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REGULAR ARTICLE

Social network disruption as a major factor associated with psychological distress 3 years after the 2004 Niigata–Chuetsu earthquake in Japan

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Abstract
Objectives The 2004 Niigata–Chuetsu earthquake of Japan caused a great deal of damage, and people living in the affected region are still struggling to reconstruct their lives. The aim of this study was to determine factors associated with psychological distress in people living in a town at the epicenter 3 years after the earthquake.
Methods We conducted a cross-sectional study from June 2007 to January 2008. Participants included 225 individuals living in Kawaguchi (age ≥20 years) who reported psychological symptoms. Information on family structure, employment status, alcohol use, social network, and extent of house damage was elicited by public health nurses conducting structured interviews. Levels of psychological distress were assessed with the Kessler Psychological Distress Scale (K10), with a K10 score ≥25 defined as psychological distress.
Results The mean age of participants was 66.1 ± 12.9 years. The prevalence of psychological distress varied among different employment classes, being 5/73 (6.8%) for participants with paid employment, 12/50 (24.0%) for full-time housewives, and 11/101 (10.9%) for those who were unemployed ($\chi^2 = 8.42$, $P = 0.015$). It also varied between participants who had lost contact with people in the community and those who had no change in social contact [9/20 (45.0%) vs. 19/189 (10.1%), respectively; $\chi^2 = 19.04$, $P < 0.001$]. Multiple logistic regression analysis showed that age [odds ratio (OR) 0.95, 95% confidence interval (CI) 0.91–0.98], poor or loss of contact with people in the community (OR 6.97, 95% CI 1.85–26.2), and lack of employment (full-time housewives or unemployed individuals) (OR 6.74, 95% CI 1.62–28.0) were associated with psychological distress.
Conclusions People who lose their social network are at a very high risk for post-earthquake psychological distress and require appropriate care.

Keywords Cross-sectional studies · Earthquakes · Mental health · Psychological distress · Social support

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Introduction

The 2004 Niigata–Chuetsu earthquake of Japan killed more than 60 people and injured more than 4800 people; approximately 103,000 people sought refuge, and 16,000 houses were completely or partially destroyed [1]. The earthquake epicenter was located in Kawaguchi Town, where almost all houses were damaged, necessitating that all of the residents seek temporary refuge. Large earthquakes are known to adversely affect the psychological status of residents of the affected areas, and the Niigata–Chuetsu earthquake was not an exception. Epidemiologic studies carried out 5 months after the earthquake reported

various psychiatric problems and psychological distress [2, 3].

Psychological problems resulting from such damage and loss appear to produce long-lasting effects after an earthquake. Studies in Turkey and Greece showed that the prevalence of psychological distress was still high in victims 3–4 years after the respective earthquakes [4, 5]. In the case of the Niigata–Chuetsu earthquake, such long-standing effects are also expected to be present among the residents of Kawaguchi Town. The Niigata–Chuetsu earthquake caused considerable damage on the ground, as well as the disruption of traffic and communication networks [6]. Thousands of people required temporary housing for up to 3 years [7], and for some the struggle to reconstruct their lives is still on-going, primarily because of financial losses. For these and other reasons, therefore, the factors associated with long-term psychological distress after the Niigata–Chuetsu earthquake are worth investigating.

The aim of this study was to determine factors associated with psychological distress in people living in Kawaguchi Town 3 years after the Niigata–Chuetsu earthquake. Short-term psychological distress after the Niigata–Chuetsu earthquake has been investigated and reported [2]. Consequently, the results of the present study can be compared with those from the short-term study.

Materials and methods

Participants

This study was conducted by the local government as a part of the post-earthquake health-check survey for people who lived in Kawaguchi in 2007 and 2008. The target group was all 2856 residents of Kawaguchi aged ≥20 years. Of the 913 individuals directly interviewed by public health nurses, 225 people reported experiencing psychological symptoms, such as sleep problems, feelings of frustration, difficulty expressing ideas, lacking the will to accomplish goals, feeling maudlin, throbbing sensations, appetite loss, increased blood pressure, catching cold easily, low back pain, tinnitus, increased alcohol use, headache, shoulder stiffness, or vertigo. These 225 individuals formed the study cohort of our study and were assessed with the Kessler Psychological Distress Scale [8]. Informed consent was obtained from all subjects, and approval for the study was granted by the Ethics Committee of the Niigata University School of Medicine.

