

RADIATION EXPOSED: A SOCIOLOGICAL INVESTIGATION OF CHERNOBYL

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Abstract

Thirty-three years have passed since the Chernobyl nuclear power plant accident. At 1.23 am. on Saturday, April 26, 1986, the No. 4 nuclear reactor exploded, giving origin to a massive plume of radioactive material in Ukraine. To shed some light on the issue, the author searched on-line databases for up-to-date scientific publications. In addition, he employed in-depth qualitative interviews (QIs) via Skype to highlight the life-stories of 16 Ukrainians who were children at the time of the catastrophe. Findings point to a description of Chernobyl as a biblical apocalypse that destroys life. Importantly, the fallout is still perceived as a living reality and not a dark part of the national history. The reason behind this haunting situation is that the state has failed to provide structural changes within a broad framework concerned to alleviate inequity in health, welfare, and human rights. Hence, a possible cost-effective measure could be the embracement of a grassroots perspective on disaster preparedness, mitigation, and management.

Keywords: Chernobyl, Ukraine, Childhood, Stigma, Thyroid Cancer

Introduction

On 25–26 April 1986, in the reactor n. 4 of Chernobyl nuclear power station, a surge triggered an explosion that released a large plume of radio-isotopes into the atmosphere. As a result of complicated meteorological conditions, the fallout created hotspots in urban, agricultural, forest, and aquatic ecosystems. In the early months, surface depositions ignited a domino effect in the ecological networks. By entering soil and water, amounts of isotopes poisoned the entire food chain. As of today, although

time has helped bury some of the most obvious physical effects of the catastrophe, the negative mental health impact is still relevant with outcomes ranging from psychological distress, symptoms of PTSD, depression, as well as anxiety disorders. Discrimination against survivors has been a recurrent element of Ukraine through post-1986 generations, and has trickled down to every corner of the country. Drawing after the afore-rationale, the present work examines the complex relationship between radiation exposure and physical/mental health in a cohort of 16 people who lived, in regions nearby Chernobyl during 1986-1991. Participants (PTs) varied in age, marital status, family history of cancer, medical diagnoses, and treatments. Results imply that across personal narratives, children's games, and jokes, Chernobyl is conceptualized as a terrible apocalypse. Furthermore, the national level spatial distribution of post-Chernobyl discourses reflects the birth of a risk society, where insecurity and danger backfire on modernity.

Materials and methods

Objectives

Previous works on Chernobyl have relied almost exclusively on quantitative estimates of diseases attributable to radiation exposure. Inasmuch, to fill the gap in the literature, the present survey is built on a qualitative analysis of life-stories. It offers readers an insight into how social forces can give some people privileges, and how the same structures can make others disadvantaged. Importantly, even if the investigation maintains technical terminology, the material discussed here is one in which the capacity, of giving subjective accounts– and of accepting *non*-biomedical explanations –is in the forefront.

Research Questions and Hypotheses

The aim of the study was two-fold: [1] to understand, acknowledge and convey the multi-dimensional impact of Chernobyl on affected communities; and [2] to reveal behavior which may have slowed down or assisted in recovery. Therefore, the research questions (RQs) were: [1] what have been the practical difficulties of survivors? and [2] does ionizing radiation (IR) produce continuous traumatic stress across victims, particularly in the form of lingering preoccupation with an invisible enemy? Consequentially, the research hypotheses (RHs) were: [1] geographical

proximity to the 1986 disaster, and [2] perception of radiation risk are indicators of physical, emotional, and mental distress.

Literature Review

A review of published literature on Chernobyl was carried out through Google Scholar (GS). To achieve this, the author adopted the Boolean search string: << (“Chernobyl” OR/AND “1986”) AND (“Ionizing Radiation” OR “Fallout”)>>. However, queries consisting of multiple combinations of the terms: “Ukraine”, “Socio-Environmental Degradation”, and “Radio-Phobia” were also utilized. The criteria for inclusion were: [1] English Language; and [2] The presence of at least one of the following information: radiation-induced physical insults in human populations, the ecology of the Chernobyl disaster, and social stigma post-1986. Exclusion criteria included newspaper articles, works not in the English language and material not related to the topics.

