

School-Based Interventions Aimed at the Prevention and Treatment of Adolescents Affected by the 2011 Great East Japan Earthquake: A Three-Year Longitudinal Study

Junko Okuyama,^{1,2} Shunichi Funakoshi,^{2,3} Hiroaki Tomita,⁴ Takuhiro Yamaguchi⁵ and Hiroo Matsuoka¹

¹Department of Psychiatry, Tohoku University Graduate School of Medicine, Sendai, Miyagi, Japan

²Miyagi Psychiatric Center, Natori, Miyagi, Japan

³Department of Community Psychiatric Medicine, Tohoku University Graduate School of Medicine, Natori, Miyagi, Japan

⁴Department of Disaster Psychiatry, International Research Institute of Disaster Science, Tohoku University, Sendai, Miyagi, Japan

⁵Division of Public Health and Forensic Medicine, Tohoku University, Sendai, Miyagi, Japan

How natural disasters affect the psychological state of adolescents has not been well studied. Thus, we examined the effect of a natural disaster on high-school-aged youth and considered the most effective forms of support following such a disaster. We examined students from two high schools that were near the epicenter of the 9.0-magnitude Great East Japan Earthquake, which struck the Tohoku coastal area on March 11, 2011, causing severe damage to the region. The questionnaires measuring depression, anxiety, and post-traumatic stress reaction (PTSR) was administered to the students 3 times between July 2012 and August 2014; students who scored above the cut-off values of these measures were considered high-risk students. School teachers, nurses, and counselors provided a school-based intervention for all high-risk students identified in the survey. Data were analyzed using the Kruskal-Wallis H-test. Survey data revealed that 860 of the 1,432 (55.9%) high school students were at high risk of psychological trauma in 2012. This rate did not change substantially in the following 2 years, reaching 1,059 of 1,488 (69.1%) in 2013, and 949 of 1,430 (62.7%) in 2014. Depression and PTSR scores were significantly lower after the intervention (for 2nd and 3rd grade students in 2013 and 2014) compared to before (for the initial 2012 survey). However, there were no significant differences between the 1st grade students for all three years. Thus, school-based interventions involving psychological testing and interviews might reduce the rates of depression and PTSR in high school students.

Keywords: disaster psychiatry; high school student; Japanese youth; school-based intervention; the Great East Japan Earthquake

Tohoku J. Exp. Med., 2017 July, **242** (3), 203-213. © 2017 Tohoku University Medical Press

Introduction

The Great East Japan Earthquake that occurred on March 11, 2011 was a large earthquake with a 9.0 magnitude on the Richter scale. The subsequent tsunami destroyed eastern coastal towns and villages in Japan (Fig. 1) (Ishigaki et al. 2013). This was one of the largest natural disasters in Japanese history, with more than 18,000 people reported dead or missing and more than 6,000 people injured (Tsuchiya et al. 2015). The catastrophic earthquake caused long-lasting depression and posttraumatic stress reaction (PTSR) among people in the affected areas.

At present, rather little is known of the mental health outcomes of adolescent following their exposure to natural

disasters. By contrast, there is substantial literature on the mental problem of the child following an earthquake, with post-traumatic stress disorder (PTSD) symptoms being the focus of most investigations (Okuyama et al. 2016a). These studies showed that children who experience a large-scale disaster tend to exhibit age-specific mental health problems, including separation anxiety or regression phenomena (Norris et al. 2002; Fujimori et al. 2011). An initial report on children's psychological reactions after a large natural disaster was published after the 1980 Italian Earthquake. By administering the Rutter Behavioral Questionnaire every month during a 1-year therapeutic intervention implemented 6 months after the earthquake, Galante and Foa (1986) showed that anxiety and fear in schoolchildren were

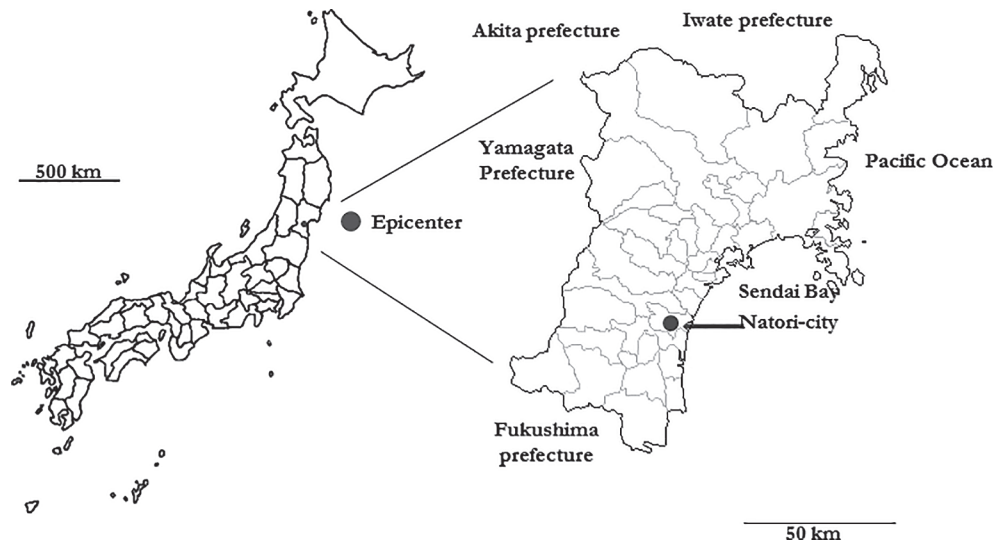


Fig. 1. The location of the epicenter of the Great East Japan Earthquake and Natori city.

(a) The epicenter of the Great East Japan Earthquake (circle) was under the Pacific Ocean, approximately 150 km east of the Miyagi Prefecture. (b) Natori city is located in the southern part of Sendai city.

significantly improved. Since this publication, the emotional disturbance of children has garnered more attention, and the increased frequency and severity of depression, anxiety and PTSR among children affected by disasters have been widely recognized. For example, the prevalence of PTSR among children who were victims of earthquake trauma ranges from 2.5% to 92% depending on the disaster and subject characteristics, assessment methods and PTSR criteria (Pynoos et al. 1993; Ma et al. 2011). Furthermore, the effects of post-disaster traumatic stress tend to persist for years with stable rates of elevated symptoms among affected children (Ye et al. 2014). Although there are fewer investigations of the effect of traumatic events caused by tsunamis on children than investigations of the effects of earthquakes, previous studies have indicated that traumatic events caused by tsunamis are significantly associated with depressive symptoms and PTSR among children. Thienkrua et al. (2006) found that 75% of 7- to 14-year-old children who changed their place of residence due to the 2004 Indian Ocean Tsunami showed evidence of PTSR. Usami et al. (2014a) and Iwadare (2013) reported the effects of the Great East Japan Earthquake on children between the ages of 6 and 15 years.

