HHS Public Access

Author manuscript

Soc Sci Med. Author manuscript; available in PMC 2017 July 01.

Published in final edited form as:

Soc Sci Med. 2016 July ; 161: 47–54. doi:10.1016/j.socscimed.2016.05.026.

"Predictors of depressive symptoms following the Great East Japan Earthquake: A Prospective study"

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Abstract

We sought to investigate prospectively the association between exposure to disaster (the 2011 East Japan Earthquake) and change in depressive symptoms among community-dwelling older adult survivors. We used two waves of data from the Japan Gerontological Evaluation Study (JAGES), an ongoing population-based, prospective cohort study in Japan. A unique feature of our study was the availability of information about mental health status pre-dating the disaster. Our sample comprised community-dwelling survivors aged 65 and older, who responded to surveys in 2010 (i.e. one year before the disaster) and in 2013 (n= 3,464). We categorized disaster exposure according to three types of experiences: loss of family/friends, property damage, and disruption in access to medical service. Our main outcome was change in depressive symptoms, measured by the 15-item geriatric depression scale (GDS). Among the participants, 917(26.5%) reported losing a family member to the disaster, while a further 537(15.5%) reported losing a friend. More than half of the participants reported some damage to their homes. After adjusting for demographics and baseline mental health, people whose homes were completely destroyed had significantly elevated depressive symptom scores three years later (+1.22 points, 95%CI: 0.80, 1.64, p<.0001). Disruption of psychiatric care was also associated with change in GDS scores (+2.51 points, 95%CI: 1.28, 3.74, p<.0001). By contrast, loss of family/friends was no longer associated with GDS after 3 years; +0.18 points (95%CI: -0.018, 0.37, p=0.08) for loss of family, and −0.045 points (95%CI: -0.28, 0.19, p=0.71) for loss of friends. Three years after the disaster, survivors of the 2011 earthquake and tsunami appeared to have recovered from loss of loved ones. By contrast, property loss and disruption of psychiatry care were associated with persistent adverse impact on mental health.

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Keywords

Japan; depression; natural disaster; disaster damage; prospective cohort study

INTRODUCTION

Previous studies have provided ample documentation of the impact of exposure to natural disasters on the mental health of survivors (Fergusson et al., 2014; Frankenberg et al., 2008; Kumar et al., 2007; van Griensven et al., 2006). Personal experience of property damage, loss of family and disruption of employment each has been linked to an increased incidence of PTSD, depression and anxiety among survivors (van Griensven et al., 2006). However, almost none of the existing studies were able to incorporate information about the mental health of survivors *pre-dating* the exposure to disaster. Thus, it is not clear whether the symptoms of mental illness among survivors already pre-dated their experience of disaster. Retrospective recall of pre-disaster mental health status is also subject to recall bias.

One notable exception is a study reported by Fergusson et al (2014), conducted after the Canterbury earthquakes in New Zealand during 2010-2011. In that study, the authors took advantage of the Christchurch Health and Development Study, a 35-year longitudinal birth cohort (635 males and 630 females), in which ***pre***-disaster mental health information was available among the survivors. They reported that prevalence of some types of mental disorders (major depression, posttraumatic stress disorder, other anxiety disorder, and nicotine dependence) was significantly increased with increasing exposure to the earthquakes. However, after adjusting confounders that had been assessed before the earthquake, the significant positive associations were substantially attenuated except for nicotine dependence. Besides, the Christchurch cohort is still relatively young (age 35 years) and many participants have not yet accumulated substantial property (e.g. own their homes). We are unaware of studies that have focused on a population of older adults with information about mental health pre-dating the onset of disaster (which is very rare, and makes our natural experiment quite unique). In addition, few previous studies have been able to provide information on survivors for an extended period of follow-up, e.g. beyond one year after exposure to disaster. Thus, the persistent mental health impacts of disaster (if any) are not well understood.

