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Kobe Earthquake and Post-Traumatic Stress in School-Aged Children

Masaharu Uemoto · Akihiro Asakawa · Shizuo Takamiya · Kiyoshi Asakawa · Akio Inui

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Abstract
Background The psychological reactions to catastrophic events are not known well in children.
Purpose The present study was performed to quantify the core features of post-traumatic stress reactions in school-children after the Kobe earthquake.
Methods Children's psychological reactions to the Kobe earthquake were examined in a total of 8,800 schoolchildren attending the third, fifth, or eighth grade in the disaster areas. The control subjects were 1,886 schoolchildren in the same grades in distant areas minimally affected by the earthquake. A self-report questionnaire was developed with reference to the Diagnostic and Statistical Manual of Mental Disorders-IV and the post-traumatic stress disorder reaction index and was used to score psychological reactions rating them from 1 to 4 depending on the frequency of the symptom. The survey was conducted four times, from 4 months to 2 years after the earthquake.
Results Three factors were consistently extracted by factor analysis on the results of each study. Factor 1 was interpreted as relating to direct fear of the disaster and general anxiety, factor 2 as relating to depression and physical symptoms, and factor 3 as social responsibility such as feelings of sympathy for those who are suffering more severely and guilt for surviving. Young schoolchildren displayed particularly high scores on these factors. Furthermore, these factors were significantly associated with injuries of the children themselves, fatalities/injuries of family members, and the experience of being rescued or staying in shelters.
Conclusions Psychological and comprehensive interventions should be directed at the most vulnerable populations of young children after future earthquakes.

Keywords Kobe earthquake · Children · Post-traumatic stress disorder

M. Uemoto
Kobe City College of Nursing,
3-4 Gakuen-nishi-machi Nishi-ku,
Kobe City 651-2103, Japan

S. Takamiya
Department of Psychiatry, Nishi-Kobe Medical Center,
5-7-1 Kojidai Nishi-ku,
Kobe City 651-2273, Japan

K. Asakawa
School Psychology, Developmental Science and Health Education Course, Hyogo University of Teacher Education Graduate School of Education - Human Development Education,
942-1 Shimokume,
Kato City 673-1494, Japan

A. Asakawa · A. Inui (✉)
Department of Psychosomatic Internal Medicine,
Kagoshima University Graduate School of Medical and Dental Sciences,
8-35-11 Sakuragaoka,
Kagoshima City, Kagoshima 890-8520, Japan
e-mail: inui@m.kufm.kagoshima-u.ac.jp

Introduction

A devastating earthquake with a magnitude of 7.2 on the Richter scale [1] hit Kobe and nearby cities in Japan early morning of January 17, 1995. Nearly 1.6 million people lived in this heavily damaged area; 5,502 died immediately, and 41,527 were wounded. A total of 39,440 houses were damaged. At the time of maximum evacuation, there were 317,000 evacuees and 1,150 shelters [2].

After the Kobe (Great Hanshin-Awaji) earthquake, people experienced devastating Haiti (2010); Bhuj, India (2001); Bam, Iran (2003); and Wenchuan, China (2008).

Much remains to be done to reduce earthquake hazards especially for those living along active plate boundaries.

Catastrophic events, in contrast to stressors of lesser magnitude, have been etiologically linked to a specific syndrome, post-traumatic stress disorder (PTSD) [3]. However, many of the studies on this syndrome have been of adults exposed to extremely life-threatening situations and there have been few empirical studies of children in such situations [4–6]. The current study was conducted to examine the magnitude, the nature, and the time–course of the psychological consequences for 8,800 schoolchildren who were greatly affected by the Kobe earthquake.

Methods

Subjects

The subjects of the survey were 8,800 schoolchildren in the third, fifth, or eighth grade at 32 elementary schools and 14 junior high schools in the disaster areas such as Kobe city and Nishinomiya city. The control subjects were 1,886 schoolchildren in the third, fifth, or eighth grade at six elementary schools and five junior high schools in distant areas that were minimally affected by the earthquake.

Questionnaire

The questionnaire was in a self-report format and consisted of 10 items about the disaster, 22 items about mental health condition, and 1 item in which participants were free to describe whatever they wished. With reference to the DSM-IV [3] and the PTSD reaction index [4–6], the items about mental health condition referred to physical symptoms (four items), anxiety symptoms (four items), depression symptoms (three items), flashback symptoms (two items), avoidance symptoms (two items), arousal symptoms (three items), regression symptoms (one item), survivor's guilt (one item), and self-esteem (two items).