Adolescents exposed to the highly disruptive natural disaster are expected to need support, but there seems to be little establish support for them. The prevalence of psychological distress among Japanese high school students was found to range from around 10.7% (in 2007) to 7.6% (in 2013), and its related to household income, parental poor education, and single parenthood (Kachi et al. 2017). These rates suggest that it is rather common for Japanese high school student to experience psychological problems; however, standardized psychological test scores for this have not been determined.

The majority of disaster studies have focused on chil-

dren under the age of 15, whereas the transitional age from child to youth (i.e., between 15 and 18 years of age) has not been assessed in post-disaster mental health studies. Among children affected by the natural disasters, the rate of development of PTSD symptoms was proportional to the damage caused by the disaster (Uemoto et al. 2012; Usami et al. 2012) and the psychological status of their parents (Endo et al. 2007; Kiliç et al. 2003). Furthermore, girls' psychological status was more strongly affected by the disaster than boys (Kuwabara et al. 2014). This high-school-aged population is susceptible to developmental and psychological problems even in typical settings and can be particularly vulnerable to traumatic events and various environmental changes caused by a disaster.

Investigations of the influence of psychological interventions for children in post-disaster settings are limited compared with studies that assess the psychological impact of disasters. In intervention studies, the variety of strategies used in individual cases has been widely discussed, including psychotherapeutic techniques (Pfefferbaum et al. 2014) and psychosocial intervention (Chemtob et al. 2002). In a past study, the most effective intervention was affect modulation (with 69.8% of participants showing an improvement from pre- to post-intervention), followed by relaxation (65.1%; Pfefferbaum et al. 2014). Another intervention (Chemtob et al. 2002), which was guided by a manual and consisted of 4 weekly sessions, led to significant reductions in self-reported symptoms among children. By contrast, intervention strategies for the population-based management of children in post-disaster settings have rarely been investigated. Recently, the implementation of a specific school-based intervention called the School Therapeutic Enhancement Program (STEP) was introduced in a school district affected by Hurricane Katrina (Goldman et al. 2015). Berkowitz et al. (2011) reported the effectiveness of

a four-session, caregiver-child and caregiver-youth intervention to prevent the development of chronic posttraumatic stress disorder. These types of interventions require considerable numbers of staff members and specialists as well as significant financial resources. Thus, this type of thorough intervention system cannot be applied to typical communities affected by disasters because manpower and budgets tend to be smaller than necessary.

In the aftermath of the Great East Japan Earthquake, we researched the application of a school-based intervention system. We conducted a school-based survey to identify psychological high-risk groups of high school students during the three years following the Great East Japan Earthquake and tsunami. We also intervened in high-risk students by integrating ordinary local resources, such as their home room teachers, school nurses, and school counselors. The results demonstrate the need for psychological interventions for high school students within 3 years of a disaster.

Methods

Participants

Two of the three high schools in Natori city, which is located on the ocean side of the Miyagi prefecture, participated in three annual mental health surveys followed by psychological interventions (Ono et al. 2013; Funakoshi et al. 2014) (Fig. 2).

One of these high schools was referred to as High School A. High School A was hit by the tsunami on the afternoon of Friday, March 11, 2011, and all educational facilities and school equipment were destroyed. Classes resumed on May 9, 2011. The students and school staff were divided into three groups and relocated to spaces in three other high schools in the region. A total of 239 students across six classes, including three first-year classes for agricultural mechanical engineering and a gardening class for each of the first-, second- and third-year students, commuted on a 1.5-hour bus ride to temporary classroom facilities 60 kilometers from the destroyed high school. The 3-hour round trip included a regular curriculum consisting of 50-minute educational programs that utilized audiovisual materials aimed at minimizing motion sickness. The remaining students utilized public transportation to commute independently to two other distant classroom facilities located 26 km and 20 km from their origi-

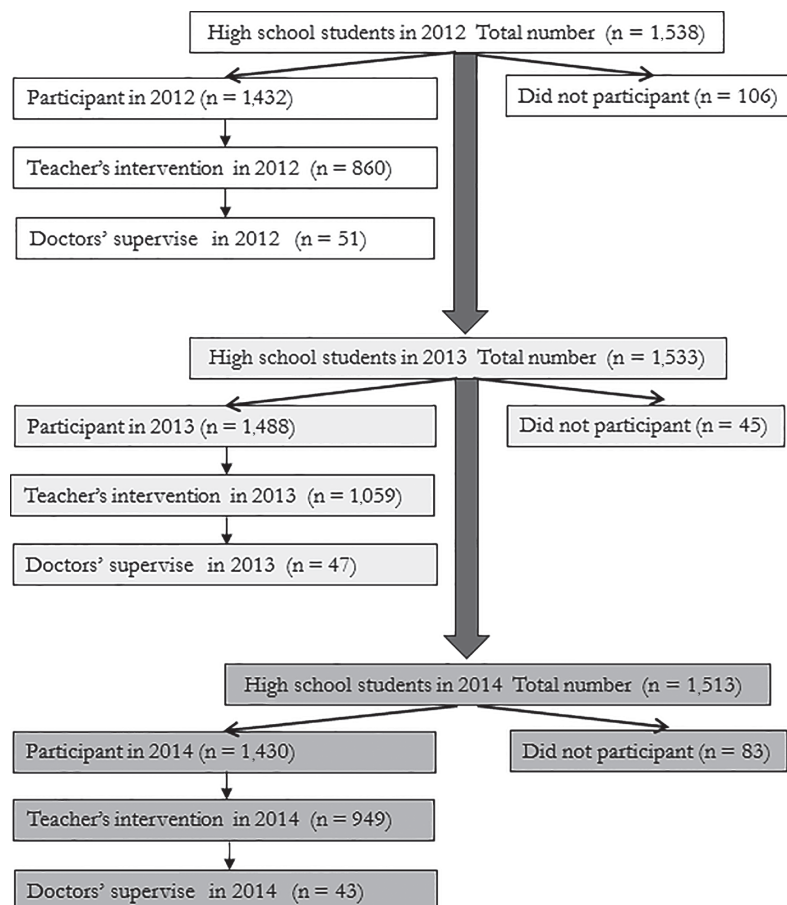


Fig. 2. The framework of the systematic psychosocial intervention for high school students affected by the Great East Japan Earthquake.

