8）広報

課題

●誤情報に基づく風評・誤解や，全国で義捐金名目の詐欺，悪質商法等，震災に便乗した犯罪が散見され，被災者等の不安をあおり立てる流言飛語が流布した．

●また，国等が実施している災害応急活動等の広報，帰宅困難者の混乱を防止する目的の広報や海外への広報が不足していた．

対策

➢ 災害時の「正常化バイアス」（非常事態の際にも，それを異常と認識せず，避難などの対応が遅れてしまうこと）を打ち消す適切な避難を促す広報のあり方や避難者・帰宅困難者の混乱を防止する広報のあり方，国等が実施している活動の広報のあり方，海外への広報のあり方などについて検討し，充実を図る必要がある．

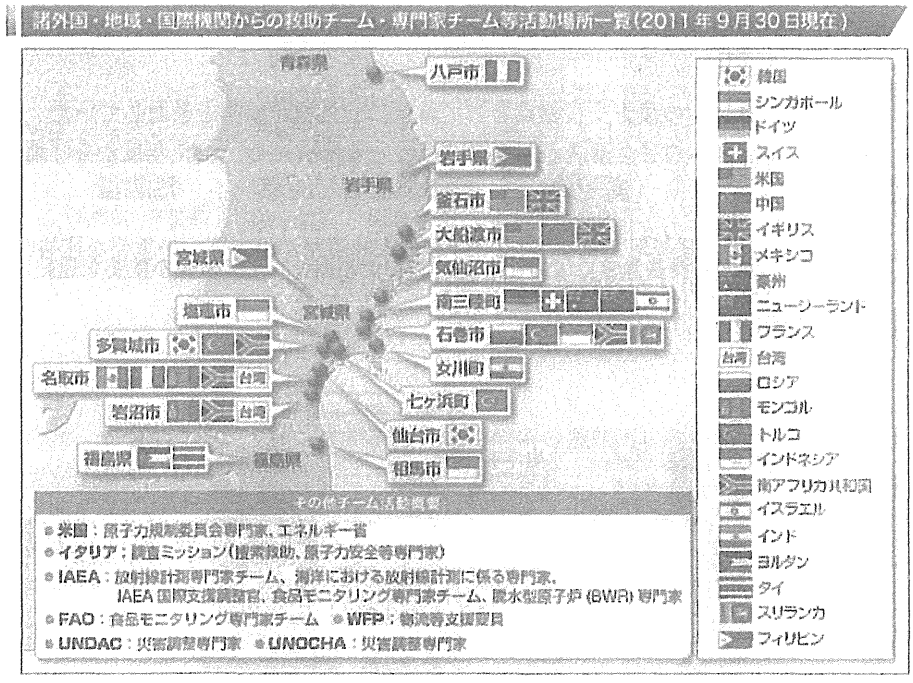
9）海外からの支援

課題

●被災地のニーズが日々変化する中，海外からの救助隊等の人的支援や支援物品は多種多様で輸送にも時間を要するため，マッチングを行うのが困難なケースがあった．

●国内輸送手段や燃料等を確保していない海外の支援部隊もあったため，救援活動の受入れに当たって，配備等の調整に貴重な人員が割かれた．

●当初，救助隊等の海外支援隊等は，被災地における地方公共団体・住民とのコミュニケーション，医療に係る国内法の問題等，国内での行動に制約事項があった．



参考資料[12]より転載

対策

➢ 海外支援の受入れやその後の対応について国が方針を示し，窓口の一本化や体制の整備を図るべきである．

➢ 海外の救助チームや医療チームの活動については，被災者側の傷害，物損を生ぜしめる場合も含め，これを補償するための法的根拠等がないところであり，制度上の位置付けを含めて必要性を検討すべきである．

10）災害時要援護者への配慮

課題

●避難所運営等，災害現場での意思決定に女性がほとんど参画しておらず，女性用物資の不足や専用スペースが設置されないなど，女性が避難生活に困難を抱えていた．

●避難所・仮設住宅や帰宅困難者対策において，子どもや女性，高齢者などを対象とした事前の検討が十分にな

されていない.

●情報提供，避難，避難生活等様々な場面で災害時要援護者への対応が不十分であったり，災害時要援護者名簿を個人情報保護の観点から有効活用できなかったりした事例もあった.

●福祉避難所を指定している市町村は全国で全体の34%にとどまる．被災した宮城県では40%であったが，岩手県では14.7%，福島県では18.6%であった.

対策

➢ 発災直後からの各段階において，男女共同参画の視点の重視に関する地方公共団体の責務を明確化するとともに，女性や子育て家庭のニーズに配慮した対応についてのマニュアルを作成すべきである.

➢ 地域防災計画，地域復興計画や避難所運営等の意思決定の場に女性が参画できるよう，また，障がい者，高齢者，子どもを含めた地域住民の視点に立った対応ができるよう，地方防災会議の構成等について見直しを行うべきである.

➢ 個人情報保護制度との関係を整理し，災害時要援護者名簿の法的位置づけを検討することにより，災害時要援護者名簿の整備・活用を促進すべきである.

3. まとめ

1) 東日本大震災は，未曾有の複合型激甚災害である.

2) この被害は広範囲に及んで死者・行方不明者は約2万人に達し，被災地の建物流出，通信網・交通網の途絶，生活必需品・燃料・医薬品・医療材料等の欠乏，災害弱者への配慮不足による影響が深刻であった.

3) 被災地の災害応急対策には多くの機関・団体・個人等が当たり，いろいろな分野や立場から数多くの報告書が作成された.

4) これらに共通した課題は，平時からのpreparationの重要性と，災害時の“CSCA”，すなわちCommand and control，Safety，Communication，Assessmentの迅速な確立[13]に集約されると考えられる.

5) 3TsのTriage，Treatment，Transportについては，従来DMAT活動として想定されていた外傷患者が少なく，3Tsの医療ニーズは少なかった.

6) 災害弱者のCWAPPF[13]，すなわちChildren，Women，Aged people，Patients，Poor people，Foreignersに対しての避難・医療支援計画の策定が必要である.

7) 今後の災害応急対策については，早期に国民が周知するように広報する必要がある.

参考資料

1) 牧原　出．災害復興における危機管理．NIRA政策レビュー　2012；No.56：3—4.
2) 内閣府（防災担当）．東日本大震災における災害応急対策の主な課題（資料3）．2012年7月.
3) 厚生労働省．厚生労働省での東日本大震災に対する対応について（報告書案の概要）．2012年7月.
4) 総務省総合通信基盤局．第4回東日本大震災における災害応急対策に関する検討会．東日本大震災における通信の被災状況，復旧等に関する取り組み状況．2011年9月29日.
5) 小井土雄一．東日本大震災におけるDMAT活動と今後の課題．第2回災害医療等のあり方に関する検討会（資料2）.
6) 災害医療等のあり方に関する検討会報告書．2011年10月.
7) 小井土雄一，近藤久禎，市原正行，他.：東日本大震災におけるDMAT活動と今後の研究の方向性．保健医療科学　2011；60：495—501.
8) 資源エネルギー庁資源・燃料部．東日本大震災における石油供給について．2011年10月4日.
9) 全日本トラック協会．東日本大震災における緊急支援物資輸送活動の記録（概要版）．2013年9月.
10) 復興庁HP．全国の避難者等の数（2011年12月15日現在）.
11) 難波　悠．被災自治体の後方支援体制の構築に向けて．東洋大学PPP研究センター所報　2011；No.015：1—8.
12) 外務省HP．世界が日本に差し伸べた支援の手～東日本大震災での各国・地域支援チームの活躍．わかる！国際情勢．Vol.73.2011年6月6日.
13) 米倉竹夫，清水直樹，六車　崇，他.：災害への備え，preparednessは十分か？　小児科診療　2014；77：13—18.

Arch Womens Ment Health (2014) 17:579–581
DOI 10.1007/s00737-014-0459-y

SHORT COMMUNICATION

Surveys of postpartum depression in Miyagi, Japan, after the Great East Japan Earthquake

Hidekazu Nishigori · Junichi Sugawara · Taku Obara · Toshie Nishigori · Kineko Sato · Takashi Sugiyama · Kunihiro Okamura · Nobuo Yaegashi

Received: 10 April 2014 / Accepted: 1 September 2014 / Published online: 10 September 2014

Abstract This study explores the correlation between the impact of the Great East Japan Earthquake and the incidence of postpartum depression in Miyagi prefecture, Japan. The design used was a cross-sectional study with self-administered questionnaires, 6–9 months after the disaster. The results showed the prevalence of postnatal women with Edinburgh Postnatal Depression Scale (EPDS) score of ≥9 to be 21.3 %. Multivariate analysis showed that exposure to tsunami (odds ratio, 1.80; 95 % confidence interval, 1.16–2.78) was significantly and independently associated with an EPDS score of ≥9. Postnatal women and their children should be treated as a vulnerable population, and a protective framework must be established to prepare for future devastating disasters.