Survey

The survey was conducted by the respective classroom teachers. First, teachers explained the contents of the survey and how to complete the questionnaire in conformity with a manual that we had prepared for teachers. For children in

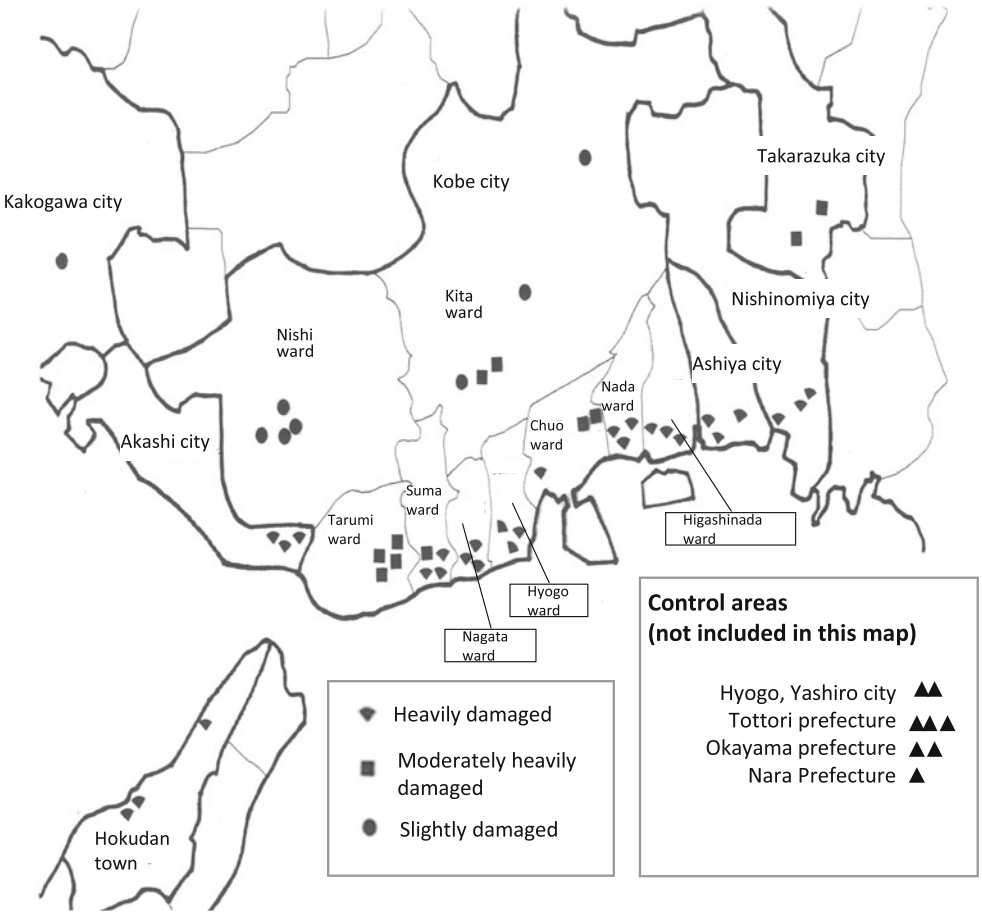

Fig. 1 Location of the schools (62 in total) where surveys were conducted 3, 6, and 12 months after the Kobe earthquake

