

Psychological Characteristics of Children at Two Years after the Great East Japan Earthquake: Analyses of Telephone Consultation Records

Reiko Sakama,¹ Hirohide Yokokawa,¹ Kazutoshi Fujibayashi,¹ Toshio Naito,¹ Yuki Sato,² Chizuru Yamanaka,² Masahiro Kikuya,² Masako Miyashita² and Shinichi Kuriyama^{2,3}

¹Department of General Medicine, Juntendo University Faculty of Medicine, Tokyo, Japan

²Tohoku Medical Megabank Organization, Tohoku University, Sendai, Miyagi, Japan

³Tohoku University International Research Institute of Disaster Science, Sendai, Miyagi, Japan

The 2011 Great East Japan Earthquake was the largest and most catastrophic earthquake and tsunami in Japanese history. The aim of the present study was to evaluate the burden and psychological characteristics of children at 2 years after this catastrophe to allow a better understanding of the situation and the provision of appropriate support. We investigated a cross-sectional study carried out in 2013 by sending a questionnaire to schools located in Miyagi Prefecture to be answered by parents or guardians. The questionnaire included the Strengths and Difficulties Questionnaire (SDQ) to estimate the psychological adaptation of children. Telephone consultations were provided for children with SDQ scores > 16 whose parents or guardians had given consent. From the target population of 12,742, a total of 4,074 responses were received (response rate: 32%), among which, 720 had an SDQ score > 16 and received a telephone consultation. At the time of the telephone consultation, 301 (42%) of the 720 children and parents or guardians showed some type of psychological reaction and were thus classified as "Insufficient recovery". Among these, 230 had not received social support at any point in time, suggesting the need for long-term psychological support. Those who resided in a coastal area tended to show a higher rate of psychological reactions than those in an inland area (27.1% vs. 12.9%, respectively). In conclusion, catastrophic disasters have a long-lasting psychological impact on children, and thus, long-term psychological support may be needed.

Keywords: children; disaster; psychological reaction; region; strengths and difficulties questionnaire score
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Introduction

The Great East Japan Earthquake that occurred on March 11, 2011 (also known as the 3.11 disaster) was the largest and most catastrophic earthquake and tsunami in Japanese history. It caused immense damage, especially in the coastal areas of the northeast part of Japan, such as Iwate, Miyagi, and Fukushima Prefectures. Located in this area is the Tohoku Medical Megabank Project, which was conducted by the Tohoku University Tohoku Medical Megabank Organization (ToMMo) and the Iwate Medical University Iwate Tohoku Medical Megabank Organization (IMM), which were launched after the catastrophe for the purpose of the early detection and future prevention of disease (Kuriyama et al. 2016).

The ToMMo Child Health Study was one of the projects conducted by ToMMo. It was designed to 1) assess the

health status of children and develop measures to meet their needs; 2) provide appropriate support to children with health concerns; and 3) identify children whose symptoms and prognosis could be improved as quickly as possible with cutting-edge medical support services.

The psychological effects of the earthquake and tsunami on children were considered likely to persist for months or even years (van Griensven et al. 2006), so mental health interventions for posttraumatic stress disorder (PTSD) and depression were suggested (Jia et al. 2013). In Japan, the post-disaster psychological effects and/or behavioral problems were considered likely to persist for years (Saito and Nishida 2001; Fujiwara et al. 2014, 2017). Uemoto et al. (2000) reported that younger age, female gender, and disaster severity were risk factors for the increased likelihood of distress or traumatic symptoms after a natural disaster.

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Correspondence: Hirohide Yokokawa, M.D., Ph.D., Department of General Medicine, Juntendo University Faculty of Medicine, 2-1-1 Hongo, Bunkyo-ku, Tokyo 113-8421, Japan.
e-mail: yokokawa@pa3.so-net.ne.jp

Mental difficulties in children recover over time (Yabe et al. 2014; Usami et al. 2014b), and recovery has been reported to be faster in elementary school children compared with high school children (Iwadare et al. 2014). Some studies have also reported that females are more susceptible than males to the psychological effects of environmental damage (Usami et al. 2014a; Lai et al. 2017).

Although several studies have reported the possible long-term psychological impacts of natural disasters on victims, as well as gender differences in terms of psychological damage, few have identified what kinds of psychological effects require the provision of mental health interventions.

Therefore, the aim of the present study was to evaluate the psychological characteristics of, and compare the psychological effects between, children living in inland and coastal areas at 2 years after the Great East Japan Earthquake.

