Child and Adolescent Suicide Risk Following the Chernobyl Disaster

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Abstract

Several studies dedicated to the psychiatric consequences of the most well-known incidences of radioactive contamination and exposure have noted elevated suicide risk among the victims of these events. The Chernobyl accident, which happened in Ukraine in 1986, spurred deep concerns on this front, especially regarding children and adolescents. These concerns extend to include those who were in utero at the moment of exposure. While the link between exposure and some neuropsychiatric disturbances has been confirmed among these children, the effect on suicide risk among them remains unclear. Unfortunately, at the pertinent time, youth cohorts were not under longitudinal study to assess the link between suicide and Chernobyl exposure. Therefore, suicidality in adolescents affected by Chernobyl and the role of radiation as a factor in suicidal behavior remains controversial and needs more thorough investigation. However, there is a high probability that these contingents have suffered from the psychosocial stress that followed the disaster, including fear and anxiety over health issues, forced and hectic evacuation, and various complications associated with adaptation to new living conditions. Another related issue was the vivid discussion of radiation exposure in scientific and nonscientific media, concerns shared among parents, and incomplete or misleading information disseminated to the wider public, which may have victimized an entire generation. Those who were born during or shortly after Chernobyl are about 30 years old today, and psychiatric disturbances and suicidality among them may bear signs

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of Chernobyl. However, a lack of objective exploration on the subject has hampered a more definitive conclusion about suicidality in this contingent. This chapter is a discussion of related research to date and projections for what more might be done.

11.1 Introduction

Accidents at nuclear power plants and other technogenic emergency events, accompanied by radioactive contamination of the atmosphere, soil, and water, have occurred for the last century with significant medical and psychological consequences. While estimating these consequences, researchers and medical practitioners had to differentiate between possible effects of irradiation itself (absorbed or accumulated due to external exposure) and psychological and psychosomatic effects. Given the multicausality of the majority of human diseases and mental disturbances, it has been a complicated task to evaluate differential input of physical and purely psychological influences.

Stress is the universal psychobiological mechanism which combines body and mind and is largely responsible both for beneficial (in case of adaptation and coping) and detrimental (in case of poor coping and frustration) results of any disturbing or traumatic factor (Jacobs 2001). Poor physical health should be recognized, along with mental health problems and impaired psychosocial functioning, as an outcome of traumatic exposure. A great majority of studies prove that PTSD and other clinically significant distress reactions are a key step in triggering the processes through which exposure affects health. These processes involve psychological, biological, behavioral, and attentional mechanisms that interact to strain the body's ability to adapt, thereby increasing the likelihood of disease and maladaptive behavior (Schnurr and Green 2004). In case of accidents and catastrophic events that involve ionizing radiation (even in low doses), an additional stress component is actualized, insofar as irradiation triggers the same molecular mechanisms that are known to be important in stress (i.e., free radical oxidative spike, cell membrane damage, impairment of mitochondria function, and stress gene induction) (Baraboy and Sutkovoy 1997; Amundson et al. 2002). More recent studies concentrate on immediate early gene induction and signs of neuroinflammation as pathogenetic pathways involved in low-dose effects (Kempf et al. 2013).

It is clear that all accidents or explosions associated with radiation and radioactive contamination will induce mixed stress response due to the combination of biological and psychological factors. However, more than likely, these types of events will also be marked by even more fear in the population than a conventional explosion or any other disaster, due to the undetectable presence of radiation by ordinary human senses and by concerns about long-lasting radiation effects (Salter 2001). Nevertheless, objective studies of the psychological and psychiatric impact

of radiation disasters and their relation to suicidal behavior are scarce. Only well-known, widespread public events have been studied from this point of view. Three major incidents in which the psychological consequences have been actively investigated are the atomic bombings of Hiroshima and Nagasaki in 1945, the accident at the Three Mile Island Nuclear Generating Station in 1979 in the United States, and the 1986 Chernobyl disaster in the USSR.