Table 1 Factor analysis

Kobe earthquake mental state index for children (Kemsi-c)	4 Months				6 Months				1 Year				2 Years			
	Factor 1	Factor 2	Factor 3	communality h2	Factor 1	Factor 2	Factor 3	communality h2	Factor 1	Factor 2	Factor 3	communality h2	Factor 1	Factor 2	Factor 3	communality h2
Do scenes of the earthquake come to mind all of sudden? or Are you afraid of another earthquake?	**0.67**	0.20	0.20	0.54	**0.67**	0.21	0.19	0.53	**0.67**	0.19	0.15	0.52	**0.65**	0.16	0.12	0.47
Are you scared when not in the company of family members and friends?	**0.63**	0.26	0.09	0.48	**0.62**	0.25	0.10	0.47	**0.62**	0.28	0.10	0.47	**0.58**	0.29	0.10	0.43
Are you afraid of another earthquake attack or other accidents?	**0.62**	0.17	0.21	0.46	**0.64**	0.19	0.20	0.49	**0.66**	0.19	0.17	0.50	**0.64**	0.20	0.16	0.48
Are you easily frightened by small noises?	**0.59**	0.18	0.17	0.41	**0.58**	0.23	0.16	0.42	**0.60**	0.24	0.14	0.44	**0.57**	0.22	0.13	0.28
Do you hate to hear or speak about the earthquake?	**0.52**	0.12	0.22	0.34	**0.54**	0.11	0.21	0.35	**0.50**	0.10	0.23	0.31	**0.52**	0.10	0.17	0.36
Are you unable to sleep when not in the company of others, or when the light is off?	**0.49**	0.28	0.03	0.32	**0.51**	0.27	0.07	0.34	**0.50**	0.24	0.05	0.31	**0.48**	0.22	0.04	0.28
Do you have dreams of the earthquake and bad dreams?	**0.47**	0.30	0.15	0.34	**0.51**	0.29	0.13	0.37	**0.53**	0.26	0.14	0.37	**0.52**	0.28	0.10	0.36
Do you hate to stay at the site of the earthquake?	**0.34**	0.15	0.08	0.15	**0.35**	0.15	0.07	0.15	**0.32**	0.14	0.07	0.13	**0.35**	0.13	0.04	0.14
Do you get angry or irritated?	0.06	**0.56**	0.03	0.32	0.08	**0.53**	0.05	0.35	0.11	**0.59**	0.03	0.36	0.10	**0.61**	0.02	0.39
Are you unable to concentrate on play or study?	0.14	**0.50**	0.07	0.28	0.16	**0.51**	0.05	0.29	0.12	**0.56**	0.06	0.34	0.09	**0.57**	0.05	0.33
Do you have headaches, stomachaches, or palpitations, or feel dizzy?	0.22	**0.50**	0.13	0.32	0.20	**0.58**	0.12	0.39	0.25	**0.56**	0.11	0.39	0.23	**0.58**	0.10	0.40
Do you feel pain when talking with other people? or Are you unable to enjoy being with others?	0.11	**0.50**	0.04	0.26	0.14	**0.55**	0.01	0.33	0.14	**0.55**	0.00	0.32	0.12	**0.55**	−0.00	0.31
Do you feel lonely or depressed?	0.38	**0.49**	0.14	0.41	0.39	**0.51**	0.16	0.44	0.14	**0.49**	0.12	0.43	0.32	**0.56**	0.14	0.44
Do you have any skin irritations?	0.28	**0.42**	0.10	0.27	0.32	**0.42**	0.10	0.29	0.41	**0.43**	0.10	0.31	0.29	**0.44**	0.12	0.30
Are you unable to sleep? Or, do you wake soon after going to bed?	0.11	**0.41**	0.08	0.19	0.10	**0.44**	0.04	0.21	0.33	**0.46**	0.05	0.24	0.15	**0.42**	0.04	0.20
Do you cry easily?	0.36	**0.41**	0.12	0.31	0.33	**0.40**	0.11	0.33	0.13	**0.43**	0.09	0.33	0.36	**0.41**	0.07	0.31
Do you want to ask someone for a help even though you can manage by yourself?	0.15	**0.40**	0.08	0.19	0.14	**0.43**	0.09	0.22	0.36	**0.40**	0.08	0.19	0.16	**0.42**	0.04	0.20
Are you unable to eat much or do you have a poor appetite?	0.16	**0.40**	0.02	0.18	0.22	**0.40**	0.02	0.21	0.15	**0.41**	0.04	0.20	0.17	**0.41**	0.06	0.20
Do you cough?	0.14	**0.32**	0.05	0.12	0.15	**0.35**	0.04	0.15	0.17	**0.39**	0.07	0.19	0.16	**0.37**	0.04	0.17
Do you strongly want to help someone in trouble?	0.17	0.07	**0.67**	0.49	0.16	0.05	**0.71**	0.54	0.19	0.72	**0.72**	0.57	0.06	0.13	**0.70**	0.51
Do you feel sorry for victims suffering from the earthquake?	0.22	0.06	**0.52**	0.33	0.24	0.07	**0.54**	0.35	0.26	0.57	**0.57**	0.39	0.04	0.23	**0.49**	0.30

Table 1 (continued)

Kobe earthquake mental state index for children (Kemsi-c)	4Months				6Months				1Year				2Years			
	Factor1	Factor2	Factor3	communality h2	Factor1	Factor2	Factor3	communality h2	Factor1	Factor2	Factor3	communality h2	Factor1	Factor2	Factor3	communality h2
Do you feel that you are helpful to somebody?	0.09	0.10	**0.33**	0.13	0.09	0.08	**0.35**	0.14	0.06	0.39	**0.39**	0.17	0.06	0.05	**0.39**	16.00
				6.93				7.45				7.56				7.19
Sums of squares of loadings	3.09	2.70	1.14		3.24	2.99	1.20		3.29	3.01	1.25		3.03	3.08	1.08	

the third grade, the teachers read out each question. In the first survey, members of the study group (including pediatric psychiatrists and psychologists) were present in case the students expressed psychological restlessness such as anxiety.