To address these limitations of previous studies, we took advantage of a unique “natural experiment” (Craig et al., 2012), afforded by the ongoing Japan Gerontological Evaluation Study (JAGES), a nationwide cohort of older community-dwelling adults which was originally established in 2010 to examine prospectively the determinants of healthy aging. (Fujiwara et al., 2014; Kondo, 2010; Matsuyama et al., 2014; Takeuchi et al., 2013) By chance, one of the field sites of the cohort was located in Iwanuma city, Miyagi Prefecture, roughly 80 km the west of the epicenter of the 2011 Earthquake and Tsunami. This design allowed us to conduct a follow-up study of survivors three years after the disaster.

METHODS

Study Population and Study Design

We utilized two surveys waves of the JAGES cohort conducted in 2010 (baseline) and in 2013 (in the aftermath of the East Japan Earthquake). The study profile has been previously been described in detail (Hikichi et al., 2012). The East Japan Earthquake and Tsunami struck on March 11th, 2011. Iwanuma city, the field site for the present study, is a coastal municipality in Miyagi prefecture in Japan, located approximately 80 km west of the epicenter of the 3.11 earthquake. A total of 187 people have lost their lives or have been missing in Iwanuma, while 48% of the land mass was inundated by the tsunami (see Figure 1) (Ishigaki et al., 2013).

The baseline survey was completed in August 2010, 7 months prior to the earthquake. Questionnaires were mailed to every resident of Iwanuma aged 65 years or older (n= 8,576), inviting them to participate in the JAGES cohort study. The questionnaires inquired about demographics as well as the 15-item Geriatric Depression Scale (GDS). The response rate to the initial invitation was 59.0% (5,058/8,576), which is somewhat higher than the average among comparable community surveys of this type (Brick JM, 2013; JENKINS, 2010; Sinclair et al., 2012). From the 5,058, we further excluded 101 due to invalid ID, sex or age, leading to 4,957 valid respondents in the baseline survey. Among the 4,957 respondents, 577 were excluded for the follow-up: lost their life in the disaster (n = 34), death from the other (natural) causes (n = 400), moved out (n = 92), address unknown (n = 17), and too sick to be conducted (n = 34) (Figure 2). The number of eligible participants for the follow-up survey was 4,380. Approximately 2.5 years after the earthquake and tsunami, we mailed the follow-up survey to all survivors between Oct 2013 and Jan 2014. The follow-up survey again included the 15-item GDS, as well as questions related to personal experience of the disaster, such as property loss and the loss of loved ones. Trained survey teams then visited all the households to collect the completed surveys. Informed consent was obtained at the time of survey collection. The response rate to the 2013 follow-up survey was 82.1% (3,594/4,380) among the eligible participants. From the 3,594 participants, we excluded 27 due to invalid consent forms, leading to 3,567 participants at the follow-up survey. We then excluded 103 participants who were missing 8 or more items on the 15-item GDS questionnaire, resulting in a final analytic sample of 3,464. A detailed flow chart of the participant selection is presented in Figure 2 (participants flow).

Dependent Variable: Geriatric Depression Scale (GDS)

In both the 2010 and 2013 surveys, we assessed depressive symptoms using the 15-item Geriatric Depression Scale, which has been previously validated (Yesavage et al., 1982). The overall GDS score is based on a linear summation of 15 items (yes (1) or no (0)) with higher score indicating higher depressive symptomatology. GDS-15 has a sensitivity of 92% and a specificity of 81% to detect major depression as ascertained by a structured clinical interview, when a cutoff point of 5 is used (Lyness et al., 1997). The Japanese version of the 15-item GDS has been also widely used in previous studies (Fujiwara et al., 2014; Imai et al., 2013; Makizako et al., 2015). Among the eligible 3464 participants, 416(12.0%) had one to seven missing data points on the GDS, and we imputed the overall score based upon the

average of the available items. The dependent variable in the present study was the difference in GDS score between baseline (2010) and follow-up (2013), subtracting GDS (2010) from GDS (2013). If the value of a participant is positive, depressive symptoms of the person in 2013 got worse from 2010.

