated range 300,000–800,000 [8])—clean-up workers—were sent into the area to engage in mitigation activities. Some of the clean-up workers experienced extremely hazardous conditions, for example, those who removed contaminated material from the roofs near the damaged reactor. Ironically, they were known as *biorobots*, as they were used instead of real robots (made in West Germany). This was because the electronic components of these real robots were affected by the high levels of radiation [2].

2. Secrecy and fears

After the accident, the world was scared. Chernobyl has been called a secret disaster and for good reason. The first indication of a major nuclear accident came from Sweden on 28 April 1986. It was soon clear that neither Sweden's Forsmark Nuclear Power Plant nor any underground nuclear test could be implicated. An analysis of the trajectory of air masses pointed towards Chernobyl. However, for a long time, the Soviet authorities continued the practice of jamming "hostile" foreign radio broadcasts and bombarded the media and public with misinformation concerning the nature and scope of the accident [9].

The roots of the Soviet secrecy are clear. Everyone, beginning with local low-level officials, and ending with the Government, applied the long-proven tactic—keep silent and you will avoid trouble. The official secrecy around the accident, and the resulting information vacuum, caused fears and rumours of all kinds. In a town in Belarus, locals explained that officials had said nothing, but that cattle herds had been evacuated [10]. Ten years after the fatal explosions, a *New York Times* journalist wrote, "people have become paralysed with fear. They are afraid to move, afraid to stay, afraid to marry, and afraid to have families" [11].

Quite interestingly, the replacement of the traditional unit of radioactivity the *curie*, with the numerically more frightening SI-derived unit, the *becquerel* ($1 \text{ curie} = 37 \times 10^9 \text{ Bq}$), contributed to the fear among the public [12].

For some, a lack of awareness of the radiation risks resulted in a total denial of any danger and, consequently, there was no fear. For these individuals, when they returned to highly contaminated areas, they reasoned, "Look at me. I'm healthy. My cow is healthy. There is no radiation. It's a fraud. It's a lie. The government is just trying to take our land." [5].

In the opinion of experts [13], for the majority of people, the Chernobyl disaster remains something that "is feared, but little understood".

Fear gave birth to rumours. Fear and rumours are tightly connected with each other: frightened people believe weird things and rumours generate new fears.

3. The spread of rumours

An atmosphere of fear and distrust and a scarcity of reliable information created a fertile ground for rumours, misconceptions and horror stories. The following represents a small sample of them:

- in Kiev, 15,000 nuclear victims were bulldozed into mass graves (in 1986) [14];
- the Chernobyl disaster was an intentional

experiment aimed at gathering knowledge about the effects of radiation on people (in 1996) [15];

- as a result of radiation, over 300,000 persons have died by now (in 2000) [16];
- “most of [the clean-up workers] are now disabled, some are terminally ill and others have died” (in 2000) [17];
- as a result of the accident in Chernobyl, the number of skin cancer cases in Romania has increased 60 times (unknown year) [18].

There is a rumour in my collection that I heard in 2001 from an acquaintance, who, as I understand it, had heard it from a direct eyewitness. I was told that in the early morning at the end of April 1986, several trucks, each carrying tens of carcasses of lethally irradiated elk, drove north on a peninsula on Saaremaa Island in Estonia. It was believed that the Chernobyl fallout had a direct negative impact on animal health approximately 1000 km from the crippled reactor!

The rumours concerning the Chernobyl accident were negative. This is consistent with the view [19] that, when the topic is an emotionally negative one, people are eager to circulate bad news, even when that news is exaggerated.

According to Allport and Postman’s basic law of rumour [20], the amount of rumour in circulation is roughly equivalent to the importance of the rumour multiplied by the uncertainty surrounding the rumour, as follows:

$$R \sim i \cdot a$$

where: R is the *amount* of rumour in circulation,

i is the *importance* of the rumour to the person who hears or reads it,
 a is the level of *ambiguity* or *uncertainty* surrounding the rumour.

In other words, the spread of the rumour decreases when uncertainty is reduced, that is, when the factual basis for not relying on the rumour is increased. In the case that uncertainty is completely eliminated ($a=0$) the rumour disappears. If we accept a correspondence theory of truth [21] that truth is a statement that corresponds to the facts, then the results of research (facts) will pave the way towards the truth and decrease the intensity of rumour.