11.2 The Role of Stress in Nuclear Disasters

In the immediate aftermath of the Hiroshima atomic bombing, mental health consequences were not studied closely enough, either in terms of mortality or morbidity. However, concerns about cancer, leukemia, and microcephaly due to in utero exposure prevailed. Fifty years later, psychiatric consequences of the bomb were more thoroughly investigated, revealing signs of psychological distress with an emphasis on apathy, disturbance of human relations, and loss of enjoyment in living. Recurring and distressing recollections of the traumatic experience and prolonged anxiety for themselves and their loved ones largely contributed to the psychological distress of survivors (Ohta et al. 2000).

As for the nuclear plant accidents, which happened during peace time, the mental state of those affected received more attention (Baum 1993). Recent synthesis of the existing evidence regarding emotional consequences of nuclear power plant disasters points to the main problematic areas of depression, anxiety, post-traumatic stress disorder, and medically unexplained somatic symptoms. These effects are often long term and associated with fears about general health impairment, especially the risk of cancer. Evidence gained from large cohorts affected by Chernobyl indicates that mothers of young children (mostly due to their anxiety regarding their children's health and development) and cleanup workers in close contact with environmental contaminants are the highest risk groups. One of the important conclusions derived from a variety of studies is that the emotional consequences occur independently of the actual radiation exposure received, thus pointing to a greater need for studying the psychological components. Studies of children that were impacted by the Three Mile Island (TMI) and Chernobyl accidents have revealed that, while their self-rated health is less satisfactory than that of their peers, their emotional, academic, and psychosocial development is comparable (Bromet 2014).

The most recent catastrophic event at the Fukushima Nuclear Power Plant adds more evidence that severe psychosocial stress associated with evacuation and fears of the harmful effects of radiation constitute the main source of mental health problems in the affected population (Kunii et al. 2016). Moreover, one study revealed that respondents who believed that radiation exposure was very likely to cause adverse health effects were significantly more likely to be psychologically distressed than other respondents, thus pointing to perceptions rather than true radiological exposure as a predictor for stress (Suzuki et al. 2015).

11.2.1 Symptoms of Stress Without Direct Exposure

A greater concern for the stress that follows radiation events has begun to take shape, especially when that stress extends beyond those with direct exposure. After the Chernobyl disaster, when psychological components seemed to be the main factor that determined the traumatization of much wider cohorts than those actually exposed, Stiehm (1992) used the term "psychological fallout" to describe the phenomenon of contagious fear and anxiety induced by the accident. Chernobyl was actually a shock for the whole of humanity, especially in Europe and republics of the former USSR. These nations and the world at large were forced to collectively face the true risks of nuclear energy, an industry whose safety was previously touted.

11.3 Irradiation and Suicidality in the Former USSR

The existential risks of nuclear disasters on the physical and mental health of affected populations are now more well understood. However, in the immediate aftermath of Chernobyl, there was not much concern or awareness regarding a possible rise of suicides in affected cohorts, nor was particular attention paid to this phenomenon among children and adolescents.

The first signs of a link between Chernobyl exposure and suicide came from morbidity and mortality data surveillance of the cleanup workers. These persons were some of the most severely exposed, due to their participation in the urgent actions taken to diminish the ecological impact of the explosion. Several studies have pointed to elevated suicide risk among exposed rescue and cleanup personnel. For instance, suicide has been ranked a leading cause of death among the Estonian liquidators (Rahu et al. 2006). In Lithuania, the suicide mortality among the cleanup workers was shown to be higher than in the general population (Kesminiene et al. 1997). Vanchieri (1997) noted that liquidators presented with a higher risk of suicide but not a higher risk of cancer as was anticipated. At the peak of these concerns, the UN Chernobyl Forum defined suicide as one of the important issues within the postaccident period (WHO 2006). The Estonian cleanup workers' risk of suicide has remained elevated, even after longer periods of observation (Rahu et al. 2013, 2015).

Studies that revealed heightened suicides among liquidators ignited interest in suicidal behavior related not only to nuclear power plants, which remain the most ecologically safe industrial settings in the absence of accidents, but to other industrial and military contexts like factories or testing grounds, where the risk of irradiation is continuously high. In particular, in the territory adjacent to Semipalatinsk, Kazakhstan (formerly the Kazakh SSR) on the nuclear testing ground, rates of suicides appeared to be higher than in the general population. Though suicide rates in Kazakhstan are generally elevated, among those involved in Chernobyl cleanup efforts, the rates were even higher (Kamarli and Abdulina 1996).