Procedure

Public health nurses conducted door-to-door interviews between June 2007 and January 2008. They elicited information regarding gender, age, employment status, household composition, alcohol use, extent of house damage, subjective physical and mental problems, and social network. To determine employment status, interviewees were asked their principal occupations, and those who did not have an occupation were classified as housewife or unemployed. Regarding social networks, participants were asked "Have you contacted your family as you did before the earthquake?" and "Have you contacted people in the community as you did before the earthquake?" Answers were categorized as "no change in contact" or "worse or loss of contact". General psychological distress symptoms were assessed with the K10 scale. Extent of house damage was categorized by the local government of Niigata Prefecture as 1, slightly damaged; 2, severely damaged; 3, almost completely destroyed; 4, completely destroyed.

Kessler Psychological Distress (K10) Scale

The 10-item K10 scale measures feelings of nervousness, hopelessness, restlessness, worthlessness, and depression. Responses were recorded using a five-category scale (1, none of the time; 2, a little of the time; 3, some of the time; 4, most of the time; 5, all of the time) for feelings experienced within the previous 30 days, with a total score ranging from 10 to 50 points. The K10 was developed using modern item response theory to be sensitive to the 90–99th percentile range of the population distribution of non-specific psychological distress. The Japanese version was developed according to the standard back-translation procedure [9]. Screening performances of the Japanese version were essentially equivalent to those reported for the original English version, suggesting that the back-translation procedure succeeded in producing a cross-culturally applicable screening scale. A person with a high K10 score is considered to have a high level of psychological distress characterized by depression, anxiety, and other psychiatric symptoms. In this study, participants with a K10 score ≥25 were considered to have psychological distress [9].

Statistical methods

The *t* test was used to determine differences in mean values between two groups, and the χ^2 test was used to test independence of categorical data in bivariate analysis. Logistic regression analysis was used to predict psychological distress (K10 score ≥25) according to age group and extent of house damage. Simple and multiple logistic regression analyses were used to test statistical associations between explanatory variables, including sex, age, household composition, house damage, employment status, contact with family, contact with people in the community,

and alcohol consumption, versus the dependent variable, i.e., psychological distress. Qualitative variables were represented by dummy variables. Data are expressed as the median or mean ± standard deviation (SD) and analyzed utilizing SAS statistical software (release 9.1.3; SAS Institute, Cary, NC). A P value <0.05 was considered to be statistically significant.

Table 1 Prevalence of psychological distress (K10 score ≥25) according to age group

Age (years)	Psychological distress, n (%)
≤49	5/21 (23.8)
50–59	7/49 (14.3)
60–69	8/47 (17.0)
70–79	6/80 (7.5)
≥80	2/28 (7.2)
	P for trend = 0.035

Table 2 Prevalence of psychological distress (K10 score ≥25) by extent of house damage

Extent of house damage[a]	Psychological distress, n (%)
Slightly damaged	3/53 (5.7)
Severely damaged	7/53 (13.2)
Almost completely destroyed	3/22 (13.6)
Completely destroyed	15/87 (17.2)
	P for trend = 0.066

[a] Ten values missing

Results

We first compared the demographic characteristics of participants assessed with K10 (K10 group, $n = 225$) with those who were not assessed (non-K10-group, $n = 688$). The mean age of the K10 group was significantly higher (66.1 ± 12.9 years) than that of the non-K10 group (62.5 ± 16.2 years; $P = 0.001$). The proportion of men in the K10 group was 30.7%, which was not significantly different from that of the non-K10 group (34.3%; $\chi^2 = 1.01$, $P = 0.316$).

The following analyses were conducted exclusively in the K10 group. The mean and median K10 scores were 16.1 ± 7.6 and 13.0, respectively. The prevalence of psychological distress (K10 ≥ 25) in men, women, and total participants was 7/69 (10.2%), 21/156 (13.5%), and 28/225 (12.4%), respectively, indicating that there were no significant gender-dependent differences in psychological distress ($P = 0.487$). As shown in Table 1, younger subjects had higher levels of psychological distress. The prevalence of psychological distress tended to be higher in participants who had more severe house damage (Table 2). Table 3 shows that the prevalence of psychological distress was significantly associated with employment status, family contact, and contact with people in the community.