Keywords Great East Japan Earthquake · Tsunami · Postpartum depression · Edinburgh Postnatal Depression Scale (EPDS)

H. Nishigori · J. Sugawara · T. Sugiyama · N. Yaegashi
Department of Obstetrics and Gynecology, Tohoku University Graduate School of Medicine, Sendai, Japan

J. Sugawara · T. Obara · T. Nishigori · N. Yaegashi
Tohoku Medical Megabank Organization, Tohoku University, Sendai, Japan

K. Sato
Department of Health Sciences, Tohoku University Graduate School of Medicine, Sendai, Japan

K. Okamura
Tohoku Kohsai Hospital, Sendai, Japan

J. Sugawara (✉)
Division of Feto-Maternal Medical Science, Tohoku Medical Megabank Organization, Tohoku University, 2-1 Seiryocho, Aobaku, Sendai, Miyagi 980-8573, Japan
e-mail: jsugawara@med.tohoku.ac.jp

Introduction

Miyagi prefecture is located on the eastern coast of Japan. Following the Great East Japan Earthquake and Tsunami on March 11, 2011, approximately 12,000 people died or went missing, and more than 460,000 houses and buildings were completely or partially destroyed. Previous studies have addressed that maternal mental health (such as perinatal depression) can be influenced by the devastation caused by a natural disaster (Harville et al. 2009). Perinatal depression affects postnatal women's health and may impact not only the newborn infant's quality of care but also the subsequent growth and development of the women's children. In the present study, we examined the Edinburgh Postnatal Depression Scale (EPDS) for postpartum depression and its risk factors (Cox et al. 1987) to assess the Great East Japan Earthquake's influence on perinatal women's mental health in Miyagi prefecture.

Materials and method

Study subjects

The study design was cross sectional. Participants were recruited from 15 hospitals and 11 clinics in the coastal area of Miyagi prefecture. They delivered between February 1, 2011, and October 31, 2011, and their homes were destroyed by the tsunami. From September 1 to November 30, 2011, the study's explanatory leaflet and the agreement document were delivered by mail to 3539 postpartum women. The self-administered questionnaires went to 683 participants, who had agreed with the study, and 677 questionnaires were returned. The Ethics Committee of the Tohoku University Graduate School of Medicine approved this study on June 27, 2011 (Number 2011-103).

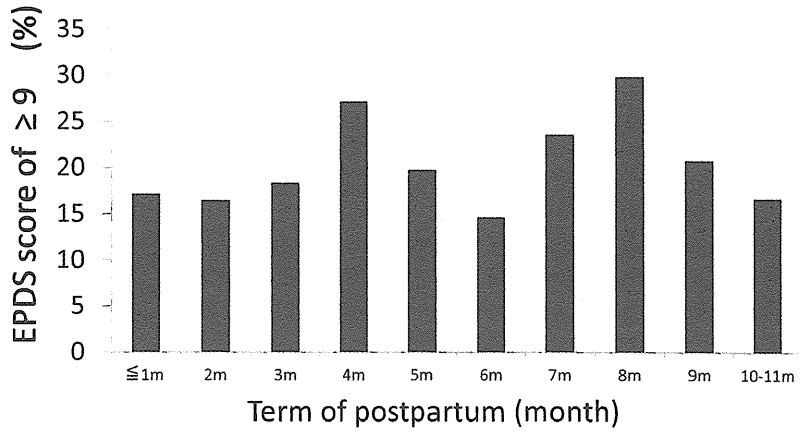


Fig. 1 The prevalence of postpartum women with an EPDS score of ≥9 in each month after delivery (n=633). Participants who delivered between February 1, 2011 and October 31, 2011. The study questionnaires were returned from September 1, 2011 to November 30, 2011

Data collection

We collected the data from the self-administered questionnaires. The cutoff score of EPDS among the Japanese population is 9, which is considered to represent a significant risk factor for postpartum depression (Okano et al. 1996).

Analysis

Both the percentage of women with an EPDS score of ≥9 and the univariate analysis of their backgrounds were analyzed. Student's t test, the chi-square test, and Fisher's test were used where appropriate for statistical analysis.

Multivariate logistic regression analyses were performed after adjusting for variables significantly associated with an EPDS score of ≥9 in a univariate analysis and the traditional risk factors for postpartum depression, including age, primiparous status, obstetric complications during pregnancy, employment, and death of loved ones. Adjusted odds ratios (ORs) and 95 % confidence intervals (CIs) were calculated to estimate the risk of an EPDS score of ≥9. All statistical analyses were performed using SAS ver. 9.3 statistical software (SAS Institute Inc., Cary, NC, USA).

Results

The questionnaires were returned from 677 participants, of which 633 were eligible for analysis. The prevalence of postpartum women with an EPDS score of ≥9 was 21.3 %. Figure 1 shows the prevalence of postpartum women with an EPDS score of ≥9 each month after delivery. Univariate analysis showed that age below 25 years (P=0.0153), obstetric complications during pregnancy (P=0.03), baby's birth weight under 2500 g (P=0.0117), destruction of the home (P=0.0335), and exposure to the tsunami (P=0.0016) were significantly different between women with an EPDS score of ≥9 and those with a score of <9. Multivariate analysis showed that age below 25 years (OR, 2.539; 95 % CI, 1.15–5.60), baby's birth weight under 2500 g (OR, 2.28; 95 % CI, 1.27–4.09), and exposure to the tsunami (OR, 1.80; 95 % CI, 1.16–2.78) were significantly and independently associated with an EPDS score of ≥9 (Table 1).

Discussion

In this study, the prevalence of postnatal women with an EPDS score of ≥9 was 21.3 %. A previous large population study on Japanese women with postnatal depression reported that 13.9 % of women had an EPDS score of ≥9 (Suzumiya et al. 2004). Our results indicated that postnatal women in Miyagi prefecture's coastal area had a remarkably higher prevalence of EPDS score of ≥9 after the disaster.

Table 1 Multivariate logistic regression analyses for postpartum women with an EPDS score of ≥9

	Odd ratio	95 % confidence interval
Age		
≥35 years	1.00	
30–34 years	1.213	0.725–2.031
25–29 years	1.723	0.994–2.987
<25 years	2.539	1.151–5.599
Multipara (primipara=0)	1.371	0.848–2.217
No employment (employment=0)	1.464	0.978–2.192
Postpartum 6~11 months (≤5 month=0)	1.161	0.776–1.736
Birth weight ≤2500 g (>2500 g=0)	2.278	1.269–4.091
Temporary dwelling or refuge (own house=0)	1.486	0.686–3.217
Exposure to the tsunami (no exposure=0)	1.795	1.157–2.784

Adjusted by postpartum depression, including age, primiparous status, obstetric complications during pregnancy, employment, and death of loved ones

As demonstrated in Fig. 1, the prevalence of a high-risk group for postpartum depression did not exhibit any correlations with the time interval after delivery. These results might suggest that postpartum women have been under chronically stressful conditions even 6 months after the disaster. Further investigations are needed to clarify the precise factors correlated to their situations.

With regard to the risk factors for perinatal depression related to the disaster, previous studies found that exposure to the storm (Xiong et al. 2010), loss of resources (Ehrlich et al. 2010), high earthquake exposure (Qu et al. 2012), and anxiety about earthquakes (Hibino et al. 2009) were more likely to cause depression in pregnant and postnatal women affected by natural disasters. In the present study, we found that exposure to the tsunami was a significant risk factor for postnatal depression. The tsunami disaster was totally unexpected for this vulnerable population; therefore, psychological trauma was much more severe than in previous natural disasters. Interventions of medical and mental care should be carried out immediately to prevent deterioration of maternal pathologic conditions and to observe newborns' development closely.

Study limitations

This study has some limitations. It was a cross-sectional study with possible self-report bias, so determining causal relationships was not possible. The prevalence of participants was low, so there was bias toward convenience sampling, and the results may not be applicable to all perinatal women in Miyagi prefecture's disaster-affected communities.

Conclusions

In conclusion, the prevalence of postnatal women with an Edinburgh Postnatal Depression Scale (EPDS) score of ≥9 was 21.3 % around 6 months after the disaster. Exposure to the tsunami was more likely to cause postnatal depression in postnatal women. Postnatal women and their children should be treated as a vulnerable population, and a further protective framework is necessary to establish preparedness for future devastating disasters.

Acknowledgments This work was supported by the Health Labour Sciences Research Grant Number H24.Jisedai-shitei 006(fukkou).

