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Article

Trends in psychological distress and alcoholism after The Great East Japan Earthquake of 2011

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ABSTRACT

Aims: Many studies have shown that natural disasters affect mental health; however, longitudinal data on post-disaster mental health problems are scarce. The aims of our study were to investigate the trend in psychological distress and alcoholism after The Great East Japan Earthquake and tsunami in north eastern Japan, in March 2011.

Methods: A longitudinal study was conducted using annual health check data for the general population, in the city of Higashi-Matsushima, which was affected by the high impact of tsunami. In 2012 and 2013, the Kessler Psychological Distress Scale and the CAGE questionnaire (for screening for alcoholism) were used to assess psychological distress and prevalence of alcoholism.

Results: Of 11,855 total eligible residents, 2192 received the annual check in 2012 and 2013. The prevalence of mental illness and the mean score of alcoholism tendency increased during the follow-up period. The majority of respondents (43.8%) with baseline serious mental illness (SMI) continued to have SMI at follow-up; only 16.7% reported recovering. Older age, female sex, and severity of home damage predicted higher psychological distress, while male sex was a risk factor for alcoholism at follow-up.

Conclusions: Psychological distress deteriorated 2 years after the huge natural disaster, compared with 1 year after the disaster. Long-term mental health care is needed for those affected by natural disasters, particularly those who have suffered loss.

Introduction

On March 11th, 2011, at 2:46 p.m., an earthquake with a magnitude of 9.0 on the Richter scale-now referred to as the Great East Japan Earthquake-affected the Pacific coast of north eastern Japan. The earthquake triggered a huge tsunami over 15 m in height that struck the Fukushima-Daiichi nuclear power plant. The number of people dead and missing as a result of the triple disaster (earthquake, tsunami, and nuclear accident) totalled more than 18,450 (Suzuki & Kim, 2012). Many people in northeast Japan suffered from long-term distress caused by the damage from the earthquake. The majority of support for the unaffected areas ended within a year after the disaster, and long-term mental health support for people in affected areas has been scarce (Fig. 1).

Previous studies have indicated there is a high prevalence of mental health problems, such as depression, after natural disasters (Tang, Liu, Liu, Xue & Zhang, 2014). The recent reports on survivors of the Great East Japan Earthquake have shown that loss of pleasure in life, change in working status, property loss, relocation, and loss of family members due to the disaster had adverse impact on mental health (Furukawa, Takeuchi, Yano & Muto, 2016; Ando et al., in press). A few multi-wave studies, with large samples, have shown different patterns of the prevalence of mental health problems after natural disasters, at different time points (i.e. increase, decrease, and no change) (Cerdá et al., 2013; Chou et al., 2007; Kessler et al., 2008; Osofsky et al., 2011; Pietrzak et al., 2012; Tsai et al., 2007). The long-term trend of psychological distress of affected residents affected by serious natural disasters has been unclear because of the small number of studies with

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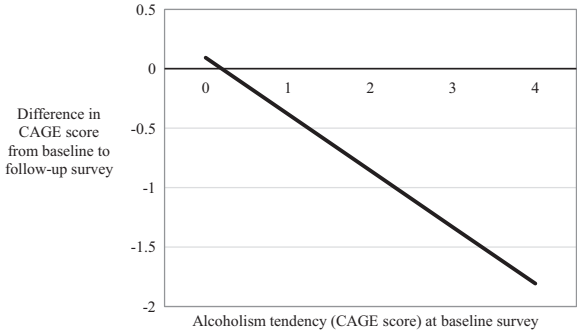

Fig. 1. Change of alcoholism tendency from baseline to follow-up survey (the line for those with mean score for each variable in Table 5).

large sample populations (Norris, 2006). Additionally, to the best of our knowledge, there have been no studies investigating the long-term trends of both psychological distress and alcohol use after natural disasters. It has been reported that substance abuse increases following natural disasters (Boscarino, Adams & Galea, 2006), and one study in affected communities after bushfires in Australia showed that the prevalence of heavy drinking was higher in highly affected areas compared with less affected areas (Bryant et al., 2014). Psychological disorders, including depression and anxiety, were generally associated with a high level of alcohol use which may be the norm prior to a natural disaster (Boschloo et al., 2013; Kessler et al., 1997). Therefore, long-term trends of psychological distress and alcohol use after disasters should be investigated concurrently.