This figure illustrates the time frame for the intervention; the number of students at High Schools A and B; the number of participating students; the number of students who saw teachers, school nurses and/or school counselors (indicated as teacher intervention); and the number of students who underwent interviews with psychiatrists or consultations with school teachers and psychiatrists (indicated as doctor supervision).

nal high school. These conditions lasted until prefabricated classrooms were completed in an assigned location 10 km inland from the original school on September 1, 2011 (Okuyama et al. 2017).

The other high school, referred to as High School B, was located inland, and the damage to the school by the tsunami was minimal. The majority of the participating students who experienced the earthquake in the Miyagi prefecture, with a seismic intensity of approximately 6, shared disaster-related experiences directly and indirectly with members of the community and repeatedly witnessed the devastated area regardless of their assigned high school or grade level. The second- or third-year high school students who participated in the study in 2012 were present in the school during the time of the disaster. The first-year students who participated in the 2012 portion of the study experienced the disaster near the time of their junior high school graduation ceremony. First-year participants from the 2013 and 2014 portions of the study were completing their first and second years of junior high school programs at the time of the

disaster.

The demographic data, including high school profiles and study participant characteristics, are listed in Table 1. Students from the third high school in Natori city were not included in this study. After the students initially participated in the program, the school terminated their involvement due to a shortage of available personnel. Only around 695 of 832 (83.5%) of students from High School B provided us with information about whether they had suffered the loss of a family member or housing damage by the disaster. Students who had lost a family member or whose house was totally destroyed (such that they could not live in it any longer) were defined as the “serious damage” group. Their characteristics are shown in Table 2.

The ethics committees of the Miyagi Psychiatric Center and Hokkaido University approved the research protocols (Funakoshi et al. 2014). We initially explained the outline of our study and the procedure to the 2 high schools, after which, with the cooperation of Miyagi-ken School Board, we obtained the school’s consent to con-

Table 1. High school profiles and participant demographics.

High school A				High school B		
The distance from the coastline	0.5km			6km		
The distance from border of inundated area	-3.5km			2km		
Damaged on Schoolhouse	Severely devastated			Subtle		
School Year	2012	2013	2014	2012	2013	2014
The number of students	706	698	686	832	835	812
The number of subjects	671	660	618	758	828	810
(% participation)	(95.0%)	(94.6%)	(90.1%)	(91.5%)	(99.2%)	(98.2%)
Male subjects	419	406	369	306	369	353
(% male)	(62.4%)	(61.5%)	(60.0%)	(40.4%)	(44.6%)	(43.6%)
Female subjects	252	254	246	452	459	457
(% female)	(37.6%)	(38.5%)	(40.0%)	(59.6%)	(55.4%)	(56.4)

Characteristics of the high schools and students affected by the Great East Japan Earthquake in Miyagi, Japan, 2011-2013.

Table 2. The number of the High School B students who suffered serious damage by the disaster.

		not serious damage		serious damage	
		n	(%)	n	(%)
Total	Total	572	82%	123	18%
	Male	240	84%	47	16%
	Female	330	81%	76	19%
	Unsigned	2		0	
Grade 1	Total	174	78%	50	22%
	Male	79	81%	19	19%
	Female	95	75%	31	25%
	Unsigned	0		0	
Grade 2	Total	190	85%	33	15%
	Male	69	86%	11	14%
	Female	119	84%	22	16%
	Unsigned	2		0	
Grade 3	Total	208	84%	40	16%
	Male	92	84%	17	16%
	Female	116	83%	23	17%
	Unsigned	0		0	

duct this study. We sent the explanatory note (wherein we explained the purpose of methods of our study and asked for students' cooperation) and the questionnaire to the high schools. Teachers were recruited to distribute these documents to the students and parents. Only students who obtained their parents' consent were allowed to complete the questionnaire. In conducting this study, we gave full consideration to students' privacy and human rights, explained the following to both students and parents: 1) To ensure students' privacy, students were asked to write only their school registration number on the questionnaire, and that no personal information would be collected at any time by researchers. 2) Students had to decide of their own free will and obtain consent from their parents before they could participate in our investigation. 3) Students who did not want to cooperate did not have to submit any information or documentation to researchers. 4) Students who did not wish to cooperate would not be put at any disadvantage. 5) The outcomes of this study would be used only for publication of academic meeting announcements and scientific articles. Completing and returning the questionnaire was considered indicative of consent to participate.

Identification of individual students using the school registration numbers, which was necessary for the school-based intervention, was done only by the school teachers; the researchers involved in analyzing the survey only ever received anonymized information marked with the school registration numbers.

The Scientific Research Center for the Prevention of Health at Hokkaido University Graduate School performed the electronic information-orientedness of the questionnaires collected from each school. Furthermore, the Scientific Research Center for the Prevention of Health and Miyagi Psychiatric Center took charge of the analysis. Interpretation of the results and the data analysis were conducted at Miyagi Psychiatric Center; the Department of Psychiatry, Tohoku University Graduate School of Medicine; and the Department of Disaster Psychiatry, Tohoku University Graduate School of Medicine; and the Department of Disaster Psychiatry, International Research Institute of Disaster Science, Tohoku University.

Assessment of school-wide mental health needs

School-wide mental health needs assessments were conducted in two high schools over three years. All students who attended either of the two high schools during 2012-2014 were eligible to participate in the screening survey described in Fig. 2. The teachers of each high school class distributed a letter explaining the survey to all children and their caregivers. The letter clarified that the survey was voluntary and that completion of the questionnaire constituted consent from the students and their caregivers. In addition, the letter specified that the survey results would be used to provide children with psychological care aimed at facilitating their education and that the obtained data would be shared among the child psychiatry community and published in journals. The questionnaire was administered to the students during their homeroom period by their homeroom teacher. Thorough scripted instructions for the administration of the psychological assessment checklists were provided to the homeroom teachers. The checklists were placed in sealed envelopes by the participants and returned to the Miyagi Psychiatric Center. The survey results were shared with each school and used to guide the implemented interventions. Then, the obtained data were sent to Hokkaido University for digital conversion and subsequent analyses. The surveys were completed in July and August of 2012, 2013 and 2014. Of the 1,538, 1,533, and 1,513 students attending the two high schools, 1,432,

1,488, and 1,430 students (93.1%, 97.1%, and 94.5%, respectively) participated in the 2012, 2013 and 2014 surveys, respectively (Table 1).

