Table 2. Adjusted odds ratios and 95% confidence intervals for insomnia.

Variables		Multivariate adjusted[1]	
		OR	95% CI
Complaint of oral health			
Toothache	N	1.00	
	Y	1.18	(0.77-1.79)
Gum problems	N	1.00	
	Y	***2.16	(1.43-3.26)
Difficulty chewing	N	1.00	
	Y	**2.22	(1.40-3.51)
Age (years)			
17-29		1.00	
30-39		*1.79	(1.07-2.97)
40-49		***3.68	(2.34-5.81)
50-59		***3.86	(2.49-5.98)
60-69		***2.95	(1.94-4.50)
70-79		**1.82	(1.17-2.82)
≥ 80		1.65	(0.99-2.77)
Gender			
Male		1.00	
Female		**1.37	(1.11-1.68)
Economic status			
Fair		1.00	
Poor		***1.82	(1.49-2.21)
Poorer		***2.02	(1.62-2.52)
Poorest		***2.24	(1.69-2.98)
Comorbidity			
Stroke	N	1.00	
	Y	0.89	(0.43-1.83)
Diabetes	N	1.00	
	Y	0.99	(0.70-1.40)
Hypertension	N	1.00	
	Y	1.02	(0.83-1.26)
CHD	N	1.00	
	Y	1.44	(0.95-2.18)
BMI			
Less than 18.5		1.00	
18.5-24.9		1.08	(0.65-1.78)
25.0-29.9		1.10	(0.65-1.86)
30 or more		1.00	(0.56-1.80)
PTSR			
Intrusion	N	1.00	
	Y	***1.73	(1.44-2.08)
Agitated	N	1.00	
	Y	***1.74	(1.42-2.15)
Hyperarousal	N	1.00	
	Y	**1.63	(1.24-2.15)
Habits			
Smoking	N	1.00	
	Y	0.91	(0.72-1.16)
Alcohol consumption	N	1.00	
	Y	*1.27	(1.02-1.57)
K6 score			
(per 1 point increase)		***1.34	(1.30-1.37)

Y, Yes; N, No.

Multiple imputation logistic regression: Areas experienced by the Great East Japan Earthquake in Miyagi, Japan, 2011-2013.

[1]Adjusted for age, sex, economic status, comorbidity, complaint of oral health, BMI, PTSR, smoking, alcohol consumption and K6 score.

Statistically significant variable (*$p < 0.05$, **$p < 0.01$ and ***$p < 0.001$).

GEJE victims recently tended to increase again. The increase in the oral symptoms related to periodontal disease leads us to assume that it is linked to the deterioration of oral hygiene among victims after the GEJE. Periodontal disease, a major chronic infectious disease, can also be exacerbated by psychological stress and depression followed by the dysregulation of the cellular and humoral pathways of the immune system (Okada et al. 2010; Warren et al. 2014). Similarly, sleep disturbances increase with psychological stress and infectious diseases (Irwin 2015). Thus, psychological stress is certainly one of the most potent confounding factors related to both periodontal disease and insomnia. The statistical correlation between periodontal disease and insomnia was attenuated, but it remained strong even after adjusting for the psychological covariates of the K6 score and PTSRs. Furthermore, the ORs for the oral symptoms of periodontal disease with reference to insomnia were similar to those of PTSRs. Although this study could not distinctly define the relationship between periodontal disease and insomnia because of less temporal data, our findings support the fact that there are other potential factors that affect the meaningful link between periodontal disease and insomnia. A future study using periodontal intervention with insomnia patients may clarify the mechanism involved in the development of the disease.

Of the 8,015 subjects participating in the present study, 38.9% (2,892 participants, with 580 missing data) were classified as suffering from insomnia. Thus, the insomnia prevalence observed in this study population was higher than that reported from other surveys conducted in Japan using the AIS (23.0-27.3% in males and 31.0-34.4% in females), but lower than that reported in non-emergency conditions (Utsugi et al. 2005; Yoshioka et al. 2012; Saijo et al. 2015). Meanwhile, the prevalence rates of insomnia after a great earthquake were reportedly 63% and 46% at 3 and 8 weeks after Hanshin-Awaji earthquake, respectively, and 60% a year after the 1999 Athens earthquake in Greece (Kato et al. 1996; Varela et al. 2008). Indeed, these studies showed higher values than those reported in the present survey. These discrepancies may be due to the longer survey periods or the lower response rate in this survey, because non-respondents tended to shows poorer health status.

The multivariable logistic analysis could further show the significant associations between insomnia and its demographic risk factors such as being female, in a difficult economic situation, and being in serious psychological stress (screened by the PTSR and K6 scores) (Lazaratou et al. 2012). The present study revealed the highest OR for insomnia in middle-aged participants (50s), which differs from that reported by previous studies, which showed that the highest prevalence of insomnia was in elderly people, majorly cause by aging. Although specific reasons for the highest prevalence of insomnia in the middle-aged group were not determined in this study, previous studies indicated that the psychological stress and depressive reactions among the disaster victims after GEJE was distinctly observed in the middle-aged group (Koyama et al. 2014; Matsubara et al. 2014). Evident from the delayed increase of suicide rates in middle-aged GEJE victims in the disaster-affected areas (Orui et al. 2015), continuous and intensive healthcare services are worth considering in support of these people.

In terms of the limitations of this study, first, the survey revealed low response rates in each panel, possibly owing to the unstable home addresses of most participants after the GEJE. Indeed, as indicated by the largest number of participants in the first survey, panel studies typically suffer from attrition, which pretend the higher response rate in the initial survey as biased inferences (Cheng and Trivedi 2015). Therefore, we cannot rule out the possibility of a selection bias. Meanwhile, since most people who do not respond tend to have a poorer health status, the association examined in the present study might be stronger in the non-respondents. Second, the subjects of this study were all disaster victims who were suffering from great psychological trauma. Therefore, it is unknown whether our results are applicable to the general population. Therefore, a future study with an appropriate design needs to be performed on the general population. Third, we did not conduct a standardized clinical periodontal examination, which could quantify the periodontal status and strengthen the intra-disease associations. However, the strength of our study is that it was a large-scale panel study on disaster victims. Natural disasters induce several public health issues. However, few studies have focused on the impact of oral health. Therefore, this study would be important in the public health field. In addition, our results could be the first to suggest the possibility of the impact of oral health on insomnia among disaster victims. As a public health implication, this indicates that a wider range of health care intervention including oral health care may be important after disasters.

In conclusion, our large-scale panel study on GEJE victims determined a strong association between periodontal disease and insomnia. This implies that reciprocal management for sleep disorders and periodontal disease would reduce intra-disease actions, which may contribute to the victims' systemic health. However, the underlying mechanism remains unclear, and adequate additional clinical research is necessary to confirm our findings.