Independent Variable: Personal experiences of earthquake and tsunami damage

On the follow-up survey, each participant was asked about their personal experiences of disaster damage in the following categories: 1) loss of family/friends, 2) loss of pets, 3) loss of/damage to property (housing and cars), 4) loss of employment, and 5) disruption in access to medical care. We chose these types of disaster experiences based on previous studies on mental health among survivors after natural disasters and considering the local culture (van Griensven et al., 2006; Frankenberg et al., 2008).

1) Loss of family or friends—Loss of family or friends during the disaster was asked as follows: “Did you lose a close relative or friend in the earthquake?” Potential responses included *“1. Close relative, 2. Close friend, 3. No”*.

2) Loss of pets—Loss of pets was asked as follows: “Did you lose a dog, cat, or other pet in the earthquake?” Potential responses included “1. Dog, 2. Cat, 3. Other pet, 4. No, 5. I did not have a pet”.

3) Damage to/Loss of property (housing and cars)—Damage to housing was assessed by the following question. “How badly was your residence damaged in the earthquake?” Potential responses ranged from “1. Completely destroyed, 2. Mostly destroyed, 3. Half destroyed, 4. Partially destroyed, 5. No damage”. The five categories are based on the official local government criteria (for the purposes of compensation); not based upon subjective judgment. Loss of car(s) was assessed by the following question. *“Did you lose your car in the earthquake?”* Potential responses ranged from “1. Yes, 2. No, 3. I did not own car(s) when the disaster happened”

4) Loss of employment—Loss of employment due to the disaster was assessed as follows: “Did your job situation change as a result of the earthquake?” Potential responses ranged from “1. I lost my job, but it was later reinstated, 2. I lost my job, and do not currently work, 3. I did not work prior to the earthquake, 4. I work in the same job as I did prior to the earthquake, 5. I started a new job”. In the analysis, we combined response categories 1) and 2) into “loss of jobs”.

5) Disruption in access to health care—Disruption in access to health care due to the disaster was assessed by the following question: “Did you experience any disruption in access to health care? Circle all that apply.” Potential responses included: “1. Dentistry, 2. Internal medicine, 3. Orthopedics, 4. Ophthalmology, 5. Psychiatry, 6. Other”. In the analysis, we focused specifically on disruption in access to psychiatric care.

Covariates

Demographic characteristics (sex, age, marital status, years of education, income, Body mass index (BMI), smoking and drinking habit, pre-existing psychiatric conditions and history of other diseases, frequency of informal socializing) and experiences of disaster damage (loss of family member(s), loss of friend(s), loss of pet(s), house damage, car damage, job loss, and disruption to medical care) are summarized in Table 1/2 and Appendix Table 1. Averages and standards deviation of change in GDS are also shown in Table 1/2. The demographic characteristics (sex, age, marital status, years of education, income, BMI, smoking and drinking habit, pre-existing psychiatric conditions and history of other diseases, frequency of informal socializing) and GDS score in 2010 were adjusted in the multivariable model, and the results were shown in Table 3.

Statistical Analysis

We used a linear regression model to examine the association between experiences of the disaster and change in GDS scores. Changes in GDS scores were entered as continuous variables. The multivariate adjusted results were expressed as non-standardized coefficients with 95% confidence intervals (CI) in Table 3. All analyses were performed with SAS version 9.4 statistical software (SAS Institute Inc, Cary, North Carolina). We defined significance as a 2-sided P value <.05.

Sensitivity analysis

We conducted analyses stratified by age, sex, and past/present history of psychiatric disease in 2010 (pre-disaster) (Table 4). We hypothesized that these variables could potentially modify the associations between personal experiences of disaster damage and depressive symptoms.

Ethics statement

The study was approved by the Human Subjects Committee of the Harvard T. H. Chan School of Public Health, the Ethics Committee of the Tohoku University Graduate School of Medicine, Research Ethics Committee of the Graduate School of Medicine at Chiba University and the Research Ethics Committee involving Human Participants of the Nihon Fukushi University.

