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Disruption of Child Environments and Its Psychological
Consequences After the Fukushima Disaster: a Narrative Review
Based on the Ecological Systems Model

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Abstract

Purpose of Review: A high prevalence of clinically significant mental health problems was found in children affected by the Fukushima disaster in Japan. We reviewed the literature on child mental health to examine how disasters impacted children in Fukushima.

Recent Findings: Children's environments, such as family and peer systems, were disrupted by radiation concerns and evacuation. As children struggled with less resources at home and school, they also had to deal with discrimination. Various interventions were implemented, ranging from government financial assistance to several mental health services provided by local care resources to families and children. In addition to organizing such interventions discretely in each microsystem, a collaborative approach involving various intervening entities across multiple levels was deemed necessary for providing comprehensive support to the affected children and their families.

Summary: To promote the healthy psychological development of children, it is necessary to provide multidimensional support for their families, particularly parents, through multidisciplinary collaboration between professionals involved in child and family care.

Keywords: Nuclear disaster . Child mental health. Child development. Parenting. Great East Japan Earthquake

Introduction

Nuclear disasters greatly impact the mental health and development of children [1]. Based on parental reports of child mental health, 16 to 25% of affected children showed mental health problems at clinical level 1 year after the Fukushima disaster [2••], while the Japanese standard was 9.3% [3]. A longitudinal study revealed that 8.8% and 8.5% of these children continued to experience very severe emotional symptoms and peer relationship

problems, respectively, even 3 years after the disaster [4••]. Disasters not only affect children's mental health as an immediate reaction to disaster experiences [5] but also incessantly impede their mental growth [6], which could consequently influence their development in the long run [7].

Nuclear disasters overwhelm family and social figures in the children's environment. For instance, family disruption, deterioration of parental mental health, discrimination in schools, immature friendships, and unstable identity development were observed after nuclear disasters [7–9]. The development of children is usually influenced by every component in their environment. Bronfenbrenner [10] conceptualized that a child is at the center of an ecological system, in which the child is surrounded by layers of systems, such as the microsystem, mesosystem, exosystem, and macrosystem. The microsystems are the systems which immediately surround and directly interact with the child, such as family and peers. The mesosystem represents the interactions among various microsystems (e.g., parent-teacher associations). The exosystems include societal conventions, such as laws, government policies, and political systems, which influence the child by impacting their meso- and microsystems. The macrosystem encompasses the value systems of the culture (e.g., collectivistic cultural values and ideologies), which have implicit but pervasive bearings on all systems previously mentioned, as well as the child. The determinants of healthy psychological development of children rely on the construction of healthy relationships and interactions with those systems involving parents, significant adults such as other family members and school teachers, as well as friends and schoolmates. In these relationships, children have certain experiences related to responsive/sensitive caregiving, acceptance, trust, and identity, at each developmental stage, which are indispensable for their healthy psychological development. In the ecological systems model, these systems interact with each other while being impacted by systems at higher levels, such as by the national and local governments.

In this review, we discuss the impact of disruption of children's environments on their deteriorated mental health conditions after the Fukushima nuclear disaster. We adopted Bronfenbrenner's [10] ecological model of human development to examine the environment of and interventions for child development by family, peers, and individual systems (Fig. 1) [10].

Environmental Systems for Child Development After the Fukushima Disaster Family System

The family system, the most important element of child development, comprises family members, such as the mother, father, siblings, and grandparents. The Fukushima nuclear disaster had serious implications on children's family lives due to radiation exposure risk and/or evacuation [11–13]. Optimum places of evacuation in terms of safety, work, school, and livelihood were often unavailable. Many families with children had to decide

whether to let their mothers and children evacuate without their fathers to alleviate financial burdens [14–16]. In fact, 22.7% of men reported that they decided to voluntarily evacuate their wives and children before prioritizing themselves [17]. Two years after the disaster, 20–40% of evacuees reported living separately from their family members with whom they used to once live in the same household [8, 18].