In the Soviet radiobiological science community at that moment, there was a vivid discussion regarding "radiosensitivity" and "radioresistance" of the central nervous system. The general understanding was that although nerve tissue remains resistant (from the point of view of cell damage) to irradiation exposure in near-lethal doses, much smaller doses may trigger a variety of pathological events involving nerve tissue indirectly. This occurs through the impairment of the vascular component or due to free radicals, oxidation stress mechanisms, and metabolic disturbances (Baraboy and Sutkovoy 1997). This discourse and extensive study led to a general consensus that low doses of irradiation, especially at the moment of acute transition from ecological doses to elevated accident-induced doses, or incorporation of radionuclides through air, water, and contaminated food may lead to biological effects in the CNS that may result in asthenic-vegetative syndrome, psychophysiological disturbances, and perhaps some unexplained somatic symptoms (Il'in 1989; Bebeshko and Korol 1995).

Still, it remained unclear whether low doses of ionizing radiation exacerbate suicidal behavior through biological mechanisms or if documented suicidal behaviors are purely due to sociopsychological phenomena. Suicide is a very complex human phenomenon, which is determined by genetic, epigenetic, psychological, and social factors, including psychosocial stress. Suicidal behavior is a continuum that includes suicidal thoughts, suicidal communications, suicide attempts, and completed suicide, each being associated with stress, psychological factors, and genetic background (Wasserman 2001). Epidemiological studies spanning decades after the Chernobyl accident have registered completed suicide rates (the monitoring of suicide attempts is rarely performed) and could give some cues, but they appear to be hampered by an inability to control for the effects of other factors, influences, and events.

11.3.1 Sociopolitical Context and Suicidality During the Collapse of the USSR

The Chernobyl accident coincided with "perestroika" (a period of democratization and reformation in the USSR) and happened several years before another dramatic event—the fall of the Soviet Union, which brought the disintegration of a huge country and subsequent migration, economic difficulty, and political instability in the newly independent states (NIS). In many of the NIS, these processes also resulted in diminished control over morbidity and mortality data, as well as other problems in the collection of public health data.

Nevertheless, reports from official sources (accumulated in the WHO Health for All Database) showed that in the NIS, from 1985 to 1992, there was a decrease in suicides followed by a sharp rise (up to 60%) from 1992 to 2000 and then a subsequent steady decrease. These sharp fluctuations have been repeatedly discussed from different points of view but mostly with a strong focus on changes in alcohol consumption. This focus is due to an anti-alcohol campaign launched by Soviet authorities from 1985 to 1990. Thus, the Chernobyl accident happened during the

most active phase of the anti-alcohol campaign, marked by vigorous advertising on TV and in the public. It is assumed by many researchers that the anti-alcohol measures were the reason for the lower aggregated suicide rates in the period from 1985 to 1991. The anti-alcohol campaign has been discussed by many authors as an example of a successful suicide prevention project at the national level (Värnik et al. 1998; Mäkinen 2000; Nemtsov 2003).

We have presented an alternative view (supported by quasi-experimental data) that one of the leading reasons for substantial lowering of suicides was "perestroika"—political reconstruction, a process of democratization started by Gorbachev in 1986 almost simultaneously with anti-alcohol measures. Our explanation is that the reason for the reduced suicides was social optimism and positive expectations in the society induced by democratization, while the later dramatic rise in suicide mortality in 1992–2002 was the result of the severe psychosocial stress caused by the disintegration of the USSR and subsequent socioeconomic problems. Alcohol explains only part of suicides, mostly those that are related to addictions and other mental health problems, while existential and psychosocial factors, associated with socioeconomic transition and disintegration of the general social and cultural space, had a wider impact, independent of mental health problems (Rozanov 2014a, b).