RESULTS

Among the participants, 917(26.5%) reported losing a family member, and 537(15.5%) losing a friend. More than half of the participants reported some extent of housing damage, while approximately 1 in 8 (12.6%) lost their car(s) (Table 2). Compared with the human and property loss, the number of those who lost their job(s) was relatively small: 186 (5.1%). Three hundred and seventeen (9.2%) participants reported disruption in access to health services of psychiatry. Mean (SD) of GDS was 3.74 (3.5) in baseline and 3.84 (3.4) in the follow-up. The average (unadjusted) increase in depressive symptomatology between waves was 0.96 points for ”entirely destroyed” of housing; 0.38 for loss of cars; 0.53 for loss of job; 1.98 for disruption of access to psychiatric care, and 0.84 points for loss of a pet cat.

Table 3 shows the multivariate adjusted associations between each type of disaster damage and change in depressive symptoms. In these models, property loss was significantly associated with worsening GDS scores: 1.40 points (95%CI: 0.96, 1.83, p<.0001) for total housing loss in comparison to those who had no damage of their house; and 0.47 points (95%CI: 0.21, 0.74, p=0.0005) for loss of car in comparison to those who had no damage of their car. Loss of employment was also associated with worsening GDS scores: 1.14 points (95%CI: 0.66, 1.62, p<.0001) in comparison to those who had kept the same job. Disruption of access to psychiatric care was significantly associated with worsening GDS: 2.51 points (95%CI: 1.28, 3.74, p<.0001) in comparison to those who did not report the disruption. By contrast, loss of family members was statistically significantly associated with worsening GDS, however, the effect size was relatively small: 0.23 (95%CI: 0.02, 0.44, p=0.035).

Table 4 shows the stratified analyses of associations between housing loss/disruption access to psychiatry and change in depressive symptoms. The impact of housing loss on GDS change was more pronounced in men, the younger old, and those with psychiatric diagnoses prior to the disaster. The interaction terms between housing loss and the stratifying variables were statistically significant in sex, but not in the other two: p for interaction was 0.013 for sex, 0.24 for age group, and 0.16 for past/present psychiatric disease. Association between change in GDS and disruption of access to psychiatry seemed to be stronger among those who had prior psychiatric diseases, but the interaction term was not statistically significant.

DISCUSSION

To our knowledge, this is the first study to utilize pre-disaster information to examine the impact of disaster damage on depressive symptoms in a community-dwelling sample of older adults. We found that loss of employment and disruption in access to psychiatric care predicts worsening of depressive symptoms up to three years after the disaster. Unexpectedly, we found that personal experiences of property damage have a more pronounced and lingering impact on depressive symptoms compared to experiencing the loss of loved ones. Our findings are more pronounced among male survivors compared to female survivors.

Our present study is consistent previous reports about the adverse mental health impacts of property damage and job loss; but our results concerning the loss of loved ones are somewhat surprising and unexpected (van Griensven et al., 2006; Zwiebach et al., 2010). The discrepancy may be due to differences in the age group of survivors. In our study, we examined survivors who were 65 or older, while most previous studies focused on younger adults who have not had time to accumulate wealth or property (or who have the prospect of many years ahead to rebuild their lives). In contrast to young adulthood, the loss of family members and friends is a more normative experience as people age, and this may have contributed to a more rapid psychological adjustment in our sample.

To our knowledge, few studies have examined the long-term impact of disaster damage on mental health. Most studies have been conducted up to a year following the experience of disaster. Arnberg et al. (2015) recently reported that exposure of tsunami was associated with an increased risk of severe psychopathology in children and adults over 5 years

independently of previous psychiatric morbidity. Our results add to the evidence that survivors of natural disasters should be actively followed long-term to prevent, detect, and alleviate psychiatric disorders that might follow.