Methods

This child health study was a cross-sectional study of the psychological characteristics of children in Miyagi Prefecture at 2 years after the Great East Japan Earthquake, analyzed by gender and school location at the time of the questionnaire survey. Informed consent to participate in our investigation was assumed to be given by returning the questionnaire. Anonymized records of telephone consultations were analyzed. This survey was conducted according to the Ethical Guidelines for Epidemiological Studies established by the Japanese government. The research protocol was approved by the Ethics Committee of Juntendo University (Tohoku University: No. 2015-1-811; Juntendo University: No. 2016066).

Study design

The original cross-sectional study was carried out from 2012 to 2015. Under the approval of the Miyagi Office of Education, the Board of Education in each city decided whether to participate. In total, 28 of 35 municipalities participated. The details of the study have been described elsewhere (Kikuya et al. 2015; Kuriyama et al. 2016).

In the present study, we investigated data, focusing on children's health, from the survey conducted June 7-28, 2013 in the following 13 municipalities: Iwanuma, Watari, Yamamoto, Shiroishi, Natori, Kakuda, Zao, Shichikashuku, Ogawara, Murata, Shibata, Kawasaki, and Marumori. We chose the survey carried out in 2013 because we thought the data would best reflect the psychological impact of the earthquake at that time; this was because 1) the target municipalities in 2013 covered all southern parts of Miyagi Prefecture, including both inland and coastal areas, and 2) there were fewer missing data owing to relocation compared with the subsequent years.

Study population

To assess psychological adaptation, we conducted a questionnaire survey of the Japanese version of the parent-rated Strengths and Difficulties Questionnaire (SDQ) (Goodman 1997). Among the 13 municipalities in the 2013 study, there were 117 public schools; 75 elementary schools, 37 junior high schools, and 5 special needs schools (Miyashita et al. 2015). We distributed the questionnaire to

12,742 children in the 2nd, 4th, 6th, and 8th grades (Fig. 1). The parents or guardians of children in public elementary, junior high, and special needs schools filled out the questionnaires and returned them by mail to our laboratory at Tohoku University. In total, 4,074 of 12,742 parents or guardians responded to the questionnaire (response rate = 32%). Among the 4,074 total respondents, 1,718 (response rate: 28.1%) were from schools located in inland municipalities, and 2,356 (response rate: 35.6%) were from schools located in coastal municipalities. Among the returned questionnaires, we excluded from analysis those with a total SDQ score of < 16 and those that had not requested a telephone consultation. The questionnaires included a section where parents or guardians could provide their name and address if they wanted the results sent back to them and if they wanted a telephone consultation. The threshold of ≥ 16 points for the total SDQ score as clinical range was based on a previous study (Matsuishi et al. 2008). Counselors conducted telephone consultations for 865 parents or guardians to investigate their child's current psychological status. The telephone consultations were conducted by nine clinical psychologists for a total of 71 days, from July 23 to November 25, 2013, as described in the study design (Kikuya et al. 2015). After excluding the responses considered as being "Uncategorized ($n = 116$)" or "Duplications ($n = 15$)," and those having "Insufficient data ($n = 14$)," 720 of the 865 responses were included in the analysis.

Strengths and Difficulties Questionnaire (SDQ) in the questionnaire survey

To assess psychological adaptation (Goodman 1997), we used the Japanese version of the parent-rated Strengths and Difficulties Questionnaire (SDQ), which is composed of 25 items divided into five subscales with five items each: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. Each item is scored on a scale from 0 to 2, with 0 for "Not true", 1 for "Somewhat true", and 2 for "Certainly true". The total scale scores, except for prosocial behavior, were summed, ranging from 0 to 40. The clinical range was defined as 16 and above (Matsuishi et al. 2008).

Classification of interview records by specialists

All responses from the 720 parents or guardians were classified by two doctors and one clinical psychologist (Fig. 1). Ambiguous words that were classified as "Uncategorized" were excluded, and children who showed traumatic reactions after the catastrophe were classified as having a positive reaction. In the case of discrepancies between our opinions, we held repeated discussions until we could reach consensus.