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Author Contributions

J.A., Y.S., Y.T., M.S., K.O., and I.T. participated in data acquisition. M.T., J.A., and Y.H. developed the concept of the study and participated in its design. T.W., M.W., H.T., and E.N. helped develop the concept of the study. M.T., J.A., Y.H., Y.T., K.O., and I.T. critically revised the manuscript. All authors have read and approved the final version of the manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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Unemployment risk among individuals undergoing medical treatment for chronic diseases

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Background	Chronic diseases increase the risk of unemployment even in non-disaster settings; therefore, in post-disaster settings, special attention needs to be paid to the employment status of those suffering from chronic diseases.
Aims	To examine the association between chronic disease and the risk of unemployment in a disaster area.
Methods	This cross-sectional study was conducted in Shichigahama Town, Miyagi, north-eastern Japan, where had been severely inundated by the 2011 tsunami. Logistic regression analyses were used to evaluate the association between undergoing medical treatment for a combination of chronic diseases (stroke, cancer, myocardial infarction and angina) and unemployment risk. Confounders such as psychological distress and levels of daily life activity were considered.
Results	Among the 2588 individuals studied, there was a statistically significant association between undergoing medical treatment for chronic disease and the risk of unemployment [odds ratio (OR) = 1.7, 95% confidence interval (CI) 1.02–2.7, $P < 0.05$]. In participants with a lower degree of psychological distress and better levels of daily life activity ($n = 1967$), no significant associations were observed (OR = 1.1, 95% CI 0.6–2.1). Conversely, in 536 participants with a higher degree of psychological distress and/or poorer levels of daily life activity, statistically significant associations were found (OR = 2.6, 95% CI 1.01–6.6, $P < 0.05$).
Conclusions	The association between undergoing medical treatment for chronic disease and unemployment risk was observed only in participants with a higher degree of psychological distress and/or poorer levels of daily life activity.
Key words	Chronic diseases; daily life activity; earthquake; psychological distress; unemployment.

Introduction

Assistance to employees with chronic diseases is an important social issue in Japan. For example, for cancer, the basic plan to promote anti-cancer measures in Japan has been promoted. The 5 year survival rate for all cancers was 57% in 2003–2005 [1]. Improvements in medical treatment technology (operations, radiotherapy and chemotherapy) have improved life expectancy in cancer patients and cancer survivors. However, in everyday life, these people face social issues such as gaining and retaining employment. Thirty per cent of employees with cancer resigned their posts voluntarily and 4% of employees with cancer were dismissed in 2004 [2]. It has been reported that cancer patients and survivors who can work find it difficult to resume working, continue working or to find a new job [3,4]. Based on this evidence, it is assumed that people with other chronic diseases may find it equally difficult to find and retain employment.

In a meta-analysis of seven studies involving a total of 18 003 participants, Van Rijn *et al.* [5] reported a significant association between various chronic diseases and employment status [pooled relative risk 1.31, 95% confidence interval (CI) 1.14–1.50] [6–12] and observed that people with chronic diseases had a higher risk of unemployment than those without such diseases.

A catastrophe such as the Great East Japan Earthquake in 2011 [13,14] greatly affected not only mental [15–17] and physical health conditions [18–21] but also employment in affected communities, with a resulting major concern for post-disaster public health [22]. However, there has been little research on the association between chronic diseases and employment in post-disaster settings. Furthermore, although psychological distress and levels of daily life activity may be important confounding factors, the effect of these factors on the employment of those with chronic diseases has not been well characterized.

This study was designed to examine the association between chronic disease status and the risk of unemployment in a coastal area affected by the tsunami. We also investigated the effects of psychological distress and level of daily life activity on the employment status of people receiving treatment for chronic diseases.

Methods

This study was part of a project called the Shichigahama Health Promotion Project, in cooperation with Tohoku University and Shichigahama Town, Miyagi, north-eastern Japan. The project involves health promotion activities, health surveys and provision of health support to people suffering from the aftermath of the 2011 earthquake. The survey aimed to evaluate the current overall health and life status of all community members, regardless of the level of house damage, in five of the most severely devastated coastal areas of Shichigahama town in September 2012. Over 10% of households were largely or totally destroyed by the earthquake and resulting tsunami [17]. The definition of large-scale damage was based on the 'largely or totally destroyed' criteria from the building damage assessment conducted by the local government of Shichigahama according to the criteria issued by the Cabinet Office, while small-scale damage constituted minimal or no damage due to the disaster.

The survey teams visited all households in the target area to ask for participation in the survey. An informed consent form and questionnaire were handed directly to those residents willing to participate and were subsequently collected. The first survey was conducted in October 2012 among residents who lived outside the five most devastated areas and whose houses had been largely or totally destroyed by the disaster. The second survey for all residents, regardless of level of house damage, in the five most devastated areas was conducted in December 2012.

Information about selected chronic diseases was collected using a self-administered questionnaire that asked whether the participants had any of eight chronic diseases: stroke, myocardial infarction or angina pectoris, cancer, kidney disease, liver disease, hypertension, diabetes mellitus and hyperlipidaemia and were undergoing medical treatment. This study focused on three chronic diseases (stroke, cancer and myocardial infarction/angina), since they were the main causes of death in Japan. Basic individual information (age, gender, income, body weight and height, time spent walking per day, current alcohol intake and current smoking levels), psychological distress and level of daily life activity, as well as detailed information regarding their personal experiences following the earthquake (the participant's location during the earthquake, evacuation, presence of post-traumatic stress response and the death of family members), was collected through the questionnaire. In this study, current alcohol consumption was divided into four categories (no drinking, ≤1 go/day, ≥2 go/day, unknown), where 22.8 g of alcohol amounts to one go or traditional unit of sake (180 ml), which also approximates to two glasses of wine (200 ml) or beer (500 ml) in terms of alcohol content.

Respondents were asked about their current working status in the questionnaire, with possible responses being: 'I am working currently', 'I am not working' (including pensioners, housewives, students and unemployed people) or 'I am looking for a job' (currently unemployed people looking for work). 'Currently working' included part-time working. Current working status was divided into two categories (employed or unemployed) and participants who were looking for work were defined as unemployed. (An additional analysis defining participants seeking work as employed produced results that were not largely different.) The study examined the effect of the degree of psychological distress or reduction in daily life activity on the association between chronic disease and the risk of unemployment. The K6 scale was used as an indicator of psychological distress [23,24]. The Japanese version of the K6 was developed recently using a standard validated back-translation method [25]. As suggested by Kessler *et al.*, we classified individuals with a K6 score of 13/24 or more as having psychological distress [15,17,26–28].

To assess participants' current level of daily life activity, we used the following three items in the questionnaire: (i) Are you working in a job involving manual handling, such as cleaning or lifting?, with the following options: almost every day, 3 days per week, 1 day per week, 1 day per month or almost never; (ii) On average, how often do you go out, including going to work?, with the same response options as the previous question; and (iii) On average, how long do you spend sitting or lying down in a day?, with the following options: 6 h or longer per day, 3–6 h per day or fewer than 3 h per day. We defined participants with poor levels of daily life activity as those who answered these questions with (i) almost never, (ii) almost never or (iii) 6 h or longer per day, respectively.

The study protocol was reviewed and approved by the Ethics Committee of Tohoku University Graduate School of Medicine.

The number of participants and percentages were compared with the demographic data (age and gender), current alcohol intake, current smoking levels and the degree of house damage. A chi-squared test was used to examine whether employment status was affected by these variables.

Multiple logistic regression analyses were conducted to evaluate the association between individuals undergoing medical treatment for a combination stroke, cancer and myocardial infarction/angina pectoris and the risk of unemployment. Odds ratios (ORs) and 95% CIs were adjusted for gender, age, current alcohol intake, current smoking levels and degree of house damage.