Enrollment

To form the sample universe, the author contacted via email two of his former university students who had fieldwork skills and volunteered in an NGO. In the correspondence, the author resorted to a layered approach: [1] the first message contained the purpose of the project, the type of audience, and the rights of PTs. [2] the second had strategies for the anonymization of biographical data, such as names, and genders. [3] the third held directions for the withdrawal of consent, and on the storage period. And [4] the fourth, carried counsels on how to lodge a complaint with a supervisory authority. It was agreed between the parties that to scrutinize groups of the Ukrainian population who were vulnerable to Chernobyl in varying degrees, participants (PTs) had to: [1] reside in regions nearby the power station, during the 1986-1991 period, when exposure levels were the highest; [2] be born before January 1987; [3] be connected with persons who worked on environmental cleanup and site recovery (CSR); [4] demonstrate basic English language (ENG), and information technology (IT) competence; and [5] be willing to be audio- and/or video-recorded. Twenty potential candidates were found, and contacted. Prior to actual data collection, the author organized an on-line educational session with his former students which included procedures for completing questionnaires, and ethical considerations. Upon conclusion, it was decided that the PTs would be recruited through a series of flyers distribute in the Kiev region. After being given enough time to consider enrolment (e.g. risks, and

benefits), and reference contacts for any further answers to pertinent questions about the survey, 4 withdrew, and 16 gave their written informed consent. Confidentiality was assured throughout the whole process.

Participants

The cohort was made of 16 Ukrainian (gender ratio= 50/50) citizens, aged 35-46. From the selection process, it was found that most were from households with a low socioeconomic status (SES) including income quintiles, housing assets, and labor market position. In 1986, all of them were minors, aged 0–14 years, who inhabited the regions of Kiev, Chernigov, and Zhitomir. In 1991–1994 their families were evacuated from the zones of strict radiation control to other places of Ukraine. At the time of the QIs, ten PTs lived in the urban area of Kiev and 6 in rural ones outside Kiev. Roughly, eight had completed Middle School of General Education (ZOSh) with the rest split between those who had homeschooling, and those who dropped out from state institutions before obtaining a certificate. Five were married or lived with a partner. Six had a diagnosis of thyroid carcinomas. Most components of the sample defined their religious affiliation as Christian Orthodox. Four women and two men reported having children. The number of latter ranged from 1 to 3 for a total of 7 individuals.

Data Collection

The project was erected upon semi-structured qualitative interviews (QIs) which reduce hierarchy between speakers, and sustain an emotional supportive setting. Because the researcher could not travel to Ukraine (due to the concomitance of financial, and time restraints), QIs relied on Skype, a VoIP (Voice over Internet Protocol) program. For probing, the author planned to conduct at most 22 QIs, but only if saturation of data was not reached before. QIs were semi-structured (ranging from 40 minutes to 90 minutes) and started with a simple background checking about personal history (*Can you tell me something about yourself?*). Then it followed a section on Chernobyl (*To what extent did the fallout impact your life?*) Next, there was an examination of any changes in attitudes towards the Self and society (*Have you experienced changes in your relationships with people who are close to you, and in how you see yourself as a person?*). The initial segment of each QI sought to promote mutual trust between PTs and the author.

Data Analysis

As verbal exchanges were made, there was a continuous processing of information: transcriptions were read, and re-read to ensure correct coding. The initial categorization of raw data was accomplished through marginal notes on the typed transcripts, and/or word pages. Step 1 resulted in a set of clusters which formed the basis for sub-sequent elaboration (e.g. Chernobyl as a site of sickness, and/or identity-reconstruction). The preliminary categories were then changed into groups (Step 2). Finally, all collected information were summarized to highlight the epistemic network linking the concepts (Step 3). Three main themes came into view which provided closure to Step 1 and 2 outlined earlier: [1] Incidents referring to disrupted feelings of fit attributed to Chernobyl [2] Indicators of renegotiating identity, and [3] Biographical work resulting from [1] and [2].

Theoretical Framework

As implied in the diathesis–stress hypothesis (DSH) traumas and the changes to one’s life or environment are risk factors for poor mental health. The situation can worsen in circumstances involving ionizing radiation (IR) because exposure is dreaded, not perceivable, and carcinogenetic. DSH implies that the likelihood of suicidal ideation and depression is higher in persons with weak resilience.