First, we established criteria for assessing psychological reactions using five concepts—re-experiencing, avoiding the traumatic event, hyper-arousal, anxiety, and dependency—as implied in previous studies (Durkin et al. 1993; La Greca et al. 2002; Dogan-Ates 2010; Liu et al. 2011; Lai et al. 2017). Then, as a preliminary analysis, we counted the frequency of words in the text files of the 720 telephone consultations using a natural language software program (NVivo 11; QSR International, Victoria, Australia). This program counts similar words, for example, cry, crying, and cried, as one unit. We obtained a list of the top 100 most frequent word units in the telephone consultation records. Two doctors (K.F and R.S) checked the list, and confirmed that it contained word units associated with all five concepts. Therefore, we also considered it appropriate to set those

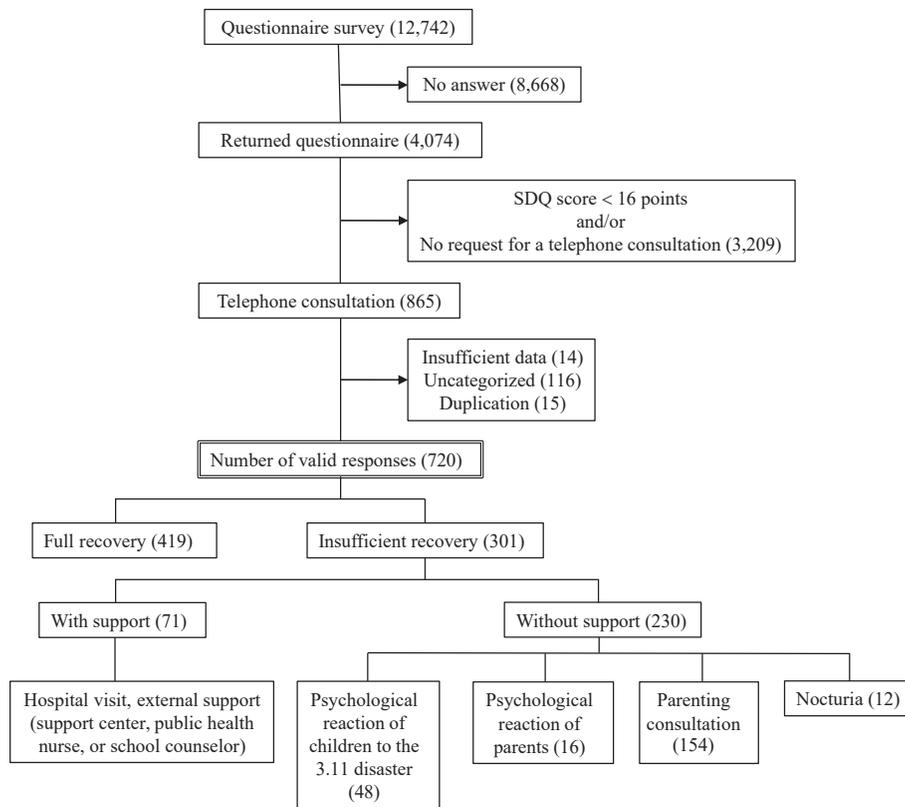


Fig. 1. Flowchart of the study.
The number of results is shown in parentheses.
SDQ, strengths and difficulties questionnaire.

five concepts as the criteria for psychological reactions in our study. Then, the two doctors and one clinical psychologist reviewed all 720 telephone consultation results to judge whether they contained any descriptions associated with psychological reactions according to the five concepts. If any psychological reaction was observed at the time of the telephone consultation, the record was classified as “Insufficient recovery”; all others were classified as “Full recovery.”

Second, “Insufficient recovery” was divided into either “With support ($n = 71$)” or “Without support ($n = 230$)”. Children and parents or guardians who had already visited a doctor or received some type of external support through a support center, a public health nurse, or a school counselor were classified as “With support,” while those who had not were classified as “Without support.”

Lastly, “Insufficient recovery without support” was divided into four categories: “Psychological reaction of children to the 3.11 disaster,” “Psychological reaction of parents,” “Parenting consultation,” and “Nocturia.” The category of “Psychological reaction of children to the 3.11 disaster” included hypersensitivity to earthquakes or loud sounds, avoiding going to the sea, headaches, or mental instability occurring after the 3.11 disaster. Parents who also had psychological reactions such as depression or mental instability were categorized as “Psychological reaction of parents.” Telephone consultations that were mainly about child development, including developmental disorders, were classified into “Parenting consultation.” “Nocturia” was classified separately because frequent urination was reported as a symptom after the Great Hanshin earthquake of 1995 (Seki and Ide 1997; Ichikawa et al. 2014).

Statistical analysis

We analyzed the data collected only after the disaster. School location at the time of the disaster was classified as either “Inland” or “Coastal” according to local municipalities in line with a previous paper on the ToMMo Child Health Study (Miyashita et al. 2015). Therefore, families that had relocated from a coastal to an inland municipality at the time of the questionnaire survey were counted as “Inland”. School grades were categorized into three groups by school year at the time of the questionnaire survey, following previous reports (Usami et al. 2014a, b): “2nd year or younger,” “3rd to 5th year,” and “6th to 8th year.” Because questionnaires were obtained 2 years after the disaster, the groups “2nd year or younger,” “3rd to 5th year,” and “6th to 8th year” corresponded to preschool, lower elementary school grades, and upper elementary school grades at the time of the disaster, respectively.