The first survey (hereafter referred to as the fourth month) was conducted during the period April 24 to May 16, 1995 with 8,800 schoolchildren in the disaster areas and 1,886 control schoolchildren. The second survey (hereafter referred to as the sixth month) was carried out during the period July 11 to 20, 1995 in the disaster areas only, and the third survey (hereafter referred to as the first year) was conducted during the period February 11 to March 22, 1996 in the disaster areas only. The fourth survey (hereafter referred to as the second year) was carried out during the period December 1 to 15, 1996 in both the disaster and control areas.

Classification of Areas by the Extent of the Disaster

Areas were classified into four categories based on the extent of the disaster (Fig. 1). Heavily damaged areas were defined as those where resident children gave less than 50% of affirmative answers to the questions "no house damage by the earthquake" and "no injuries to the family members due to the earthquake" (n=4,293 children in the first survey). Moderately heavily damaged areas had 50–70% of affirmative answers to these questions (n=1,645 children in the first survey), and slightly damaged areas had 71–90% of affirmative answers (n=2,862 children in the first survey). Control areas had nearly 100% affirmative answers. These classifications paralleled the extent of the disaster on the Richter scale.

Factor Analysis

The answers to the survey were rated from 1 to 4 depending on the frequency of the symptom (1="none", 2="sometimes", 3="often", and 4="always"). Three factors were consistently elicited in the analysis of the results of the survey carried out at 4 months, 6 months, 1 year, and 2 years after the earthquake (Table 1).

Factor 1 is related to fear and anxiety and includes the following eight items: Do scenes of the earthquake come to mind all of sudden? Or are you afraid of another earthquake? Are you scared when not in the company of family members and friends? Are you afraid of another earthquake attack or other accidents? Are you easily frightened by small noises? Do you hate to hear or speak about the earthquake? Are you unable to sleep when not in the company of others or when the light is off? Do you have dreams of the earthquake and bad dreams? Do you hate to stay at the site of the earthquake?