Needs assessment survey tool

Three types of psychological tests were administered for all participants.

The Quick Inventory of Depressive Symptomatology (QIDS-J) is a 16-item checklist designed to assess depressive symptoms using a scale ranging from 0 to 27 (Rush et al. 2003). Subjects with scores greater than 11 are considered to be in a moderate to severe depressive state.

The Zung Self-Rating Anxiety Scale (SAS) consists of 20 assessment items, each of which is graded on a scale of 1-4 points (Zung et al. 1990). Subjects with an SAS score greater than the cut-off of 40 points are considered to have anxiety.

The Impact of Event Scale-Revised (IES-R) was used to assess subjective distress caused by the earthquake and tsunami in the high school students. On this scale, respondents were asked to indicate to what extent they were distressed within the past 7 days (Weiss 2007). It is a validated measurement of self-reported post-traumatic stress symptoms related to a specific traumatic event that occurred in the past 7 days. The IES-R includes 22 items to measure symptoms of intrusive memory, avoidance and numbing, and hyperarousal (Horowitz et al. 1979). Responders rate each item from zero ("not at all") to four ("very much"), resulting in a total score ranging from 0 to 88. Participants with an IES-R score greater than 25 are considered to be suffering from PTSD.

School staff

Homeroom teachers distributed the questionnaire to all students. Selected staff within each participating school (i.e., deputy principal, homeroom teachers, school nurses, and school counselors) took charge of the intervention. The teachers were supervised on a weekly basis by school nurses and on a monthly basis by school counselors and the adolescent psychiatrist at the Miyagi Psychiatric Center. Our decision to empower the staff to conduct the intervention was based on the previous research (Wolmer et al. 2003, 2005); we intend this to better assist the students with their psychological distress, thereby decreasing their symptoms and promoting school revitalization.

At students' or parents' behest, students with severe psychological state were referred to the psychiatrist at the Miyagi Psychiatric Center. Note that the two students who were referred to the psychiatric care center, we have described at the case report (Okuyama 2016b).

Intervention procedures

High-risk students requested certain interventions from their home room teachers, school nurses, or school counselors or met at least one of the following criteria: a QIDS-J score equal to or greater than 11; an SAS score equal to or greater than 40; or an IES-R score equal to or greater than 25. Among the high-risk individuals, students who had severe mental or behavioral problems, including truancy, or who requested an interview with a psychiatrist were referred to an adolescent psychiatrist at the Miyagi Psychiatric Center. Psychiatrists at the Miyagi Psychiatric Center who specialized in adolescent psychiatry provided consultation meetings once a month with the school teachers to follow up on student progress and conducted interviews with the students when needed.

Table 3. The characteristics of teacher interventions and supervision requirements of doctors based on the number of students beyond the cut-off value for each psychological test at High School A and High School B.

School year	2012 (<i>n</i> = 1538)	2013 (<i>n</i> = 1533)	2014 (<i>n</i> = 1513)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
The number of total subjects	1,432 (93.1)	1,488 (97.1)	1,430 (94.5)
High school A	671 (95.0)	660 (94.6)	618 (90.1)
High school B	761 (91.5)	828 (99.2)	812 (98.2)
The number of high-risk students who underwent follow-up interviews	860 (55.9)	1,059 (69.1)	949 (62.7)
High school A	375 (53.1)	444 (63.6)	404 (58.9)
High school B	485 (58.3)	615 (73.7)	545 (65.9)
The number of students with a QIDS-J score of equal to or greater than 11	239 (15.5)	198 (12.9)	175 (11.6)
The number of students with a SAS score of equal to or greater than 40	756 (49.2)	816 (53.2)	738 (48.8)
The number of students with an IES-R score of equal to or greater than 25	270 (17.6)	219 (14.3)	221 (14.6)
The number of students who were referred to adolescent psychiatrists	51 (3.6)	47 (3.2)	43 (3.0)
A high school	35 (5.0)	43 (6.2)	15 (2.2)
B high school	16 (1.9)	4 (0.5)	28 (3.4)

Data analyses

To determine the psychological changes within each student during the 3-year period studied and to evaluate the interventions, analyses were conducted for each high school based on the 3 types of psychological tests. Table 3 shows the number of students who underwent follow-up interviews and the number of students who had scores greater than the cut-off values for each of the main psychological tests. Respondents' mental health was compared according to their school and grade (Table 4). We further examined the effect of the interventions on students' psychological test results for all three years (Table 5).

All analyses were conducted using SPSS Statistics 22.0. The Kruskal-Wallis H-test was used to evaluate the chronological changes over the three years of observation and the changes following an intervention. Some students had incomplete data for the psychological tests; however, in comparison to the whole dataset, there was relatively little missing data. Therefore, we assumed for the statistical analyses that the data were missing completely at random, and did not substitute the missing data with mean scores.

Results

The number of high-risk students who underwent follow-up interviews for psychosocial support

All high-risk students with a QIDS-J score equal to or greater than 11, an SAS score equal to or greater than 40, an IES-R score equal to or greater than 25, or who requested interventions underwent follow-up interviews provided by their homeroom teacher, school nurse, or school counselor. The number of students who underwent follow-up interviews and the number of students who had a scores greater than the cut-off values set for any of the psychological tests are listed in Table 3 and are divided by school year. In 2012, 860 of 1,432 high school students

who participated in the intervention project (60.1%) met the high-risk criteria and underwent follow-up interviews. Similarly, 1,059 of 1,488 students (71.2%) and 949 of 1,430 students (66.4%) underwent follow-up interviews in 2013 and 2014, respectively. Within the high-risk group, 51 (3.6%), 47 (3.2%), and 43 (3.0%) students were referred to adolescent psychiatrists in 2012, 2013, and 2014, respectively (Table 3). Table 3 provides the profiles of the high-risk students in each high school. In High School A, 375 of 671 (55.9%) students, 444 of 660 (67.3%) students and 404 of 618 (65.4%) students underwent follow-up interviews in 2012, 2013 and 2014, respectively. In High School B, 485 of 761 (63.7%) students, 615 of 828 (74.3%) students and 545 of 812 (67.1%) students underwent follow-up interviews in 2012, 2013 and 2014, respectively. The numbers of High School A students who received interventions from a psychiatrist were 35 (5.0%), 43 (6.2%) and 15 (2.2%) in 2012, 2013, and 2014, respectively. The numbers of High School B students who received interventions from a psychiatrist were 16 (1.9%), 4 (0.5%) and 28 (3.4%) in 2012, 2013, and 2014, respectively.