Even though the evacuation demanded a change in family routines, it demanded an even more drastic change in family composition. Adjustment to new routines increases stress among children and adults [19], which is associated with fluctuating parental resources, deteriorating parenting quality, and emotional insecurity [20]. Such instability could cause children to develop behavioral and cognitive problems in their home and school [19] and decrease their resilience from the disaster [21]. The decision-making process left many families with a sense of guilt and conflict in balancing health risks and economic needs [22, 23].

Mothers' mental health conditions are known to influence children's psychological status. A link between parental and child mental health has been found in nuclear disaster research, including maternal anxiety and children's emotional disorders [7], somatic, and memory problems [6, 24]. A study found that in children affected by the Fukushima disaster, mothers' post-traumatic stress symptoms predicted children's mental health problems 2 years post the incident [25].

Many mothers have been living with severe nervousness and anxiety after the Fukushima nuclear disaster because of their children. They reported feeling isolated and burdened with single parenting [15, 16], and had to resolve their children's problems such as school concerns, anxiety about the future, sense of loss of their pre-disaster life, and lack of friends, on their own [14]. A study involving mothers with infants revealed that the mothers in Fukushima scored higher on psychological distress and post-partum depression than mothers from other areas of Japan. The mothers' anxiety about radiation exposure, such as negative feelings toward their pregnancy due to adverse effects of radiation exposure, predicted higher depressive symptoms [26]. In fact, depressive symptoms were found in 28% of mothers with infants 1 year after the accident [27]. A longitudinal study by Kuroda et al. [26] found that over 30% and 16–17% of mothers in Fukushima had anxiety and depressive symptoms as well as post-partum depression, respectively, during 5 years after the accident; these rates were higher than the rates in other areas of Japan. Long-lasting poor mental health in mothers of Fukushima was congruent with the previous findings from Three Mile Island and Chernobyl incidents (see [5, 28–30]), indicating that children may struggle as a result of significant changes in the family system, which could be attributed to the deteriorated mental health of their parents after nuclear disasters.

Inadequate emotional availability of parents toward their children could induce delayed behavioral problems in them, particularly after disasters. The use of corporal punishment by parents was associated with more behavioral problems in children affected by

the Great East Japan Earthquake (GEJE) and the Fukushima nuclear disaster [31]. Many parents with young children, especially mothers, hesitated to allow children to participate in outdoor activities for a long time because of deep concerns about radiation exposure, resulting in insufficient exercise and arrested development of athletic abilities in the affected children [32, 33]. Lower levels of exercise were associated with poor mental health in children of Fukushima in the long term [4••, 34].

Although there are fewer reports on the effects of family members other than mothers in the context of the Fukushima disaster, roles of other members in the family system, such as the father, should also be considered [35, 36]. For some voluntarily evacuated mothers, the absence of fathers in their lives emerged as a concern and a trigger for anxiety. Mothers reported confined and strained relationships between them and their children, in which mediation by fathers was not available [37]. These mothers who voluntarily evacuated also faced unstable mental states due to the father's absence [23]. In many cases, children reluctantly accepted their fathers' absence [16, 37]. Given the importance of a father's role in child development, his absence could affect the child's psychological development in the long run.

Peer System

The peer system of children was significantly affected by the GEJE and the Fukushima disaster. Children establish relationships with peers, build social skills, and learn how to adapt to the social demands of the world, through which they develop their sense of self and establish self-identity. Schools usually function as one of the major sources of social relationships for school-aged children. Since severely affected schools were evacuated and moved to a substitute location, schools that survived the tsunami and nuclear disaster were ordered to function as long-term shelters for displaced people and were thus closed for an extended period of time [38]. As the needs of displaced people for housing increased, prefabricated, temporary housings occupied the schoolyards, which led children to lose their playground and a place dedicated to them [39]. Even after schools resumed, children faced restrained outdoor activities, suspension of extracurricular activities, and many classmates moving away [38, 40], leading to significant changes in their peer relationships.