Simple logistic regression was conducted to confirm associations determined by the χ^2 analysis (Table 4). The results of the multiple logistic regression analysis are also shown in Table 4 (model 1); odds ratios of contact with people in the community, contact with family, and employment status associated with psychological distress were high. The two variables of employment status, both

Table 3 Prevalence of psychological distress (K10 score ≥25) by household composition, employment status, social network, and alcohol use

Characteristics	Psychological distress, n (%)	χ^2 test
Household composition		
Nuclear family	16/132 (12.1)	$\chi^2 = 0.03$, $P = 0.861$
Extended family	12/93 (12.9)	
Employment status[a]		
Having a job	5/73 (6.8)	$\chi^2 = 8.42$, $P = 0.015$
Housewife	12/50 (24.0)	
Unemployed	11/101 (10.9)	
Contact with family[a]		
No change in contact[b]	24/216 (11.1)	$\chi^2 = 16.35$, $P < 0.001$
Worse or loss of contact[b]	4/6 (66.7)	
Contact with people in the community[a]		
No change in contact[b]	19/189 (10.1)	$\chi^2 = 19.04$, $P < 0.001$
Worse or loss of contact[b]	9/20 (45.0)	
Alcohol consumption[a]		
No	15/144 (10.4)	$\chi^2 = 1.92$, $P = 0.383$
Sometimes	7/38 (18.4)	
Every day	4/38 (10.5)	

[a] Some values missing

[b] Compared with pre-earthquake status

Table 4 Result of simple and multiple logistic regression analyses for psychological distress (K10 score ≥25)

Predictor variable	Odds ratio	95% Confidence interval	*P* value
Simple logistic regression analysis			
Sex (1, women; 0, men)	0.73	0.29–1.80	0.489
Age (years)	0.97	0.94–1.00	0.038
Household composition (1, nuclear family; 0, extended family)	0.93	0.42–2.07	0.861
House damage[a]	1.38	0.98–1.95	0.066
Employment status (1) (0, having a job; 1, housewife or unemployed)	2.48	0.90–6.81	0.078
Employment status (2) (1, housewife; 0, having a job or unemployed)	3.14	1.37–7.18	0.007
Contact with family (1, loss of contact; 0, no change)	16.0	2.78–92.0	0.002
Contact with people in the community (1, worse or loss of contact; 0, no change)	7.32	2.69–19.9	<0.001
Alcohol consumption (0, no; 1, sometimes; 2, everyday)	1.11	0.67–1.86	0.680
Multiple logistic regression analysis [model 1 (full model)]			
Sex (1, women; 0, men)	1.16	0.29–4.58	0.837
Age (years)	0.95	0.91–0.99	0.024
Household composition (1, nuclear family; 0, extended family)	1.03	0.38–2.79	0.949
House damage[a]	1.22	0.81–1.83	0.344
Employment status (1) (0, having a job; 1, housewife or unemployed)	4.47	0.94–21.2	0.060
Employment status (2) (1, housewife; 0, having a job or unemployed)	2.25	0.68–7.45	0.184
Contact with family (1, loss of contact; 0, no change)	4.00	0.43–37.5	0.224
Contact with people in the community (1, worse or loss of contact; 0, no change)	7.15	1.85–27.6	0.004
Alcohol consumption (0, no; 1, sometimes; 2, everyday)	1.35	0.62–2.91	0.449
Multiple logistic regression analysis [model 2 (Employment status (2) was excluded from model 1]			
Sex (1, women; 0, men)	1.52	0.42–5.49	0.521
Age (years)	0.95	0.91–0.98	0.006
Household composition (1, Nuclear family; 0, Extended family)	0.98	0.37–2.61	0.969
House damage[a]	1.21	0.81–1.82	0.347
Employment status (1) (0, having a job; 1, housewife or unemployed)	6.74	1.62–28.0	0.009
Contact with family (1, loss of contact; 0, no change)	4.07	0.43–38.5	0.221
Contact with people in the community (1, worse or loss of contact; 0, no change)	6.97	1.85–26.2	0.004
Alcohol consumption (0, no; 1, sometimes; 2, everyday)	1.29	0.61–2.76	0.509

[a] Coded as 0, slightly damaged; 1, severely damaged; 2, almost completely destroyed; 3, completely destroyed

significant in the bivariate model, were not statistically significant in the multivariate model. This difference is likely due to their inter-correlation, and thus only employment status (1) (having a job or not), the stronger predictor, was included in the multivariate model (Table 4, model 2). Lack of employment (as full-time housewives or unemployed individuals) was associated with psychological distress.