4. The search for the truth

The most authoritative review summarising the results of Chernobyl-related health effect studies is the recent United Nations Scientific Committee on the Effects of

Atomic Radiation (UNSCEAR) 2000 Report [6]. Among its 10 annexes, one (Annex J) is dedicated to exposures and effects of the Chernobyl accident, and another (Annex I) addresses issues of epidemiological evaluation of radiation-induced cancers. The major conclusions of the UNSCEAR 2000 Report and some other publications [22–26] are as follows:

1. The *only* substantiated public health impact attributable to radiation exposure has been a sharp increase in childhood thyroid cancer (totalling approximately 1800 cases in three countries in 1990–1998). This finding was initially received with great scepticism because of the short latency period, but is now widely accepted. Inadequate distribution of potassium iodide/iodate tablets for preventative thyroid blocking of radioiodines, and living in endemic goitre regions, have further contributed to an unprecedented epidemic of childhood thyroid cancer.
2. There is currently *no* internationally accredited evidence of an elevation in the risk of leukaemia.
3. There is *no* scientific evidence of an increase in overall cancer incidence or mortality that could be associated with radiation exposure.
4. There is *no* evidence of an increase in birth defects over time.
5. There is *clear* evidence of non-radiation-related psychological disorders due to fear of radiation, inevitable rumours of detrimental health effects, stress of relocation, economic hardships, highly politicised handling of the consequences of the accident, and some other factors. The Estonian Study of Chernobyl Cleanup Workers [27] found that there was a substantial excess of suicide during the first 6.5 years following the accident, possibly due to forced recruitment for clean-up, uncertainty about radiation dose and its effects, and about future radiation-related health risks.
6. Reports of health effects caused by radiation have been *greatly exaggerated*.

5. Challenges, challenges...

The pure and simple truth is rarely pure and simple. Oscar Wilde

In the search for the truth through epidemiological reasoning, serious challenges have been considered by researchers:

1. There is a weak infrastructure in epidemiology in the three affected countries. A history of scientific isolation [28,29] means that epidemiology is still

considered a science of the occurrence of infectious diseases [30]. Consequently, close international cooperation in conducting epidemiological studies is a must to avoid erroneous conclusions generated by flawed study design, lack of (detailed) individual exposure data, differential follow-up, poor record-keeping, inappropriate statistical analyses, and other methodological problems.

2. Not enough attention was paid to internationally recognised techniques of disease registration in the affected territories. International efforts to improve the registration system have been made, but there is still much work to do. In fact, the situation may be worsening in some areas. For example, there are indications that official health statistics in Belarus today are less reliable than in the time of Soviet rule [31].
3. Most published studies used an ecological design. These studies are very dependent on the quality of the disease registries, particularly cancer registries and mortality registries. A time trend analysis may be biased when comparing disease incidence rates for periods before and after the accident.
4. Emphasis has been put on screening at the expense of well-designed and well-conducted epidemiological studies. Thus, “collaborating Western researchers have a mission to spread their knowledge of designing studies, estimating study size and power, developing study protocols, writing proposals for funding, analysing data, drawing conclusions, and writing scientific papers...” [29].
5. The interpretation of study findings is difficult because of economic and social changes. It is very complicated to separate the effects caused by exposure to radiation from the accident, and those caused by economic and social decline. The decline is associated with low incomes, poor living conditions, demoralisation, poor diet, alcoholism, tobacco abuse, social polarisation and a growing culture of dependency [32]. As a matter of fact, in the affected territories, a wide spectrum of diseases, related to a low socioeconomic status [33], prevails, and may overshadow any radiation effects.

Some say that the UNSCEAR 2000 Report has dispelled the myth of huge health risks after Chernobyl; others [34] state that “the accent put in the Report agrees with atomic lobby interests” and contains cynical statements. Some think that heavily contaminated areas will be resettled and economically and socially rehabilitated. Some [35], having generalised the results of major industrial disasters, cannot exclude the possibility that

communities near Chernobyl “simply cease to exist”. And, some propose a trip to the Chernobyl area [36], thus encouraging us to face our fears, consider the rumours and find our own truth in an apocalyptic environment.

A combination of political will to guarantee more money for research, and international interdisciplinary research efforts of scientists are necessary to learn more about the long-term health effects of the accident. The cliché, “more research is needed”, is placed here with the additional emphasis that it is not only needed, but there is an obligation on the part of the worldwide research community to measure the health consequences of Chernobyl.

Acknowledgements

The author’s research at the institute is financed by the Estonian Ministry of Education (target funding 0192112s02). Thanks are extended to Peter Inskip and Edward Gelb for commenting on earlier versions of this paper.

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