11.3.2 Fluctuations in Suicide Rate

We have pointed to features that support our explanation that it was the fall of the USSR that actually caused (among other reasons) substantial change in suicide rates in the former republics. However, this is not meant to overgeneralize the effect or assume that each of the republics was affected in the exact same way. For example, sharp fluctuations in suicide rates took place only in the economically developed and industrialized former USSR republics—The Russian Federation, Ukraine, Belarus, Kazakhstan, and Baltic republics, while in the mostly agricultural republics of Central Asia and Caucasus, the reaction to social changes was rather modest. It is likely this reflects deep cultural, ethnic, and religious differences inherent to each of the former Soviet republics (Rozanov 2014a, b). Disintegration of the country was associated with complex, severe, and long-lasting negative social, economic, and political processes that impacted huge groups of people and touched different ages, from youngsters, who were still dependent on the economic state of their caregivers, to retired citizens, mostly dependent on social welfare. The disintegration impacted all former republics, though in the more agrarian ones, the specific impact on suicide rates may have been attenuated. It should also be noted that the more bucolic Central Asian and Caucasian republics did not suffer from the effects of Chernobyl either.

Teenage suicide in the last decades of the Soviet Union and in the post-Soviet era was thoroughly analyzed in a detailed report initiated by UNICEF (İvanova et al. 2011). According to the data collected, the suicide rate among adolescents aged 15–19 years in the Soviet Union started to grow from 1965 and reached a peak in the

Soviet era from 1970 to 1975. Then, there was a gradual decline, which became especially clear during the democratization period (1986–1989), but soon after, in the early 1990s, there was a sharp rise lasting until 2002, after which a steady decline started again, which in recent years is not as clear (İvanova et al. 2011). This evolution coincides with the fluctuations of the rate of suicide in the general population, suggesting that youth suicides are largely but not completely dependent on the same global factors as adult suicides. Fluctuations in suicide rates for males and females in Ukraine from 1980 to the 2012 can be seen in Fig. 11.1. As shown, the worst period of suicidality between 1980 and 2012 fell between 1995 and 2000, while the Chernobyl disaster in 1986 co-occurred with some of the lowest suicide rates of that particular decade. Despite the fact that the graphs below reflect general downward trends in suicidality from the mid-1990s through 2012 regardless of gender, more specific data of this time period actually point to an increase in adolescent suicides, while suicides in middle-aged are stable or decreasing (Rozanov et al. 2012).

Data on suicide rates (general population) for all regions of Ukraine for a comparatively short but interesting period of time—from 1991 to 1998 can be found below in Table 11.1. As shown, Ukraine is divided geographically into four main regions—Southern, Western, Eastern, and Central—and further into smaller administrative units called oblasts. Suicide rates within the country differ accordingly. In the industrialized regions (Eastern, Central, and Southern), suicides were almost three times higher than in the agricultural Western region. Ethno-cultural factors may also account for these differences. Looking at the change of rates over time, one can observe a gradual rise from 1991 to 1998 in virtually all oblasts. Perhaps surprisingly, suicide rates in the oblasts most affected by radioactive contamination (Kiev, Tchernigov, Vinnitsa) are comparable with most of the unaffected areas. Moreover, there were unaffected regions where the rise was even more pronounced than in the areas affected directly by Chernobyl. The geographical gradient

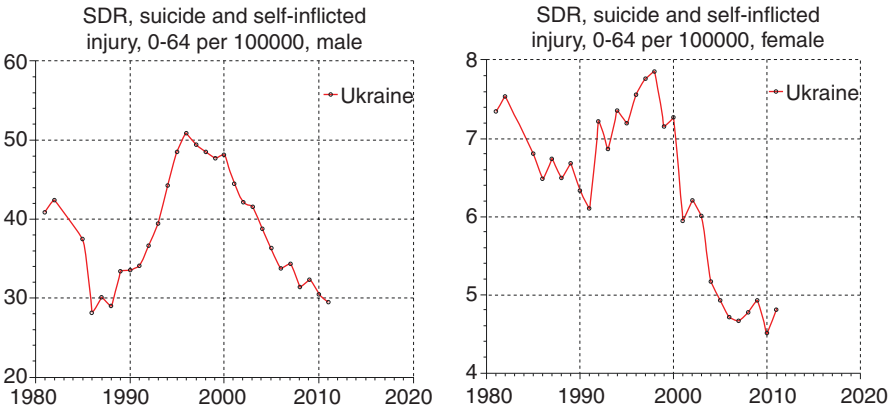

Fig. 11.1 Age-standardized death rates (SDR), suicide and self-inflicted injury in general Ukrainian population (data from WHO "Health for All" Database)