The two-tailed Student’s *t* test was used for analysis, and *P* values < 0.05 were considered statistically significant. All statistical analyses were performed using JMP Pro 11.2.0 software (SAS Institute Inc. Cary, NC, USA).

Results

Among the 720 valid responses (with an SDQ score > 16 and a request for a telephone consultation), 58.2% ($n = 419$) and 41.8% ($n = 301$) were classified as “Full recovery” and “Insufficient recovery,” respectively. Among those classified as “Insufficient recovery,” 71 were classified as “With support” and 230 as “Without support” (Fig. 1).

Table 1. Gender, school year, and school location of children in the 230 telephone consultations classified as insufficient recovery without support at the time of the disaster.

	Number (%) of children
Gender	
Boy	131 (57.0)
Girl	99 (43.0)
School year	
2nd year or younger	95 (41.3)
3rd to 5th year	60 (26.1)
6th to 8th year	75 (32.6)
School location	
Coastal	129 (56.1)
Inland	101 (43.9)

Among the 230 classified as “Without support,” the vast majority of the questionnaires had been completed by the mother ($n = 216$ [93.9%]), followed by the father ($n = 13$ [5.7%]) or a grandparent ($n = 1$ [0.4%]).

As shown in Table 1, among children in the 230 telephone consultations classified as having insufficient recovery without any social support at the time of the telephone consultation, 131 (57.0%) were boys, and 129 (56.1%) were living in a coastal area. The number of children by school grade at the time of the questionnaire survey was 95 (41.3%) for “2nd year or younger,” 60 (26.0%) for “3rd to 5th year,” and 75 (32.6%) for “6th to 8th year.” Among the 230 valid responses, six parents in “Parenting consultation” were worried about the effects of radiation. Two parents in “Psychological reaction of parents” took such effects very seriously, and one of them repeatedly relocated as a result.

We further divided the 230 telephone consultations into four categories: “Psychological reaction of children to the 3.11 disaster ($n = 48$),” “Psychological reaction of parents ($n = 16$),” “Parenting consultation ($n = 154$),” and “Nocturia ($n = 12$)” (Fig. 1). In the category of “Psychological reaction of children to the 3.11 disaster,” children showed hypersensitivity to earthquakes, aftershocks, or sounds, aphonia, emotional instability, truancy, onychophagia, a refusal to go to the restroom alone, and physical symptoms such as headaches, abdominal pain, or nausea caused by watching earthquake-related scenes that started to be recognized after the disaster. In the category of “Psychological reaction of parents,” some showed irritation, anxiousness, or depressive symptoms. In the category of “Parenting consultation,” parents or guardians had difficulties providing mental care for children who were isolated at school, restless, or nervous, who frequently lost their temper, and who were suspected of having a developmental

disorder. Specifically, the parents mentioned symptoms such as learning disabilities, developmental disabilities, internal personality disorders, hyperactivity, stuttering, and bullying. In the category of “Nocturia,” parents or guardians took exaggerated symptoms seriously.

We then subdivided each category by location of schools (Fig. 2). The number of telephone consultations in the categories of “Psychological reaction of children to the 3.11 disaster,” “Psychological reaction of parents,” “Parenting consultation,” and “Nocturia” was 35, 7, 80, and 7 in coastal areas, and 13, 9, 74, and 5 in inland areas, respectively. As shown in Table 2, marginally significant differences were seen in the proportion of the four categories between the location of schools ($P = 0.055$). In particular, the proportion of “Psychological reaction of children to the 3.11 disaster” tended to be higher in coastal versus inland areas (27.1% vs. 12.9%, respectively).

Table 3 shows the number of children among the 48 in the category of “Psychological reaction of children to the 3.11 disaster” by school grade and gender. Girls tended to be predominant in “3rd to 5th year” (lower grades of elementary school), whereas boys tended to be predominant in “6th to 8th year” (upper grades of elementary school); however, this difference was not significant ($P = 0.344$).

