Disaster Behavioral Health: Psychological Effects of the Fukushima Nuclear Power Plant Accident

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Contents

Abstract

We reviewed studies regarding the mental health problems of the people who were directly affected by the past three severe nuclear accidents: the Three Mile Island accident, the Chernobyl accident, and the Tokaimura accident. These events brought us many lessons on complicated and long-term

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sociopsychological effects of the people who met with a nuclear accident. The Fukushima nuclear power plant accident also caused multidimensional behavioral problems of the residents in Fukushima. The various sociopsychological reactions among the Fukushima people can be summarized within five main issues: posttraumatic stress response, chronic anxiety and guilt, ambiguous loss, separated families and communities, and stigma. We should provide the effective intervention to mitigate mothers' anxieties and guilty feelings, dispel the stigma against the Fukushima people, and prevent exhaustion or burnout of the local staff.

4.1 Introduction

The Great East Japan Earthquake brought serious effects on the vast area of Fukushima prefecture. The coastal area in Fukushima, called "Hama-Dori," was heavily affected by the huge tsunami and 1,817 people were presumed dead. However, needless to say, the most serious and long-term effects on the people in Fukushima were caused by the several explosions of the Fukushima Daiichi nuclear power plant after the total electric power loss. The explosions of the three reactor buildings resulted in radioactive contamination in a vast area of the Fukushima prefecture. As the radioactive substances with a long half-life like cesium-134 (^{134}Cs) and cesium-137 (^{137}Cs) widely fell, decontamination efforts using various methods and tools have been tried in many places in Fukushima. Although the Japanese government declared a "cold shutdown" of the plant 9 months after the accident, the process to completely decommission the reactors is estimated to take more than 30 years at least. Even now, there are 17,000 people that were evacuated to temporary houses, 34,000 in municipally subsidized rental houses, and 57,000 living out of Fukushima prefecture.

The nuclear fallouts are both directly and indirectly influencing not only the medical and welfare service but also the politics and the economy of Fukushima. Considering the widespread effects caused by the accident, the psychological problems of the people living in or evacuated from Fukushima should be noted. In this chapter, we will first briefly review past studies regarding the psychological consequences of people experiencing severe nuclear accidents. Subsequently, we will identify the behavioral health problems among the Fukushima people including sociopsychological issues such as public stigma.

4.2 Behavioral Effects Resulting from the Past Nuclear Accidents

Nuclear disasters are very rare events; however, their effects threaten those affected on two levels: from the molecular level to the social level (Christodouleas et al. 2011; Norris et al. 2002a, b). To understand the various psychological impacts affecting the people who have experienced severe nuclear accidents similar to the

Fukushima disaster, we have reviewed past studies related to three nuclear disasters: two very famous nuclear disasters in human history and the first fatal nuclear accident in Japan.

The accident at Three Mile Island (TMI) occurred in 1979 (President's Commission on the accident at Three Mile Island 1979) and was registered as a level 5 on the International Nuclear Event Scale by the International Atomic Energy Agency (IAEA). A series of longitudinal epidemiologic studies was designed to focus on the mental health of the mothers of young children living within ten miles of the plant (Bromet et al. 1982; Fienberg et al. 1985). The concerns about the potential effects of radiation exposure on their children and the mothers' vulnerability to depression were defining reasons as to why they specifically chose those mothers (Fienberg et al. 1985). The results showed that mothers had a stronger risk of experiencing clinical episodes of anxiety and depression during the year following the accident (Bromet et al. 1982). The results from cluster analysis of the same group 10 years following the accident showed two major subgroups of women: those whose temporal profiles were either (a) stable and at a low, clinically nonsignificant psychiatric symptom level across all measurements points (65 % of the sample) or (b) at consistently elevated levels of distress (35 % of the sample) (Dew and Bromet 1993). Multivariate analyses indicated that the pre-accident characteristics, as well as the parameters reflecting the respondents' initial involvement along with the reactions to the accident, were important for distinguishing between the women within the two temporal profile groups (Dew and Bromet 1993). Meanwhile, another study by Prince-Embury and Rooney (1995) revealed that an increased lack of control, a lack of faith in the radiation experts, and an increased fear of developing cancer were observed among the residents following the restart of the nuclear-powered generator.

Other studies on the psychological impacts of nuclear plant workers were conducted by Kasl et al. (1981a, b), and the results demonstrated that the workers of the TMI reactor reported experiencing recurring periods of anger, extreme anxiety, and other varying psychophysiological symptoms at the time of the accident. Six months after the accident, the rate of demoralization was greater primarily among the TMI non-supervisory workers.