Among all students from the two high schools, only 3 with severe psychological problems were referred to the Miyagi Psychiatric Center. The students received only psychotherapy without medication. Details on 2 of these students are reported in a case report in a previous case study (Okuyama et al. 2016b).

Psychological changes during the 3-year study period: comparison among the grades

Table 4 shows the results of analysis the effect of time on psychological test scores in students affected by the

Table 4. Comparison of the mental health of high school students in 2012, 2013 and 2014.

QIDS-J	School Year	2012			2013			2014			P value
		N	Mean	Sd	N	Mean	Sd	N	Mean	Sd	
Total	Total	1,299	6.42	4.96	1,384	5.77	4.44	1,404	5.28	4.33	0.01
	High School A	603	6.70	4.64	614	6.24	4.62	593	5.67	4.48	
	High School B	696	6.18	4.36	770	5.39	4.26	811	5.00	4.19	
Grade 1	High School A	209	6.16	4.42	207	6.14	4.87	231	5.96	4.48	0.769
	High School B	224	6.19	4.44	248	5.57	4.10	276	5.20	4.18	0.029
Grade 2	High School A	202	6.93	4.71	196	5.73	3.95	180	5.13	4.50	0.000
	High School B	223	6.02	4.22	259	5.29	4.07	269	4.85	4.24	0.001
Grade 3	High School A	192	7.05	4.77	211	6.79	4.88	182	5.85	4.45	0.029
	High School B	249	6.31	4.42	263	5.34	4.59	266	4.95	4.15	0.000

SAS	School Year	2012			2013			2014			P value
		N	Mean	Sd	N	Mean	Sd	N	Mean	Sd	
Total	Total	1,288	41.2	5.53	1,334	41.2	5.08	1,271	40.9	5.13	0.225
	High School A	598	40.8	6.12	570	40.4	5.56	538	40.6	5.46	
	High School B	690	41.6	4.96	764	41.7	4.61	733	41.1	4.87	
Grade 1	High School A	205	40.6	5.63	196	40.7	5.69	205	40.7	5.65	0.884
	High School B	235	41.1	4.76	257	42.0	4.92	255	41.2	5.27	0.042
Grade 2	High School A	201	41.2	6.85	181	39.8	4.60	165	40.7	5.91	0.425
	High School B	220	41.7	4.87	252	41.5	4.07	238	41.1	5.04	0.630
Grade 3	High School A	192	40.7	5.80	193	40.7	6.02	168	40.3	5.00	0.883
	High School B	235	41.9	5.21	255	41.5	4.79	240	40.9	4.24	0.090

IESR	School Year	2012			2013			2014			P value
		N	Mean	Sd	N	Mean	Sd	N	Mean	Sd	
Total	Total	1,432	13.0	15.6	1,488	11.2	15.0	1,430	10.6	14.8	0.01
	High School A	671	15.5	17.4	660	14.2	17.5	618	12.5	16.5	
	High School B	761	10.8	13.4	828	8.77	12.1	812	9.20	13.3	
Grade 1	High School A	233	13.3	16.2	233	15.5	16.0	231	14.4	17.1	0.873
	High School B	254	11.6	13.3	282	10.7	14.1	276	12.0	13.7	0.071
Grade 2	High School A	219	17.0	18.1	211	12.1	16.6	196	13.4	17.2	0.000
	High School B	242	11.0	13.7	272	7.32	9.50	270	9.25	13.3	0.014
Grade 3	High School A	219	16.4	17.7	216	17.0	19.5	191	9.32	14.5	0.071
	High School B	265	9.93	13.2	274	8.18	11.9	266	7.79	11.9	0.006

QIDS-J, Quick Inventory of Depressive Symptomatology; SAS, Zung Self-Rating Anxiety Scale; IES-R, Impact of Event Scale-revised.

disaster. The Kruskal-Wallis H-test, revealed that the QIDS-J and IES-R scores significantly decreased over the study period ($df = 2$, $P < 0.01$). Results of the Kruskal-Wallis test revealed no significant difference in the SAS scores for 3 years ($df = 2$, $P = 0.225$).

To determine whether these results illustrate change in the mental health status of high school students affected by disaster in general, we compared the changes in psychological test scores among students of same grades in High Schools A and B (which differed significantly in their degree of natural disaster-related damage). The results are shown in Table 4. We found no significant changes in the QIDS-J ($df = 2$, $P = 0.769$), SAS ($df = 2$, $P = 0.884$), or IESR scores ($df = 2$, $P = 0.873$) over the study period among the first-year students of High School A. However, for first-year students in High School B, the QIDS-J ($df = 2$, $P = 0.029$) and SAS ($df = 2$, $P = 0.42$) scores decreased over the study period. The IES-R scores of the first-year students from High School B, however, did not significantly change ($df = 2$, $P = 0.71$).

As for the psychological test scores of second-year

students in each study year, we found that the QIDS-J (High school A: $df = 2$, $P = 0.000$; High school B: $df = 2$, $P = 0.001$) and IES-R scores (High school A: $df = 2$, $P = 0.000$; High school B: $df = 2$, $P = 0.014$) significantly decreased over the study period in both schools. The SAS scores, however, did not significantly change in either school (High school A: $df = 2$, $P = 0.425$; High school B: $df = 2$, $P = 0.630$).

For third-year students, the QIDS-J (High school A: $df = 2$, $P = 0.029$; High school B: $df = 2$, $P = 0.000$) and IES-R scores (High school A: $df = 2$, $P = 0.071$; High school B: $df = 2$, $P = 0.006$) of both schools significantly decreased over the 3 years. Again, the SAS scores did not significantly change in either school (High school A: $df = 2$, $P = 0.883$; High school B: $df = 2$, $P = 0.090$).