References

Cox JL, Holden JM, Sagovsky R (1987) Detection of postnatal depression: development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry 150:782–786

Ehrlich M, Harville E, Xiong X, Buekens P, Pridjian G, Elkind-Hirsch K (2010) Loss of resources and hurricane experience as predictors of postpartum depression among women in southern Louisiana. J Womens Health (Larchmt) 19(5):877–884. doi:10.1089/jwh.2009.1693

Harville EW, Xiong X, Pridjian G, Elkind-Hirsch K, Buekens P (2009) Postpartum mental health after Hurricane Katrina: a cohort study. BMC Pregnancy Childbirth 9:21. doi:10.1186/1471-2393-9-21

Hibino Y, Takaki J, Kambayashi Y, Hitomi Y, Sakai A, Sekizuka N, Ogino K, Nakamura H (2009) Relationship between the Noto-Peninsula earthquake and maternal postnatal depression and child-rearing. Environ Health Prev Med 14(5):255–260. doi:10.1007/s12199-009-0090-0

Okano T, Murata M, Msuji F, Tamaki R, Nomura J, Miyaoka H, Kitamura T (1996) Validation and reliability of Japanese version of the EPDS. Arch Psychiatr Diagn Clin Eval 7:525–533, Article in Japanese with English abstract

Qu Z, Wang X, Tian D, Zhao Y, Zhang Q, He H, Zhang X, Xu F, Guo S (2012) Post-traumatic stress disorder and depression among new mothers at 8 months later of the 2008 Sichuan earthquake in China. Arch Womens Ment Health 15(1):49–55. doi:10.1007/s00737-011-0255-x

Suzumiya H, Yamashita H, Yoshida K (2004) Hoken Kikan ga Jishisuru Boshi houmon taisyosha no sango utsu byou zenkoku tashisetsu chosa (article in Japanese). Kousei no Shihyo 51:1–5

Xiong X, Harville EW, Mattison DR, Elkind-Hirsch K, Pridjian G, Buekens P (2010) Hurricane Katrina experience and the risk of post-traumatic stress disorder and depression among pregnant women. Am J Disaster Med 5(3):181–187

OPEN ACCESS Freely available online

PLOS ONE

Clinically Significant Behavior Problems among Young Children 2 Years after the Great East Japan Earthquake

Takeo Fujiwara[1]*, Junko Yagi[2], Hiroaki Homma[3], Hirobumi Mashiko[4], Keizo Nagao[5], Makiko Okuyama[6] for the Great East Japan Earthquake Follow-up for Children Study Team[¶]

1 Department of Social Medicine, National Research Institute for Child Health and Development, Tokyo, Japan, **2** Department of Neuropsychiatry, Iwate Medical University, Iwate, Japan, **3** Miyagi Prefectural Comprehensive Children's Center, Miyagi, Japan, **4** Department of Neuropsychiatry, Fukushima Medical University, Fukushima, Japan, **5** Nagao Mental Clinic, Mie, Japan, **6** Department of Psychosocial Medicine, National Center for Child Health and Development, Tokyo, Japan

Abstract

Background: On March 11, 2011, a massive undersea earthquake and tsunami struck East Japan. Few studies have investigated the impact of exposure to a natural disaster on preschool children. We investigated the association of trauma experiences during the Great East Japan Earthquake on clinically significant behavior problems among preschool children 2 years after the earthquake.

Method: Participants were children who were exposed to the 2011 disaster at preschool age (affected area, n = 178; unaffected area, n = 82). Data were collected from September 2012 to June 2013 (around 2 years after the earthquake), thus participants were aged 5 to 8 years when assessed. Severe trauma exposures related to the earthquake (e.g., loss of family members) were assessed by interview, and trauma events in the physical environment related to the earthquake (e.g. housing damage), and other trauma exposure before the earthquake, were assessed by questionnaire. Behavior problems were assessed by caregivers using the Child Behavior Checklist (CBCL), which encompasses internalizing, externalizing, and total problems. Children who exceeded clinical cut-off of the CBCL were defined as having clinically significant behavior problems.

Results: Rates of internalizing, externalizing, and total problems in the affected area were 27.7%, 21.2%, and 25.9%, respectively. The rate ratio suggests that children who lost distant relatives or friends were 2.36 times more likely to have internalizing behavior problems (47.6% vs. 20.2%, 95% CI: 1.10–5.07). Other trauma experiences before the earthquake also showed significant positive association with internalizing, externalizing, and total behavior problems, which were not observed in the unaffected area.

Conclusions: One in four children still had behavior problems even 2 years after the Great East Japan Earthquake. Children who had other trauma experiences before the earthquake were more likely to have behavior problems. These data will be useful for developing future interventions in child mental health after a natural disaster.

Citation: Fujiwara T, Yagi J, Homma H, Mashiko H, Nagao K, et al. (2014) Clinically Significant Behavior Problems among Young Children 2 Years after the Great East Japan Earthquake. PLoS ONE 9(10): e109342. doi:10.1371/journal.pone.0109342

Editor: Kenji Hashimoto, Chiba University Center for Forensic Mental Health, Japan

Received April 27, 2014; **Accepted** September 5, 2014; **Published** October 21, 2014

Data Availability: The authors confirm that, for approved reasons, some access restrictions apply to the data underlying the findings. Due to the ethical restriction by Institutional Review Board, the data cannot be made available in the manuscript, the supplemental files, or a public repository. Please contact corresponding author, Takeo Fujiwara, with any data requests.

Funding: This study is supported by a grant from the Ministry of Health, Labour and Welfare (H24-jisedai-shitei-007). The role of funders is implementation of this study.

Competing Interests: The authors have declared that no competing interests exist.

* Email: fujiwara-tk@ncchd.go.jp

¶ Membership of the Great East Japan Earthquake Follow-up for Children Study Team is provided in the Acknowledgments.

Introduction

On March 11, 2011, a massive undersea earthquake and subsequent tsunami struck East Japan. With a Richter-scale magnitude of 9.0, the Great East Japan Earthquake was one of the most powerful earthquakes on record and the largest to hit Japan. As of September 2013, the Fire and Disaster Management Agency reported 18,703 deaths, 2,674 missing, and 6,220 injured as a result of the disaster [1]. The most severely affected area was located on the Pacific Ocean side of northeast Japan, encompassing Iwate, Miyagi, and Fukushima prefectures, with 21,262 casualties (18,592 deaths and 2,670 people missing) [1]. Furthermore, 1,706 children lost a parent in the disaster [2].

Several studies have reported the impact of natural disasters on children's mental health, including studies on the 1995 Hanshin-Awaji earthquake in Japan [3–5], the 1999 Marmara earthquake in Turkey [6–11], the 2004 Indian Ocean earthquake and tsunami [12–17], Hurricane Katrina in the USA in 2005 [18–21], and the 2008 Sichuan earthquake in China [22–25]. Interestingly, most of these previous studies focused on posttraumatic stress disorder (PTSD) or depression as mental health outcomes among children, and few studies investigated the impact of exposure to natural

disasters on behavior problems, especially in the preschool to pre-adolescent age range. When assessing mental health status among young children after a natural disaster, it is difficult to diagnose PTSD or depression because young children's responses might be unreliable during the psychiatric interview. Instead, a caregiver's assessment of behavior using the Child Behavior Checklist (CBCL) is better suited to identify young children who need mental health services after a natural disaster, as the CBCL has valid cut-off scores that identify clinically significant behavior problems. It has been suggested that PTSD symptoms can be estimated by CBCL [26], but the validity is arguable [27].

McLaughlin et al. reported that 2 years after Hurricane Katrina approximately 15% of children aged 4 to 17 years showed serious emotional disturbances using the Strength and Difficulties Questionnaire, that is, emotional and behavioral problems that cause significant impairment in role functioning [21]. Further, 3 years after the disaster Lowe et al. assessed behavior problems using the Behavioral Problems Index, which is based on the CBCL, and reported that hurricane-related stressors were indirectly associated with behavior problems [28]. Chemtob et al. assessed the impact of the World Trade Center attack on the mental health of preschool children using the CBCL, and reported that 15–30% of preschool children who were exposed to high-intensity traumatic events related to the World Trade Center attack, such as witnessing the towers collapse, had behavioral symptoms [29].

Moreover, as young children are exposed to multiple trauma experiences after a natural disaster, such as losing a home, parent or friend; witnessing a tsunami or fire; seeing a dead body, or experiencing restrictions on their lifestyle due to radiation, it remains unclear which exposure is associated with which mental disorder or behavior problem. Thienkrua et al. reported that after the tsunami in Sumatra, extreme panic or fear was associated with PTSD, whereas believing that one's own or a family member's life had been in danger was associated with depression in children aged 7 to 14 years in Thailand [12]. To the best of our knowledge, no study has reported the association between specific trauma experiences in a natural disaster and behavior problems among preschool children. Further, there is a need to investigate whether trauma experiences that occurred before the Great East Japan Earthquake, such as the loss of a family member or separation from a caregiver, are associated with behavior problems among children in the affected area, which may have no association in the unaffected area.