In psychoanalytic theory, catharsis is defined as the release of feelings and thoughts associated with a traumatic past. The term comes from the Greek “katharsis” meaning “purgation of pity, and fear” (Golden, 1973). Although considered an emotional rescue, the discharge can have an adversarial impact on the mind of an individual. One criterion that medical personnel adopt to judge the efficacy of story-retelling as a “catharsis” or its opposite, “rumination” (that would heighten stress instead of lowering it), is whether memory recall, and psychological therapy act harmoniously or antagonistically (Thompson, 2010). Group size and composition are among the factors that influence the performance.

According to Goffman’s writing (Kusow, 2004), stigma is a set of social relations and social relationships that depress the quality of life (QOF). The nature of stigma is two-fold: on one side there is public stigma (PS) or the discrimination and devaluation by others. On the other side, there is self-stigma (SS) or the introjection of stereotypes and prejudices among people who feel excluded. Sometimes, this phenomenon is

based on an enduring feature of identity conferred by a health problem or health related condition (Weiss & Ramakrishna, 2006). PS and SS have harmful effects on self-esteem and self-efficacy.

The medical model of disability implies a stable vision of a perfect and immutable body, against which all persons must be measured. At the best, it tends to accentuate someone's needs, putting his/her deficiencies at the center of a physician's action. At the worst, it characterizes some human beings as deviant subjects who cannot really fit in any groups, unless they can be made to conform through treatment (Erevelles, 2002) and/or discipline. Apropos of it, Perlin (1999) noticed that the ontology underlying Western legislation on disability issues is inherently negative. This means that even laws aiming to empower the individual, treat disability as a condition that ought to be avoided or cured (e.g. insanity and/or dementia).

Ethical Consideration

All PTs were informed of the purpose of the survey, that their participation was voluntary, that they could withdraw at any time, and that they would not be disadvantaged in any way if they choose to leave or not to participate. All names were altered in written and spoken reports. Electronic data were crypto graphed, and saved in a password-protected hard-drive.

Results

The Chernobyl nuclear power plant, consisting of four RBMK-1000 graphite-moderated reactors, is a closed facility near the abandoned town of Pripyat, in the northern part of Ukraine. This part of the country has been known as a Belarussian-type woodland with a low population density. Due to a flaw in the design, and inadequately trained personnel, the unit no. 4 caught fire on 26 April 1986 (perhaps because of a major nuclear runaway explosion in a loss-of-coolant event) and burned for 10 days. During that time, radioactive substances in the form of gases, vapors, aerosols and 'hot particles' spread over Europe. Local meteorological conditions, particularly atmospheric transport phenomena and precipitation directed fallout deposition. The official evacuation of Pripyat was delayed 36 hours and the evacuation of a wider perimeter including the larger city of Chernobyl (located 9 miles southeast

of Pripyat) did not occur until May. As was stressed during the 1996 EU/IAEA/WHO Summing-up-Conference millions of people ended up living in areas that were highly contaminated (Balonov, 2007). The individual response ranged from overreaction (e.g. hysteric fear to carry out outdoor recreational activities), to complete disregard of any advice given by national institutions. Although, Chernobyl is the most severe incident in the history of the world nuclear industry, quantifying its true scale is problematic. It is still unknown how some clean-up workers who were dispatched around the reactor survived nuclear pollution, or how those who kept living in no-go areas have borne up against the environment (Korblein, 2003). An epidemiological screening among the adult population of the Gomel region (Belarus) indicated higher rates of self-reported physical and psychological abnormalities than in a comparable unexposed area (Havenaar et al., 2003). From the data set compiled after 1986, an increased risk of papillary thyroid carcinoma (PTC), associated with a very large amounts of iodine 131, was found in children living in Belarus and Ukraine (Astakhova et al., 1998). Within the papillary group, a few subtypes were noted, including classical or usual type, follicular variant, solid variant, and mixed patterns (LiVolsi et al., 2011). The discovery is valuable because unlike other malignancies, PTC is rare in minors (Nikiforov & Gnepp, 1994). Psycho-neurological aberrances characterized by multiple unexplained symptoms (e.g. fatigue, sleep, mood disturbances, impaired memory, and/or concentration) were cited by Bromet (2014). In general, these anomalies are consistent with those documented after other toxic events, such as the 1945 atomic bombings of Hiroshima, and Nagasaki. Hundorova (2001) - a Ukrainian novelist- wrote that 1986 gave birth to a post-Apocalyptic reality. In other words, humanity has since been living in a time of continued uncertainty, and possibility