To test psychological distress or level of daily life activity, the participants were stratified according to the degree of these in the analyses. Individuals undergoing medical treatment for chronic diseases (yes or no) and levels of psychological distress or daily life activity ('participants with lower degree of psychological distress or better level of daily life activity' or 'participants with higher degree of psychological distress and/or poorer level of daily life activity status') were put in a multiple logistic regression model with the interaction terms. We conducted additional analyses for each chronic disease undergoing medical treatment (stroke, cancer or myocardial infarction/angina pectoris) as exposures in the model.

Data were analysed using SAS 9.3 (SAS Institute, Cary, NC, USA) with significance set at $P < 0.05$.

Results

Of the study population of 7036 participants (2910 with large-scale damage and 4126 with small-scale damage to their homes), 6840 (97%) were contacted by the survey team, of which 4949 (70%) completed and returned the questionnaire with written informed consent. Of the total participants, 3963 (56%) disclosed their current working status in the questionnaire and of these 2588 (37% of the total) were aged between 20 and 64. Thus, data from 2588 participants (991 with large-scale damage and 1597 with small-scale damage) were subjected to the following analyses.

Table 1 summarizes the demographic characteristics (age and gender) for the employed and unemployed participants along with health and life status, which includes current alcohol intake, current smoking levels and degree of damage to their homes. The number of employed participants was 1959 (76%); 629 were unemployed (including those who were looking for a job). Unemployed participants were older and more likely to be women, non-current drinkers or non-current smokers compared with those employed. There was no difference

Table 1. Participant characteristics (demographics and lifestyle) by employment status in the Shichigahama Health Promotion Project, Shichigahama town, Miyagi, north-eastern Japan

Demographics and lifestyle characteristics	Employment status		*P* value of χ^2 test
	Employed (n = 1959), n (%)	Unemployed (n = 629), n (%)	
Age at survey in years			
20–39	669 (34)	186 (30)	<0.01
40–49	524 (27)	109 (17)	
50–59	540 (28)	156 (25)	
60–64	226 (12)	178 (28)	
Gender			
Men	1131 (58)	165 (26)	<0.01
Women	828 (42)	464 (74)	
Current alcohol consumption[a]			
Non-drinker	611 (31)	279 (44)	<0.01
≤1 go/day	665 (34)	133 (21)	
≥2 go/day	297 (15)	28 (4)	
Unknown	386 (20)	189 (30)	
Current smoking levels			
Non-smoker	1138 (58)	451 (72)	<0.01
Current smoker	773 (39)	138 (22)	
Unknown	48 (2)	40 (6)	
Degree of damage to homes			
Large-scale damage	737 (38)	254 (40)	NS
Small-scale damage	1222 (62)	375 (60)	

NS, not significant.

[a]Current alcohol consumption was divided into four categories (no drinking, ≤1 go/day, ≥2 go/day, unknown), 22.8 g of alcohol amounts to one go or traditional unit of sake (180 ml), which also approximates two glasses of wine (200 ml) or beer (500 ml) in terms of alcohol contents.

in the degree of damage to houses based on employment status.

Table 2 indicates the number of employed and unemployed participants receiving medical treatment for chronic diseases. There were 87 participants receiving such treatment; 7 were receiving treatment for stroke, 33 for cancer and 47 for myocardial infarction/angina.

There was a statistically significant association between undergoing treatment for chronic disease and the risk of unemployment (multivariate OR = 1.7, 95% CI 1.02–2.7, $P < 0.05$). Considering the potential relationship between psychological distress and level of daily life activity with the employment status of chronically ill patients, participants were divided into two subpopulations, a psychosocially healthy group (i.e. with both lower psychological distress and better levels of daily life activity) and a relatively unhealthy group (i.e. with either higher psychological distress or poorer levels of daily life activity or both). In the psychosocially healthy group ($n = 1967$), no significant association was observed between undergoing treatment for chronic disease and the risk of unemployment (multivariate OR = 1.01, 95% CI 0.6–2.1), whereas in the relatively unhealthy group ($n = 536$) a significant association was found between medical treatment for chronic disease and risk of unemployment (multivariate OR = 2.6, 95% CI 1.01–6.6, $P < 0.05$). Psychological distress and level of daily life activity tended to mediate the association between chronic disease status and unemployment, but the interaction did not reach statistical significance (85 participants who did not respond to the questions about psychological distress and/or level of daily life activity were not included in this analysis) (Table 3).

We also conducted separate analyses on the association between undergoing medical treatment for each chronic disease (stroke, cancer or myocardial infarction/angina) and the risk of unemployment. Despite apparently raised risks of unemployment, these were not statistically significant (multivariate OR = 3.9, 95% CI 0.7–22.7 for stroke, OR = 1.6, 95% CI 0.8–3.5 for cancer and OR = 1.5, 95% CI 0.7–2.9 for myocardial

Table 2. Number of participants undergoing medical treatment for chronic diseases (stroke, cancer and myocardial infarction/angina pectoris) by employment status

Number of participants undergoing medical treatment for chronic diseases	Employment status	
	Employed	Unemployed
Stroke	3	4
Cancer	17	16
Myocardial infarction/angina pectoris	34	13
Combination of medical treatment for chronic diseases (considered duplicate diseases)	54	32

Table 3. Multivariate OR[a] and 95% CI for 'unemployment' by undergoing medical treatment for chronic diseases (stroke, cancer and myocardial infarction/angina pectoris)

	All subjects ($n = 2588$)		Participants with lower degree of psychological distress and better level of daily life activity ($n = 1967$)	
	Employed ($n = 1959$)	Unemployed ($n = 629$)	Employed ($n = 1522$)	Unemployed ($n = 445$)
Combination of medical treatment of chronic diseases (stroke, cancer and myocardial infarction/angina pectoris)				
Age-, gender-adjusted OR (95% CI)	1.0 (Reference)	1.7 (1.03–2.8)	1.0 (Reference)	1.1 (0.6–2.1)
P value	–	<0.05	–	NS
Multivariate adjusted OR (95% CI)	1.0 (Reference)	1.7 (1.02–2.7)	1.0 (Reference)	1.1 (0.6–2.1)
P value	–	<0.05	–	NS
Each medical treatment for chronic disease				
Stroke				
Multivariate adjusted OR (95% CI)	1.0 (Reference)	3.9 (0.7–22.7)	1.0 (Reference)	0.9 (0.04–9.0)
P value	–	NS	–	NS
Cancer				
Multivariate adjusted OR (95% CI)	1.0 (Reference)	1.6 (0.8–3.5)	1.0 (Reference)	1.3 (0.5–3.1)
P value	–	NS	–	NS
Myocardial infarction/angina pectoris				
Multivariate adjusted OR (95% CI)	1.0 (Reference)	1.5 (0.7–2.9)	1.0 (Reference)	1.1 (0.4–2.7)
P value	–	NS	–	NS

Table 3. *(Continued)*

	Participants with higher degree of psychological distress and/or poorer level of daily life activity (n = 536)		Participants who did not respond to the questions about psychological distress and/or level of daily life activity (n = 85)		P value for interaction[b]
	Employed (n = 377)	Unemployed (n = 159)	Employed (n = 60)	Unemployed (n = 25)	
Combination of medical treatment (stroke, cancer and myocardial infarction/angina pectoris)					
Age-, gender-adjusted OR (95% CI)	1.0 (Reference)	2.6 (1.04–6.6)	1.0 (Reference)	2.7 (0.4–19.3)	NS
P value	–	<0.05	–	NS	
Multivariate adjusted OR (95% CI)	1.0 (Reference)	2.6 (1.01–6.6)	1.0 (Reference)	2.4 (0.2–28.3)	NS
P value	–	<0.05	–	NS	
Each medical treatment for chronic disease					
Stroke					
Multivariate adjusted OR (95% CI)	1.0 (Reference)	>999.9 (2.6–NA)	1.0 (Reference)	NA	NS
P value	–	NA	–		
Cancer					
Multivariate adjusted OR (95% CI)	1.0 (Reference)	1.5 (0.3–8.6)	1.0 (Reference)	NA	NS
P value	–	NS	–		
Myocardial infarction/angina pectoris					
Multivariate adjusted OR (95% CI)	1.0 (Reference)	1.9 (0.6–6.4)	1.0 (Reference)	1.0 (0.03–17.5)	NS
P value	–	NS	–	NS	

NA, not applicable; NS, not significant.