Thus, the purpose of this study is to investigate the association of trauma experiences among preschool children on clinically significant behavior problems 2 years after the Great East Japan Earthquake.

Methods

Sample

We recruited affected children with a multistage sampling method in Iwate, Miyagi, and Fukushima prefectures, which were closest to the earthquake epicenter and affected by the tsunami (Figure 1). First, we selected municipalities within each prefecture that were severely affected by the tsunami (coastal side) and radiation caused by the nuclear power plant explosion in Fukushima prefecture. Second, we invited preschools in the selected municipalities to participate. In Iwate prefecture, three municipalities were selected, and four of 32 preschools agreed to participate. In Miyagi prefecture, one municipality was selected, and two of 16 preschools agreed to be involved. Further, in Fukushima prefecture, four municipalities were selected and four of 120 preschools agreed to participate. Third, we defined our target sample as children who were enrolled in a class of 3- to 5-year-olds in the fiscal year of 2010, that is, children who experienced the earthquake on March 11, 2011. Then, from September 2012 to June 2013, principals or staff of the preschools asked the caregivers of the targeted children (N = 787) to participate in the study. Finally, the caregivers of 205 children gave informed consent for their child to participate (consent rate: 26.0% of target children) and 178 children (Iwate, 59, Miyagi, 53, Fukushima, 66) completed the questionnaire or interview (participation rate: 87.3% of consented children; 170 completed the questionnaire (95.5%) and 150 completed the interview (84.3%)). Our solicitations to participate were largely refused due to the high transience of residents who had to relocate to other areas after the earthquake, especially in Fukushima. Research coordinators obtained written informed consent from all participants. For children, written informed consent was obtained from the child's parent or legal guardian. The Research Ethics Committee at the National Center for Child Health and Development approved this study, including the informed consent procedure.

For comparison, we selected Mie prefecture, which is located in West Japan and was unharmed by the earthquake and tsunami on March 11, 2011. Similar to the sampling strategy in the affected area, two municipalities were selected in Mie prefecture, in which one preschool agreed to participate. Children enrolled in the class of 3- to 5-year-olds in the fiscal year of 2010 were selected and recruited, and 30 out of 220 eligible children participated in the study (consent and participation rate: 13.6%). Two additional communities were selected in the municipalities, and caregiver consent to participate was obtained for 52 out of 608 eligible children (consent and participation rate: 8.6%), resulting in a sample of 82 children from unaffected areas (total consent and participation rate: 9.9%).

Measurements

Trauma exposure related to the physical environment was assessed via questionnaires administered from September 2012 to June 2013 (around 2 years after the earthquake). Trauma exposure related to the physical environment included status of the home (lost or completely damaged, partially damaged, or not damaged), experience of staying at a shelter immediately after the earthquake, living in temporary housing, evacuating to a relative's house, and family members living in separate places. We assessed these exposures by asking, for example, "Did you stay at a shelter at the time of the Great East Japan Earthquake?", for which the response items were "yes" or "no".

Information on severe trauma exposure was collected through interviews by child psychiatrists or clinical psychologists, who were blinded to the children's psychopathological status. In defining trauma exposure, we referred to a previous study assessing children's mental health [12] and the experiences reported in the affected area of a tsunami. Severe trauma exposure assessed by the semi-structured interview method included separation from caregivers, loss of a close family member, loss of distant relatives or friends, witnessing the tsunami waves, witnessing someone being swept away by the tsunami, witnessing a fire, seeing a dead body, hearing the sound of the nuclear power plant explosion, and experiencing restrictions on their lifestyle due to radiation (e.g. unable to play outside, drink tap water, or eat local food).

Caregivers were also asked questions using the Trauma Events Screening Inventory (TESI-C), modified for use with preschool children [29] and further adapted for use in Japan, inquiring whether the child had experienced a wide range of traumatic events, including the experience of a close friend or family member

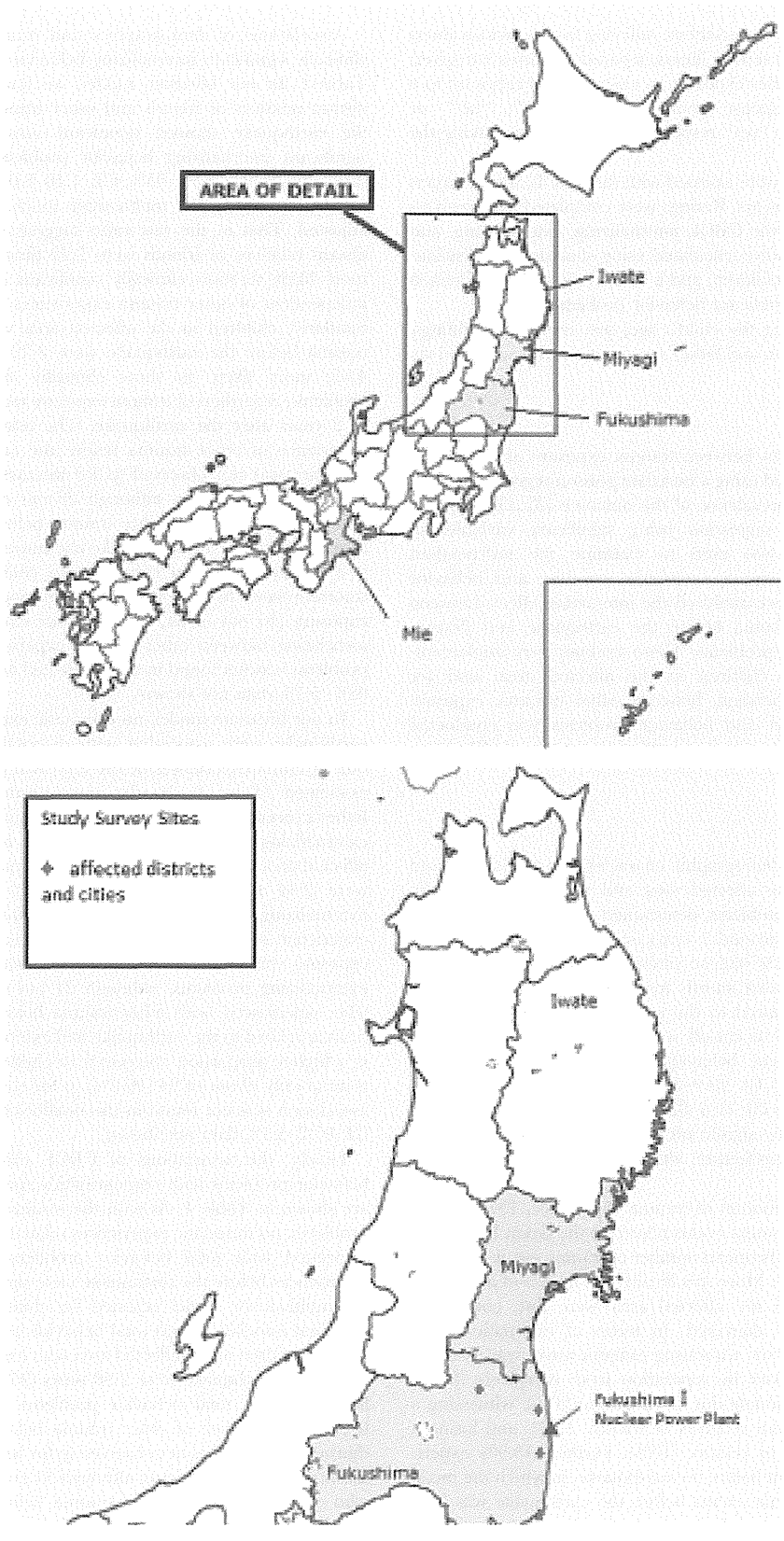


Figure 1. Study sites and provinces affected by the Great East Japan Earthquake.
doi:10.1371/journal.pone.0109342.g001

being involved in a serious accident, suffering from a serious illness or dying; self-injury or serious illness; separation from a caregiver; assault, bullying, or other exposure to violence; and exposure to a natural disaster. Response items included "yes", "no", or "unknown", and only "yes" responses were coded as having the actual experience.

Behavior problems were assessed with the CBCL, which targets children aged 4 to 18 years. Ratings were completed by caregivers [30]. The T score of the CBCL internalizing, externalizing, and total problem scores were calculated using standardized distribution among Japanese children, and a T score over 63 was defined as having clinically significant behavior problems [31].

Covariates, including the child's age, sex, number of siblings, parental age, education, and father's occupation were collected via questionnaire.