The lack of longitudinal studies may be partly attributed to ethical issues and the feasibility of conducting research after natural disasters. One article highlighted that participants in post-disaster research with mental illness in need of treatment should be referred to clinical care (Ferreira, Buttell & Ferreira, 2005). From the acute phase, immediately post-earthquake, until the present day, we have continuously supported the mental health services of the city of Higashi-Matsushima in northeast Japan, which the earthquake and tsunami severely affected (Araki, Kuwabara, Ando & Kasai, 2014; Kuwabara et al., 2015). We collaborated with the city of Higashi-Matsushima government and the public health centre, and have continued follow-up support for annual health checks to identify people at risk and in need of care. The aims of this study were to investigate the trends in psychological distress and alcoholism in the general population in the affected area, after the earthquake in 2011, and to examine factors predicting mental health problems, using data from two annual mental health check surveys.

Methods

Study design

A longitudinal cohort study using data from two annual health checks was conducted in Higashi-Matsushima. The baseline health check was conducted in 2012, and the follow-up health check was conducted in 2013.

Participants

Data were collected during annual health checks for residents aged 19 years or older, who enrolled in the national health insurance scheme in Higashi-Matsushima in north-east Japan. The city is located on the coast, and 65% of the area was flooded by the tsunami in 2011. More than 1000 of 40 000 residents in the city lost their lives to the disaster. The annual mental health check was initiated for the residents from 2012 as part of a collaborative effort with Higashi-Matsushima city to identify residents at risk and in need of mental health care. This study was approved by the Ethical Committee, Faculty of Medicine, The University of Tokyo [Approval no. 3583-(2)] and Tokyo Metropolitan Institute of Medical Science [Approval no. 14–21]. Requirement for informed consent was waived by the Ethics Committee of the Faculty of Medicine, The University of Tokyo. Instead, we publicized the use of the survey data for the purpose of this study on our research team web page (Department of Youth Mental Health). The use of anonymous data for research was clearly stated on the cover of the health check questionnaire in 2013, providing people with the opportunity to be excluded from the study.

Data collection

Data were collected using self-reported questionnaires. An invitation letter and questionnaire was delivered to residents of Higashi-Matsushima who were eligible for the health check. Those who received the health check filled in the questionnaire and returned it to the health check venue.

Measures

Psychological distress was assessed using the Kessler Psychological Distress Scale (K6) score of nonspecific psychological distress, to screen for the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM IV) anxiety-mood disorders during the last 30 days (Kessler et al., 2002). A score of 8–12 was classified as mild to moderate mental illness (MMI) and 13–24 as serious mental illness (SMI). It should be noted that, in our study, SMI is defined by scores on K6 measuring anxiety and depression and does not mean the diagnosis of schizophrenia or bipolar disorder.

People who scored higher than 20 at the baseline survey were followed-up at least once by telephone and/or a visit by community health nurses in the public health centre. Probable alcoholism was defined as those who scored two or more in the CAGE questionnaire (a mnemonic for attempts to Cut back on drinking, being Annoyed at criticisms about drinking, feeling Guilty about drinking, and using alcohol as an Eye opener) (Ewing, 1984). Dichotomous questions were used to address four types of current sleep disturbance problems, including difficulty in getting to sleep, nocturnal awakening, early morning awakening, and insufficient sleep (changed to daytime sleepiness on the 2013 survey).

Covariates

Data were also collected to control for potential confounding factors: age; sex; living status (alone, with family) and home damage (total collapse, major collapse, half collapse, partial damage and no damage). Additionally, intention to seek help was assessed by a dichotomous question: ‘Do you want a consultation about your mental health?’ People who intended to seek help were followed-up at least once by telephone and/or a visit by community health nurses in the public health centre.