[a]The multivariate ORs and 95% CIs were adjusted for gender, age in years (20–39, 40–49, 50–59, 60–64), current alcohol intake (non-drinker, ≤1 go per day, ≥2 go per day, unknown), current smoking levels (non-smoker, current smoker or unknown) and degree of house damage (large-scale damage, small-scale damage).

[b]Undergoing medical treatment for chronic diseases (yes or no) and the psychological distress or level of daily life activity ('participants with lower degree of psychological distress and better level of daily life activity' or 'participants with higher degree of psychological distress and/or poorer level of daily life activity') were put in a multiple logistic regression model with the interaction terms (85 participants who did not respond to the questions about psychological distress and/or level of daily life activity were not included in this analysis).

infarction/angina). In participants with a lower degree of psychological distress or better levels of daily life activity (n = 1967), the risk of unemployment for individuals with each chronic disease was not raised (multivariate OR = 0.9, 95% CI 0.04–9.0 for stroke, OR = 1.3, 95% CI 0.5–3.1 for cancer and OR = 1.1, 95% CI 0.6–6.4 for myocardial infarction/angina). However, in participants with a higher degree of psychological distress and/or poorer levels of daily life activity (n = 536), despite apparently raised risks of unemployment for individuals with each chronic disease, these were not statistically significant (multivariate OR = 1.5, 95% CI 0.3–8.6 for cancer and OR = 1.9, 95% CI 0.6–6.4 for myocardial infarction/angina). No significant interaction between psychological distress and level of daily life activity factors was observed between individuals undergoing medical treatment for each chronic disease and the risk of unemployment.

Discussion

In this study, individuals undergoing medical treatment for chronic diseases had significantly increased rates of unemployment with an OR of 1.7. An increase in social and psychological issues after a disaster was expected and our results indicated that there was a statistically significant association between undergoing medical treatment for the chronic diseases stroke, cancer and myocardial infarction/angina and being unemployed in all participants.

Our results were consistent with a meta-analysis based on surveys conducted in non-disaster settings [5], which demonstrated that it was more difficult for people suffering from chronic diseases to work than those without chronic disease with an OR of 1.31 (95% CI 1.14–1.50). Caution should be used when comparing our study with previous data as we only considered three chronic diseases that are the main causes of death in Japan: stroke, cancer and myocardial infarction/angina. However, in previous studies, a wider range of chronic diseases have been investigated, such as neoplastic [7], respiratory [8,9,11], musculoskeletal [8,9,11,12], cardiovascular [9,11], diabetes [10], gastrointestinal [10], urogenital [10], skin [10], haematological [10], neurological and sensory [10], mental [10] and unspecified [6,11]. The relative risk of unemployment in the post-disaster settings may be much higher than in non-disaster settings. Analyses of associations between undergoing medical

treatment for each of the three chronic diseases considered and employment status showed that there were no significant associations, which may have been due to an insufficient sample size (Table 3). The data also suggested that high rates of unemployment may not be specific to individual chronic diseases but rather are increased for everyone suffering from chronic disease.

In this study, psychological distress and level of daily life activity, both of which were reported to be substantially affected in post-disaster settings, were taken into account as potential factors, which could affect employment in subjects being treated for chronic disease. In earlier studies, the effects of psychological distress or level of daily life activity on the risk of unemployment in chronic disease patients have been unresolved [5]. In participants who had lower psychological distress or better levels of daily life activity, no significant associations between undergoing medical treatment for chronic diseases and the rate of unemployment were found, whereas significant associations were found in those who had either high psychological distress or poor levels of daily life activity. The data suggest that the unemployment risks of people suffering from chronic diseases need to be considered, as increased psychological distress and decreased levels of daily life activity are often observed in post-disaster settings. Employment support and promotion of mental health and daily life activity are needed to maximize social resilience among chronically ill patients in communities affected by disasters. The data also suggest that it is important to evaluate the psychological distress and levels of daily life activity in chronically ill patients to assist them in finding or keeping employment and in supporting their health and life conditions even in non-disaster settings. Although van Rijn has reported a significant association between chronic disease and employment status with a relative risk of 1.31 in such settings, the relative risk is expected to be higher in subpopulations with higher psychosocial distress and/or poorer levels of daily life activity. Collecting more information on psychological distress and levels of daily life activity would assist in providing more effective social support for chronically ill patients.

This study had several limitations. Firstly, our sample size of 2588 was insufficiently large to obtain adequate statistical strength to measure the real effect of specific chronic diseases on unemployment risk. Secondly, due to its cross-sectional design, we could not determine a causal relationship between undergoing medical treatment for chronic diseases and the rates of unemployment in this study. Thirdly, because we assessed individuals with chronic diseases and daily life activity using a self-reported assessment, the actual medical treatment status or daily life activity might have been incorrectly classified. Fourthly, the response rate (56%) was not high, so the study may be biased towards healthier people in the community. However, any such bias did not affect the internal validity of the association between chronic disease status and employment status. Finally, we were unable to collect detailed information on clinical status (e.g. treatment methods, disease sites or disease stages). The clinical status of those people receiving medical treatment for chronic diseases might have affected their rates of unemployment. In view of these results, we suggest that to reduce the risk of unemployment in people being treated for chronic diseases, healthcare workers should provide stress management [29] and physical function rehabilitation [30] and should monitor the degree of psychological distress or levels of daily life activity in such people.

In conclusion, the association between undergoing medical treatment for a combination of chronic diseases (stroke, cancer or myocardial infarction/angina) and unemployment was observed only in participants with a higher degree of psychological distress and/or poorer levels of daily life activity.

Key points

- This study used population-based cross-sectional data from over 2500 participants to investigate the association between undergoing medical treatment for a combination of chronic diseases and unemployment rates in a disaster area.
- The association between undergoing medical treatment for a combination of chronic diseases (stroke, cancer or myocardial infarction/angina) and unemployment was observed only in participants with a higher degree of psychological distress and/or poorer levels of daily life activity.
- Employment support and promotion of mental health and daily life activity are needed to maximize social resilience among chronically ill patients in communities affected by disasters.

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Conflicts of interest

None declared.