Discussion

Two years after the Great East Japan Earthquake, 12,742 children in the 2nd, 4th, 6th, and 8th grades of public elementary, junior high, and special needs schools located in the southern part of Miyagi Prefecture, including both inland and coastal areas, were surveyed using the SDQ. After 1-4 months, telephone consultations were conducted with 865 children who had a total SDQ score of > 16 , according to requests from a parent or guardian. After

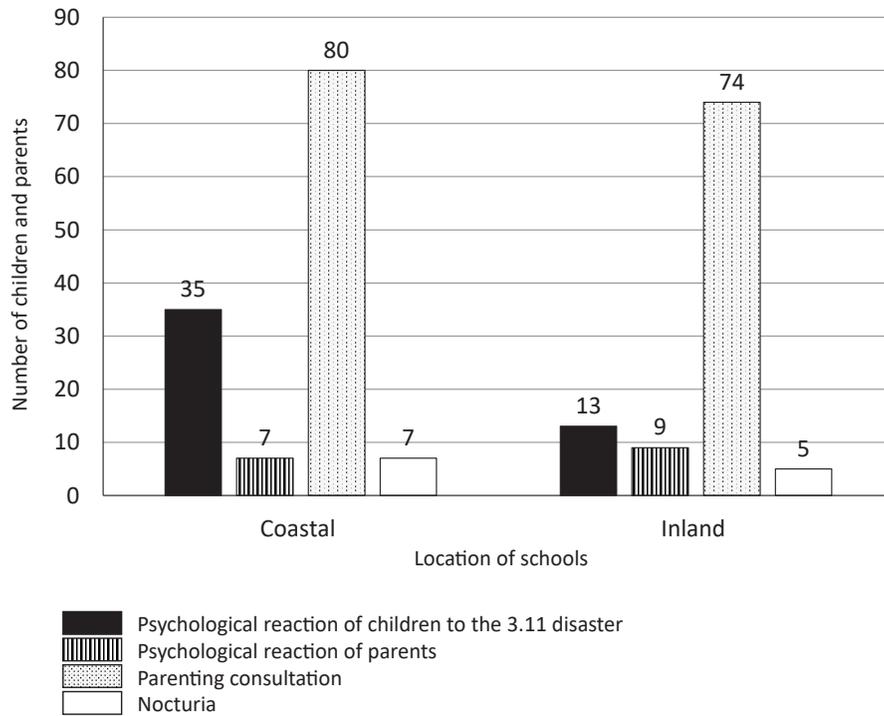


Fig. 2. Number of children and parents categorized as having a psychological reaction, parenting consultation, and nocturia by school location. The 230 children and parents were classified as insufficiently recovered from the catastrophe without any social support at the time of the telephone consultation.

Table 2. Number (%) of telephone consultations classified as having a psychological reaction, parenting consultation, and nocturia by school location.

	Total (n = 230)	Coastal (n = 129)	Inland (n = 101)	P value*
Psychological reaction of children to the 3.11 disaster	48 (20.9%)	35 (27.1%)	13 (12.9%)	0.055
Psychological reaction of parents	16 (7.0%)	7 (5.4%)	9 (8.9%)	
Parenting consultation	154 (67%)	80 (62.0%)	74 (73.3%)	
Nocturia	12 (5.2%)	7 (5.4%)	5 (5.0%)	
Total	230 (100%)	129 (100%)	101 (100%)	

*Chi-square test.

excluding uncategorized telephone consultations, duplications, and those with insufficient data, 720 telephone consultation records were analyzed. Among these telephone consultations, 419 (58.2%) were classified as “Full recovery” and the other 301 (41.8%) as “Insufficient recovery.” After excluding 71 telephone consultations classified as “with support,” a majority of telephone consultations were “Parenting consultation” (n = 154), followed by “Psychological reaction of children to the 3.11 disaster” (n = 48), suggesting they were still suffering from serious psy-

chological reactions related to the disaster.

Our results showed that even at 2 years after the disaster, 230 consultation subjects (31.9%) exhibited a psychological reaction. Among children who had not received any external support, those who lived in coastal areas showed more psychological reactions than those who lived in inland areas. Previous studies have reported that the loss of a loved one, relocation, and impaired parental mental health influence pediatric mental health (Takaya et al. 1998; Fujiwara et al. 2014; Lieber 2017). Even though we were

Table 3. Number of children among the 48 in the category of “psychological reaction of children to the 3.11 disaster” by school grade and gender.