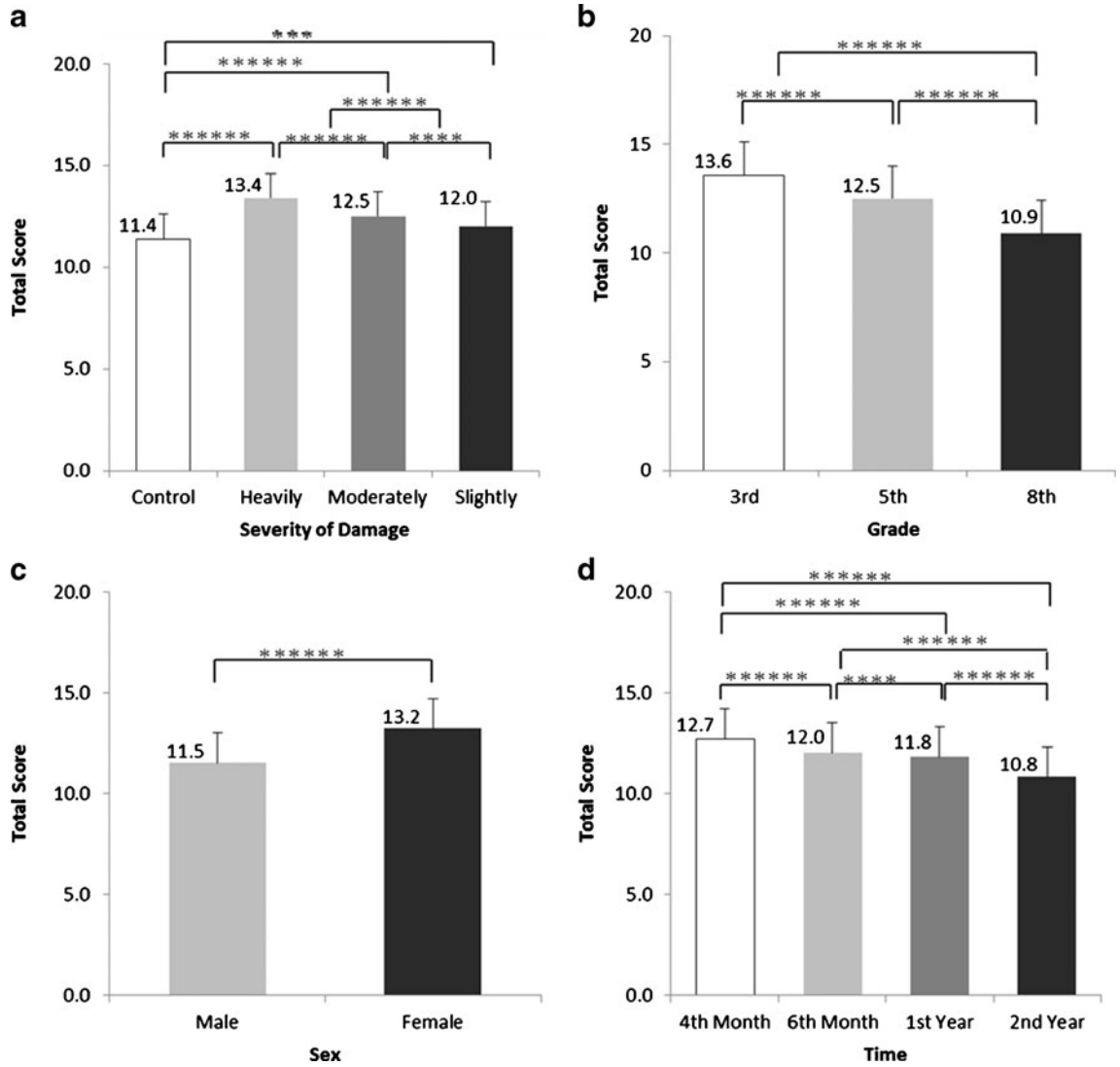

Fig. 2 Cluster analysis of the total scores of factor 1 (fear and anxiety) in terms of the extent of the disaster that the children experienced (**a**), the children's grade (**b**), their sex (**c**), and the length of time after the earthquake (**d**). Each class is handled as a unit, and data are expressed as mean±SD; *$p<0.05$, **$p<0.01$, ***$p<0.005$, ****$p<0.001$, *****$p<0.0005$, ******$p<0.0001$

Factor 2 is related to depression and physical symptoms and includes the following 11 questions: Do you get angry or irritated? Are you unable to concentrate on play or study? Do you have headaches, stomachaches or palpitations, or feel dizzy? Do you feel pain when talking with other people? Or are you unable to enjoy being with others? Do you feel lonely or depressed? Do you have any skin irritations? Are you unable to sleep? Or do you wake soon after going to bed? Do you cry easily? Do you want to ask someone for a help even though you can manage by yourself? Are you unable to eat much, or do you have a poor appetite? Do you cough?

Factor 3 is related to social responsibility (consideration for others) and includes the following 3 items: Do you strongly want to help someone in trouble? Do you feel sorry for victims suffering from the earthquake? Do you feel that you are helpful to somebody?

Analysis of Variance

Analyses of variance were performed on mean scores of the total count of factors 1, 2, and 3, and the trend and recovery process were evaluated in terms of the extent of the disaster that the children experienced, the grade of the children, their sex, and the length of time after the earthquake. Statistical Analysis System was used to further analyze each of the three factors. Each class was handled as a unit for statistical analysis. Data are expressed as means±SD.

Results

Nearly 100% (99.9%, 99.8%, 99.8%, and 99.7%) of the children provided sufficient responses to the question-