Chronological changes in mental health during the intervention program with students who entered high school in 2012 and 2013

To examine the program's efficacy, the mental health of participants who started the intervention program as first-

Table 5. Longitudinal changes in the psychological condition of high school students.

High School A	N	The number of students intervened (%)	QIDS-J			SAS			IES-R		
			Mean	Sd	The number of students of score equal or more than 11 (%)	Mean	Sd	The number of students of score equal or more than 40 (%)	Mean	Sd	The number of students of score equal or more than 25 (%)
2012 (Grade 1)	233	124 (53.2)	6.17	4.41	33 (14.2)	40.6	5.62	107 (45.9)	13.3	16.2	44 (18.9)
2013 (Grade 2)	211	105 (49.8)	5.73	3.94	25 (11.8)	39.8	4.59	88 (41.7)	12.1	16.6	40 (19.0)
2014 (Grade 3)	191	99 (51.8)	5.85	4.44	31 (16.2)	40.3	4.99	84 (44.0)	9.32	14.5	22 (11.5)
P value			0.243			0.643			0.004		

High School B	N	The number of students intervened (%)	QIDS-J			SAS			IES-R		
			Mean	Sd	The number of students of score equal or more than 11 (%)	Mean	Sd	The number of students of score equal or more than 40 (%)	Mean	Sd	The number of students of score equal or more than 25 (%)
2012 (Grade 1)	254	154 (60.6)	6.19	4.42	34 (13.4)	41.1	4.74	145 (57.1)	11.6	13.3	36 (14.2)
2013 (Grade 2)	272	172 (63.2)	5.46	4.09	30 (11.0)	41.6	4.07	166 (61.0)	7.37	9.54	15 (5.5)
2014 (Grade 3)	266	160 (60.2)	5.01	4.18	31 (11.7)	40.9	4.26	147 (55.3)	7.72	11.7	25 (9.4)
P value			0.005			0.263			0.000		

QIDS-J, Quick Inventory of Depressive Symptomatology; SAS, Zung Self-Rating Anxiety Scale; IES-R, Impact of Event Scale-revised.

year students in 2012 was compared with re-evaluations in 2013 and 2014 after the students had undergone one or two years of intervention, respectively (Table 5).

Between-year differences in the median QIDS-J scores of High School B were evident according to the results of a Kruskal–Wallis H-test. This indicated that at least one of the years had a significantly different median ($P=0.005$). Post hoc pairwise comparisons revealed that the 2014 score was only statistically significant from the 2012 and 2013 scores.

Between-year difference in the median IES-R scores for High School A were also evident ($P = 0.004$). Post hoc pairwise comparisons revealed that the 2014 score significantly differed from the 2012 scores. We also observed between-year differences in the median IES-R scores for High School B ($P = 0.000$), and post hoc comparisons indicated that the 2012 score was significantly differed from both the 2013 and 2014 scores.

Discussion

Our analysis of the baseline mental health of first-year high school students affected by the Great East Japan Earthquake indicated that the psychological symptoms of these students, especially anxiety and post-traumatic stress reactions, did not improve two or three years after the earthquake when compared with their symptoms from one year after the disaster.

A previous study reported that 60.1% of high school students who experienced a disaster needed psychological

interventions (Funakoshi et al. 2014). That study showed that 71.2% and 66.4% of high school students exhibited symptoms of depression, anxiety, or post-traumatic stress two and three years after the disaster, respectively. The authors also suggested that the majority of youths with traumatic symptoms resulting from disasters, such as a massive earthquake, may not recover within three years. However, Usami et al. (2014b) showed that the baseline PTSSC-15 (a self-completion questionnaire on traumatic symptoms) scores of younger children (kindergarteners and first- to third-grade elementary school students) who participated in the survey 20 months after the Great East Japan Earthquake were significantly lower than those who participated in the survey 8 months after the disaster. Therefore, the psychological symptoms that occur in youth and adolescent survivors may last longer than those that occur in children.

Evaluation of interventions for depression, anxiety and PTSD based on longitudinal data

The mental health status of first-year students in the two high schools in 2012, 2013 and 2014 were compared to evaluate baseline alterations in the mental health conditions of students who had not undergone the interventions (Table 5).

To evaluate the effects of the interventions, baseline variables that were independent to the intervention, including the natural recovery of mental health, as well as QIDS-J-based depressive states, SAS-based anxiety states, and IES-R-based PTSD, were evaluated (Table 4). The results

indicated that the baseline mental health status of first-year high school students prior to the interventions was equivalent over the observation period (2012-2014).

Table 4 indicate that the PTSR of high school students responded to at least two years of intervention. The depressive symptoms showed noticeable improvement in students who entered High School A and High School B in 2012. Although only the High School B had an improvement in depressive symptoms with significant difference, for three years. By contrast, high school students with anxiety did not respond to the interventions. The anxiety experienced by high school students may depend on a wide range of factors that are not restricted to the disaster but that reflect more inevitable and essential aspects of high school, including proceeding to the next stage of their education or career. The data suggest that PTSR and depressive symptoms can be used as outcome indicators for post-disaster interventions for adolescents.

Feasibility of school-based interventions

Schools can be an optimal location for psychiatric teams to support children and youths who are affected by traumatic events (Langley et al. 2015). Chemtob et al. (2002) found reductions in reports of trauma-related symptoms in children following treatment, suggesting that interventions provided by therapists are effective. A previous report demonstrated the efficiency of a school-based post-disaster intervention system for youths called STEP (Goldman et al. 2015). However, the STEP intervention requires considerable numbers of staff members and specialists as well as significant financial resources. Such a thorough intervention system cannot be applied to communities affected by disasters that have limited manpower and a small budget. In the current study, we introduced a more concise, school-based post-disaster intervention system that integrated local personnel involved in high school education and mental health care prior to the earthquake. Goldman et al. (2015) reported similar results, showing that depressive symptoms improved after intervention. These authors did not assess anxiety or PTSR; thus, we cannot further compare our intervention effects with those of the previous study. In our study, the chronological changes in mental health indicators suggest certain levels of intervention efficiency. The type of intervention utilized may empower teachers to play a key role in crisis management in the affected area. Schoolteachers who are assigned a proactive role in crises would likely play an effective role, particularly with the support and cooperation of mental health workers, including child psychiatrists. Our study supports the effectiveness of school-based interventions of high school students following disasters. Establishment of empowerment program of the high school teachers who intervention to the students affected by natural disaster is needed.