School year	Total	Male	Female	Chi-square P value
2nd year or younger	15	6	9	
3rd to 5th year	19	8	11	0.344
6th to 8th year	14	9	5	
Total	48	23	25	

“Grade” indicates school grade at the time of the disaster. “School year” indicates the school year when the questionnaire was obtained. Because questionnaires were obtained 2 years after the disaster, children were 2 years younger at the time of the disaster.

not sure of the damage status of each case, children who resided in coastal areas could have suffered more environmental and psychological damage from the earthquake and tsunami than those who lived in inland areas and may explain why children residing in coastal areas tended to show a higher rate of psychological reactions. These findings suggest that more attention should be paid to children who show a higher rate of psychological reactions, and highlight the necessity of quickly identifying symptomatic children without social support and of establishing a system of long-term support for children who experience a disaster. Among the 230 telephone consultations classified as having insufficient recovery without support, 154 (67.0%) were categorized as “Parenting consultation”. Their parents or guardians were still struggling with parenting. It remains unclear whether the disaster itself was the main reason for “parenting consultations” (the majority of which were conducted by telephone), or whether the demand was typical, regardless of the disaster. Because those obstacles can manifest at the time of a disaster, however, regular child-rearing assistance is also crucial.

In line with previous studies, our study showed that 230 of consultation subjects surveyed still had psychological reactions at 2 years after the Great East Japan Earthquake. Some studies have reported that psychological effects or behavior problems can last for years after a disaster (Saito and Nishida 2001; Fujiwara et al. 2014, 2017), and another (van Griensven et al. 2006) reported that psychological effects in children can last for months or years after an earthquake or tsunami. The necessity of long-term mental health services and early interventions following a major disaster have also been suggested (Houston et al. 2015; Pfefferbaum et al. 2017). Seki and Ide (1997) reported that infants have difficulties sleeping because of the fear of earthquakes, etc. In the present study, we also showed the possible need for persistent support based on the symptoms of the child and their traumatic experience, such as an evacuation, the loss of a relative, or damage to their home. Identifying the actual psychological reactions

should help clarify the most appropriate approaches for those in need so that they can prepare for the next natural disaster.

Of significance for victims and their families is to think about their functioning after a disaster. As noted by McDermott and Cobham (2012), children and adults are affected by the same disaster, which can impair the functioning of the family and their capacity to provide support. In the present study, 16 cases of “Psychological reaction of parents” were identified. Therefore, functioning after a disaster is crucial. McFarlane (1987) and Bokszczanin (2008) also reported the possibility that the association between parenting and family functioning could predict PTSD symptoms in children. Scaramella et al. (2008) also reported that a depressed mood in mothers is expected to be indirectly associated with a reduction in parenting efficacy. Focusing on parenting, family functioning, and the mental status of parents in advance could help reduce the psychological impact of natural disasters on children.

In line with previous studies reporting long-lasting psychological impacts after a catastrophe, we found that 31.9% of the telephone consultations evaluated in the present study were still suffering from psychological reactions. These findings are expected to be valuable for primary care providers and administrators to develop support systems for future catastrophes in regard to identifying symptomatic children in need while simultaneously providing cognitive behavioral therapies.

This study did have several limitations. First, although all of the public schools in the study area participated, we did not target the entire disaster-affected area. Second, this study consisted of a parent-administered questionnaire study. Therefore, our results could be influenced by the parents’ motivational level of interest in their child’s health and parents’ level of fatigue in answering the questionnaire. Third, we analyzed data collected only after the disaster; therefore, the prevalence of symptoms before and after the disaster cannot be compared. Fourth, all telephone consultation records were collected by clinical psychologists and

retrospectively classified by two doctors and one clinical psychologist; therefore, children were not evaluated directly by child psychiatrists. Fifth, because the response rate to the questionnaire survey was low (32%), the possibility of self-selection bias cannot be ruled out. Parents who were interested in their child's psychological problems might have responded more frequently than those who were not; therefore, the prevalence of children with SDQ scores > 16 could have been overestimated. Furthermore, as shown in Fig. 1, we excluded parents who did not request a telephone consultation, which could have led to another selection bias. Parents who are indifferent to or neglect their children would not have been included in our aggregation of telephone consultations, even if their children were in the clinical range in regard to SDQ scores. We believe that this is a major limitation of the study. As reported in previous studies, evacuating and experiencing the loss of a relative have a massive impact on children. However, it remains unclear which type of damage has the strongest association with living area (inland vs. coastal). Further analyses of detailed information about not only area of residence, but also type of loss or damage, are needed to clarify the reason for the significant difference in psychological reactions between coastal and inland areas.

In conclusion, the results of the present study suggest that catastrophic disasters have a long-lasting psychological impact on children, and thus, long-term psychological support may be needed.

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Conflict of Interest

The authors declare no conflict of interest.