Statistical analysis

Since the objective of this study was to examine the mental health of residents between 2012 and 2013, the analysis focused mental health-related data for individuals who had health checks in both 2012 and 2013. Prevalence of mental illness, alcoholism, and sleep disturbance between the baseline and follow-up surveys were compared using within-respondent paired comparison tests (McNemar's test and Wilcoxon signed-rank test). We examined patterns of onset, recovery, and persistence of SMI and alcoholism using cross tabulations (chi-square test). Multivariate linear regression analysis was conducted to examine factors predicting mental distress and alcoholism. Since the number of independent variables (in addition to covariates) is rela-

tively large in this analysis, unstable parameter estimates and improper solutions were expected to be observed when we apply mixed-effects model (and note that even in this model we believe controlling psychological distress and alcoholism tendency at first visit is much more desirable to better clarify the causal effects from independent variables). Thus, we did not choose to use mixed-effects model in our research. The variance inflation factor (VIF) analysis was conducted to investigate multicollinearity of independent factors. The significance level was set at $P < 0.05$. All statistical analyses were conducted in IBM SPSS Statistics Version 22.

Results

A total of 11,855 residents were invited for the health checks in 2012, of which 3515 participated. The mean age was 64.6 years (standard deviation (SD) 13.2), and 54.9% of participants were female. In 2013, a total of 11,349 residents were invited for the health check, and 4121 participated. For those who had the health check in 2013, the mean age was 64.1 years (SD 14.0), and 56.3% were female. Of the 3515 people who received the health check in 2012, 2192 people received the health check in 2013, giving a follow-up rate of 62.4%. When comparing the baseline data of individuals who were followed up in 2013 and those who were lost to follow-up, those who were followed up in the 2013 health check were older and were more likely to have no damage to their homes ($P < 0.001$). Additionally, those who were followed up had lower psychological distress and lower proportion of probable alcoholism ($P < 0.001$ and $P = 0.040$, respectively) in 2012. There were no difference in the proportion of females, living status (living alone or not), prevalence of sleep disturbance, and help-seeking behaviour between those who were lost to follow up and those who were included in the study. This study includes only those who took both annual health checks, and their demographic data are presented in Table 1. The mean age was 65.9 years (range 20 to 90 years, median 68 years) and 53.6% were female. Approximately 90% of the participants reported their homes suffered from more than partial destruction.

The prevalence of mental illness, alcoholism, and sleep disturbances are shown in Table 2. The prevalence of mental illness (serious mental illness and mild-moderate mental illness) increased during the follow-up period ($P < 0.001$). The prevalence of sleep disturbance (for problems getting to sleep, and for other types of sleep disturbances) also increased during the follow-up period (P=0.020, and $P < 0.001$, respectively). The prevalence of alcoholism did not significantly increase during the follow-up period (P=0.149), but the mean CAGE score increased during the follow-up period, from a mean of 0.14 ± 0.43 in 2012, to a mean of 0.17 ± 0.46 in 2013 (P=0.011).

Decomposition of estimated prevalence of anxiety-mood disorders and probable alcoholism between the two surveys are shown in Table 3. A large proportion of individuals with SMI at follow-up either already had SMI at baseline (30.0%) or progressed from baseline MMI (40.0%).

Table 1
Demographic characteristics of the participants in the study (N=2192).

	N (*mean*)	% (*SD*[a])
Age	(*65.9*)	(*11.8*)
Sex (female)	1175	53.6
Living alone	196	9.2
Home damage		
Total collapse	749	36.2
Major collapse	447	21.6
Half collapse	495	23.9
Partial collapse	118	5.8
No damage	262	12.7

[a] Standard deviation.