Discussion

Based on the results of a health survey conducted 3 years after the Niigata–Chuetsu earthquake, we have demonstrated that the social network and employment status are significantly associated with psychological distress among people living near the epicenter of the earthquake. These two factors are controllable, and thus should be the focus of the discussion.

We found that participants who were estranged from others in their community were at higher risk for experiencing psychological distress. Previous studies have also reported that disruption of the social network increases post-earthquake psychological distress. Bland et al. [10] reported that Italian men who were evacuated farther away from family and/or friends experienced higher levels of psychological distress 3–4 years after an earthquake. Chou et al. [11] studied Taiwanese survivors 21 months after an earthquake and found that house damage adversely affected social networks, which in turn strongly influenced mental health. Four years after two severe earthquakes in Turkey, Kiliç et al. [12] studied earthquake survivors who migrated to Ankara; the results of their study also suggest that social network disruption due to relocation increases

psychological distress. The outstanding finding of our study is the large difference in the prevalence of psychological distress between participants with or without intact social networks. The target group of our study were only those individuals reporting psychological symptoms in a structured interview; therefore, this difference may have been larger if the general population of Kawaguchi had been studied.

We found that full-time housewives or unemployed individuals were at higher risk for post-earthquake psychological distress. Başoğlu et al. [13] reported a similar finding among earthquake survivors in Turkey and pointed out that housewives may have a greater emotional attachment to their homes because their homes and families play larger roles in their lives. We also assumed that cultural factors may be associated with the similar finding in our study. Housewives in Japan traditionally care for all family members, including husband, children, and the husband's parents [14]. In addition, housework as well as raising and caring for children have been considered exclusively the work of housewives [15]. This tradition seems to be more prevalent in rural areas in Japan. Within the context of this cultural background, full-time housewives may experience more psychological stress when a natural disaster, such as a large earthquake occurs. A high prevalence of psychological distress in unemployed people was also reported after the 2003 Bam Iranian earthquake [16]. This finding may be due, in part, to financial losses and cost burdens from house damage that adversely affect psychological health [11, 17, 18].

Although full-time housewives were found to have a higher prevalence of psychological distress in our study, a gender difference was not observed, possibly because only 32% of the women in our study were full-time housewives. Reports of associations between gender and post-earthquake psychological distress have been inconsistent [13, 16, 17]. In a study of Turkish earthquake survivors in which 82% of the women were full-time housewives, Başoğlu et al. [13] suggested that women tend to have dependent roles in traditional societies, such as the Turkish society, increasing their risk for emotional repercussions following a disaster. In contrast, Woersching et al. [17] did not find worse post-earthquake mental health among Salvadoran women, who do not tend to have such a dependent position in their culture.

We also showed a higher prevalence of psychological distress among younger adults (age $\leq$49 years). The association between age and psychological distress is not clear in the general Japanese population [19]. Interestingly, our results are in contrast to those of Toyabe et al. [2], who clearly showed that General Health Questionnaire (GHQ)-assessed psychological distress was higher in older adults living in temporary housing 5 months after the Niigata–Chuetsu earthquake. The difficult living conditions of temporary housing may have increased psychological distress more dramatically in elderly earthquake victims compared with younger victims. The situation had changed 3 years after the earthquake, by which time victims had returned home and were struggling to reconstruct their lives after financial losses [20]. In this latter situation, younger adults may experience more psychological stress than older adults. Thus, long-term strategies to relieve psychological distress should target younger adults more aggressively than older ones.

There were a number of limitations to our study. One major limitation is that we were unable to interview all residents of Kawaguchi (i.e., K10 data were obtained only from participants who reported one or more subjective psychological symptoms). This prevented us from determining the actual prevalence of psychological distress among the general population of the town. In addition, we used prevalence data to determine odds ratios by logistic regression analysis. Odds ratios are useful for assessing the strength of association between predictor and outcome variables. However, they may not accurately estimate relative risks and should therefore be interpreted cautiously. Finally, the cross-sectional nature of our study does not allow causal relationships to be determined. Despite these limitations, these data on the post-earthquake psychological status of people living in a town at the epicenter of an earthquake are important and worth reporting.

In summary, the results of this study demonstrate that 3 years after the Niigata–Chuetsu earthquake, estrangement from others in the community, being a housewife or unemployed, and a younger age are associated with psychological distress in people who were living in the town (epicenter) at the time of the earthquake. Of these three factors, reduced social estrangement showed the strongest association with psychological distress. We conclude that people estranged from their families and communities are at a very high risk for experiencing psychological distress and require the appropriate health care.

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