A major strength of our study is the availability of information about mental health status pre-dating the disaster. To our knowledge, only one previous study by Fergusson and colleagues (2014) has incorporated pre-disaster information. In that study, they found prevalence of some types of mental disorders (major depression, posttraumatic stress disorder, other anxiety disorder, and nicotine dependence) was significantly increased with increasing exposure to the earthquakes. However, after adjusting confounders that had been assessed before the earthquake, the significant positive association disappeared except for nicotine dependence. The New Zealand sample was comparatively young (35 years), whereas our sample comprised older individuals. Thus, the two sets of studies provide complementary evidence on the impacts of disaster on mental health. Given the aging of populations across the globe – combined with the rising frequency and severity of natural disasters (Van Der Vink et al., 1998; Van Aalst, 2006) – it is important to understand and prepare for the impacts of disaster in this age group.

We believe the effect size of disruption of access to psychiatry and destruction of houses should be crucial, because experiencing property loss was comparable to the magnitude of association between low educational attainment and depressive symptoms. (Table 1/2). Besides, 1 point of change in 15-item GDS corresponds approximately to effect of 12-weekly-sessions cognitive behavioral therapy (Huang et al., 2015). Notably, disruption of access to psychiatric care was associated a substantial increase in GDS scores, over 2 points of change in GDS, and was in fact even larger in its impact than property damage (Table 3). This implies that special psychiatric services, such as Psychological First Aid (Cherie Castellano, 2006), or mobile psychiatry teams, should be a priority in the aftermath of disasters, and may be effective in alleviating the burden of mental problems following disasters. However, at the same time, this interpretation should be approach with some caution, as only 17 participants reported interruption in psychiatric care.

Losing cats was significantly associated with change in GDS. Pet therapy might improve mental illness (Moretti et al., 2011), and, therefore, the observed significant association might be also causal. However, losing cats would be just a proxy of losing houses or cars, because its coefficient was substantially attenuated when “losing cats” and “house damage” were adjusted in the same time (data not shown).

Limitations

We note a number of limitations in the current study. First, experiences of disaster damage and depressive symptoms were based on self-report, and therefore, potentially subject to common method bias. We cannot exclude the possibility that individuals whose depressive symptoms increased between survey waves were also more likely to selectively recall personal experiences of damage. Second, a small portion of the baseline participants (577/4,957) were lost to follow-up, which may have resulted in bias. However, since individuals with worsening mental health symptoms were more likely to be lost to follow-up, we believe that this resulted in a bias towards the null. However, we believe that the

actual number of individuals lost to follow up in our sample is quite low (by international standards) due to the Japanese compulsory system of domiciliary registration wherein all residents are required to notify authorities of changes in address. Indeed our overall follow-up rate was quite high, almost 80%, and thus we believe that the extent of bias induced by loss to follow-up is quite small.

Conclusion

Loss of homes, cars, jobs and disruption of access to psychiatric care were significantly associated with worsening depressive symptoms even three years after the Great East Japan earthquake and tsunami. On the other hand, survivors appeared to have substantially recovered following the loss of family and friends.

Acknowledgments

We appreciate the support and cooperation of the Iwanuma Mayor's office, and the staff of the Department of Health and Welfare of Iwanuma city government.

This work was supported by the NIH (R01 AG042463), as well as the Grant-in-Aid for Scientific Research2011-2016 (23243070), 2011?2014 (No. 22390400) and 2012-2015 (No. 24390469) from the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), Health Labour Sciences Research Grant 2012-2015 (H24-Choju-Wakate-009), and the Center for Well-being and Society, Nihon Fukushi University, MEXT-Supported Program for the Strategic Research Foundation at Private Universities, 2009-2013. The funding sources did not have a role in the design and conduct of the study; the collection, management, analysis, or interpretation of the data; the preparation, review, or approval of the manuscript: or the decision to submit the manuscript.

Dr. Tsuboya made the analysis plan, analyzed the data, and made a draft. Dr. Aida, Dr. Hikichi, Dr. Subramanian, Dr. Kondo, Dr. Osaka, and Dr. Kawachi conception and design, acquisition of data, analysis and interpretation of data. All authors revised the draft critically and approved the final manuscript. Dr.Tsuboya is a guarantor. No financial disclosures were reported by the authors of this paper

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Highlights

- Few studies have considered the mental health of survivors pre-dating the disaster.
- Property loss resulted in more lasting adverse impacts on mental health.
- Lack of access to psychiatric care was associated worsening of depressive symptoms.
- These problems could be mitigated by mobile psychiatry teams after disasters.