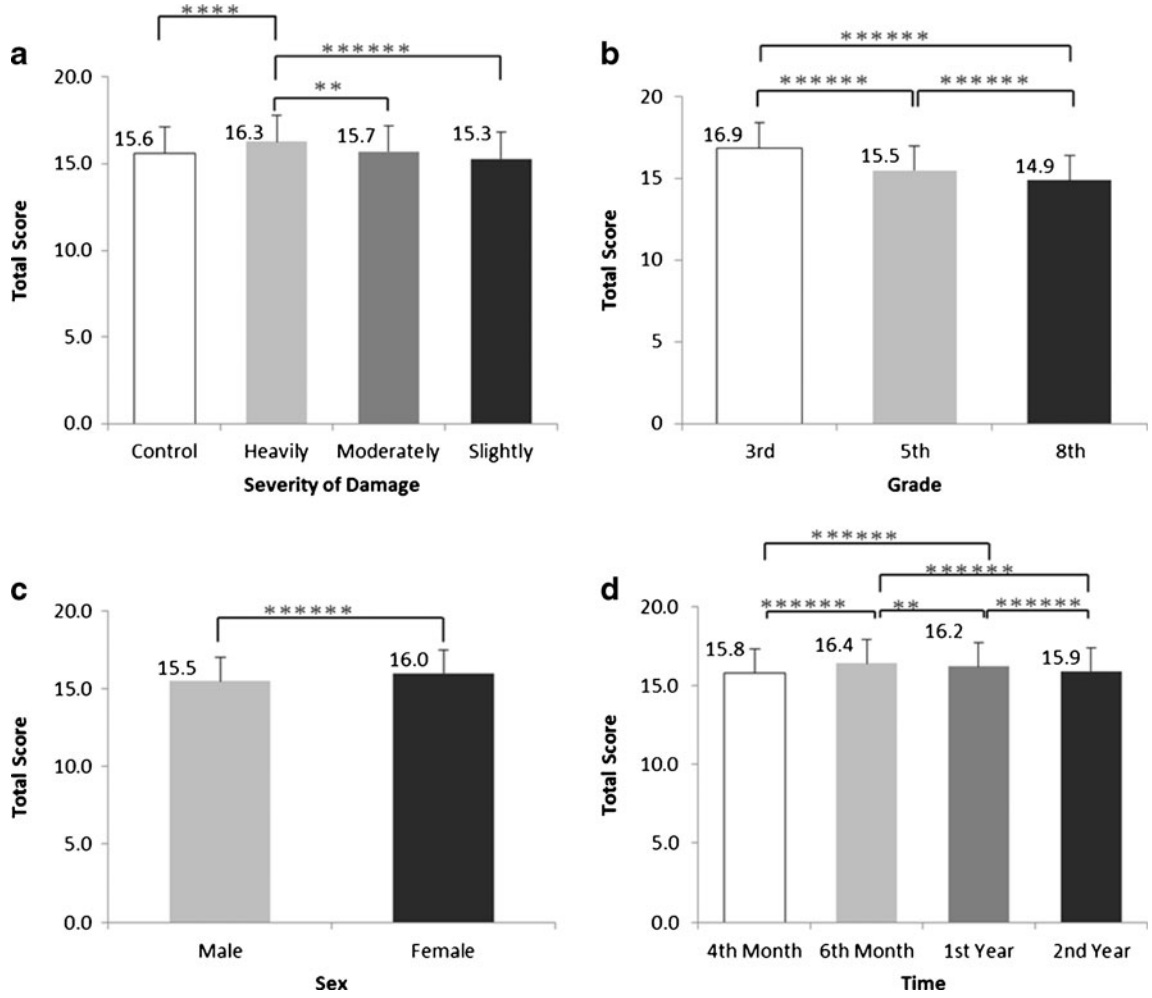

Fig. 3 Cluster analysis of the total scores of factor 2 (depression and physical symptoms) in terms of the extent of the disaster that the children experienced (**a**), the children's grade (**b**), their sex (**c**), and the length of time after the earthquake (**d**). Each class is handled as a unit, and data are expressed as mean±SD; *$p<0.05$, **$p<0.01$, ***$p<0.005$, ****$p<0.001$, *****$p<0.0005$, ******$p<0.0001$

naires carried out at 4 months, 6 months, 1 year, and 2 years after the earthquake. Three factors were consistently extracted by factor analysis on the results of each survey.

Factor 1

Factor 1 was interpreted as relating to direct fear of the disaster and general anxiety. The maximum score was 32 (achieved if all answers were "always") and the minimum score was eight (if all answers were "none"). As shown in Fig. 2a, the highest score was demonstrated in highly damaged areas [13.4 vs. 11.4 (control), $p<0.0001$]. Even in the slightly damaged areas, the difference from the control areas was statistically significant ($p<0.005$). It is possible that the effects of mass media and images on television concerning the earthquake influenced the results for control children. In fact, the scores in control areas were significantly reduced 2 years after the earthquake ($p<0.005$). The anxiety score was highest in the youngest (third grade) schoolchildren (Fig. 2b) and was higher in females than in males (Fig. 2c). The scores decreased over time (Fig. 2d), irrespective of grade and gender. Factor 1 was significantly associated with injuries of the children themselves ($p<0.001$), fatalities/injuries of family members ($p<0.0001$) or friends ($p<0.001$), and an experience of being rescued ($p<0.001$) or staying in a shelter ($p<0.001$). These results suggest that factor 1 is directly related to the child's experience of the earthquake.

Factor 2

Factor 2 was interpreted as relating to depressive and psycho-physical symptoms. The maximum score was 44 (achieved if all answers were "always"). As shown in Fig. 3, factor 2 was strongly affected by the severity of earthquake damage experienced (Fig. 3a), the child's grade (Fig. 3b), and gender (Fig. 3c), as was the case for factor 1.