References

- Bokszczanin, A. (2008) Parental support, family conflict, and overprotectiveness: predicting PTSD symptom levels of adolescents 28 months after a natural disaster. *Anxiety Stress Coping*, **21**, 325-335.
- Dogan-Ates, A. (2010) Developmental differences in children's and adolescents' post-disaster reactions. *Issues Ment. Health Nurs.*, **31**, 470-476.
- Durkin, M.S., Khan, N., Davidson, L.L., Zaman, S.S. & Stein, Z.A. (1993) The effects of a natural disaster on child behavior: evidence for posttraumatic stress. *Am. J. Public Health*, **83**, 1549-1553.
- Fujiwara, T., Yagi, J., Homma, H., Mashiko, H., Nagao, K. & Okuyama, M.; Great East Japan Earthquake Follow up for Children Study Team (2014) Clinically significant behavior problems among young children 2 years after the Great East Japan Earthquake. *PLoS One*, **9**, e109342.
- Fujiwara, T., Yagi, J., Homma, H., Mashiko, H., Nagao, K. & Okuyama, M.; Great East Japan Earthquake Follow up for Children Study Team (2017) Symptoms of post-traumatic stress disorder among young children 2 years after the Great East Japan Earthquake. *Disaster Med. Public Health Prep.*, **11**, 207-215.
- Goodman, R. (1997) The strengths and difficulties questionnaire: a research note. *J. Child Psychol. Psychiatry*, **38**, 581-586.
- Houston, J.B., Spialek, M.L., Stevens, J., First, J., Mieseler, V.L. & Pfefferbaum, B. (2015) 2011 Joplin, Missouri tornado experience, mental health reactions, and service utilization: cross-sectional assessments at approximately 6 months and 2.5 years post-event. *PLoS Curr.*, **7**, ecurrents.dis.18ca227647291525ce3415bec1406aa5.
- Ichikawa, E., Osawa, Y. & Maruyama, A. (2014) Literature review for psychological impact of children at the time of a disaster. *Seishin Kango*, **44**, 149-152 (in Japanese).
- Iwadare, Y., Usami, M., Suzuki, Y., Ushijima, H., Tanaka, T., Watanabe, K., Kodaira, M. & Saito, K. (2014) Posttraumatic symptoms in elementary and junior high school children after the 2011 Japan earthquake and tsunami: symptom severity and recovery vary by age and sex. *J. Pediatr.*, **164**, 917-921 e911.
- Jia, Z., Shi, L., Duan, G., Liu, W., Pan, X., Chen, Y. & Tian, W. (2013) Traumatic experiences and mental health consequences among child survivors of the 2008 Sichuan earthquake: a community-based follow-up study. *BMC Public Health*, **13**, 104.
- Kikuya, M., Miyashita, M., Yamanaka, C., Ishikuro, M., Sato, Y., Obara, T., Metoki, H., Nakaya, N., Nagami, F., Tomita, H., Kiyomoto, H., Sugawara, J., Hozawa, A., Fuse, N., Suzuki, Y., et al. (2015) Protocol and research perspectives of the ToMMo child health study after the 2011 Great East Japan Earthquake. *Tohoku J. Exp. Med.*, **236**, 123-130.
- Kuriyama, S., Yaegashi, N., Nagami, F., Arai, T., Kawaguchi, Y., Osumi, N., Sakaida, M., Suzuki, Y., Nakayama, K., Hashizume, H., Tamiya, G., Kawame, H., Suzuki, K., Hozawa, A., Nakaya, N., et al. (2016) The Tohoku Medical Megabank project: design and mission. *J. Epidemiol.*, **26**, 493-511.
- La Greca, A.M., Silverman, W.K., Vernberg, E.M. & Roberts, M.C. (Eds.) (2002) *Helping children cope with disasters and terrorism*. American Psychological Association, Washington, DC.
- Lai, B.S., Lewis, R., Livings, M.S., La Greca, A.M. & Esnard, A.M. (2017) Posttraumatic stress symptom trajectories among children after disaster exposure: a review. *J. Trauma. Stress*, **30**, 571-582.
- Lieber, M. (2017) Assessing the mental health impact of the 2011 Great Japan Earthquake, tsunami, and radiation disaster on elementary and middle school children in the Fukushima Prefecture of Japan. *PLoS One*, **12**, e0170402.
- Liu, M., Wang, L., Shi, Z., Zhang, Z., Zhang, K. & Shen, J. (2011) Mental health problems among children one-year after Sichuan earthquake in China: a follow-up study. *PLoS One*, **6**, e14706.
- Matsuishi, T., Nagano, M., Araki, Y., Tanaka, Y., Iwasaki, M., Yamashita, Y., Nagamitsu, S., Iizuka, C., Ohya, T., Shibuya, K., Hara, M., Matsuda, K., Tsuda, A. & Kakuma, T. (2008) Scale properties of the Japanese version of the Strengths and Difficulties Questionnaire (SDQ): a study of infant and school children in community samples. *Brain Dev.*, **30**, 410-415.
- McDermott, B.M. & Cobham, V.E. (2012) Family functioning in the aftermath of a natural disaster. *BMC Psychiatry*, **12**, 55.
- McFarlane, A.C. (1987) Family functioning and overprotection following a natural disaster: the longitudinal effects of post-traumatic morbidity. *Aust. NZ J. Psychiatry*, **21**, 210-218.
- Miyashita, M., Kikuya, M., Yamanaka, C., Ishikuro, M., Obara, T., Sato, Y., Metoki, H., Nakaya, N., Nagami, F., Tomita, H., Kiyomoto, H., Sugawara, J., Hozawa, A., Fuse, N., Suzuki, Y., et al. (2015) Eczema and asthma symptoms among school-