The situation was even worse for children from evacuated families. Evacuated children experienced multiple school transfers, which were accompanied by the disruption of their peer relationships. Within 2 years after the Fukushima disaster, 34.8% and 30.9% of evacuated families changed their residential location three to four times and five times or more, respectively [8], which led to frequent changes in their schools. As they left their hometown, children lost touch with most of their life-long friends and struggled to make new friends in the new schools, not knowing how long the evacuation would last [23]. Concerns for their school and education, as well as lack of friends, impacted children's mental health [14]. An

overwhelming majority (81.0%) of evacuated children reported feeling distressed and suffering at their new school: taking a long time to make friends (41.2%), facing difficulty in communicating due to different dialects (52.9%), not wanting to attend school (64.7%), and being unable to attend school eventually (23.5%) [41]. In fact, behavioral problems, such as aggression and a lack of concentration, were associated with changing schools [42]. Children also suffered from difficulties in relationships with their peers; 77.5% of the affected children from 1st to 9th grade had moderate to severe peer relationship problems, which were consistent for over 3 years [4••], denoting their persisting struggles at school. These studies show how changes in the school environment impacted the development of children's social and interpersonal competency as well as development of the "self." Such negative consequences occurred for both evacuated and non-evacuated children from Fukushima.

Individual System

Children encounter challenges related to the development of their identity and sociability, as they often experience discrimination as nuclear disaster survivors. Parents feared that their children would suffer discrimination regarding marriage and reproduction, as there will be a risk and fear of potentially damaged DNA and malformation in future offspring [22, 43]. Such concerns reflect similar discrimination experienced by atomic bomb survivors reported almost half a century ago [44]. Female college students affected by the Fukushima disaster also reported similar concerns [45]. Discrimination against atomic bomb survivors engendered the long-term stigma that impacted survivors' life decisions regarding marriage, pregnancy, and employment [46, 47]. Additionally, inconsistent information on radiation effects on reproduction made the residents of Fukushima vulnerable to discrimination [48].

In an attempt to avoid becoming targets of discrimination, many evacuated families often chose to hide their identities in their new host communities. Mothers reported that they did not disclose their identity as an evacuee family from Fukushima, the name of their hometown in the ordered evacuation zone, or information on receiving financial compensation, with the residents in their new community as well as with the parents of their children's school friends [49].

In the family, some mothers found it difficult to communicate with their children about their hometown, while others reported that their children hardly talked about or had little memory of their hometown [49]. Children thus grew up in an environment where reminders of their hometown, Fukushima, vanished, leading to the development of identities different from that of their parents.

Furthermore, many children affected by the Fukushima disaster faced bullying. Almost 200 cases of bullying in schools toward children evacuees from Fukushima prefecture were reported by the Ministry of Education, Culture, Sports, Science, and Technology [50]. This report revealed that verbal bullying ranged from subtle insinuation and teasing to

obvious discrimination (i.e., being told “Go back to Fukushima,” and “Don’t come near me because I will get infected with radioactive particles”) while serious cases resulted in extortion of money or violence. Research conducted with evacuated children reflected the incidence of bullying. Three years after the Fukushima disaster, 20% of parents reported that their children had been targets of bullying [51]. In fact, the evacuated children were significantly more likely to report victimization by bullying than anything else [52]. These experiences of bullying and discrimination toward affected children could lead to self-stigmatization and, in the long run, could jeopardize a healthy identity development.

As described previously, children’s peer relationships were disrupted by various social factors, such as radiation and evacuation. Children experience a lack of play, social recreation, and extracurricular school activities, which might lead to stable friendships that allow for the development of healthy social skills and identity. The period of mid-childhood to adolescence is crucial for the development of various competencies through peer relations, self-integration, and individuation through identity development, peer networks, and intimacy [53]. Deprived social relationships at school as well as communities could cast a shadow on their development of who they are. Recent findings obtained from a large-scale survey revealed that the prevalence of probable depression among adolescents and young adults affected by the disaster was considerably higher than that of the national standard [54]. This suggests prolonged developmental effects on young people experiencing an unstable environment in adolescence, which is crucial to establish a healthy self-identity.

