International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 2s, 2025
https://www.theaspd.com/ijes.php

The Risks of Nuclear Energy Uses on Humans and the Environment

[1]Abdulrahman Ahmad N. Alhathi, [2]Khalid Ali Y. Alshahrani and [3]Ali Muhammad Muhammad Al-Darwbi
[1,2]Assistant Professor, Privet Law, Department of Law, College of Business Administrative, Najran University, Najran, Kingdom of Saudi Arabia.
[3]Phd (Law) from the Islamic University of Medina.
[1]aalharthe@nu.edu.sa, [2]kaalshahrani@nu.edu.sa and [3]Addaroobi27@gmail.com
[1]https://orcid.org/0009-0002-7180-3452, [2]https://orcid.org/0009-0004-5925-4141 and
[3]https://orcid.org/0000-0002-2953-8846

Received: 05th March 2025
Revised: 08th April 2025
Accepted: 10th April 2025

Abstract: *Through an analytical approach, this study examines the risks associated with the use of nuclear energy on humans and the environment. Our investigation reveals that the dangers posed by nuclear energy to human health may be immediate, manifesting shortly after exposure, or long-term, emerging years later. Additionally, there are potential future risks that could result in severe chronic diseases, not only affecting individuals exposed to radiation but also impacting genetic material and subsequent generations.*

Moreover, the severe effects of nuclear radiation on environmental components may not only degrade ecosystems but may also render them unsafe or uninhabitable, either temporarily or permanently.

The study further recommends strict adherence to all nuclear safety and security standards, beginning from the planning phase of nuclear reactors through to their operation and maintenance. It also advocates for the construction of nuclear facilities in remote areas, far from populated regions, to mitigate the risk of radiation exposure in the event of a malfunction or nuclear accident. Lastly, the study emphasizes that nuclear energy should be strictly confined to peaceful and civilian applications.

Keywords: *Nuclear Energy, Usage Risks, Human Health, Environment.*

INTRODUCTION

Despite the significant role that nuclear energy plays in modern life having become one of the fundamental pillars in meeting the growing global demand for energy its expanded use, whether for **peaceful purposes** such as electricity generation and nuclear medicine, or for **military applications** like the development of nuclear weapons, carries numerous **serious negative consequences**. Chief among these is the issue of **radioactive pollution**, which represents one of the most pressing challenges facing humanity today.

In this context, the current section will focus on analyzing and clarifying the **grave risks** that may result from the use of nuclear energy. These risks include those that **directly impact human health and safety**, as well as those that **threaten environmental balance** and cause **long-term ecological harm**. This study will detail how **nuclear radiation affects living organisms and ecosystems**, with particular attention to the **short- and long-term consequences** of radiation exposure.

This study addresses the **risks associated with nuclear energy use**, focusing firstly on its effects on humans and secondly on its **impact on the environment**, as well as exploring **strategies to mitigate or avoid these risks**.

The objective of this study is to examine the **hazards of nuclear energy use** on both **human health** and the **natural environment**. The **first part** of the study investigates the risks to human health, while the

second part explores the environmental dangers of nuclear energy utilization.

RESEARCH METHODOLOGY

The methodology of this study centers on analyzing the **risks associated with the use of nuclear energy on humans and the environment** by employing a **comprehensive and in-depth analytical approach**. This method enables a thorough examination of all aspects related to the hazards of nuclear energy use both in terms of its **impact on human health** and its **effects on the environment**.

Risks of Nuclear Energy Use on Human Health

The harmful effects of the peaceful use of nuclear energy typically occur in the event of nuclear accidents or radiation exposure. When not fatal, the resulting radiation can cause severe disabilities, deformities, and chronic impairments that are difficult to treat. These effects stem from the impact of nuclear radiation on living cells, caused by reactions that deviate from the cell's natural biological processes. Radiation leaks may occur in nuclear reactors due to operational errors, improper storage or transportation of nuclear waste, or uncontrolled reactions in fissile materials (Al-Hamawi, 2014; Qashqoush, 2018).

When a person is exposed to nuclear radiation, the radiation can penetrate bodily tissues, kill cells, and damage bone marrow, leading to several serious conditions such as paralysis, leukemia, infertility, and other diseases. Among the most severe outcomes of radiation exposure are cancers. It has been known for over 90 years that ionizing radiation can cause cancer. However, the disease often manifests only after a long latency period following the initial cellular damage. Tissues with high rates of cell division are especially vulnerable to developing tumors due to radiation.

One such disease is leukemia, which can appear two to five years after exposure, while solid tumors may not become evident for ten years or even decades. These tumors include cancers of the brain, chest, colon, thyroid, breast, ovaries, lungs, bladder, stomach, and esophagus (Al-Jazzar & Saqr, 2011; Hassan, 2017).

Pregnant women exposed to nuclear radiation are at risk of giving birth to children with severe deformities. Exposure during the eighth to fifteenth weeks of pregnancy is particularly dangerous, as the cerebral cortex is forming during this period. Potential outcomes include mental retardation, congenital abnormalities, severe disabilities, stunted growth, and infant mortality either before or shortly after birth, or even within the early years of life. Studies have shown that children born to women who survived nuclear accidents have higher mortality rates (Mansour, 1990; Khalil, 1995; Fathi & Al-Oboudi, 2000).

Research has also demonstrated long-term and heritable effects of radiation, including increased rates of diabetes, high cholesterol, abnormalities in enzymatic activity (such as transaminases and alkaline phosphatase), cancers, especially leukemia, anemia, hemolysis, cellular fragility, infertility, birth defects, frequent miscarriages, a rise in cases of deafness, blindness, and skin diseases, and kidney failure (Bousaq, n.d.; Abu Ghazaleh, 2010).