Analysis

First, the associations between trauma exposure and behavior problems were analyzed using a bivariate poisson regression model because of the high prevalence of the outcome [32,33]. Further, multivariate poisson regression using significant variables in bivariate regression was used to examine the independent associations between trauma exposure variables and behavior problems. Moreover, we analyzed the interaction effects between exposure to other trauma before the earthquake and disaster exposure for behavior problems. These analyses were implemented primarily among children in the affected area, and for comparison, the association between other trauma exposure before the earthquake and behavior problems was conducted separately among children in the unaffected area. Stata MP 12 was used for analysis.

Results

Table 1 shows the demographic characteristics of children and their caregivers in the affected area and the rate of clinically significant behavior problems determined by the CBCL. Children's mean age was around 7 years, sex distribution was equal, and approximately 22% had no siblings. In the unaffected area, caregivers who responded (mostly mothers) were older and more highly educated compared to the affected area. Overall, in the affected area the clinical cut-off was exceeded for internalizing, externalizing, and total behavior problems in 27.7% (95% confidence interval [CI]: 20.9–34.4), 21.2% (95% CI: 15.0–27.4), and 25.9% (95% CI: 19.2–32.5) of participants, respectively. The rate of clinically significant behavior problems did not significantly differ by prefecture, although children in Fukushima showed lower rates.

Regarding the distribution of trauma experience, 157 children (92.4%) experienced trauma events related to the Great East Japan Earthquake, in which the mean number of trauma events was 3.23 (SD = 1.94, range 0–9). More specifically, the homes of about half of the participants in the affected area were lost, completely damaged, or partially damaged. In terms of traumatic events revealed in the interviews, witnessing tsunami waves was the most frequent (44%), followed by separation from caregivers (39%), restrictions on their lifestyle due to radiation (28%), witnessing a fire (21%), losing distant relatives or friends (18%), and losing a close family member or relative (10%). Further, 45.9% experienced a traumatic event before the earthquake, in which the mean number of other trauma events before the earthquake was 0.74 (SD = 0.98, range 0–4), mostly the death of a close friend or family member (19.4%), a close friend or family member having a serious illness (16.5%), and being separated from their caregiver (15.9%).

Associations of demographics and traumatic experience with clinically significant internalizing behavior problems are shown in Table 2. In our bivariate model, we found that the deaths of distant relatives or friends and other trauma experienced before the earthquake showed significant association with clinically significant internalizing behavior problems (47.6% vs. 20.2%, rate ratio [RR]: 2.36, 95% CI: 1.10–5.07), and they remained significant even in the multivariate model, which were mutually adjusted. That is, the rate ratio suggests that children who lost distant relatives or friends were 2.22 times (95% CI: 1.03–4.78) more likely to show clinically significant internalizing problems, independent of other trauma experiences before the earthquake. Similarly, children in the affected area who experienced other trauma before the earthquake were 2.22 times (95% CI: 1.22–4.07) more likely to show clinically significant internalizing problems, regardless of trauma exposure related to the earthquake, at 2 years after the earthquake. The interaction effect between experience of other trauma before the earthquake and disaster exposure was not observed (p for interaction term = 0.502) for internalizing problems, although 28 out of 73 (38.4%) children who experienced both other trauma before the earthquake and trauma related to the earthquake had internalizing problems. This is a higher proportion compared to children who experienced trauma related to the earthquake only and had no prior trauma exposure (15 out of 84, 17.9%, p for chi-square = 0.004). The association between other trauma experiences and internalizing problems was not found in the unaffected area (RR: 0.64, 95% CI: 0.07–5.73, data not shown).

In our bivariate model, no traumatic experiences related to the earthquake were associated with externalizing problems, while other trauma experiences before the earthquake were significantly associated (Table 3). In the multivariate model adjusted for father's occupation, which showed significant association with externalizing problems in the bivariate model, children in the affected area who experienced other trauma before the earthquake were 2.41 times (95% CI: 1.16–4.99) more likely to show externalizing behavior problems. The interaction effect between experience of other trauma before the earthquake and disaster exposure was not observed (p for interaction term = 0.296) for externalizing problems, although 24 out of 73 (32.9%) children who experienced both other trauma before the earthquake and trauma related to the earthquake had externalizing problems. This is a higher proportion compared to children exposed to disaster trauma only (9 out of 84 (10.7%), p for chi-square = 0.001). This association was not found in the unaffected area (RR: 1.28, 95% CI: 0.32–5.12, data not shown).

Finally, the associations of CBCL clinically significant total behavior problems with demographics and traumatic experiences are shown in Table 4. As with the results regarding externalizing problems, no traumatic experiences related to the earthquake were associated with total behavior problems, while other trauma experiences before the earthquake were significantly associated. In the multivariate model adjusted for child age, which showed a marginal association with total behavior problems in the bivariate model, children in the affected area who experienced other trauma before the earthquake were 2.98 times (95% CI: 1.53–5.81) more likely to show total behavior problems. The interaction effect between experience of other trauma before the earthquake and disaster exposure was not observed (p for interaction term = 0.242) for total behavior problems, although 31 out of 73 (42.5%) children who experienced both other trauma before the earthquake and trauma related to the earthquake had total behavior problems. This is a higher proportion compared to children exposed to disaster trauma only (10 out of 84 (11.9%), p for chi-square <0.001). This

Table 1. Demographic characteristics, trauma exposure related to the Great East Japan Earthquake, other trauma events before the earthquake, and clinically significant behavior problems among young children in the affected area 2 years after the earthquake (N = 170).

Characteristics		n or Mean	% or SD
Mean child age in years		7.1	1.0
Child age group	5 years	23	13.5
	6 years	64	37.7
	7 years	38	22.4
	8 years	45	26.5
Child sex	Boys	84	49.4
	Girls	86	50.6
Number of siblings	No sibling	37	21.8
	1 sibling	83	48.8
	2+ siblings	48	28.2
	Missing	2	1.2
Mean caregiver age in years		36.3	6.2
Caregiver's education	High school or less	79	46.5
	Some college	69	40.6
	College+	20	11.8
	Missing	2	1.2
Father's occupation before earthquake	Manual/Other/Unemployed	88	51.8
	Non-manual	38	22.4
	No response	44	25.9
Exposure to trauma events related to the Great East Japan Earthquake	Home lost or completely damaged	45	26.5
	Home partially damaged	43	25.3
	Stayed at shelter	50	29.4
	Lived in temporary housing	34	20.0
	Evacuated to relative's house	96	56.5
	Family members lived in separate places	53	31.2
	Separation from caregiver	54	31.8
	Lost close family member or relative	11	6.5
	Lost distant relative or friend	21	12.4
	Witnessed tsunami waves	63	37.1
	Witnessed someone being swept away by tsunami	11	6.5
	Witnessed a fire	30	17.7
	Saw a dead body	3	1.8
	Heard the sound of nuclear power plant explosion	3	1.8
	Experienced restrictions on lifestyle due to radiation	32	18.8
	Any of these events	157	92.4
	Number of these events	3.23	1.94
Exposure to other trauma events before the Great East Japan Earthquake	Involvement in a serious accident	5	2.9
	Witnessed a serious accident	0	0
	Attacked by a dog or other animals	0	0
	Had a close friend or family member who had a serious illness	28	16.5
	Death of a close friend or family member	33	19.4
	Visited hospital due to serious disease or injury, or underwent a serious medical procedure, or admitted to hospital	15	8.8
	Separated from a caregiver	27	15.9
	Experienced sexual assault	0	0
	Experienced other criminal assault	3	1.8

Table 1. Cont.

Characteristics		n or Mean	% or SD
	Bullied by peers at preschool or in the neighborhood	3	1.8
	Experienced violence from a close friend or family member	2	1.2
	Witnessed a violent incident involving a close friend or family member	5	2.9
	Had a close friend or family member who attempted suicide	2	1.2
	Experienced a previous natural disaster	1	0.6
	Other stressful events	5	2.9
	Any of these events	78	45.9
	Number of these events	0.74	0.98
CBCL clinically significant behavior problems	Internalizing problems	47	27.7
	Externalizing problems	36	21.2
	Total problems	44	25.9

CBCL: Child Behavior Checklist.

doi:10.1371/journal.pone.0109342.t001

association was not found in the unaffected area (RR: 1.03, 95% CI: 0.20–5.28, data not shown).

Discussion

We found that clinically significant behavior problems were reported in 26% of young children 2 years after the Great East Japan Earthquake. Interestingly, we observed that the rate of internalizing problems (28%) was higher than the rate of externalizing problems (21%) in the affected area. As internalized problems are less likely to be recognized compared to externalized problems in this age group, these behavior problems may have been underestimated during the 2 years following the earthquake.