Interventions for Child Development After the Fukushima Disaster

Interventions for the Family System

After the Fukushima nuclear disaster, there were many interventions targeting the family, peer groups, and individual children. First, immediately after the disaster struck, guidelines laid out by the national and local government established the foundation for mitigating the damage to children’s environment and family system. This included the provision of temporary housing, financial assistance, and dispatching public servants to affected local municipal offices, such as child protective services [55, 56].

In the aftermath of the disaster, provision of temporary housing and financial resources were two of the most important issues that could determine whether families, particularly those that included extended family members, could remain intact and continue to sustain their lives together after evacuation. The national government encouraged prefectural governments to dispatch support personnel, such as social service workers, to facilitate local governments to provide continuous services to people affected by the disaster. In addition, even if local governments could not provide direct instrumental support, they played a key role in providing informational support. The local government in the affected areas assisted their residents in recovering their living by procuring and disseminating the latest information on available housing, financial assistance, radiation

exposure, and health concerns. The local governments developed a network of evacuated and non-evacuated residents and communicated with them through newsletters, websites, social media, telephone consultation services, and home visits by social service workers.

Furthermore, interventions aimed at improving the mental health of family members and providing information regarding risk perception that was related to their mental health were also important in restoring the family system of children. Local mental health services, such as psychiatric clinics and counseling centers, were crucial given the high prevalence of depression and anxiety among mothers and children. Meanwhile, home visit programs for evacuee mothers with young children for providing emotional support were reported as necessary and helpful by evacuee mothers [11]. In addition, Fukushima Health Management Survey (FHMS) conducted longitudinal epidemiological studies including the Mental Health and Lifestyle Survey targeting residents from the evacuation zones and the Pregnancy and Birth Survey targeting mothers who had registered their pregnancies in Fukushima prefecture. The FHMS established a Mental Health Support Team that provided outreach telephone counseling for emotional support, and information regarding mental health care and radiation concerns to the parents of high-risk children and high-risk mothers for post-partum depression, as identified in their survey [57]. Additionally, members of the Support Team of FHMS connected struggling families with relevant local government offices, so that the public health nurses from local governments could provide home visits to high-risk families if necessary [58]. Furthermore, local communities, municipalities, or medical/scientific institutions organized risk communication meetings involving radiation professionals to educate the affected residents, such as the meetings organized by the Radiation Medical Science Center for FHMS [59].

Interventions for the Peer System

To enhance peer-support functioning among children, psychoeducation classes aimed at teaching the relationship between disaster and stress reactions were conducted, so that the school culture could be more trauma-informed [55]. Furthermore, bullying associated with the Fukushima nuclear disaster reflected the prejudice against the evacuated families existing in the society, which had become pervasive even among school-aged children. Since stigma and discrimination could stem from the lack of accurate information and understanding of nuclear disasters and radiation risks, classes on radiation effects were conducted using supplemental textbooks prepared by the Ministry of Education, Culture, Sports, Science and Technology [56] and by inviting experts of radiological medicine as guest lecturers [57].

Furthermore, since indoor children's playgrounds, space where children could play within the grounds of temporary housing facilities, or parks and schoolyards in the communities were unavailable, children were able to take advantage of interventions provided by adults to improve their disrupted peer system. Non-profit organizations visited shelters and provided play equipment and conducted activities for children, which were welcomed by

parents, who also enjoyed communicating with each other [58]. One of the unique aspects of post-nuclear disasters was that children's outdoor play became strongly restricted due to concerns about adverse health effects of radiation, despite play spaces being available.