Table 2
Trends in the estimated prevalnece of anxiety-mood disorders (in the 30 days before health checkup) and alcohol abuse in the two surveys (N=2192).

	baseline survey		follow-up survey		p-value
	%	(se[b])	%	(se)	
Mental Illness[c]					
Serious Mental Illness	2.5	0.4	4.1	0.4	< 0.001*
Mild-Moderate Mental Illness	8.6	0.6	12.3	0.7	
Probable alcoholism[d]	2.0	0.3	2.6	0.3	0.149
Sleep disturbance					
Problem getting to sleep	17.8	0.8	19.7	0.8	0.020*
Problem staying asleep	32.5	1.0	38.9	1.0	< 0.001*
Waking too early	33.3	1.0	40.1	1.0	< 0.001*

* $p < 0.05$
[b] Standard error,
[c] Serious mental illness and mild-moderate mental illness were defined by K6 score (13–24 and 8–12, respectively),
[d] Probable alcoholism was defined by CAGE score more than 2.

Table 3
Decomposition of estimated prevalnce of anxiety-mood disorders and probable alcoholism between the two surveys.

	SMI[a]		Alcoholism	
	%	(se[b])	%	(se)
I. Profiles of follow-up cases				
Persistence	30.0	5.4	26.8	5.9
Progression	40.0	5.9	44.6	6.6
Delayed onset	30.0	5.4	28.6	6.0
(n)	(70)		(56)	
II. Transitions among baseline cases				
Persistence	43.8	7.2	34.9	7.3
Improvement	39.6	7.1	51.2	7.6
Recovery	16.7	5.4	14.0	5.3
(n)	(48)		(43)	

[a] SMI: serious mental illness defined by K6 score of 13–24.
[b] Standard error.

Almost half of the respondents with baseline SMI (43.8%) continued to have SMI at follow-up, and a relatively small proportion (16.7%) recovered. A similar trend was observed for alcoholism. The majority of those diagnosed with alcoholism at follow-up (71.4%) already had some symptoms of alcoholism at baseline, and many of those with alcoholism at baseline (86.0%) had not recovered at follow-up.

Multiple linear regression analysis, adjusting for baseline psychological distress, indicated that being older and female predicted higher psychological distress at follow-up (P=0.031 and P=0.025, respectively) (Table 4). The VIFs for all the independent factors were less than 5, and multicollinearity was not detected. Additionally, seriousness of home damage and difficulty in getting to sleep predicted higher psychological distress at follow-up ($P < 0.001$ and P=0.005, respectively).

Males were at increased risk of alcoholism at follow-up ($P < 0.001$) (Table 5). Nocturnal awakening and early morning awakening increased the risk of alcoholism (P =0.021 and P=0.041), but insufficient sleep decreased the risk of alcoholism at follow-up (P=0.014). Also for this analysis, the VIFs for all the independent factors were less than 5, and multicollinearity was not detected.

The result of the multiple regression analysis indicated that as the baseline alcoholism tendency was stronger, the increase of alcoholism tendency during the follow-up period was smaller.

Table 4
The effects of socio-demographic and psychological features at the baseline survey in predicting trends in estimated psychological distress at the follow-up survey[b].

	B	95% CI	*p*-value
Age	0.014	0.001 to 0.027	0.031*
Female sex	0.362	0.045 to 0.680	0.025*
Having cohabitant (vs living alone)	−0.466	−0.989 to 0.057	0.081
Home damage[c]	0.241	0.132 to 0.350	< 0.001*
Seeking help for mental health	−0.059	−0.823 to 0.705	0.879
Sleep disturbance			
Difficulty in getting to sleep	0.609	0.188 to 1.029	0.005*
Nocturnal awakening	0.300	−0.033 to 0.632	0.077
Early morning awakening	−0.100	−0.425 to 0.225	0.546
Insufficient sleep	0.146	−0.316 to 0.607	0.536
Psychological distress (K6 score)[d]	0.697	0.649 to 0.745	< 0.001*
Alcoholism tendency (CAGE score)[e]	−0.092	−0.452 to 0.268	0.615

R^2=0.444, adjusted R^2=0.440.
* $p < 0.05$
[b] Multivariate linear regression model predicting psychological distress (K6 score) controlling for baseline value of the outcome variable.
[c] Damage to house was evaluated by 5-point Likert scale (1=no damage to 5=total collapse).
[d] K6: Kessler Psychological Distress Scale.
[e] CAGE: questionnaire for screening for alcoholism.