To the best of our knowledge, this is the first study to show the rate of behavior problems using the CBCL among 5- to 8-year-old children 2 years after the Great East Japan Earthquake. The rate of clinically significant behavior problems using the CBCL was equivalent to findings from the study of preschool children exposed to the World Trade Center attack, for which the rate was 15–30% for each subscale of the CBCL [29]. McLaughlin et al. reported that 2 years after Hurricane Katrina, 15% of children aged 4 to 17 years had serious emotional disturbances (defined by a combination of scores for conduct problems, hyperactivity-inattention, emotional symptoms, peer problems, and symptom-related impairment measured by the Strengths and Difficulties Questionnaire) [21]. Furthermore, depression, which can be considered an internalizing problem, was reported in 12% of children aged 7 to 14 years who had been living for 9 months in displacement camps after the 2004 Indian Ocean earthquake and tsunami [12]. Although a simple comparison is not plausible because of differences in age, ethnicity, type of disaster, and timing of the assessment after the disaster, it is noteworthy that the rate of children aged 5 to 8 years with behavior problems after the Great East Japan Earthquake was higher than the rate after Hurricane Katrina or after the 2004 Indian Ocean disaster in affected parts of southern Thailand, which illustrates the severity of the trauma experienced by children residing in the affected area of Japan as a result of the earthquake, tsunami, and subsequent radiation crisis.

We found that losing distant relatives or friends was associated with clinically significant internalizing problems, but not externalizing or total behavior problems. This is consistent with previous research, which shows that depression among children after the 2004 Indian Ocean tsunami in devastated areas of southern Thailand was associated with the experience of a close family member or friend being injured [12]. The experience of losing a relative or friend may cause children to feel sadness, fear, or regret because they were unable to help during the tsunami, which leads to internalizing behavior. In our study, the lack of association of depression with losing a close family member or relative might have been due to selection bias and lack of power; that is, caregivers who lost a family member were less likely to participate in this study. In our study, only two children lost a close family member or relative. A previous study also reported that a natural disaster's long-term repercussions on children's mental health is influenced by various determinants including being separated from caregivers, experiencing traumatic events, and feeling that one's life or that of a close friend or family member is under threat [34].

We also found that other trauma experiences that occurred before the earthquake were significant risk factors for behavior problems among young children who were exposed to the earthquake, regardless of internalizing or externalizing behavior problems. This is consistent with findings of behavior problems in children after the World Trade Center attacks that showed a combined effect of other trauma exposure before the attacks, and traumatic events related to the attacks showed synergistic effects on behavior problems. High-risk approaches targeting young children who have been exposed to other trauma before the earthquake might be an efficient strategy to provide mental healthcare resources, which are limited after the earthquake.

Several limitations of this study must be addressed. First, the participants were not a representative sample of the municipalities affected by the earthquake; that is, we selected municipalities where one of the authors had enough personal connections to conduct this study. Furthermore, children with severe mental disorders in the target population may have been reluctant to join this study because they had already received psychiatric services. Alternatively, caregivers who were concerned about their children's mental health might have been more likely to participate in this study. Nonetheless, the significance of this study is that it reveals the rate of children with behavior problems in a community sample. Second, the CBCL was filled out by caregivers only; thus, behavior problems in school were not included. Further

Table 2. Bivariate and multivariate analyses of CBCL clinically significant internalizing behavior problems among young children 2 years after the Great East Japan Earthquake (N = 170).

			CBCL clinically significant internalizing behavior problems					
			n	%	Bivariate RR	95% CI	Multivariate RR	95% CI
Demographics	Child age group	5–6 y	19	21.8	reference			
		7–8 y	28	33.7	1.54	(0.86–2.77)		
	Child sex	Boy	28	33.3	reference			
		Girl	19	22.1	0.66	(0.37–1.19)		
	Number of siblings	No sibling	8	21.6	reference			
		1 sibling	26	31.3	1.45	(0.66–3.20)		
		2+ siblings	12	25.0	1.16	(0.47–2.83)		
	Caregiver age group	36 or less	28	28.6	reference			
		37+	19	26.4	0.92	(0.52–1.65)		
	Education	High school or less	18	22.8	reference			
		Some college+	29	32.6	1.43	(0.79–2.58)		
	Father's occupation before earthquake	Manual/Other/Unemployed	19	21.6	reference			
		Non-manual	12	31.6	1.46	(0.71–3.01)		
		No response	16	36.4	1.68	(0.87–3.28)		
Traumatic experience	Status of home	Lost or completely damaged	13	28.9	0.99	(0.50–1.94)		
		Partially damaged	10	23.3	0.79	(0.38–1.66)		
		Not damaged	24	29.3	reference			
	Stayed at shelter	Yes	17	34.0	1.50	(0.81–2.77)		
		No	25	22.7	reference			
	Lived in temporary housing	Yes	10	29.4	1.15	(0.57–2.33)		
		No	33	25.6	reference			
	Evacuated to relative's house	Yes	22	22.9	0.70	(0.39–1.26)		
		No	22	32.8	reference			
	Family members living in separate places	Yes	14	26.4	1.41	(0.76–2.62)		
		No	30	27.5	reference			
	Separation from caregiver	Yes	17	31.5	1.24	(0.65–2.37)		
		No	20	25.3	reference			
	Lost close family member or relative	Yes	2	18.2	0.63	(0.15–2.62)		
		No	31	29.0	reference			
	Lost distant relative or friend	Yes	10	47.6	**2.36**	**(1.10–5.07)**	**2.22**	**(1.03–4.78)**
		No	19	20.2	reference		reference	
	Witnessed tsunami waves	Yes	17	27.0	0.97	(0.51–1.82)		

Table 2. Cont.

		CBCL clinically significant internalizing behavior problems					
		n	%	Bivariate RR	95% CI	Multivariate RR	95% CI
	No	22	27.9	reference			
Witnessed someone being swept away by tsunami	Yes	4	36.4	1.36	(0.48–3.83)		
	No	35	26.7	reference			
Witnessed a fire	Yes	9	30.0	1.10	(0.52–2.32)		
	No	30	27.3	reference			
Saw a dead body	Yes	2	66.7	2.41	(0.58–10.02)		
	No	37	27.6	reference			
Heard the sound of nuclear power plant explosion	Yes	0	0.0	NA			
	No	31	25.6				
Experienced restrictions on lifestyle due to radiation	Yes	8	25.0	0.99	(0.44–2.23)		
	No	21	25.3	reference			
Exposure to any trauma events or other trauma before the earthquake	Yes	31	39.7	**2.29**	**(1.25–4.18)**	**2.22**	**(1.22–4.07)**
	No	*16*	*17.4*	*reference*			

CBCL: Child Behavior Checklist.
RR: rate ratio.
doi:10.1371/journal.pone.0109342.t002

Table 3. Bivariate and multivariate analysis of CBCL clinically significant externalizing behavior problems among young children 2 years after the Great East Japan Earthquake (N = 170).

			CBCL clinically significant externalizing behavior problems					
			n	%	Bivariate RR	95% CI	Multivariate RR	95% CI
Demographics	Child age group	5–6 y	14	16.1	reference			
		7–8 y	22	26.5	1.65	(0.84–3.22)		
	Child sex	Boy	19	22.6	reference			
		Girl	17	19.8	0.87	(0.45–1.68)		
	Number of siblings	No sibling	8	21.6	reference			
		1 sibling	16	19.3	0.89	(0.38–2.08)		
		2+ siblings	11	22.9	1.06	(0.43–2.64)		
	Caregiver age group	36 or less	16	16.3	reference			
		37+	20	27.8	1.70	(0.88–3.28)		
	Education	High school or less	18	22.8	reference			
		Some college+	18	20.2	0.89	(0.46–1.71)		
	Father's occupation before earthquake	Manual/Other/Unemployed	14	15.9	reference		reference	
		Non-manual	7	18.4	1.16	(0.47–2.87)	1.02	(0.41–2.53)
		No response	15	34.1	**2.14**	**(1.03–4.44)**	1.69	(0.80–3.58)
Traumatic experience	Status of home	Lost or completely damaged	10	22.2	1.30	(0.58–2.93)		
		Partially damaged	12	27.9	1.63	(0.76–3.53)		
		Not damaged	14	17.1	reference			
	Stayed at shelter	Yes	12	24.0	1.39	(0.67–2.86)		
		No	19	17.3	reference			
	Lived in temporary housing	Yes	7	20.6	0.98	(0.43–2.26)		
		No	27	20.9	reference			
	Evacuated to relative's house	Yes	16	16.7	0.62	(0.32–1.22)		
		No	18	26.9	reference			
	Family members living in separate places	Yes	10	18.9	0.82	(0.40–1.71)		
		No	25	22.9	reference			
	Separation from caregiver	Yes	12	22.2	1.17	(0.55–2.50)		
		No	15	19.0	reference			
	Lost close family member or relative	Yes	0	0	NA			
		No	26	24.3				
	Lost distant relative or friend	Yes	4	19.1	0.99	(0.34–2.94)		
		No	18	19.2	reference			
	Witnessed tsunami waves	Yes	16	25.4	1.67	(0.79–3.53)		
		No	12	15.2	reference			

Table 3. Cont.