The Chernobyl disaster was the first level 7 disaster on IAEA's scale. Although the radiation reached fatal levels, and some 300,000 residents were relocated, the Chernobyl Forum Report from the twentieth anniversary of the Chernobyl event concluded that the mental health effects were the most significant public health consequence of the accident (The Chernobyl Forum 2006; Bromet and Havenaar 2007; Bromet et al. 2011). The cleanup workers showed an increased suicide rate over a longer period of time (Rahu et al. 2006), and the male liquidators complained more often about depression, anxiety disorders, posttraumatic stress disorder (PTSD), suicide ideation, and severe headaches than the control group (Loganovsky et al 2008).

The results of the studies on the influence of the cognitive functioning of the exposed infants are still inconsistent (Bromet et al. 2011); one study showed that Chernobyl did not influence the cognitive functioning of exposed infants in the long

term, though many evacuee mothers believed that their offspring had memory problems (Taormina et al. 2008). General population studies also reported a high prevalence rate of depression and PTSD especially among mothers with young children (Bromet et al. 2011).

In Tokaimura, Japan, the criticality accident occurred in a uranium reprocessing facility operated by JCO, the Japanese nuclear company, on 30 September 1999 (IAEA 1999). This resulted in the deaths of two JCO staff members and the evacuation of 161 residents. This accident, which was ranked a level 4 on the IAEA's scale, was considered the worst civilian nuclear radiation accident in Japan prior to the Fukushima Daiichi nuclear power plant accident of 2011.

Following the Tokaimura accident, Japanese psychiatrists began performing consultations of the 59 residents 2–4 weeks after the disaster and found that they complained about concerns of their physical health, anxiety, insomnia, and irritability (Tomita and Nakajima 1999). Furthermore, they also found that mothers with child were concerned about future risks to their pregnancy and the possible adverse effects on their child, including those who were exposed in utero.

Surveys on the symptoms of posttraumatic stress disorder were also conducted after the interventional seminars for the residents around the site. The topics of the lectures were on PTSD symptoms and related psychological issues, titled "Care of Child (after the accident)." Surveys were also conducted at the consultation center (Konishi and Inamoto 1999), and a screening questionnaire of PTSD symptoms (the impact of events scale-revised (IES-R)) was also performed (Asukai et al. 2002). Among the 424 event participants, 31 residents (7.2 %) were considered part of the high-risk group. Meanwhile, 47.5 % ($n = 19$) of the consultation center visitors ($n = 40$) were placed in the high-risk group. They also revealed that the close proximity and the subjective threat of death had also influenced the IES-R score.

These studies, which addressed the psychological issues in the nuclear crisis in Japan for the first time, brought important findings which can help us to understand the victim's experience after a severe nuclear accident like the Fukushima disaster.

4.3 Psychological Consequences of Fukushima Disaster

There were very complicated psychological impacts on the Fukushima people after the nuclear crisis. We demonstrate five main features as seen in Table 4.1.

4.3.1 Posttraumatic Stress Responses

When the first explosion of the plant occurred following the earthquakes and tsunami, most people, even those who lived near the plant, did not expect such a serious nuclear crisis to happen. They were so poorly prepared for such a crisis that they fell into a panic. The lack of information from the government about the accident spurred the people further. Amid the confusion, most of the

Table 4.1 Features of psychological impact on the Fukushima people after the accident

Psychological impact	Features
Posttraumatic stress responses	Traumatic memories of plant explosion and evacuation Hyperarousal Reexperiencing symptoms
Chronic anxiety and guilt	Fear of radioactive exposure, especially in the case of parents with young children Negative influence on children's development Guilt about abandoning friends and neighbors
Ambiguous loss experience	Loss of home through evacuation rather than damage Uncertainty of nuclear accident evacuees about returning home
Separated families/ communities	Weakened resilience within community Increased conflicts within and between families Frustration of neighboring cities that take in evacuees
Self-stigma	Discrimination against workers and young women Concealment of history in Fukushima Righteous anger Loss of self-esteem

residents living within 30 km from the plant were trying to escape from their hometown. Although some people initially had been optimistic and refused to leave, most of them were eventually evacuated in fear of the meltdown and radioactive exposure.