Study limitations

This study's main limitation is the lack of baseline information concerning high school student's psychological functioning. This information would have facilitated the comparison of symptoms with regard to both pre- and post-suffering of the disaster and to intervention-control baseline differences. Although assessing the symptom levels of youths before traumatic exposure may provide valuable information, the implementation of this type of assessment is complex and requires awareness and flexibility within the education system. By using a large sample and following annual changes within a student group, we attempted to overcome the lack of baseline data and assumed that pre-exposure and pre-intervention symptoms levels were comparable.

A second limitation is the lack of information from additional sources, such as parents or other family members, whose observations of the high school students' adaptations may add important information on student functioning in addition to pathological responses. Reports from teachers or the addition of family investigations in a sample of youths would increase the validity of the assessment. Unfortunately, the conditions under which this study was implemented (disaster rehabilitation was still occurring in the area) required us to obtain the information by utilizing the resources of the high school.

Furthermore, this study only represented high school students who agreed to a psychological distress assessment. Some students may have been affected by severe psychological conditions that prevented their participation in the assessment and intervention system. Moreover, the influence of the experimenter's behavior, personality traits, or expectancies on the results of his or her psychological score. The assessment data were shared with school teachers, which potentially alienated a portion of the students who did not want their psychological conditions known to teachers. Additionally, the study included only two schools from a large number of high schools affected by the Great East Japan Earthquake.

Finally, the present study did not assess previous cumulative traumatic experiences and types of exposure. Previous studies have shown that teacher-based interventions performed after a disaster are less effective in children with multiple previous traumas. These children might require a combined universal specific approach (Wolmer et al. 2003, 2011). Future studies are needed to elucidate whether such vulnerability is also relevant to a preventive approach.

Acknowledgments

We really appreciate high school students, their parents and school staffs affected by the Great East Japan Earthquake. We also are grateful for assistance given by Professor Kenzo Denda and Assistant Professor Takao Inoue, department of health science, school of medicine, Hokkaido University.

Conflict of Interest

The authors declare no conflict of interest.