The author noticed that many PTs talked relatively little about their physical health. As it was stressed elsewhere, it might be because they were restrained by personal embarrassment. Discussions could also be impeded by privacy concerns, and/or fear of mistreatment. Nonetheless, six PTs self-reported radiation-induced thyroid carcinoma, and the associated need of balancing a complex medication regimen. Two of them confessed to have been combatting loneliness, which added another burden to their already stressful lives. Overall, it was recognized that a significant role in the genesis of (their) borderline functioning was played by

unfavourable events such as the break of microsocial contacts, and adaptational difficulties, which appeared being linked to the evacuation and relocation from childhood residence. PTs identified some degree of overt prejudicial attitudes stemming from co-workers, employers and teachers, and indirect discrimination owing to generalized policy neglect (e.g. Ukrainian laws are vulnerable to the very prejudicial attitudes they are intended to abate). During QIs, all cohort members seemed to be aware not only of the author but also of “ghostly audiences”, who were not physically present but whom they seemed to be addressing (e.g. friends). In their dialogues, PTs adopted the words “sadness”, and “helplessness”, in personal and group references. Occasionally, they encoded them within humorous episodes (e.g. “*You’re lucky you don’t glow at night*”), but the relative frequency of these comments reflected the negative tension stemming from discussing Chernobyl. Probably, because disasters of that scale impose a burden on individuals placed in the position of providing support for others while trying to make life bearable for themselves. That is why, whenever PTs thought of what they still must endure, many could not help driving themselves toward finding a positive outlook in their basic framework of thought. Yet, some preferred embracing a “cautious” hope. In this case, the most courageous response was that “*no matter what, we should never stop fighting*”. And what the speaker basically argued is that, despite the prospects not being very auspicious, the future was still wide open.

Limitations

As with all empirical efforts, there are factors which limit the generalizability of the findings. One of the drawbacks was that the selectors could have had their own criteria and/or priorities. They might have chosen subjects whom they thought have no trouble voicing their feelings. And it is hard to say something on people who refused to have a part, since nobody inquired into their reasons. Another limitation was that false positive (PTs who affirmed to have lived nearby Chernobyl but did not) rates are unknown. It was also noticed that VoIP whilst erasing physical borders, can affect non-verbal cues. Finally, objectivity could have been undermined by the “Hawthorne effect” (Adair, 1984) which implies that interviewees might provide socially acceptable responses or responses which they feel the audience wants to hear. Nonetheless, even if the influence of these factors cannot be dismissed, the consistency across previous

investigations using samples from this type of Ukrainian population adds support for the validity of the results.

Discussion

Radiation and Radioactivity

All organisms are made of atoms jointed into molecules by electron bonds. Ionizing radiation (IR) is a form of radiation with enough energy to separate electrons from the orbit of an atom. It is produced by physical processes in which unstable atomic nucleus (radionuclides) lose energy and decay into more stable symmetries. On Earth, it takes a few forms: Alpha particles, Beta particles, X-Ray/Gamma radiation, Neutron radiation and Cosmic radiation (Holmes-Siedle & Adams, 1993). The amount of radioactive decays that are occurring in each sample is defined as radioactivity while radiation refers to the flux of energy travelling in the form of particles or waves from a source (nuclides/atoms) through space or other mediums. Radioactivity of an element decreases in time and it can be appreciated by a mathematical exponential formula. Per contra, radiation is hardly quantifiable. Problems in detection are given by self-absorption (e.g. the outer layer of human skin absorbs all alpha radiation) and (low-level) back ground radiation from naturally occurring radioactive substance.

Ionizing Radiation and Health Effects

Exposure to IR causes chromosomal abnormalities, inflammation, and an increased rate of the degenerative tissue injury normally associated with aging (Spitz & Hauer-Jensen, 2014). Physical factors concur in delineating the gravity of short-term and long-term biological consequences. For dose limitation purposes, the International Commission on Radiological Protection (ICRP) classified the consequence of IR exposure into tissue reactions, and stochastic effects. However, the boundary between the two is sometimes vague. The former, (alternatively known as deterministic effects), refers to the killing of cells, the prevention of their reproduction and/or their correct functioning. Since tissues, and organs are not influenced by minor insults, a threshold dose exists which must be overcome for (measurable) radiation-induced lesions to occur (Schull, 1998). The latter alludes to aberration that happens by chance, and whose incidence does not depend on dose. The most cited ones are carcinogenesis (also called

oncogenesis or tumorigenesis), teratogenesis, genetic mutations, cognitive decline, and cardiac pathologies (Davis et al., 2005)