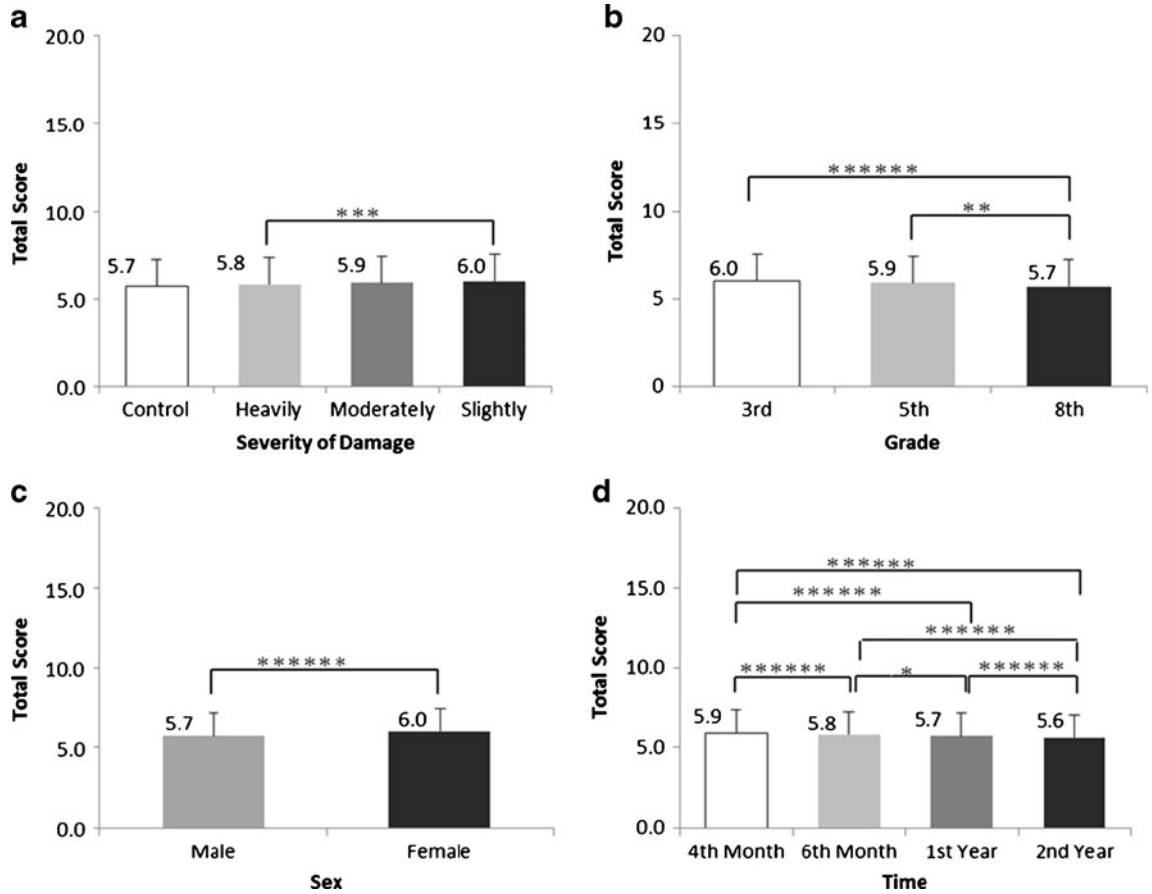

Fig. 4 Cluster analysis of the total scores of factor 3 (social responsibility) in terms of the extent of the disaster that the children experienced (**a**), the children's grade (**b**), their sex (**c**), and the length of time after the earthquake (**d**). Each class is handled as a unit and data are expressed as mean±SD; *$p<0.05$, **$p<0.01$, ***$p<0.005$, ****$p<0.001$, *****$p<0.0005$, ******$p<0.0001$

However, with regard to the extent of the disaster, statistically significant differences were observed only in heavily damaged areas. Moreover, the score at the sixth month was significantly higher than that at the fourth month ($p<0.0001$), and the score returned to the level of the fourth month at 2 years after the earthquake (Fig. 3d). Factor 2 was significantly associated with injuries of the children themselves ($p<0.0001$), fatalities/injuries of family members ($p<0.0001$) or friends ($p<0.0001$), and an experience of being rescued ($p<0.0001$) or staying in a shelter ($p<0.0001$). These results suggest that although factor 2 was directly related to the experience of the earthquake, it was modified by environmental changes.

Factor 3

Factor 3 was interpreted as relating to social responsibility, such as feelings of sympathy for the people who suffered most and guilt for surviving. The maximum score was 12 (achieved if all answers were "always").