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Short communication

Long-term impact of the 2011 Great East Japan Earthquake and tsunami on functional disability among older people: A 3-year longitudinal comparison of disability prevalence among Japanese municipalities

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ABSTRACT

It has been unclear whether the prevalence of disability is higher in an area affected by natural disaster than in other areas even if more than one year has passed since the disaster. The aim of this ecological study was to examine whether the rate of increase in disability prevalence among the older population was higher in disaster-stricken areas during the 3 years after the Great East Japan Earthquake (GEJE) and tsunami. This analysis used public Long-term Care Insurance (LTCI) data covering 1570 municipalities. "Disaster areas" were considered to be the three prefectures most affected by the earthquake and tsunami: Iwate, Miyagi, and Fukushima. The outcome measure was the number of aged people (≥65 years) with LTCI disability certification. Rates of change in disability prevalence from January 2011 to January 2014 were used as the primary outcome variable, and compared by analysis of covariance between "coastal disaster areas", "inland disaster areas" and "non-disaster areas". The mean rate of increase in disability prevalence in coastal (14.7%) and inland (10.0%) disaster areas was higher than in non-disaster areas (6.2%) ($P < 0.001$). During the 3 years after the earthquake, the increase of disability prevalence from before the GEJE continued to be higher in the disaster-stricken areas.

1. Introduction

Natural disasters affect functional status among older people. The Great East Japan Earthquake (GEJE) and tsunami on March 11, 2011, directly caused more than 15,000 deaths, but also affected the functional status of older survivors (Ishigaki et al., 2013). Our previous study showed that the prevalence of functional disability increased steeply during the one year after the GEJE, especially in the coastal disaster areas most severely affected by the disaster (Tomata et al., 2014).

Currently, even 3 years after the GEJE, about 315,000 people still remain at evacuation sites (Ishigaki et al., 2013). Previous studies have indicated that such relocated individuals tend to have psychological morbidity and physical inactivity (Murakami et al., 2014; Uscher-Pines, 2009). Therefore, there has been some concern that disability prevalence will continue to increase in the disaster-stricken areas. However, to our knowledge, no study has yet reported this long-term impact of the GEJE.

The aim of this ecological study was to test the hypothesis that the increase in the rate of disability prevalence among the older

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population was higher in the disaster-stricken areas than in other areas of Japan, after more than one year had passed after the GEJE. For this purpose, we analyzed Japanese national statistical data covering a period of 3 years after the disaster.

2. Methods

2.1. Study design

The authors performed an ecological study using data from the Report on the Status of the Long-term Care Insurance (LTCI) Project, issued by the Ministry of Health, Labour and Welfare of Japan (Ministry of Health). The Report on the Status of the (LTCI) Project is based on a routine survey conducted on data from all Japanese municipalities.

To confirm whether the changes that occurred in the 3-year period after the GEJE were particularly bigger than those that had occurred in the one-year period before it, statistical data for the 50 months from January 2010 to February 2014 were collected. These data included the status of municipalities at the end of each month.

2.2. Outcome

Functional disability was defined according to disability certification in the LTCI system. Disability prevalence (%) in each municipality every month was calculated as the "number of persons who were certified for LTCI/number of insured elderly population aged ≥65 years".

The LTCI is a mandatory form of social insurance designed to assist the frail elderly in their daily activities (Tsutsui and Muramatsu, 2005). Every person aged >65 years is eligible for formal caregiving services. A person must be certified according to the nationally uniform standard to receive caregiving services through the LTCI system.

2.3. Statistical analysis

All municipalities in Japan which were included in the LTCI system as of February 2014 (n = 1579) were defined as the study subjects.

In the present study, "disaster areas" were defined as municipalities in the prefectures of Iwate, Miyagi, and Fukushima, which were extensively damaged by the GEJE (Ishigaki et al., 2013). Furthermore, the disaster areas were classified into "coastal disaster areas" (municipalities bordering the Pacific coast) and "inland disaster areas" for assessing the damage caused by the tsunami, in common with the previous study (Tomata et al., 2014). Additionally, "non-disaster areas" were defined as the municipalities in the other 44 prefectures in Japan.

The municipalities were excluded if any data necessary for the main analysis were missing because the damage caused by the GEJE was particularly great and no statistical information was available because regional government offices were temporarily non-functional (n = 7. These municipalities included 13,621 insured elderly persons [0.05% of all insured elderly persons in all the municipalities]). As a result, a total of 1572 municipalities were included in the main analysis.

Because these excluded municipalities did not meet this exclusion criterion when we used only two data points (January 2011 and January 2014), we also conducted sensitivity analysis using all of the municipalities (n = 1579).

The primary outcome was the annual rate of change in disability prevalence from January 2011 to January 2014.

To check whether the degree of increase in the prevalence of disability was higher in the disaster-stricken areas at each point, we compared the rates of change in disability prevalence for every one-year period between each of the years.

3. Results

3.1. Baseline characteristics

The baseline characteristics in January 2011 were as follows (Table 1). The mean number of insured elderly persons aged ≥65 years was 19,346 in the coastal disaster areas, 9787 in the inland disaster areas, and 18,969 in the non-disaster areas (P = 0.135 by ANOVA). The mean disability prevalence was 16.0% in the coastal disaster areas, 16.5% in the inland disaster areas, and 16.7% in the non-disaster areas (P = 0.399 by ANOVA).

3.2. Three-year change in disability prevalence

As shown in Table 2, the mean rate of increase in disability prevalence differed significantly among the area groups at 2 years and 3 years later ($P < 0.001$). In the 3 years after the GEJE, the rate of increase in disability prevalence was significantly higher in coastal (14.7%) and inland (10.0%) disaster areas than in non-disaster areas (6.2%) (post-hoc univariate analysis by Dunnett's t test; $P < 0.001$).

We compared the rates of change in disability prevalence for every one-year period between each of the years, and the differences between groups (F-value) decreased with each passing year (Table S1). The rate of increase in coastal disaster areas tended to be higher than in non-disaster areas at each point, but the mean rates between January 2013 and January 2014 did not differ significantly (post-hoc univariate analysis by Dunnett's t test; $P = 0.176$).

Because the excluded municipalities did not meet this exclusion criterion when we used only two data points (January 2011 and January 2014), we also conducted sensitivity analysis using all of the municipalities (n = 1579). In the 3 years after the GEJE, the rate of increase in disability prevalence in coastal disaster areas was 18.5% (Table S2).

3.3. Fifty-month change in disability prevalence

Disability prevalence increased in each region between January 2010 and February 2014 (Fig. 1). In this analysis, the sample size was n = 1526 municipalities (among 1572 municipalities, some were excluded if: 1) any data from January 2010 to February 2014 had been rendered unavailable [n = 8]; 2) data had been recorded using the classification system employed before April 2006 [n = 2]; or 3) the outcome variable [mild disability or moderate to severe disability] when stratified by the age structure of the population [65–74 years or ≥75 years] was 0% at any point, because it was a village with a particularly small population [n = 36]).

Even more than one year after the disaster, disability prevalence in coastal disaster areas tended to increase.

4. Discussion

The aim of this ecological study was to examine whether the increase in the rate of disability prevalence among the older population during the 3 years after the GEJE was higher in the disaster-stricken areas, relative to other areas of Japan. This analysis showed that disability prevalence in disaster-stricken areas increased more markedly during the 3 years after the GEJE, especially in coastal disaster areas where the damage due to the tsunami had been especially serious. However, the difference in the degree of increase in disability prevalence between the disaster-stricken and non-disaster areas tend to shrink year by year (Table S1).