Table 5
The effects of socio-demographic and psychological features at the baseline survey in predicting trends in estimated alcoholism tendency at the follow-up survey[b].

	B	(95% CI)	*p*-value
Age	0.000	−0.001 to 0.002	0.713
Female sex	−0.154	−0.193 to -0.114	< 0.001*
Having cohabitant (vs living alone)	−0.002	−0.068 to 0.063	0.943
Home damage[c]	0.007	−0.006 to 0.021	0.286
Seeking help for mental health	−0.029	−0.123 to 0.066	0.549
Sleep disturbance			
Difficulty in getting to sleep	−0.020	−0.073 to 0.032	0.450
Nocturnal awakening	0.049	0.007 to 0.090	0.021*
Early morning awakening	0.042	0.002 to 0.083	0.041*
Insufficient sleep	−0.072	−0.130 to −0.015	0.014*
Psychological distress (K6 score)[d]	0.000	−0.006 to 0.006	0.971
Alcoholism (CAGE score)[e]	0.525	0.481 to 0.570	< 0.001*

R^2=0.332, adjusted R^2=0.328.
* $p < 0.05$.
[b] Multivariate linear regression model predicting alocoholism tendency (CAGE score) controlling for baseline value of the outcome variable.
[c] Damage to house was evaluated by 5-point Likert scale (1=no damage to 5=total collapse).
[d] K6: Kessler Psychological Distress.
[e] CAGE: questionnaire for screening for alcoholism.

Discussion

This study showed the long-term trends of psychological distress and alcoholism on affected residents, after the Great East Japan Earthquake of 2011, using the two surveys, in 2012 and 2013. The prevalence of mental illness and sleep disturbance and the mean score of alcoholism tendency increased between 2012 and 2013.The majority of respondents with baseline SMI had not recovered at follow-up, and a relatively small proportion recovered. Older age, being female, seriousness of home damage, and difficulty in getting to sleep at baseline predicted more psychological distress at follow-up, while being male, nocturnal awakening, and early morning awakening were risk factors for alcoholism. To the best of our knowledge, this is the largest longitudinal study after a natural disaster (Cerdá et al., 2013; Chou et al., 2007; Kessler et al., 2008; Osofsky et al., 2011; Pietrzak et al., 2012; Tsai et al., 2007). A major strength of our study is a long observation period and small attrition bias in the follow-up survey.

The prevalence of mental illness and sleep disturbance increased during the first 2 years after the earthquake in 2011. This trend was consistent with a previous study demonstrating a trend of increased serious mental illness, which was assessed between 5–7 and 17–19 months after a natural disaster (Kessler et al., 2008). Conversely, some studies have shown no change in prevalence of depression, which was assessed between 5–9 and 14–18 months after a hurricane in America (n = from 658 to 487) (Pietrzak et al., 2012) and between 6–9 and 13–18 months after a hurricane in America (n = 841 to 638), after natural disasters (Osofsky et al., 2011). The results from these two studies were different from our results, possibly because these data were not based on the panel study using exact same sample like our study. Nevertheless, there have been no studies reporting a decrease in the prevalence of serious mental illness during the first 2 years after a disaster. These results suggest that people affected by a serious natural disaster would be exposed to long-lasting stressors, which affect their mental health.