As shown in Fig. 4, the total score of social responsibility was lowest in the heavily damaged areas (Fig. 4a). The score was significantly higher in the third and the fifth grade than in the eighth grade (Fig. 4b) and in females than in males (Fig. 4c). The score decreased over time as the effects of the disaster were being remedied (Fig. 4d). Factor 3 was significantly associated with injuries of the children themselves ($p<0.0001$) and fatalities/injuries of family members ($p<0.0001$).

Discussion

Disasters in urban areas have been shown to severely affect vulnerable members of society [7–9]: the elderly [2], the disabled, the women, and the children. After the Kobe earthquake, psychological care was needed to prevent suicides and alcohol dependency [9]. Privacy, income, jobs, and health were the major issues of concern at relief shelters. However, the effects of the earthquake on the mental health of children remain largely unknown.

The present survey was completed by 8,800 school-children in the disaster areas. The questionnaire was originally developed based on the findings about PTSD of

previous studies [4–6] and the information about PTSD in the Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV [3]. It was applicable to children and it quantitatively measured psychological reactions after traumatic stress. High scores on the questionnaire indicated that children had many symptoms related to PTSD. The validity of the questionnaire was also supported by our study that showed a highly significant correlation with scores on the General Health Questionnaire (GHQ; unpublished data). The GHQ has been used in various countries as a screening instrument to detect potential psychiatric problems or disorders including those observed in patients with diabetes mellitus [8] and anorexia nervosa [10] and in medical staff [11] after the Kobe earthquake.

Most research on PTSD has been based on criteria in the DSM-III or the DSM-III-R and has examined adults rather than children [12]. The effects of traumatic stressors such as warfare, criminal violence, burns, and serious accidents on children have only recently been studied. Rynoos et al. [13] reported the post-traumatic stress reactions in children after the Armenian earthquake in 1988. High rates of chronic, severe PTSD reactions were found among children in the most damaged cities. PTSD consists of re-experiencing the trauma through dreams and waking thoughts, persistent avoidance of reminders of the trauma and numbing of responsiveness to such reminders, and persistent hyperarousal [14]. However, the criteria for PTSD remain controversial [15]. Furthermore, problems occur in the application of the available criteria for PTSD to victims of natural disasters [16], to young children [17], and to those with different social and cultural backgrounds. Using the questionnaire, profound post-traumatic stress reactions in school-aged children, which were subdivided into three main factors, were clearly demonstrated. Factor 1 consisted of fear and anxiety, factor 2 of depression and physical symptoms, and factor 3 of social responsibility. These factors differed based on the extent of the disaster that the children experienced, their grade and sex, and the time of the survey. Greater earthquake damage to houses and family members was associated with more severe fear, anxiety, depression, or physical symptoms. Young schoolchildren and girls were especially vulnerable. In the Armenian earthquake, girls reported more persistent fears than boys [13]. Debate continues regarding whether children are more susceptible to the development of PTSD than adults [18] and about the association of PTSD with female gender [18,19]. It appears that younger schoolchildren do not have sufficient skills to cope with life-threatening traumatic stress. Gender differences may be due to a cultural background that facilitates strong emotional reactions in females [20] or to preexisting levels of anxiety in females [21]. Although fear and anxiety symptoms tended to lessen by 1 year after the earthquake, depression and physical symptoms became more evident 6 months to 1 year after the earthquake. Because psychic trauma in childhood frequently results in arrested emotional development [14], long-term psychological consequences are a serious concern. The consequences of psychic trauma are often underestimated and even mental health services often fail to provide adequate care [22]. In the Armenian earthquake, untreated adolescents who were exposed to severe trauma were at risk for chronic PTSD and depressive symptoms [23]. However, brief trauma/grief-focused psychotherapy was effective in reducing PTSD symptoms and halting the progression of depression [23].

The Kobe earthquake exposed serious flaws in the Japanese emergency services. The scale of the earthquake was beyond all expectations and the contingency plans for a large disaster proved to be inadequate [2]. On March 11, 2011, a magnitude 9.0 earthquake struck northeastern Japan but seismic risk assessments, tsunami preparedness, and the hardiness of the Fukushima Daiichi nuclear power plant did not meet expectations, and emergency plans were again inadequate. Even a highly organized and affluent society may come to a standstill when it experiences such a substantial disaster [2]. The need to revise earthquake probability analyses extends far beyond Japan [24].

The phenomenon of PTSD and the course of the illness may differ based on the nature of the traumatic events as well as in unique populations of individuals such as children [25]. The current study extracted and quantified the core features of the post-traumatic stress reactions in 8,800 schoolchildren after the disastrous Kobe earthquake. This study strongly indicates the need for the comprehensive treatment of child trauma victims, including medical and welfare treatment. Psychological interventions should be targeted toward young schoolchildren in regions affected by the recent earthquake.

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