Carcinogenesis

Absorption of energy from IR by the genetic material in the cell leads to damage to DNA, which in turn leads to cell death, chromosome aberrations and gene mutations. Collaborative case-control studies indicate that not only acute radiation but also low-dose radiation exposure may trigger Papillary Thyroid Carcinoma (PTC) with risk greatest in those youngest at exposure (< 10–15 years of age), more elevated in females than males, and in those who have a deficiency in stable iodine (Cardis & Hatch, 2011). In 1992, the first official reports described 114 cases of thyroid cancer across Belarusian children, and youth; the increase started in 1990, less than four years after the accident (Kazakov, 1992).

Respiratory Diseases

The fallout provoked an increase of non-malignant respiratory illnesses in almost every person who was in contaminated territories. Acute respiratory virus infections and acute bronchitis were manifold higher in breast-fed babies from Chernobyl than in other municipalities (Zubovich et al., 1998). Most texts reported bronchopulmonary morbidity. Sickness was associated to the breathing of gaseous-aerosol form of hot nucleotides but other insults were considered consequences of changes in the immune and hormonal systems. For Takamura et al. (2000), hearsay or actual knowledge about IR, fostered radio-phobia. This public anxiety led to a decline in the rate of tuberculosis screening, which was based on fluoroscopy. Thus, in Eastern Europe, including former USSR, rising TB rates have been reported

Damage to Reproductive Functions

In the Chechersky district of the Gomel region (Belorussia), and the Polesky district of the Kiev region (Ukraine), clinical examinations of 688 pregnant women followed by 7000 longitudinal laboratory data on the physical development of newborn babies (3 years before the accident, and 5 years after it) revealed the existence of physical deformities (Kulakov et al., 1993). Moreover, Birioukov et al. (1993) put forward for consideration a deterministic relationship between chronic radiation dermatitis of varying severity, and impairments in exocrine and/or endocrine testicular function (e.g. aspermia, azoospermia, and oligospermia).

Neuropsychological Disorders

Anxiety, Post Traumatic Stress Disorder (PTSD), and Major Depression (MD) were among the major ailments afflicting survivors, and/or their families. It also evident that Ukrainian younger generation suffered from victim mentality. Emotional disequilibrium was documented by Mykhaylov & Zdesenko (2013) and Loganovsky et al. (2008) who argued that PTSD in evacuees was stronger than in Afghan war veterans with mild closed head injury. Psycho-neurological syndromes characterized by multiple unexplained symptoms (e.g. fatigue, sleep, mood disturbances, impaired memory, and/or concentration) were cited in several Russian papers. In general, these anomalies are consistent with those documented after other toxic technological events, such as the 1945 atomic bombings of Hiroshima, and Nagasaki.

Suicidality

Widespread debates, headlines and statements made across Ukrainian communities around the nexus of IR exposure and the increase of cancer risk, magnified psychological distress, and comorbid psychic conditions. As a result, suicide ideation, and attempted suicide rose in Estonia, Ukraine, Latvia, and Kyrgyzstan. Rahu et al. (1997) and Rahu (2003) asserted that high peaks recurred for at least 17 years.

A Requiem for Chernobyl

In April 1986, several people died, either from blast effects or Acute Radiation Syndrome (ARS). Overtime, an increased mortality rate was found in those who were onsite as personnel (Mettler et al., 2007). Chernobyl caused a higher than normal frequency of chromosomal aberrations, and behavioral disorders, including attention deficit, or hyperactive disturbances (Loganovsky & Loganovskaja, 2013). Damage was also hypothesized among the general population but, as of today, there is no convincing body of knowledge. More correct estimations would have required advanced health statistics and surveillance over a long period of time (Williams & Baverstock, 2006). Unfortunately, the dissolution of the Soviet Union in 1991 and the absence of a standard framework for radiation sickness (e.g. neuropsychological damage, including those that may be subclinical), made correct assessment almost impossible.