			CBCL clinically significant externalizing behavior problems					
			n	%	Bivariate RR	95% CI	Multivariate RR	95% CI
	Witnessed someone being swept away by tsunami	Yes	3	27.3	1.43	(0.43–4.73)		
		No	25	19.1	reference			
	Witnessed a fire	Yes	7	23.3	1.28	(0.54–3.03)		
		No	20	18.2	reference			
	Saw a dead body	Yes	0	0	NA			
		No	28	20.9				
	Heard the sound of nuclear power plant explosion	Yes	0	0.0	NA			
		No	23	19.0				
	Experienced restrictions on lifestyle due to radiation	Yes	4	12.5	0.61	(0.21–1.81)		
		No	17	20.5	reference			
	Exposure to any trauma events or other trauma before the earthquake	Yes	25	32.1	2.68	(1.32–5.45)	2.41	(1.16–4.99)
		No	11	12.0	reference		reference	

CBCL: Child Behavior Checklist.
RR: rate ratio.
doi:10.1371/journal.pone.0109342.t003

Table 4. Bivariate and multivariate analysis of Child Behavior Checklist (CBCL) clinically significant total behavior problems among young children 2 years after the Great East Japan Earthquake (N = 170).

			CBCL clinically significant total behavior problems					
			n	%	Bivariate PR	95% CI	Multivariate PR	95% CI
Demographics	Child age group	5–6 y	16	18.4	reference		reference	
		7–8 y	28	33.7	1.83	(0.99–3.39)	1.25	(0.93–1.67)
	Child sex	Boy	27	32.1	reference			
		Girl	17	19.8	0.61	(0.34–1.13)		
	Number of siblings	No sibling	13	35.1	reference			
		1 sibling	22	26.5	0.75	(0.38–1.50)		
		2+ siblings	8	16.7	0.47	(0.20–1.14)		
	Caregiver age group	36 or less	23	23.5	reference			
		37+	21	29.2	1.24	(0.69–2.25)		
	Education	High school or less	21	26.6	reference			
		Some college+	23	25.8	0.97	(0.54–1.76)		
	Father's occupation before earthquake	Manual/Other/Unemployed	18	20.5	reference			
		Non-manual	11	29.0	1.42	(0.67–3.00)		
		No response	15	34.1	1.67	(0.84–3.31)		
Traumatic experience	Status of home	Lost or completely damaged	12	26.7	1.21	(0.59–2.52)		
		Partially damaged	14	32.6	1.48	(0.74–2.98)		
		Not damaged	18	22.0	reference			
	Stayed at shelter	Yes	14	28.0	1.28	(0.66–2.48)		
		No	24	21.8	reference			
	Lived in temporary housing	Yes	9	26.5	1.03	(0.50–2.16)		
		No	33	25.6	reference			
	Evacuated to relative's house	Yes	22	22.9	0.81	(0.44–1.49)		
		No	19	28.4	reference			
	Family members living in separate places	Yes	15	28.3	1.14	(0.61–2.15)		
		No	27	24.8	reference			
	Separation from caregiver	Yes	17	31.5	1.38	(0.71–2.68)		
		No	18	22.8	reference			
	Lost close family member or relative	Yes	1	9.1	0.31	(0.04–2.30)		
		No	31	29.0	reference			
	Lost distant relative or friend	Yes	8	38.1	1.71	(0.76–3.85)		
		No	21	22.3	reference			
	Witnessed tsunami waves	Yes	19	30.2	1.40	(0.73–2.70)		

Table 4. Cont.

			CBCL clinically significant total behavior problems				
		n	%	Bivariate PR	95% CI	Multivariate PR	95% CI
	No	17	21.5	reference			
Witnessed someone being swept away by tsunami	Yes	4	36.4	1.49	(0.53–4.21)		
	No	32	24.4	reference			
Witnessed a fire	Yes	10	33.3	1.47	(0.70–3.05)		
	No	25	22.7	reference			
Saw a dead body	Yes	1	33.3	1.28	(0.17–9.32)		
	No	35	26.1	reference			
Heard the sound of nuclear power plant explosion	Yes	0	0.0	NA			
	No	28	23.1				
Experienced restrictions on lifestyle due to radiation	Yes	6	18.8	0.78	(0.31–1.94)		
	No	20	24.1	reference			
Exposure to any trauma events or other trauma before the earthquake	Yes	32	41.0	**3.15**	**(1.62–6.11)**	**2.98**	**(1.53–5.81)**
	No	12	13.0	reference		reference	

CBCL: Child Behavior Checklist.
RR: rate ratio.
doi:10.1371/journal.pone.0109342.t004

research should combine teacher and caregiver CBCL ratings. Third, severe traumatic experiences related to the earthquake were assessed through interviews with children, but some children might not describe their true experiences to an interviewer. We double-checked the reported experiences by interviewing caregivers and preschool teachers, but we considered the trauma described by child participants themselves as being the most authentically representative of the children's trauma. Fourth, our sample size was relatively small; thus, there may have been too few participants to properly assess the significance of the associations between specific traumatic experiences and behavior problems. However, even with this small sample size, we demonstrated that some specific traumatic experiences were associated with behavior problems, which informs suggestions for future prevention of behavior problems after a natural disaster. Fifth, the response rate is not very high, especially in Fukushima. This is because most children were evacuated from the original community as a result of the radiation crisis, thus it was extremely difficult to obtain consent.

In conclusion, clinically significant behavior problems were found in one of four young children living in the area affected by the Great East Japan Earthquake, even 2 years after the disaster. Specific trauma experience, i.e., loss of distant relatives or friends, was associated with internalizing problems, but not externalizing or total behavior problems. Moreover, children who experienced other trauma events before the earthquake were more likely to have behavior problems. Based on these findings, we make a call for further interventions for young children exposed to the disaster, such as psychoeducation programs to provide information on traumatic symptoms, coping strategies and recovery, in collaboration with school and preschool principals, teachers, and school counselors. Moreover, larger studies using representative samples are essential to further address the mental health needs of young children exposed to the 2011 disaster.

Acknowledgments

We thank all the participants who contributed to this study. We also thank the child psychiatrists and psychologists who provided extra mental health support to participants when requested during interviews. In addition, we thank the research coordinators, especially Ms Maiko Osawa and Ms Hisayo Saeki, who coordinated the logistics for this study, and Ms. Emma Barber for her editorial assistance. The Great East Japan Earthquake Follow-up for Children Study Team is composed of Dr Takehito Yambe and Ms Mitsuko Miura, Iwate Medical University, Dr Hirokazu Yoshida, Miyagi Prefectural Comprehensive Children's Center, Dr Yoshiko Yamamoto, Iwaki Meisei University, Ms Noriko Ohshima, Fukushima Gakuin University, Dr Keiichi Funahashi and Ms Mai Kuroda, Saitama Children's Hospital, Dr Takahiro Hoshino, Musashino Gakuin School, Ms Rie Mizuki, Dr Lena Akai, and Dr Yoshiyuki Tachibana, National Center for Child Health and Development, lead by Dr Makiko Okuyama (okuyama-m@ncchd.go.jp).

Author Contributions

Conceived and designed the experiments: MO KN HH HM JY TF. Performed the experiments: MO KN HH HM JY TF. Analyzed the data: TF. Contributed reagents/materials/analysis tools: MO KN HH HM JY TF. Wrote the paper: MO KN HH HM JY TF. Collected samples: KN HH HM JY.