Table 1
Characteristics of municipalities on baseline (January 2011) according to regions (n = 1572).

	Coastal disaster areas (n = 29)		Inland disaster areas (n = 82)		Non-disaster areas (n = 1461)		p^b	F^b
	Mean	SD	Mean	SD	Mean	SD		
Number of insured elderly persons	19,346	36,787	9787	14,086	18,969	41,493	0.135	2.0
Proportion of persons ≥75 y (%)[a]	52.3	3.7	57.7	5.2	52.4	7.1	<0.001	22.1
Prevalence of disability (%)	16.0	1.2	16.5	2.0	16.7	2.9	0.399	0.9

[a] Proportion per all insured elderly persons (≥65 y).
[b] Parameters of one-way ANOVA (p-value and F-value. Degrees of freedom = 2).

Table 2
Regional comparisons of rates of change in disability prevalence during the three years following the month before the Great East Japan Earthquake (n = 1572 municipalities).[a]

	n	1-year later				2-years later				3-years later			
		Mean	(95%CI)	p	F	Mean	(95%CI)	p	F	Mean	(95%CI)	p	F
Coastal disaster areas[b]	29	9.2	(7.9–10.5)	<0.001	44.9	12.1	(10.0–14.2)	<0.001	37.1	14.7	(12.1–17.2)	<0.001	30.2
Inland disaster areas	82	4.2	(3.4–5.0)			8.7	(7.5–10.0)			10.0	(8.4–11.5)		
Non-disaster areas	1461	2.9	(2.7–3.1)			5.0	(4.7–5.3)			6.2	(5.9–6.6)		

[a] Rate (%) of change in disability prevalence from January 2011. Adjusted means and 95% confidence interval (95%CI) of means were estimated by analysis of covariance (degrees of freedom = 2) based on mean proportion of individuals aged ≥75 years at the baseline (52.7%).
[b] Disaster areas were defined as the three prefectures most severely impacted by the disaster (Iwate, Miyagi and Fukushima). "Coastal" means municipalities located on the Pacific coast where the tsunami struck on March 11, 2011.

A limitation of the previous study had been that post-disaster data during the one year after the GEJE for the 15 municipalities where the damage had been particularly great were not obtained, because regional government offices had not been functional after the disaster (Tomata et al., 2014). The main analysis of this study (Table 2) also excluded a proportion of these municipalities (n = 7) to include the changes that had occurred over one year. However, the disability prevalence data for these municipalities were finally reported more than one year after the GEJE. Therefore the present study was able to include all of the municipalities in the sensitivity analysis to compare rates of change in disability prevalence from January 2011 to January 2014 (Table S2), and the results can be interpreted without any underestimation resulting from incomplete sampling. The sensitivity analysis showed that the mean rate

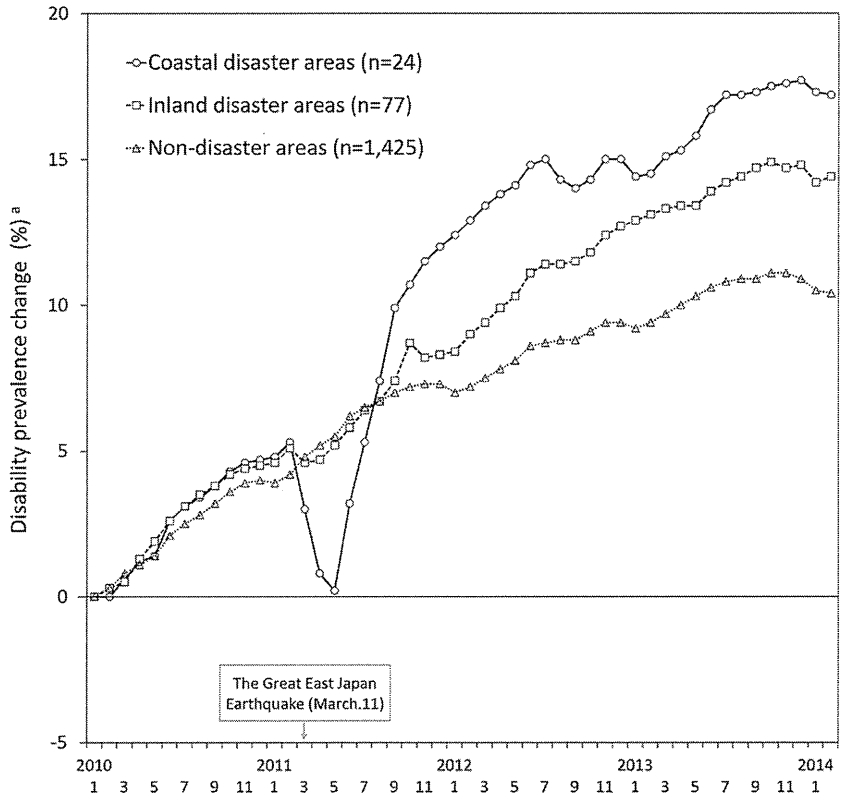

Fig. 1. Monthly trends in disability prevalence before and after the Great East Japan Earthquake (n = 1526 municipalities). (a) Adjusted means were estimated by analysis of covariance (adjustment item: proportion of individuals aged ≥75 years at the baseline). The estimations were based on the average of the adjustment item (proportion of individuals aged ≥75 years = 51.1%).

of increase in disability prevalence among coastal disaster areas was higher than that obtained in the main analysis (18.5% in Table S2 and 14.7% in Table 2), because municipalities excluded in the main analysis had marked increases in disability prevalence after the GEJE. This result suggested that the results of our previous study (Tomata et al., 2014) and the main analysis in the present study had been underestimated.

Although the mortality rate in disaster-stricken areas did not increase further beyond 6 months after the GEJE (Uchimura et al., 2014), the suicide rate increased after the 2-year mark (Orui et al., 2015). Therefore the aftermath of the GEJE appeared to extend beyond one year.

This study had several limitations, including the possibility of confounding by personal and local characteristics, as this was an ecological study.

5. Conclusions

The GEJE was a Japanese disaster of historical proportions, and even more than one year later, the increase of disability prevalence continued to be higher in disaster-stricken areas than those before the event.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2015.11.016.

Competing interests

None to declare.

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RESEARCH ARTICLE

Changes in Cognitive Functions in the Elderly Living in Temporary Housing after the Great East Japan Earthquake

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Abstract

On March 11, 2011, Japan experienced an earthquake of magnitude 9.0 and subsequent enormous tsunamis. This disaster destroyed many coastal cities and caused nearly 20,000 casualties. In the aftermath of the disaster, many tsunami survivors who lost their homes were forced to live in small temporary apartments. Although all tsunami survivors were at risk of deteriorating health, the elderly people were particularly at a great risk with regard to not only their physical health but also their mental health. In the present study, we performed a longitudinal cohort study to investigate and analyze health conditions and cognitive functions at 28, 32, and 42 months after the disaster in the elderly people who were forced to reside in temporary apartments in Kesennuma, a city severely damaged by the tsunamis. The ratio of people considered to be cognitively impaired significantly increased during the research period. On the other hand, the mean scores of the Kessler Psychological Distress Scale-6 and Athens Insomnia Scale improved based on the comparison between the data at 24 and 42 months. The multiple logistic regression analysis revealed that frequency of "out-of-home activities" and "walking duration" were independently associated with an increase in the ratio of people with cognitive impairment. We concluded that the elderly people living in temporary apartments were at a high risk of cognitive impairment and "out-of-home activities" and "walking" could possibly maintain the stability of cognitive functions.