Thirty-three years have passed by, but for PTs, everyday existence has been impacted by public hostility and attacks of panic. In their testimonies, Chernobylite was the substantive adopted by residents of resettlement zones to describe them (Martin, 2015). And, since there is no treatment for the mutagenic capacity of ionizing radiation that could have justified an epistemological division between (potentially) sick and healthy Ukrainian citizens, the goal was merely one of de-humanization. It has been recognized that many persons boycotted schools that allowed 'nuclear refugees' to attend classes. One source— who grew up in Kiev— told of people expressing fear of shaking hands with him and his mother. Others mentioned that sanitation workers refused to collect trash from their households. These stories were both unique and common: unique because suffering is personal and common because most PTs face similar circumstances. As it was empathically put into words: "*Ukraine thought of us as something to be protected from*". In this context, for those who did not reveal anything about their past or who unveiled selectively, the factors assessed in their decision were [1] health; [2] means of livelihood; and [3] the ability (or lack thereof) to accept negative feedbacks (Quigley, 1989). Nonetheless, some PTs spoke about their life to their acquaintances, and did so freely. Others felt that they could share more information about themselves in future if the biases were reduced. But for all of them, to go on living meant fitting Chernobyl into their biographies, incorporating the risk of illness, and violence into the Self. Six PTs confessed to have undergone cancer surgery (4–10 years after 1986) at the thyroid, with follow-up every 6-to-12 months, for 5-to-6 years. Because they had their glands removed, they have been taking medicines to supplement the hormones that were lost since the school age. In a way, their stories acted as a mnemonic bridge to the past, and a mechanism of identity-making. PTs explained that the treatment of cancer was usually very aggressive, which resulted in accompanying and devastating side effects.

Terror of death affected the proper functioning of their Self, while the ability of taking control of the situation brought them the ability to fulfill their dreams, and participate, as much as possible, in a social life (Hockenberry-Eaton & Minick, 1994). Notably, PTs processed the disease under the following categories: [1] "knowing" (about the practical aspects of the disease); [2] "caring" (for Self, and being protected by friends, family and medical personnel); [3] "being unique" (due to the "Chernobyl

necklace”- the horizontal scar left by gland removal on the base of the neck); and “fear” (of having another health issue, of stigma and of going outside). Another topic covered by PTs was the satisfaction of basic needs in hospitals. For example, they disliked not having their parents/siblings with them and their weak social position regarding the rules, that, at times, failed – or were perceived as such- to respect their dignity. As they recalled “*There was a sense of depression, and anger, and it showed up in pretty powerful ways*”. However, some PTs embraced both expressions of loss, and of celebrating life. Viewed as an outcome, the time spent fighting the malignancy resulted in an increased awareness of the frailty of the human body. All PTs felt relief at receiving a non-judgemental approach during the QIs, and not being forced into accounting for their behaviour. They reported the benefits of talking about their lives, and explained that debating brought about a sense of empowerment and, a cathartic release of emotions, which might have propelled long-term psychological benefits. A smaller group of PTs zeroed in on that being encouraged to reflect supported a process of working through difficulties. These considerations are not unheard in the literature, de facto they are supported by Bull (2010), and Biddle et al. (2013).

Conclusion

The legacy of Chernobyl embraces emergency evacuations, forced resettlement, disruption of kin networks, bonds of friendship and loss of trust in the Ukrainian central government. Despite considerable investments of resources, a reliable system for ensuring the safety of people has been never put in place. For PTs, recovery has been difficult to sustain, as years pass by and the struggles of taking medicine, rebuilding livelihoods, and surviving in a harsh socio-economic environment, take their toll. An inference that can be made is that how they think about their past, present, and future is a critical component of their adaptational outcomes. Even if a test of the direction of causality among these variables was outside the scope of the project, the strength of the associations implies the possibility of a complex interplay which requires further enquiries.

Looking Back to Go Forward

Among PTs, the ongoing process of overcoming various dilemmas—between societal prescribed roles and actual needs on the ground, teaches us that nuclear

disasters leave a lasting mark on their victims. Since health consequences (e.g. cancer, pathological changes in reproductive function, and peri-natal illnesses) may start to arise 5-to-10 years after exposure to ionizing radiation, it would be of great value to adopt a multi-dimensional approach to interpreting data, weighting the impacts of age, geographical dispersion, and of gender of sufferers; and integrate the evaluation of latency periods between exposure and disease diagnosis development. In parallel, medical personnel ought to consider how personality characteristics, family-level measures of hardiness or resilience, and neighborhood-level SES, impact long-term psychological outcomes. A re-thinking of the way local populations handle themselves can help bring society back to its full potential. In this context, it is imperative for countries with nuclear disaster-affected areas, to enhance their collaborations with international partners, and develop deeper synergies between the state and NGOs.

Competing Interests Statement

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