



Reasoned Opinion

Long-Term Health Impacts of the Chernobyl Disaster: Updated Insights *Ketevan Khazaradze^{1*}, Nino Japaridze², Aza Revishvili¹, Irina Javakhishvili³*

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Abstract:

The legacy of the Chernobyl disaster illustrates the far-reaching and multifaceted consequences of large-scale radiation exposure. While acute radiation sickness was rare, the long-term health impacts, including thyroid cancer, other malignancies, and chronic non-cancer morbidity, persist decades later. The purpose of our research was to determine the problem of radiation due to increased number of cancer cases in Belarus, Ukraine, Russia and Georgia. As a result of the research, it was determined that the problem is substantial and needs furthermore investigation and continuing surveillance.

Key words: Chernobyl, Radiation, Cancer.

Introduction

The Chernobyl nuclear accident of April 26, 1986, remains one of the most catastrophic environmental disasters in modern history. A flawed safety test at Reactor No. 4 triggered a thermal explosion, destroyed containment structures, ignited fires, and released vast quantities of radio nuclides into the environment. The fallout affected much of the European Soviet Union, contaminating air, soil, water, and the food chain [1].

During operation, various radionuclides in dense and gaseous states were produced in the uranium-graphite-channel boiling reactor, a thermal explosion occurred, the reactor's protective shell was broken, a fire broke out, radionuclides were released, and radioactive precipitation appeared. The precipitation was most abundant near the nuclear power plant, i.e. there was the

highest level of radiation. Radioactive contamination covered almost the entire European part of the former Soviet Union. In areas far from the reactor, contamination of milk with iodine-131 was found, and subsequently with cesium radionuclides - cesium-137 (half-life 30 years) and cesium-134 (half-life 2 years) - which got into food products. In several regions - in the south of Belarus and in the western regions of the RSFSR, the level of cesium-137 content in the soil led to restrictions on the use of agricultural products (especially mushrooms and berries). Strict sanitary control was established over livestock products and vegetables. Therefore, clean products were imported from other regions [2].

Exposure and Early Response

As a result of the assessment of the situation by specialists, they conditionally divided the population into three groups. The first group



included the evacuated population living directly around the nuclear power plant; The second group - those living relatively far away. For them, irradiation was not dangerous, although it required restrictions and detailed sanitary control of products; In the third group - territories where increased radioactivity was noted, although it was not necessary to take any measures (Georgia turned out to be among them).

“Academician Revaz Khazaradze” writes in his book “Human and Radiation” (1988) that “as a result of in-depth medical examinations, it was determined that none of the evacuated residents had either radiation sickness or any deviation from the health norm associated with irradiation.” [2].

Long-Term Epidemiological Findings, Thyroid and Hematological Cancers

Subsequent epidemiological studies have documented a significant rise in thyroid cancer incidence, particularly among individuals exposed to radioactive iodine-131 during childhood or adolescence. More than 11,000 cases have been diagnosed in Belarus, Ukraine, and certain Russian oblasts, with the incidence continuing to increase as these cohorts age. The primary exposure route was ingestion of contaminated milk in the days following the accident [3].

The Survivors of acute radiation syndrome and cleanup workers also exhibit elevated risks for various cancers. In a long-term Ukrainian cohort of over 110,000 cleanup workers, researchers found statistically significant increases in thyroid cancer (SIR 4.18), multiple myeloma (SIR 1.61), leukemia, breast cancer, and all-site cancers (SIR 1.07) over a 30-year span. Cardiovascular disease and mental health disorders were found to be substantially elevated [4].

Non-cancer effects, such as increased prevalence of cataracts, have influenced

regulatory decisions regarding occupational radiation limits [5]. Furthermore, Israeli research indicates that immigrants from the affected areas have higher hospitalization rates for circulatory, endocrine, neoplastic, and ocular diseases, even decades after exposure [6].

Ecological Research

Recent genomic sequencing studies have yielded important new insights:

1. Children born to exposed parents showed no statistically significant increase in de novo germline mutations, a finding that provides reassurance regarding transgenerational hereditary risk [7].
2. Thyroid tumors in exposed individuals exhibited higher rates of double-strand DNA breaks and gene fusions, particularly involving BRAF, RAS, and RET, suggesting distinct, dose- and age-dependent mechanisms of radiation-induced carcinogenesis, in contrast to the point mutations typically seen in unexposed cases [8].

Parallel ecological studies have employed wildlife species, such as birds, insects, and mammals, as biological sentinels. These organisms exhibited developmental abnormalities, elevated mutation burdens, and genomic instability in heavily contaminated zones. These findings support human risk models independent of confounding social variables [9].

Projected Overall Burden

Estimates from the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) indicate a collective exposure dose of approximately 500,000–600,000 person-Sieverts. This level of exposure is projected to result in 30,000 to 70,000 excess cancer cases, including over 17,000 thyroid cancers, nearly half of which



are expected to occur outside of Belarus, Ukraine, and Russia [10].

Discussion and Recommendations

- **Latency and Duration:** Thyroid cancer typically manifests after a latency period of 4–5 years, and incidence remains elevated even 30–40 years post-exposure [11].
- **Beyond Cancer:** Cardiovascular, endocrine, neuropsychiatric, and ocular outcomes remain areas of concern and require ongoing medical monitoring.
- **Mechanistic Insights:** Genomic research has helped identify molecular signatures of radiation exposure without confirming heritable genetic damage.
- **Emerging Research Needs:** Further studies are required to assess the long-term health of aging exposed populations, investigate non-thyroid cancer incidence, and evaluate transgenerational effects.

Conclusion

The legacy of the Chernobyl disaster illustrates the far-reaching and multifaceted consequences of large-scale radiation exposure. While acute radiation sickness was rare, the long-term health impacts, including thyroid cancer, other malignancies, and chronic non-cancer morbidity, persist decades later. Advances in genomic science have clarified tumor pathogenesis and reduced concern over heritable mutations. Nonetheless, continued surveillance and long-term research are essential, particularly among ageing and high-risk populations.

ჩერნობილის კატასტროფის გრძელვადიანი ზემოქმედება ჯანმრთელობაზე: განახლებული მონაცემები

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აბსტრაქტი

ჩერნობილის კატასტროფის შედეგები ასახავს ფართომასშტაბიანი რადიაციული ზემოქმედების გრძელვადიან და მრავალმხრივ შედეგებს. მიუხედავად იმისა, რომ მწვავე რადიაციული ავადმყოფობა იშვიათი იყო, ჯანმრთელობაზე გრძელვადიანი ზემოქმედება, მათ შორის ფარისებრი ჯირკვლის კიბო, სხვა ავთვისებიანი სიმსივნეები და ქრონიკული არასიმსივნური ავადობა, ათწლეულების შემდეგაც გრძელდება. ჩვენი კვლევის მიზანი იყო რადიაციის პრობლემის დადგენა, რაც გამოწვეულია კიბოს შემთხვევების ზრდით ბელარუსში, უკრაინაში, რუსეთსა და საქართველოში. კვლევის შედეგად დადგინდა, რომ პრობლემა მნიშვნელოვანია და საჭიროებს შემდგომ კვლევას და მუდმივ მეთვალყურეობას.

საკვანძო სიტყვები: ჩერნობილი, რადიაცია, კიბო.

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