The prevalence of alcoholism did not significantly increase during the first 2 years after the disaster. (P=0.149), but the mean score for CAGE (for screening for alcoholism) increased during the first 2 years after the disaster (P=0.011). These results are consistent with the findings of previous research which indicated that alcohol consumption increased after Hurricanes Katrina and Rita and concluded the disaster and post-disaster stressors might result in increased post-disaster alcohol use (Cerda, Tracy & Galea, 2011). In contrast, a study on the impact of earthquakes (New Zealand, 2010–2011) on the mental health, using a data from population-based cohort study, has shown that the extent of earthquake exposure was not associated with the prevalence of alcohol abuse (Fergusson, Horwood, Boden & Mulder, 2014). Exposure to a huge natural disaster may not increase the prevalence of alcohol abuse, but may increase alcohol consumption of the exposed populations. Seriousness of home damage predicted deterioration of psychological distress in the present study ($P < 0.001$). This is consistent with a previous study reporting an association between home damage and a higher prevalence of depression after a disaster (Tang et al., 2014). Additionally, another study showed that destruction of a home was independently associated with a higher level of PTSD (Posttraumatic Stress Disorder) 18 months after a disaster (Berg et al., 2012). Home damage or destruction could lead to several adversities, including loss of a family member and property, relocation, and lack of a social network, which may cause the observed outcomes. For example, bereavement after natural disasters increases the risk of psychological problems (Berg et al., 2012; Wadworth, DeCarlo Santiago & Einhorn, 2009). Female sex predicted increased psychological distress at follow-up in the present study. This is consistent with a previous study, which found female sex was a risk factor for depression after natural disasters (Tang et al., 2014). One possible reason for this is that women may be more likely to be influenced by social factors after disasters (e.g. experiences of relocation) (Yokoyama et al., 2014).

A diagnosis of alcoholism one year after the earthquake did not predict psychological distress in the subsequent year. As suggested in a previous study (Kessler et al., 1997), alcohol use problems may not precede mental health problems, but may occur after mental health problems. Psychological distress one year after the disaster did not predict alcoholism in the subsequent year, which was consistent with a previous study (Nordløkken, Pape & Heir, 2016). While being male predicted increased risk of alcoholism at follow-up in our study, this may be because men tend to use alcohol to cope with their emotional problems following disasters (North, Ringwalt, Downs, Derzon & Galvin, 2011).

The present study has several methodological limitations. First, detailed information about post-disaster factors such as bereavement, loss of property, and loss of social networks were not obtained, because the surveys aimed to identify residents at risk and in need of mental health care. Second, the participation rate of the first annual check was

not very high, leading to potentially underestimating the prevalence of baseline mental illness. Third, we should also consider selection bias, because those who participated to both surveys were different from those who participated only to the baseline survey in several characteristic (i.e. age, house damage, psychological distress). Further, we did not have the information on those who did not participate to neither of the surveys. Forth, mental health problems were estimated by self-reported questionnaires, which are less well validated than those based on clinical interviews. Fifth, due to various ethical issues, public health nurses performed interventions (refer to method section) for some residents based on the information from the annual checks. In addition, change in psychological distress and/or alcoholism tendency may also depend on whether participants of the survey received mental health treatment between the first and second surveys. However, we did not collect the information on mental health treatment. Finally, although the condition prior to the disaster strongly predicted mental health after disaster (Lowe, Joshi, Pietrzak, Galea & Cerdá, 2015), we did not have the information on pre-disaster condition of the participants.

Conclusions

Our study demonstrated that a serious natural disaster had a long-term effect on the mental health of residents in the area severely affected by the disaster. The prevalence of SMI and sleep disturbance increased between baseline (12 months after the earthquake) and the following year (24 months after the earthquake). The majority of individuals who had SMI or alcoholism 1 year post-disaster did not recover during the subsequent year. Older age, female sex, and seriousness of home damage predicted higher psychological distress 2 years after the disaster. These findings indicate the need for long-term care for individuals who are affected by a serious natural disaster, especially for those whose homes are seriously damaged. We are going to continue collecting data to see if there are any further lasting effects from the earthquake.

Conflict of interest

None declared.

Ethical standards

The authors assert that all procedures contributing to this research comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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Authors' contributions

A. Kanehara and S. Ando designed the study, conducted analyses, interpreted the data, and drafted the manuscript. T. Araki and H. Kuwabara designed the study, collected the data and revised the manuscript. S. Usami conducted the analyses, interpreted the data, and revised the manuscript. Y. Kano and K. Kasai designed the study, interpreted the data, and revised the manuscript. All the authors approved the final version of the manuscript.

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