Concerns for obesity and poor motor

function development in children stemmed from a lack of physical exercises [32]. This led to the construction of indoor playgrounds in Fukushima [59]. While the provision of playgrounds was useful for younger children to socialize with other children, school-aged children tended to rely heavily on the initiatives of each school for various activities.

Interventions for the Individual

Disrupted schooling and changes in schools made keeping up with schoolwork difficult for many evacuated children. Afterschool study programs were implemented by a non-profit organization in Fukushima. Such activities were welcomed by affected families since they supplemented reduced parental support for children and prevented them from falling behind, academically [60].

To support children's mental health, delivering interventions directly on-site in schools was effective as it provided easier accessibility to affected children. Psychoeducation classes to learn about the relationship between disaster and stress reactions could help children cope with the impact of the disaster [55]. Similarly, learning about accurate information on radiation risks [56, 57] could reduce their unwarranted anxiety and self-stigmatization, and help them resist prejudice and discrimination, leading to a healthier development of identity. To achieve the abovementioned objective, the government dispatched its employees to affected areas as well as in schools in the area. This ensured mental health care for affected children was supported by school counselors who were recruited from various areas of Japan.

Moreover, multidisciplinary teams, including psychiatrists, clinical psychologists, and social workers, provided local schools with outreach consultation and made referrals to mental health facilities as well as dispatched professionals to provide assessment/psychological testing [61]. These interventions helped improve the quality of mental health care at school as well as at local mental health facilities where children could seek support.

Conclusion

The development of children is fostered by the combined dynamic influence of their families and peers, whose functions are also under the influence of systems at higher levels, including the local and national governments. In this review, challenges posed to children's psychological development after the Fukushima disaster were discussed by examining family, peer, and individual systems. Research on children affected by the Fukushima nuclear disaster revealed that mental health problems deteriorated to reach a clinically significant level after

the disaster and these problems persisted for several years. While the literature points to accumulated consistent findings of the negative impact of the nuclear disaster on children, the psychological problems among children were caused by the negative alterations in their environment at multiple levels, namely the family system, peer system, and individual system, based on the ecological systems model.

Changes in the family system where the family experienced separation due to evacuation were also linked to disrupted parenting routines and parents bearing the tremendous weight of raising their children under stressful circumstances. Children's peer system was disrupted by moving to new communities and schools. Changing schools multiple times deprived children of their life-long social network at home and placed an enormous burden on them to adapt to their new schools. Moreover, evacuated families and children experienced discrimination which led them to hide their regional identity to avoid discrimination. This in turn resulted in them losing connections to their hometown as well as the disruption of childhood peer relationships, possibly hindering the development of a healthy self-concept.

Previous and ongoing interventions have been implemented by systems at multiple levels, ranging from micro- to exosystems. While interventions at the exosystem level were instrumental in laying the foundation, such as temporary housing provision and financial assistance, various organizations at the microsystem level implemented interventions addressing mental health issues, including telephone counseling, home visits by social services workers, and risk communication meetings for radiation concerns. Education on stress reaction and health risks from radiation, and peer support that were provided at school may have contributed to preventing discrimination against the affected children. Facilitation of children's play implemented by non-profit organizations assisted in developing children's peer system.

The ecological systems model suggests the importance of collaborations among different systems that includes children's immediate environments as well as the impact of the systems at higher levels, which provides a structure for relief and recovery for children and their families. We have described various initiatives supporting children and their families, each of which has derived positive effects at the immediate environment level. Simultaneously, we need to invest our efforts in identifying strategies to coordinate those activities and collaborate to maximize their positive effects on children's healthy development, particularly to tackle issues associated with nuclear disasters, such as risk perception and discrimination, which are rooted across multiple levels of the society. For instance, when mental health providers treat children, it is critical to promote coordination between their families and schools because these systems share the major responsibilities for a child's care. Furthermore, in order to tackle discrimination against children affected by the nuclear disaster, the national government must commit to educating students and their families about radiation through the school system and their communities across the country.