References

- Berkowitz, S.J., Stover, C.S. & Marans, S.R. (2011) The Child and Family Traumatic Stress Intervention: secondary prevention for youth at risk of developing PTSD. *J. Child Psychol. Psychiatry*, **52**, 676-685.
- Chemtob, C.M., Nakashima, J.P. & Hamada, R.S. (2002) Psychosocial intervention for postdisaster trauma symptoms in elementary school children: a controlled community field study. *Arch. Pediatr. Adolesc. Med.*, **156**, 211-216.
- Endo, T., Shiroki, T., Toyabe, S., Akazawa, K., Someya, T. & Someya, T. (2007) Parental mental health affects behavioral changes in children following a devastating disaster: a community survey after the 2004 Niigata-Chuetsu earthquake. *Gen. Hosp. Psychiatry*, **29**, 175-176.
- Fujimori, K., Tanaka, K., Usami, M. & Kasahara, M. (2011) Children's experience in the natural disaster. *Trauma. Stress*, **9**, 165-171 (in Japanese).
- Funakoshi, S., Ohno, T., Kodaka, A., Okuyama, J., Honda, N., Inoue, T., Miyajima, M., Tomita, H., Denda, K. & Matsuoka, H. (2014) Factors associated with the psychological impact of the Great East Japan Earthquake on high school students 1 year and 4 months after the disaster. *Seishin Shinkeigaku Zasshi*, **116**, 541-554 (in Japanese).
- Galante, M.A. & Foa, D. (1986) An epidemiological study of psychic trauma and treatment effectiveness for children after a natural disaster. *J. Am. Acad. Child Psychiatry*, **25**, 357-363.
- Goldman, E.E., Bauer, D., Newman, D.L., Kalka, E., Lochman, J.E., Silverman, W.K., Jensen, P.S., Curry, J., Stark, K., Wells, K.C. & Bannon, W.M. (2015) A school-based post-Katrina therapeutic intervention. *Adm. Policy Ment. Health*, **42**, 363-372.
- Horowitz, M., Wilner, N. & Alvarez, W. (1979) Impact of Event Scale: a measure of subjective stress. *Psychosom. Med.*, **41**, 209-218.
- Ishigaki, A., Higashi, H., Sakamoto, T. & Shibahara, S. (2013) The Great East-Japan Earthquake and devastating tsunami: an update and lessons from the past Great Earthquakes in Japan since 1923. *Tohoku J. Exp. Med.*, **229**, 287-299.
- Iwadare, Y. (2013) A follow up survey of children after the 2011 Japan earthquake and tsunami. *Jpn. Bull. Soc. Psychiat.*, **22**, 340-345 (in Japanese).
- Kachi, Y., Abe, A., Ando, E. & Kawada, T. (2017) Socioeconomic disparities in psychological distress in a nationally representative sample of Japanese adolescents: a time trend study. *Aust. NZ J. Psychiatry*, **51**, 278-286.
- Kiliç, E.Z., Özgüven, H.D. & Sayil, I. (2003) The psychological effects of parental mental health on children experiencing disaster: the experience of Bolu earthquake in Turkey. *Fam. Process*, **42**, 485-495.
- Kuwabara, H., Araki, T., Yamasaki, S., Ando, S., Kano, Y. & Kasai, K. (2014) Regional differences in post-traumatic stress symptoms among children after the 2011 tsunami in Higashi-Matsushima, Japan. *Brain Dev.*, **37**, 130-136.
- Langley, A.K., Gonzalez, A., Sugar, C.A., Solis, D. & Jaycox, L. (2015) Bounce back: effectiveness of an elementary school-based intervention for multicultural children exposed to traumatic events. *J. Consult. Clin. Psychol.*, **83**, 853-865.
- Ma, X., Liu, X., Hu, X., Qiu, C., Wang, Y., Huang, Y., Wang, Q., Zhang, W. & Li, T. (2011) Risk indicators for post-traumatic stress disorder in adolescents exposed to the 5.12 Wenchuan earthquake in China. *Psychiatry Res.*, **189**, 385-391.
- Norris, F.H., Friedman, M.J., Watson, P.J., Byrne, C.M., Diaz, E. & Kaniasty, K. (2002) 60,000 disaster victims speak: part I. An empirical review of the empirical literature, 1981-2001. *Psychiatry*, **65**, 207-239.
- Okuyama, J., Funakoshi, S. & Honda, N. (2016a) A review of psychological reactions to catastrophic earthquake in children and adolescents. *Jpn. J. Child Adolesc. Psychiatr.*, **57**, 183-194.
- Okuyama, J., Funakoshi, S., Honda, N. & Kodaka, A. (2016b) About the school absenteeism of high school students who experienced the Great East Japan Earthquake. *Jpn. J. Psychiatr. Treat.*, **31**, 645-649 (in Japanese).
- Okuyama, J., Funakoshi, S., Tomita, H., Yamaguchi, T. & Matsuoka, H. (2017) Mental health and school-based intervention among adolescent exposed to the 2011 Great East Japan Earthquake and tsunami. *Int. J. Disaster Risk Reduct.*, **24**, 183-188.
- Ono, T., Funakoshi, S., Kakuto, Y., Taniguchi, H., Takamatsu, K., Nomura, R., Yokokawa, N., Saitou, K., Kayama, A., Ishiguro, N., Omuro, N., Katsura, M., Hamaie, Y., Kodaka, A., Matsumoto, K. & Matsuoka, H. (2013) Natori EI Project: the early intervention project for psychiatric disorders by the Miyagi Psychiatric Center. *Seishin Shinkeigaku Zasshi*, **115**, 147-153 (in Japanese).
- Pfefferbaum, B., Sweeton, J.L., Nitiéma, P., Noffsinger, M.A., Varma, V., Nelson, S.D. & Newman, E. (2014) Child disaster mental health interventions: therapy components. *Prehosp. Disaster Med.*, **29**, 494-502.
- Pynoos, R.S., Goenjian, A., Tashjian, M., Karakashian, M., Manjikian, R., Manoukian, G., Steinberg, A.M. & Fairbanks, L.A. (1993) Post-traumatic stress reactions in children after the 1988 Armenian earthquake. *Br. J. Psychiatry*, **163**, 239-247.
- Rush, A.J., Trivedi, M.H., Ibrahim, H.M., Carmody, T.J., Arnow, B., Klein, D.N., Markowitz, J.C., Ninan, P.T., Kornstein, S., Manber, R., Thase, M.E., Kocsis, J.H. & Keller, M.B. (2003) The 16-Item Quick Inventory of Depressive Symptomatology (QIDS), clinician rating (QIDS-C), and self-report (QIDS-SR): a psychometric evaluation in patients with chronic major depression. *Biol. Psychiatry*, **54**, 573-583.
- Thienkrua, W., Cardozo, B.L., Chakkraband, M.L., Guadamuz, T.E., Pengjuntr, W., Tantipiwatanaskul, P., Sakornsatian, S., Ekassawin, S., Panyayong, B., Varangrat, A., Tappero, J.W., Schreiber, M. & van Griensven, F. (2006) Symptoms of post-traumatic stress disorder and depression among children in tsunami-affected areas in southern Thailand. *JAMA*, **296**, 549-559.
- Tsuchiya, M., Aida, J., Hagiwara, Y., Sugawara, Y., Tomata, Y., Sato, M., Watanabe, T., Tomita, H., Nemoto, E., Watanabe, M., Osaka, K. & Tsuji, I. (2015) Periodontal disease is associated with insomnia among victims of the Great East Japan Earthquake: a panel study initiated three months after the disaster. *Tohoku J. Exp. Med.*, **237**, 83-90.
- Uemoto, M., Asakawa, A., Takamiya, S., Asakawa, K. & Inui, A. (2012) Kobe earthquake and post-traumatic stress in school-aged children. *Int. J. Behav. Med.*, **19**, 243-251.
- Usami, M., Iwadare, Y., Kodaira, M., Watanabe, K., Aoki, M., Katsumi, C., Matsuda, K., Makino, K., Iijima, S., Harada, M., Tanaka, H., Sasaki, Y., Tanaka, T., Ushijima, H. & Saito, K. (2012) Relationships between traumatic symptoms and environmental damage conditions among children 8 months after the 2011 Japan Earthquake and Tsunami. *PLoS One*, **7**, e50721.
- Usami, M., Iwadare, Y., Kodaira, M., Watanabe, K., Ushijima, H., Tanaka, T., Harada, M., Tanaka, H., Sasaki, Y. & Saito, K. (2014a) Did parents teachers struggle with child survivors 20 months after the 2011 Earthquake and Tsunami in Japan? A retrospective observational study. *PLoS One*, **9**, e96459.
- Usami, M., Iwadare, Y., Watanabe, K., Kodaira, M., Ushijima, H., Tanaka, T., Harada, M., Tanaka, H., Sasaki, Y. & Saito, K. (2014b) 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.
- Weiss, D.S. (2007) The impact of event scale: revised. In *Cross-cultural assessment of psychological trauma and PTSD*, edited by Wilson, J.P. & Tang, C.S.K. Springer, New York, pp. 219-238.
- Wolmer, L., Hamiel, D. & Laor, N. (2011) Preventing children's posttraumatic stress after disaster with teacher-based intervention: a controlled study. *J. Am. Acad. Child Adolesc. Psychiatry*, **50**, 340-348.
- Wolmer, L., Laor, N., Dedeoglu, C., Seiv, J. & Yazgan, Y. (2005) Teacher-mediated intervention after disaster: a controlled three-year follow-up of children's functioning. *J. Child Psychol. Psychiatry*, **46**, 1161-1168.
- Wolmer, L., Laor, N. & Yazgan, Y. (2003) School reactivation programs after disaster: could teachers serve as clinical mediators? *Child Adolesc. Psychiatr. Clin. N. Am.*, **12**, 363-381.
- Ye, Y., Fan, F., Li, L. & Han, Q. (2014) Trajectory and predictors of depressive symptoms among adolescent survivors following the Wenchuan earthquake in China: a cohort study. *Soc. Psychiatry Psychiatr. Epidemiol.*, **49**, 943-952.
- Zung, W.W., Magruder-Habib, K., Velez, R. & Alling, W. (1990) The comorbidity of anxiety and depression in general medical patients: a longitudinal study. *J. Clin. Psychiatry*, **51**, 77-80.
-