Table 11.1 Suicide rates in different administrative parts (oblasts) of Ukraine from 1991 to 1998[a] (per 100,000)

Oblast	Years							
	1991	1992	1993	1994	1995	1996	1997	1998
Southern region								
Odessa	26.0	26.2	26.1	29.3	31.0	34.0	36.5	34.6
Kherson	25.6	28.4	31.7	31.0	39.5	37.2	40.1	38.5
Nikolaev	25.6	23.5	24.3	25.2	28.1	29.4	30.9	28.8
Range and average level: 23.5–40.1; 30.4								
Western region								
Ivano-Frankovsk	7.4	10.2	11.8	12.8	10.3	13.0	13.0	–
Lwow	7.7	6.6	8.8	9.1	8.8	9.2	9.9	11.1
Ternopol	8.7	10.2	9.8	11.0	11.8	12.0	10.1	13.2
Transcarpathian	13.1	13.4	15.0	16.2	16.4	19.4	16.5	18.4
Tchernovtsy	10.2	13.0	14.8	10.6	11.4	13.2	13.3	12.2
Range and average level: 6.6–19.4; 11.9								
Eastern region								
Dniepropetrovsk	20.4	25.0	27.1	29.4	30.3	33.3	34.8	34.1
Donetsk	23.5	25.9	29.2	34.1	36.2	38.2	37.9	39.5
Kharkov	21.9	22.8	26.1	31.3	34.6	37.0	36.5	34.3
Sumy	28.8	32.6	34.4	42.6	43.0	44.4	43.2	42.6
Zaporozhye	23.5	31.0	30.5	32.3	37.6	40.6	35.3	36.1
Lugansk	26.2	26.6	29.5	35.5	36.8	39.2	39.0	39.2
Range and average level: 20.4–44.4; 33.6								
Central region								
Kiev	20.2	21.1	23.8	27.7	27.4	29.7	28.2	30.0
Kirovograd	27.2	31.6	29.7	34.8	35.4	38.2	39.6	37.3
Tchernigov	29.5	31.3	32.5	35.1	40.1	39.5	40.7	43.0
Poltava	26.4	27.7	29.5	31.9	35.8	35.2	39.9	37.3
Tcherkassy	26.7	29.4	28.3	29.6	30.2	31.9	33.7	35.8
Vinnitsa	25.5	26.0	27.9	28.0	29.2	28.8	29.7	29.7
Zhytomir	18.6	19.6	22.8	25.7	27.3	29.2	25.2	26.8
Range and average level: 18.6–43.0; 30.4								

Derived from Kryzhanovskaya and Pilyagina (1999)

[a]The names of regions are given in accordance with the names for this period

(decreasing from East to West) was so strong that it actually hid all possible effects of the Chernobyl factor.

11.3.3 Psychosocial Factors and Epigenetic Phenomena

Unfortunately, neither children irradiated in utero nor "Chernobyl children" (evacuees and non-evacuees affected by Chernobyl) were monitored for suicidality in Ukraine. As a result, we can rely only on the national suicide data, which cannot distinguish suicide rates across those exposed and not exposed to the Chernobyl

factor, and fail to account for psychosocial stress, collective trauma, and the psychological influences of fear, anxiety, and hopelessness. Moreover, general trends coincide with expected in utero effects—for instance, those who were exposed in utero would reach "suicide onset age" (14 years) exactly in 2000–2001, when the highest peak of suicide was observed in the post-Soviet era. Since that peak in 2001, suicide rates in younger people have decreased at a slower rate than in older ones, but this also coincides with more global trends involving psychosocial and existential factors, rather than exposure to specific trauma (Rozanov 2014b). Of course, effects of exposure to Chernobyl disaster factors cannot be excluded, but these effects seem to "dissolve" in more general dynamics.