In other words, discrimination cannot be addressed by focusing solely on the areas affected by the disaster.

This paper reviewed the various challenges faced by evacuees of Fukushima, as well as ascertained the secure future of Fukushima. However, the issues discussed here should be applied in case of any future nuclear disaster. It is vital that each system supporting child development should prepare to collaborate with one another at the immediate level of the child's environment, while the national and local governments should create supporting structures that coordinate with and allow collaboration of such systems for a favorable outcome.

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This article described the collaboration between university-based mental health professionals and schools as well as local mental health facilities in Fukushima to support the children affected by the nuclear disaster, primarily involving the experts' outreach initiatives.

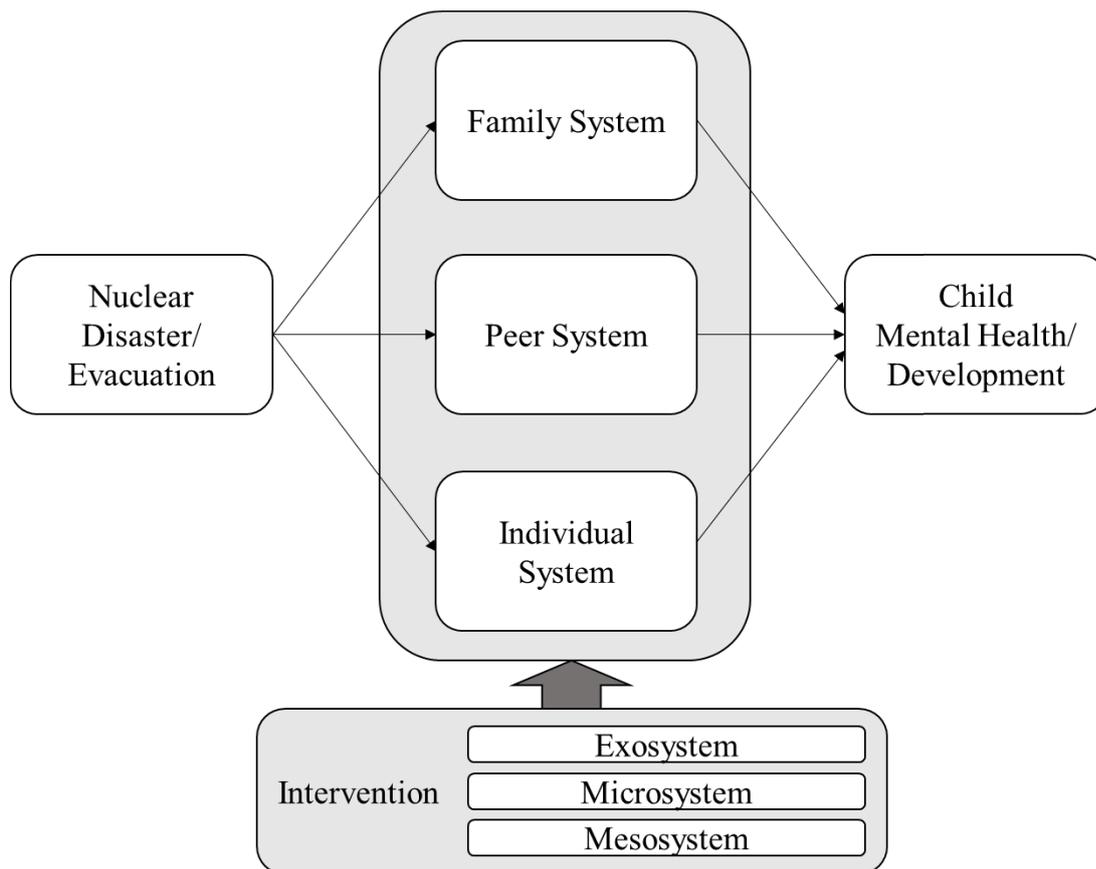


Fig. 1 Factors affecting children's mental health after the Fukushima nuclear disaster