References

1. Fire and Disaster Management Agency (2013) Higai-hou. Fire and Disaster Management Agency.
2. Japan Child and Family Research Institute (2013) Almanac of data on Japanese children 2013. Tokyo: KTC Chuoh Publishing.
3. Uemoto M, Shioyama A, Koide K, Honda M, Takamiya S, et al. (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.
4. Shioyama A, Uemoto M, Shinfuku N, Ide H, Seki W, et al. (2000) [The mental health of school children after the Great Hanshin-Awaji Earthquake: II. Longitudinal analysis]. Seishin Shinkeigaku Zasshi 102: 481–497.
5. Kitayama S, Okada Y, Takumi T, Takada S, Inagaki Y, et al. (2000) Psychological and physical reactions on children after the Hanshin-Awaji earthquake disaster. Kobe J Med Sci 46: 189–200.
6. Laor N, Wolmer L, Kora M, Yucel D, Spirman S, et al. (2002) Posttraumatic, dissociative and grief symptoms in Turkish children exposed to the 1999 earthquakes. J Nerv Ment Dis 190: 824–832.
7. Tural U, Coskun B, Onder E, Corapcioglu A, Yildiz M, et al. (2004) Psychological consequences of the 1999 earthquake in Turkey. J Trauma Stress 17: 451–459.
8. Sahin NH, Batigun AD, Yilmaz B (2007) Psychological symptoms of Turkish children and adolescents after the 1999 earthquake: exposure, gender, location, and time duration. J Trauma Stress 20: 335–345.
9. Bal A, Jensen B (2007) Post-traumatic stress disorder symptom clusters in Turkish child and adolescent trauma survivors. Eur Child Adolesc Psychiatry 16: 449–457.
10. Eksi A, Braun KL (2009) Over-time changes in PTSD and depression among children surviving the 1999 Istanbul earthquake. Eur Child Adolesc Psychiatry 18: 384–391.
11. Celebi Oncu E, Wise AM (2010) The effects of the 1999 Turkish earthquake on young children: analyzing traumatized children's completion of short stories. Child Dev 81: 1161–1175.
12. Thienkrua W, Cardozo BL, Chakkraband ML, Guadamuz TE, Pengjuntr W, et al. (2006) Symptoms of posttraumatic stress disorder and depression among children in tsunami-affected areas in southern Thailand. JAMA 296: 549–559.
13. Agustini EN, Asniar I, Matsuo H (2011) The prevalence of long-term post-traumatic stress symptoms among adolescents after the tsunami in Aceh. J Psychiatr Ment Health Nurs 18: 543–549.
14. Piyasil V, Ketuman P, Plubrukarn R, Jotipanut V, Tanprasert S, et al. (2007) Post traumatic stress disorder in children after tsunami disaster in Thailand: 2 years follow-up. J Med Assoc Thai 90: 2370–2376.
15. Piyasil V, Ketumarn P, Prubrukarn R, Pacharakaew S, Dumrongphol H, et al. (2008) Psychiatric disorders in children at one year after the tsunami disaster in Thailand. J Med Assoc Thai 91 Suppl 3: S15–20.
16. Ularntinon S, Piyasil V, Ketumarn P, Sitdhiraksa N, Pityaratstian N, et al. (2008) Assessment of psychopathological consequences in children at 3 years after tsunami disaster. J Med Assoc Thai 91 Suppl 3: S69–75.
17. Piyasil V, Ketumarn P, Prubrukarn R, Ularntinon S, Sitdhiraksa N, et al. (2011) Post-traumatic stress disorder in children after the tsunami disaster in Thailand: a 5-year follow-up. J Med Assoc Thai 94 Suppl 3: S138–144.
18. Scheeringa MS, Zeanah CH (2008) Reconsideration of harm's way: onsets and comorbidity patterns of disorders in preschool children and their caregivers following Hurricane Katrina. J Clin Child Adolesc Psychol 37: 508–518.
19. Marsee MA (2008) Reactive aggression and posttraumatic stress in adolescents affected by Hurricane Katrina. J Clin Child Adolesc Psychol 37: 519–529.
20. Osofsky HJ, Osofsky JD, Kronenberg M, Brennan A, Hansel TC (2009) Posttraumatic stress symptoms in children after Hurricane Katrina: predicting the need for mental health services. Am J Orthopsychiatry 79: 212–220.
21. McLaughlin KA, Fairbank JA, Gruber MJ, Jones RT, Lakoma MD, et al. (2009) Serious emotional disturbance among youths exposed to Hurricane Katrina 2 years postdisaster. J Am Acad Child Adolesc Psychiatry 48: 1069–1078.
22. Liu M, Wang L, Shi Z, Zhang Z, Zhang K, et al. (2011) Mental health problems among children one-year after Sichuan earthquake in China: a follow-up study. PLoS One 6: e14706.
23. Zhang Z, Ran MS, Li YH, Ou GJ, Gong RR, et al. (2012) Prevalence of post-traumatic stress disorder among adolescents after the Wenchuan earthquake in China. Psychol Med 42: 1687–1693.
24. Jia Z, Shi L, Duan G, Liu W, Pan X, et al. (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.
25. Yang R, Xiang YT, Shuai L, Qian Y, Lai KY, et al. (2013) Executive function in children and adolescents with posttraumatic stress disorder 4 and 12 months after the Sichuan earthquake in China. J Child Psychol Psychiatry.
26. Dehon C, Scheeringa MS (2006) Screening for preschool posttraumatic stress disorder with the Child Behavior Checklist. J Pediatr Psychol 31: 431–435.
27. Loeb J, Stettler EM, Gavila T, Stein A, Chinitz S (2011) The child behavior checklist PTSD scale: screening for PTSD in young children with high exposure to trauma. J Trauma Stress 24: 430–434.
28. Lowe SR, Godoy L, Rhodes JE, Carter AS (2013) Predicting mothers' reports of children's mental health three years after Hurricane Katrina. J Appl Dev Psychol 34: 17–27.
29. Chemtob CM, Nomura Y, Abramovitz RA (2008) Impact of conjoined exposure to the World Trade Center attacks and to other traumatic events on the

behavioral problems of preschool children. Arch Pediatr Adolesc Med 162: 126–133.
30. Achenbach TM (1991) Manual for Child Behavior Checklist/4-18 and 1991 Profile. Burlington, VT: University of Vermont, Dept. of Psychiatry.
31. Itani T, Kanbayashi Y, Nakata Y, Kita M, Fujii H, et al. (2001) Standardization of the Japanese version of the Child Behavior Checklist/4–18. Psychiatr Neurol Pediatr Jpn 41: 243–252 (in Japanese with English abstract).
32. Zhang J, Yu KF (1998) What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. JAMA 280: 1690–1691.
33. Barros AJ, Hirakata VN (2003) Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. BMC Med Res Methodol 3: 21.
34. Lubit R, Rovine D, DeFrancisci L, Eth S (2003) Impact of trauma on children. J Psychiatr Pract 9: 128–138.

特集●福島の被ばく不安

福島県の災害とこどもへの支援

増子　博文

福島県における東日本大震災後の，こどものメンタルヘルスについて概説した．避難を余儀なくされた住民を対象とした福島県県民健康調査の結果では，SDQ（Strength and Difficulties Questionnaire）を指標にした支援を要するこどもの割合は，4～6歳・小学生・中学生のいずれの年齢層においても，一般人口と比較して高値であった．避難生活の長期化に伴い，養育者の疲弊がこどものメンタルヘルスに対して影響することが懸念されている．今後，長期にわたり，身体的・精神的健康調査の継続が必要である．

Key Words　PTSD，SDQ，東日本大震災，放射能，こども

はじめに

本稿では，まず災害後のこどものメンタルヘルスの特徴を概説する．その中で，症例（自験例）の提示をして，PTSDの病態について考察する．また福島県・県民健康調査県民健康管理調査「こころの健康度・生活習慣に関する調査」について述べる．以上を通して，震災後のこどものメンタルヘルスを保持するための対策を模索する（県民健康調査については福島県立医科大学倫理委員会の承認を得た）．

こどものPTSD（post-traumatic stress disorder；外傷後ストレス障害）の特徴

こどものPTSDの臨床像は年齢に従って変化することが知られている．年齢別にみたPTSD症状を**表1**に示した[9]．2歳半までにみられる「夜中に目が覚める」，2歳半から6歳までにみられる「出来事の混乱した理解」「魔術的な解釈」，6歳から11歳までにみられる「自罰的な理解」，11歳から18歳にみられる「人間関係のもち方の変化」「大人になり急ぐ」などは，いずれも見逃されやすいが診断的価値が高い．

また，こどもへの適切な対応の方法について**表2**に紹介した[5]．「子どもたちにかかわる時間を増やす」ことは理想ではあるが，養育者によっては困難な場合もありうる．多忙な養育者に対しては，短時間でも，頻回かつ高密度なかかわりが有効であることを勧めるのが次善の策である．

子どものPTSD症例（自験例[7]）

症例は，2歳男児である．阪神淡路大震災後にPTSD症状を示した．震災時たまたま覚醒していて，地鳴りからの全経過を体験した．その後，フラッシュバックとして，午前5時46分に睡眠中でも覚醒して泣くことを繰り返した．

阪神淡路大震災後に60代男性作家が同様の体験を記載している．すなわち，PTSD症状としてのフラッシュバック（再体験）は，時計で時刻を知るに至らない年齢の子どもから，高度な知的作業に従事する成人に至るまで，年齢を超えた一貫

福島県立医科大学医学部神経精神医学講座
〒960-1295　福島県福島市光が丘1