Direct effects are those that appear rapidly, within days or months of exposure. These may include severe burns requiring surgical intervention. In extreme cases, radiation doses can be so high that they result in immediate death, particularly during nuclear incidents (Editorial Board, 2006).

Regardless of the nature of the damage—whether immediate, delayed, or potential future harm the impact of nuclear sources is catastrophic by all measures. These damages not only lead to severe chronic illnesses in those directly exposed but also cause genetic mutations, extending their effects to future generations, including the children and grandchildren of those exposed, even if they themselves do not show symptoms initially.

Therefore, it is imperative to raise public awareness about the general risks of radiation, with special emphasis on nuclear radiation due to its extreme severity. We stress the importance of strict adherence

to nuclear safety and security standards from the planning phase through reactor operation and maintenance.

We also recommend that nuclear reactors be built in remote areas, far from population centers, to minimize the risk of human exposure in the event of a leak or nuclear accident. These areas should be completely free of residential density, with sufficient distances between reactors and the nearest human settlements to enhance public safety and contain radiation spread during emergencies.

Additionally, comprehensive emergency plans must be developed in advance for all potential scenarios, along with continuous training for operational teams on safety procedures. Collectively, these measures will significantly reduce the risks while ensuring the continued peaceful and beneficial use of nuclear energy.

Risks of Nuclear Energy Use on the Environment

Human activity often results in disturbances to the natural balance and integrity of ecosystems a phenomenon widely recognized as pollution. Among its most dangerous forms is radioactive contamination.

Radioactive pollution is defined as an increase in radioactive activity levels beyond scientifically acceptable limits, thereby negatively impacting natural elements such as water, air, and soil, and posing serious harm to human health (Qashqoush, 2018). Radioactive environmental pollution—whether of air, water, or soil—is one of the most severe consequences of the growing use of nuclear technology, whether for peaceful or military purposes. The radioactive waste generated by nuclear fission reactions causes substantial harm to environmental safety and public health. This waste may be gaseous, liquid, or in the form of ash, with gaseous emissions posing a significant threat to populations living near nuclear reactor sites in the event of a leak (Abu Raheel & Al-Baghdadi, 2002; Da'is, 1985).

The use, testing, or transportation of nuclear energy, radioactive materials, or nuclear weapons results in the contamination of air, water, and food with radioactive substances. These substances infiltrate the food chain, moving from insects to plants, birds, animals, and ultimately, humans. Many radioactive isotopes remain active for long periods, intensifying the harmful effects of radiation on all components of the environment. This makes radioactive pollution a principal factor in environmental degradation. Large areas of land become unsuitable for agriculture or industry due to changes in soil properties. Groundwater sources are also contaminated, rendering them unusable, while seas and oceans are polluted, resulting in the death of marine life.

In addition, radioactive contamination leads to the destruction of plant life, including the loss of trees and vegetation that beautify and enrich ecosystems. Nuclear explosions also release intense radiation that damages the atmosphere, contributing to global warming and rising temperatures (Hashimi, 2013; Al-Mohammadi & Jumaa, 2017).

Nuclear pollution can occur during reactor construction or operation, nuclear fuel production, reactor functioning, or nuclear weapons testing. The transportation of radioactive materials between countries further spreads contamination along the routes. Additionally, dumping nuclear waste into seas and oceans allows ocean currents to carry radioactive materials far beyond the dumping sites, thereby polluting distant marine areas and altering the natural properties of seawater, with devastating effects on marine organisms (Al-Far, 1985; Binnona, 1971; Naaman, 2001).

While some argue that nuclear energy is a relatively clean source compared to fossil fuels such as coal and oil which are major contributors to air pollution—nuclear energy is still fraught with environmental risks. The high costs and advanced technologies required to ensure environmental protection underscore the complexity of managing nuclear energy. Despite its peaceful uses, nuclear energy remains inherently dangerous. The radioactive waste, nuclear accidents (such as the Chernobyl disaster in the former Soviet Union and the recent Fukushima incident in Japan), and nuclear dumping are all persistent sources of environmental pollution (Ramadan, 2013).

RESULTS

The findings of the study on the risks of nuclear energy use on human health and the environment revealed the following:

1. **Nuclear damage to humans may be immediate**, appearing shortly after exposure, or **long-term**, manifesting years later. There are also **potential future harms** that could result in serious chronic diseases. These do not only affect individuals directly exposed to radiation but may also **impact genetic material**, passing on consequences to **future generations**.
2. **Nuclear radiation poses severe threats to all environmental components—**land, air, and water alike.
3. The **extensive impacts of nuclear radiation** may render environmental elements **unsafe or entirely unusable**, whether temporarily or permanently.
4. **Non-compliance with nuclear safety and security standards** is identified as a major contributor to the risks associated with nuclear energy use.

RECOMMENDATIONS

Based on the findings of the study on the risks of nuclear energy use to humans and the environment, the following recommendations are proposed:

1. **Raising public awareness** about the risks of radiation in general, and **nuclear radiation in particular**, due to its profound dangers.
2. **Strict adherence to all nuclear safety and security standards**, beginning with reactor planning and continuing through to operation and maintenance phases.
3. **Construction of nuclear reactors in remote areas**, far from populated zones, to reduce the risk of human exposure in the event of a leak or nuclear incident.
4. **Limiting the use of nuclear energy to peaceful and civilian applications** only.

ACKNOWLEDGMENT

The authors are thankful to the Deanship of Graduate Studies and Scientific Research at Najran University for funding this work under the Growth Funding Program grant code (NU/GP/SEHRC/13/121-7).

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