From the point of view of modern models of suicidal behavior such as stress-vulnerability and diathesis-stress, impairments of neurodevelopmental processes associated with the impact of early life stress may be very important (Wasserman 2001; Van Heeringen and Mann 2014). Recent studies provide an insight into the pathophysiology of suicidal behavior by confirming the role of early negative life events (including in utero stress) that may alter brain maturation during development through the involvement of epigenetic phenomena. Lesions or developmental abnormalities in the hippocampus, amygdala, and prefrontal cortex induced by early life stress may lead to long-lasting cognitive, behavioral, psychological, and psychiatric consequences and may serve as risk factors for suicide (Turecki 2014; Rozanov 2017). Epigenetic changes are widespread and involved in the effects of different types of stress, as well as environmental exposures, both chemical and physical (Vaiserman 2015). From this point of view, one cannot exclude the effect of irradiation stress involving free radicals, neuronal membrane damage, neurotoxicity, stress gene induction, and other processes in the brain tissue.

One study screened about 116,000 adolescents who were affected by Chernobyl (who were up to 6 years of age or in utero when exposed to nuclear fallout or were born up to 45 months after Chernobyl) for thyroid diseases and mental health problems 13 years after the disaster occurred. It this cohort, depression was diagnosed in 13.2%, suicidal ideation in 5.3%, and attempted suicide in 2.3% (Contis and Foley Jr. 2015). Underlying features of the participants' depression were negative mood, interpersonal difficulties, negative self-esteem, ineffectiveness, and anhedonia. The authors pointed to these findings as a sign of increased prevalence of depression and suicidal thoughts in exposed children. However, other studies suggested that the prevalence of depression, suicidal ideation, and suicide attempts were the same or even higher in a general sample of Ukrainian adolescents. For instance, a study performed in Ukraine according to the European SEYLE protocol revealed mild depression in 20.65% of respondents and moderate and marked depression in 11.06% and 11.22% of adolescents, respectively. It was also found that 8.13% of youngsters were thinking about taking their own life and the incidence of suicide attempts in the 6 months prior to reporting was 6% (Rozanov et al. 2013). These data reflect a bundle of psychological and mental health problems in contemporary adolescents which can be attributed to a variety of factors, among which stress, poor sleep, family problems, and relationships with peers and school teachers seem to be at the

forefront. One cannot exclude the multiple effects of exposure to Chernobyl factors, ranging from irradiation to family relocation and from oxidative to psychosocial stress. However, these factors are difficult to untangle from the more typical adolescent stressors, and thus it is hard to discern what specific role the exposure might have played.

11.4 Conclusion

In conclusion, there is no objective data to suggest that early life exposure to Chernobyl has led to elevated suicides in youngsters. The only conclusive data regarding elevated risk of suicide in connection to the Chernobyl accident are results of mortality monitoring of the cleanup personnel (i.e., people directly involved in the elimination of the most severe consequences of the catastrophe). Recent observations confirm a higher suicide rate, higher incidence of mental health problems, and elevated suicidal ideation among these workers in comparison with controls, with suicidal ideation being the strongest manifestation (Rahu et al. 2015; Laidra et al. 2017). Unfortunately, youth cohorts were not under longitudinal study in regard to the link between suicide and Chernobyl; therefore, suicidality in adolescents affected by Chernobyl and the role of radiation as a factor of suicidal behavior remains controversial and need more thorough investigation. On the other hand, widespread, indirect media exposure to the gruesome effects of Chernobyl may have in some ways victimized the entire generation of children who were born shortly before or shortly after the event. It is still a part of the general discourse in Ukraine, The Russian Federation, and Belarus to label someone as part of the "Chernobyl generation." This phrase is sometimes used for explaining a high morbidity rate (especially in cases of anxiety about contracting a deadly disease) in comparatively young people. As to the elevation in suicide rates which can be seen in modern youngsters, the general opinion tends to associate it with growing psychosocial stress, pressure to succeed, difficulty finding meaning or purpose in life, and impaired self-actualization. Those who were born during and shortly after Chernobyl are about 30 years old today, are already having children of their own, and constitute some of the most active and productive members of the population in former Soviet republics. Certainly, such a mass trauma did not pass without consequence, and therefore morbidity and mortality among them should bear some sign of Chernobyl. However, a lack of objective research has hampered a more definitive conclusion about the role that this catastrophic event might have played in these lives.

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