Introduction

On March 11, 2011, Japan experienced unexpected strong earthquakes and tsunamis, resulting in one of the worst disasters in the nation's history [1]. After the disaster, thousands of people were forced to live in temporary apartments because they had lost their homes. The room space of these temporary apartments was so small and limited (5 m^2/person) that the residents were unable to continue their daily activities such as farming and fishing. In addition, the people lost their local community and opportunities for communication, which they previously had. Of the disaster victims, particularly the elderly people were at a higher risk of decrease in their mental and physical health than younger adults. Our group previously reported that cognitive functions and behavioral and psychological symptoms of dementia were significantly exacerbated in patients with Alzheimer's disease (AD) who lived in these shelters compared with patients who did not experience the earthquake and those who remained in their own homes [2,3]. Furthermore, we reported that the ratio of elderly people with cognitive impairment was higher in the residents of temporary apartments than that of those living in other areas [4]. Therefore, it was quite important to longitudinally examine and analyze the health and cognitive condition of elderly people living in temporary apartments after the disaster. In the present study, we performed a longitudinal cohort study to clarify the health status and cognitive functions in the elderly people who lived in these temporary apartments.

Materials and Methods

Research Subjects

The names, addresses, and dates of birth of the source population were obtained from the city office of Kesennuma after the agreement treaty between the Tohoku University and Kesennuma city. The subject inclusion criteria were as follows: (i) lived in Kesennuma on March 11, 2011 (the day of the earthquake), (ii) aged $\geq$65 years on March 11, 2011, and (iii) lived in temporary apartments in Kesennuma on March 1, 2013. The total number of recruited subjects was 2,149 (male/female: 882/1,367). Their mean age at the first survey was 76.4 ± 6.0 years of age. The present study was approved by the Tohoku University ethical committee and written informed consent was obtained from all participants.

Questionnaires on health status

We employed a set of modified questionnaires, which had already been widely used in previous studies [5,6,7]. Our questionnaire comprised of 116 questions, including items of activity of daily living (ADL), the Lawton's instrumental ADL (I-ADL), the Kessler Psychological Distress Scale-6 (K6), and Athens Insomnia Scale (AIS). The questionnaires were distributed by mail first and were recollected by the researchers of Tohoku University and Shin Joho Center Inc. door to door one to two weeks later. If the subjects had difficulty in filling the questionnaires because of reasons such as cognitive impairment, their families or caregivers filled the questionnaires.

Cognitive examination

Touch panel computers, on which 15 questions were already installed, were employed to examine cognitive functions [4,8,9,10]. The 15 questions evaluated memory, orientation, and pattern recognition. The best possible score was 15, and scores of $\leq$12 were considered to be indicative of cognitive impairment [8,9].

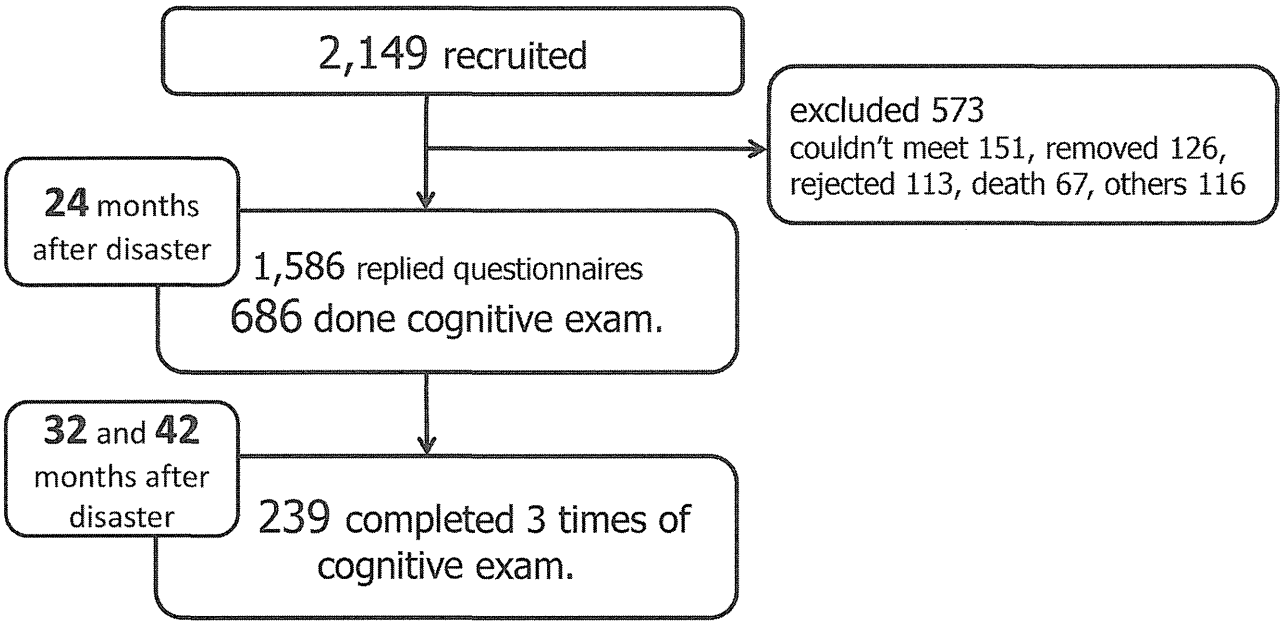

Fig 1. Schema of study design, sample selection, and study population.

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Statistical methods

Logistic regression analysis was used to identify factors independently associated with change in the proportion of people with cognitive impairment after adjustment for age, gender, hypertension, diabetes and dyslipidemia by univariate analysis. We also used a two-sided t test for numerical variables and the Chi-square test for categorical variables in the analyses of longitudinal change in each category. Statistical significance was set at $P < 0.05$. All the statistical analyses were performed using JMP Pro (version 10.0.2,11.2).

Results

We started this study in March 2013, when two years had passed since the disaster. One to two weeks after the questionnaires were mailed to the participants, researchers visited each temporary apartment and collected the questionnaires. The questionnaires were distributed and collected three times (24, 32, and 42 months after the disaster). Cognitive examination was also performed three times according to the same schedule. The study profile is presented in Fig 1. The number of participants at the beginning of the study was 2,139. At 42 months after the earthquake, 239 subjects had completed all the questionnaires and cognitive examinations.

The ratio of people considered to be cognitively impaired was calculated and the change was analyzed at each time point during the study period. The ratio significantly increased during the research period by 32%, 35%, and 42% at 24, 32, and 42 months after the disaster, respectively (Fig 2). These ratios were significantly higher than those obtained in other regions, i.e., the prevalence of dementia in the population (aged $\geq$65 years) was reported to be 22.5% in Japan [11] and the proportion of elderly people considered to be low cognition based on a touch-panel computer's score of $\leq$ 12 was reported to be 28.0% in another area [8,9,10].