Afterwards, the government gradually lifted the residential restriction and some of the evacuees returned to their hometown. However, even until today, they still have traumatic memories about the explosions and their evacuation, which yielded various symptoms of posttraumatic stress disorder (PTSD) such as hyperarousal and reexperiencing symptoms (Maeda 2012). The people returning to their hometown are still worried that another explosion at the plant might occur again in the near future. Their worries and anxieties are likely to make them emotionally unstable and may disturb the return of the evacuees. Even in the coastal areas that contain low air level of cesium (e.g., Minami-Soma City), many evacuees still hesitate to return to their hometown due to their close proximity to the plant. Their hesitation shows that the posttraumatic responses and the worries of another explosion among the evacuees continue to exist.

Three months after the Fukushima accident, Kyutoku et al. (2012) performed an online survey for the people in the Tohoku disaster area and revealed that the level of PTSD symptoms for the earthquake and tsunami was significantly higher than that of the nuclear accident. However, considering that the people living near the plant also lived in the coastal area affected by the disaster, both the tsunami and the nuclear crisis may have given them more fearful experiences than the people solely living far from the plant. In the study of the initial patients visiting psychiatric clinics in Fukushima Prefecture after the disaster, the patients showing PTSD or adjustment disorder were 13.9 % of the total number ($n = 1{,}321$) (Miura et al. 2012). Unfortunately, we are not able to precisely estimate the psychiatric influence of the nuclear crisis because of a lack of control group comparisons between the Fukushima

Prefecture patients and other disaster areas. However, it is quite possible that the explosion at the plant gave rise to serious traumatic responses among the people living near the plant.

4.3.2 Chronic Anxiety and Guilt

Many of the residents in Fukushima still have chronic anxieties due to the fear of radioactive contamination. Similar to the Three Mile Island in 1979 and the Chernobyl accident in 1986 (Dew and Bromet 1993; Bromet et al. 2011), it is likely that the anxieties among mothers with young children are the highest. The parents are especially nervous about their children possibly touching or handling something dangerous. However, their concerns and the restrictions on their children's outdoor activities could actually have a negative influence on their children's psychological state, as well as their physical development (Save the Children 2012). In a survey of 97 parents visiting a pediatric clinic in Fukushima City 5 months after the disaster, 77.2 % answered that their children became more stressed due to the restrictions on their outdoor activities. 85.1 % also answered that they, if possible, hoped to move to a less affected area (Kitajo 2011).

In addition, many of the parents who stayed behind in Fukushima have experienced guilt for their children and have expressed their fear of being accused of allowing their children to continue to be exposed to radiation by staying in Fukushima (Save the Children 2012). Conversely, the parents who managed to relocate to other areas also had guilt due to the fact that they felt that by escaping their hometown, they abandoned their friends and their neighbors.

It is important to note that the anxieties and guilt from the parents, especially the mothers, are likely to lead to their children's instability. The survey of the pediatric clinic described above (Kitajo 2011) also showed that compared with those before the disaster, the children in Fukushima city tended to be more irritable, more easily offended, more apathetic, and more obsessive. While interacting with their children, their mothers also tended to become more anxious. Furthermore, the mothers' anxieties might elicit negative reactions in their children again, creating a vicious circle. As Raphael (1986) described in her book, these strong interactions between parents and their children are quite common in disasters. Unfortunately, many of the parents and their children in Fukushima are facing these negative intra-familial interactions, such as distress towards other family members.

4.3.3 Ambiguous Losses

In Fukushima, there are still vast areas where people are in danger of radioactive contamination as well as danger from the effects of the tsunami. Over 100,000 people have been evacuated, and many have lost their homes, their jobs, family members, or their sense of community. The elderly people are especially likely to have many difficulties in their readjustment due to the difficulty in changing their jobs and adapting themselves to new circumstances.

Given these losses, we should note that their losses brought by the nuclear crisis are very differently ambiguous from those of the tsunami. Though many houses where the evacuees lived before the disaster are not damaged in appearance, many evacuees are still not allowed to stay or live there by the government's order. Even after the government lifted the restrictions, many evacuees are still hesitant about returning to their homes for several reasons, such as the fear of insufficient decontamination, the difficulty in finding employment, or simply due to uncertainty. On the other hand, the tsunami survivors, despite their great and apparent loss, seemed to have overcome their traumatic experiences faster than the people affected by the accident.

The Fukushima evacuees continue to face a dilemma; they can continue waiting for their hometown to someday become habitable again, but it is unknown when such a situation will occur. Also, this uncertainty has led to difficulties in both compensations and the welfare service. Similar to having a missing loved one (Boss 1999), such ambiguous loss delays the recovery process of the evacuees and may lead to continuing psychiatric problems for the people of Fukushima. In particular, we should pay attention to occurrence of depression or suicide. For example, in Fukushima Prefecture, 32.4 % of the new outpatients having depression or PTSD answered that their symptoms are related to the nuclear accident (Miura et al. 2012). In regard to suicide, several suicidal cases closely related to the nuclear crisis were reported by media, but we have not been able to accurately report on all of these situations.