- children in coastal and inland areas after the 2011 Great East Japan Earthquake: the ToMMo child health study. *Tohoku J. Exp. Med.*, **237**, 297-305.
- Pfefferbaum, B., Nitiéma, P., Tucker, P. & Newman, E. (2017) Early child disaster mental health interventions: a review of the empirical evidence. *Child & Youth Care Forum*, **46**, 621-642.
- Saito, S. & Nishida, Y. (2001) A study on psychological effects of the Great Hanshin-Awaji Earthquake: the report about the investigation after 5 years passed. *Report of Research Center for Urban Safety and Security Kobe University*, **5**, 251-257 (in Japanese).
- Scaramella, L.V., Sohr-Preston, S.L., Callahan, K.L. & Mirabile, S.P. (2008) A test of the Family Stress Model on toddler-aged children's adjustment among Hurricane Katrina impacted and nonimpacted low-income families. *J. Clin. Child Adolesc. Psychol.*, **37**, 530-541.
- Seki, W. & Ide, H. (1997) A study of mental influences on pre-school age children of the Great Hanshin-Awaji Earthquake: from the interview with parents of 98 nursery school infants. *Medical Journal of Kobe University*, **57**, 241-250 (in Japanese).
- Takaya, Y., Yamamoto, A., Kobayashi, Y., Nakaoka, A., Kakuda, H., Nakagomi, S., Osaki, F. & Katada, N. (1998) The effect of Hanshin-Awaji Earthquake on the physical and psychological health status of maternal-child and their on environment. *J. Jpn. Acad. Nurs. Sci.*, **18**, 40-50 (in Japanese).
- Uemoto, M., Shioyama, A., Koide, K., Honda, M., Takamiya, S., Shirakawa, K., Utsumi, K., Matsumoto, H. & Yamamoto, K. (2000) The mental health of school children after the Great Hanshin-Awaji Earthquake: I. Epidemiological study and risk factors for mental distress. *Seishin Shinkeigaku Zasshi*, **102**, 459-480 (in Japanese).
- Usami, M., Iwadare, Y., Watanabe, K., Kodaira, M., Ushijima, H., Tanaka, T., Harada, M., Tanaka, H., Sasaki, Y. & Saito, K. (2014a) Analysis of changes in traumatic symptoms and daily life activity of children affected by the 2011 Japan earthquake and tsunami over time. *PLoS One*, **9**, e88885.
- Usami, M., Iwadare, Y., Watanabe, K., Kodaira, M., Ushijima, H., Tanaka, T., Harada, M., Tanaka, H., Sasaki, Y. & Saito, K. (2014b) Decrease in the traumatic symptoms observed in child survivors within three years of the 2011 Japan earthquake and tsunami. *PLoS One*, **9**, e110898.
- van Griensven, F., Chakkraband, M.L., Thienkrua, W., Pengjuntr, W., Lopes Cardozo, B., Tantipiwatanaskul, P., Mock, P.A., Ekassawin, S., Varangrat, A., Gotway, C., Sabin, M. & Tappero, J.W.; Thailand Post-Tsunami Mental Health Study Group (2006) Mental health problems among adults in tsunami-affected areas in southern Thailand. *JAMA*, **296**, 537-548.
- Yabe, H., Suzuki, Y., Mashiko, H., Nakayama, Y., Hisata, M., Niwa, S., Yasumura, S., Yamashita, S., Kamiya, K. & Abe, M.; Mental Health Group of the Fukushima Health Management Survey (2014) Psychological distress after the Great East Japan Earthquake and Fukushima Daiichi Nuclear Power Plant accident: results of a mental health and lifestyle survey through the Fukushima Health Management Survey in FY2011 and FY2012. *Fukushima J. Med. Sci.*, **60**, 57-67.
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