Regarding psychological status, depression status as measured by K6 questions, (6.0, 5.6, and 5.6 at 24, 32, and 42 months, respectively), and insomnia condition as measured by AIS questions, (4.7, 4.6, and 4.2 at 24, 32, and 42 months, respectively) significantly improved

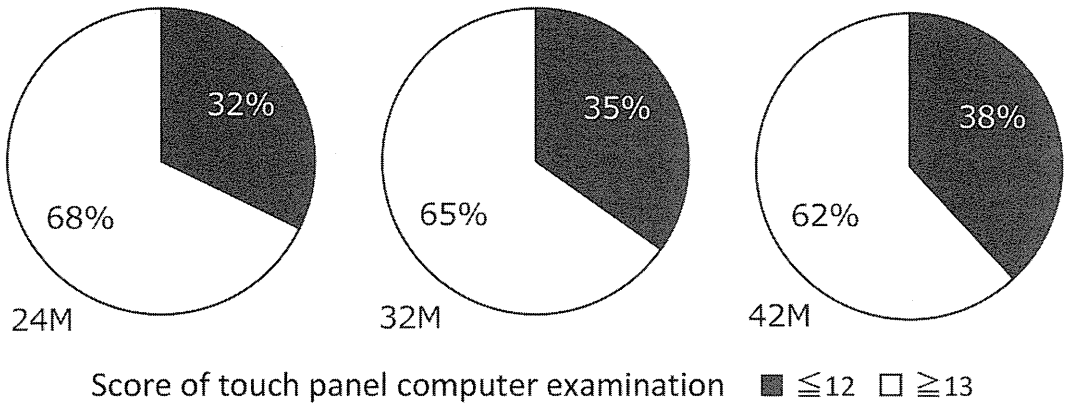

Fig 2. Changes in the ratio of people with normal cognitive function and those with declined cognitive function. White and black portions indicate the ratio of people with normal cognitive function (touch panel computer exam score of ≥13) and declined cognitive function (exam score of ≤12), respectively, at 24, 32, and 42 months after the disaster.

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based on the comparison between the data at 24 and 42 months (Table 1). These results suggest that the elderly people were in the process of mental recovery after the disaster.

In the comparison between the group in which the cognitive function declined (a touch-panel computer exam score of ≤12 at 24 months and/or that of ≤ 12 at 42 months) and the group in which the function did not decline (a touch-panel computer exam score of ≥ 13 at 24 months and/or that of ≥ 13 at 42 months), a multiple logistic regression analysis was employed to elucidate the factors associated with the change in cognition. It revealed that frequency of

Table 1. Change in each item at 24, 32, and 42 months after the disaster.

	24 months	32 months	42 months	Statistics
Ages, years	79.3±6.0	79.7±5.8	80.5±5.8	*1,*2,*3
Male (%)		102 (42.7)		
BMI (kg/m^2)	23.4±3.0	23.4±3.1	23.6±3.6	n.s.
Grip (kg) male	24.3±8.0	24.2±7.8	24.2±7.7	n.s.
Grip (kg) female	23.7±7.7	23.5±7.7	23.4±7.5	n.s.
Lawton's I-ADL male	4.4±1.0	4.4±1.0	4.4±11.1	n.s.
Lawton's I-ADL female	6.9±1.4	7.1±1.3	7.1±1.3	n.s.
Solitude (%)	22 (11.5)	25 (13.7)	22 (11.5)	n.s.
Family bereavement (%)		99 (44.8)		
Awareness of cognitive decline after the disaster	98 (51.9)	99 (52.4)	116 (61.4)	*1,*2
Take treatment for dementia	7 (3.0)	5 (2.3)	13 (5.4)	n.s.
Score of touch-panel computer examination	12.8±2.0	12.7±2.1	12.6±2.3	n.s.
≤12 points (%)	77 (32.2)	83 (34.7)	91 (38.1)	*1,*2,*3
Athens Insomnia Scale (AIS)	4.7±3.7	4.6±3.7	4.2±3.7	*2,*3
Total score of K6 test	6.0±5.0	5.6±5.0	5.6±4.9	*1,*3
Frequency of out of home activities ≥ 3days /week (%)	133 (60.2)	135 (65.5)	141 (61.6)	n.s.
Walking duration ≥ 0.5 h/day	95 (43.8)	94 (43.3)	92 (42.4)	n.s.

*1 $P< 0.05$, Between 24 and 32 months

*2 $P< 0.05$, Between 32 and 42 months

*3 $P< 0.05$, Between 24 and 42 months

doi:10.1371/journal.pone.0147025.t001

"out-of-home activities" and "walking duration" showed an independent association with the ratio of people with cognitive impairment (Table 2). As shown in Figs 2 and 3, the group with a lower frequency of "out-of-home activities" had a significantly increased ratio of people with impaired cognitive functions (touch-panel computer exam score $\leq$ 12). These results suggest that the elderly people who lived in temporary apartments had a higher risk of cognitive deterioration and opportunities for "out-of-home activities" and "walking" possibly keeps cognitive functions stable.

Discussion

The Great East Japan Earthquake adversely affected human lives, particularly physical and mental health, as well as access to jobs, housing, buildings, and community. Many tsunami survivors who lost their residence had to continue their lives in a limited space [1]. Not only thousands of people lost their lives due to the earthquake and tsunamis but also the mental and physical health of several survivors deteriorated during the long process of evacuation [7]. In particular, the elderly people were more susceptible to losing their life or suffering poor health after the disaster. Temporary apartments were started to be built some weeks after the earthquake. Needless to say, these apartments were much better than shelters such as gymnasiums and school halls; however, their space was so small and the communities, which the people used to have, hardly existed anymore. In these inferior conditions, there was concern regarding the physical and mental health of temporary apartment residents, particularly the elderly. Cloyd and Dyer stated that older adults are extremely vulnerable after catastrophic events through their experience with Hurricane Katrina [12,13]. Therefore, we started a survey of the health and cognition of the elderly people living in temporary apartments. Firstly, the ratio of people with low cognitive functions was significantly higher in these people than those living in the non-disaster area [4,8,9,10,11]. The ratio also increased during the research period. Our group previously reported a worsening of AD symptoms after the earthquake [2,3]. The reasons we speculate for these phenomena are as follows: (i) dramatic changes in the living space,

Table 2. Logistic regression analysis to identify factors independently associated to cognitive functions.

	Declined or maintained low score based on the touch-panel computer exam.	Improved or maintained high score based on the touch-panel computer exam.	Statistics
Subject number (%)	91 (38.1)	148 (61.9)	$P = 0.0414$
Age (years)	80±5.6	78.3±6.4	n.s.
BMI (kg/m^2)	24±3.3	23.3±2.9	n.s.
Grip (kg)	23±6.5	24.6±8.5	n.s.
Athens Insomnia Scale (AIS) (at 24 months)	4.6±3.6	5.1±4.0	n.s.
Total score of K6 test (at 24 months)	6.0±4.6	6.0±5.2	n.s.
Touch-panel computer exam score (at 24 months)	12.0±2.4	13.3±1.6	$p<0.0001$
Touch-panel computer exam score (at 32 months)	12.0±2.5	13.2±1.7	$p<0.0001$
Touch-panel computer exam score (at 42 months)	10.0±2.3	13.9±0.7	$p<0.0001$
Walking duration $\geq$ 0.5 h/day (%) (at 24 months)	26 (31.7)	69 (51.1)	$p<0.005$
Frequency of out of home activities 3 $\geq$ days/week (at 24 months)	35 (41.2)	98 (72.1)	$p<0.0001$
Solitude	6 (7.0)	18 (12.9)	n.s.

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