4.3.4 Separated Families and Communities

In Fukushima, many people were relocated from the affected area both voluntarily and involuntarily. Multiple factors, such as the fear of radioactive exposure, along with residential restrictions, compensations, employment, and/or other personal reasons, divided the residents into two groups: those who decided to relocate and those who did not. Unfortunately, the dissonance between these two groups often arose, which broke the bonds between the original residents.

Generally, if a natural disaster strikes, the bonds and cohesiveness among residents tend to become stronger and, moreover, may enhance the resilience of communities and reduce mental health problems. The past epidemiological study (Kessler et al. 1999) also revealed that the prevalence of PTSD among the people who experienced natural disasters was considerably lower than that among those who experienced other manmade incidents (e.g., motor vehicle accidents, physical assaults, rapes). Japan is known for being affected by a large number of natural disasters, such as earthquakes, tsunamis, or typhoons, and the communities in Japan have developed a sense of resilience from such incidents. However, since the Fukushima accident was essentially a manmade disaster rather than a natural one, the resilience of the communities and the families has weakened.

In Fukushima, there have been three types of discordance which have led to dissonance within both families and the community:

- Family members having different opinions on the physical risk induced by radioactive exposure
- Interfamilial conflicts caused by differences in residential restrictions or compensations
- Frustrations between evacuees and neighboring members taking in large numbers of evacuees (e.g., Iwaki City)

As time passed since the disaster, the souring relationship between the community members and the evacuees worsened due to several reasons: the delinquency of taxes, the unclear period of the evacuees' stay, an increase in population, and the rise in land cost. These three types of discordance have created tension within the population of Fukushima.

4.3.5 Stigma and Self-Stigma

Although the authorities such as the World Health Organization (2013) recommended that the people in Fukushima should not be fearful of the radiation risks in regard to their physical condition, many people are still skeptical. Taking into account the psychosocial burden of the evacuees, it is problematic that there is a public stigma forming through ignorance about the radiation. For example, Shigemura et al. (2012) showed that discrimination was associated with both general psychological distress and posttraumatic responses among the workers engaging in the repair of the destroyed plant. Furthermore, many young women in Fukushima are afraid of how people may look down on them due to assumptions regarding the influence of radiation on pregnancy or on genetic inheritance (Glionna 2012). Some also believe that the women exposed to radiation should not be allowed to marry or reproduce. Unfortunately, due to these misconceptions, many evacuees are hiding the fact that they lived in Fukushima after moving to other prefectures (Save the Children 2012).

This phenomenon reminds us of the atomic bomb survivors of Hiroshima and Nagasaki. They also tried to hide their life history and refused to discuss their experiences of the atomic bombing. In particular, young female survivors also showed the same strong tendency of concealing their experience as those of Fukushima and showed worse psychological symptoms than those of male survivors (Yamada and Izumi 2002).

The self-awareness of both of the atomic bomb survivors and the Fukushima people can be regarded as a "self-stigma" induced by the public stigma related to radioactive contamination. According to the idea of Corrigan et al. (2006), who studied the traits of self-stigma among people with mental disorders, the self-stigma would cause either righteous anger or a loss of self-esteem within the stigmatized people. Also, in the case of Fukushima, such self-stigmas are likely to cause emotional distress within the victims. Given the considerable psychological effects from the self-stigma, dispelling public stigma should be highly prioritized in order to prevent the Fukushima people from further stigmatizing themselves.

4.4 Summary and Implications

In this chapter, we reviewed studies regarding the mental health problems of the people of the nuclear accidents and showed the current behavioral health problems in Fukushima. The various sociopsychological reactions among the Fukushima people can be summarized within five main issues: posttraumatic stress response, chronic anxiety and guilt, ambiguous loss, separated families and communities, and stigma.

Given these complicated problems regarding mental health among the Fukushima people, we should consider the following three approaches. First, we should focus on high-risk groups, such as mothers having young children, and provide effective psychological interventions for them. Second, we should provide adequate risk communication and programs involving the media to dispel the stigma towards the Fukushima people. Lastly, we should provide active support for the medical and welfare of the workers in Fukushima to prevent burnout or exhaustion. By taking these steps towards understanding and resolving these difficulties in a long-term perspective, we can provide strong, relevant aid to those affected by the accident and finally help the Fukushima people overcome the effects of the nuclear power plant accident.

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