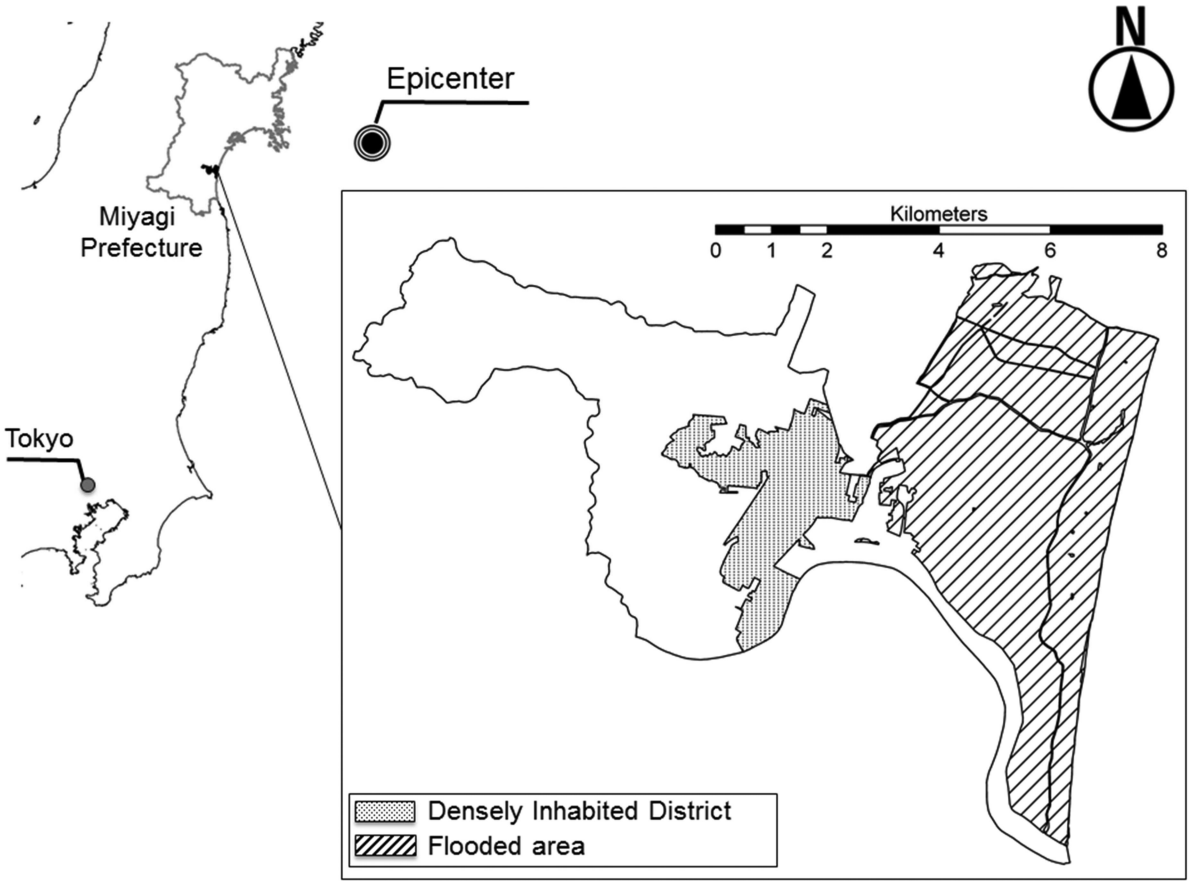

Figure 1.

A map of Iwanuma. Iwanuma is a coastal municipality in Miyagi prefecture in Japan, and is located approximately 80 km west of the epicenter of the 3.11 earthquake. A total of 187 people have lost their lives or have been missing in Iwanuma, while 48% of the land mass was inundated by the tsunami.

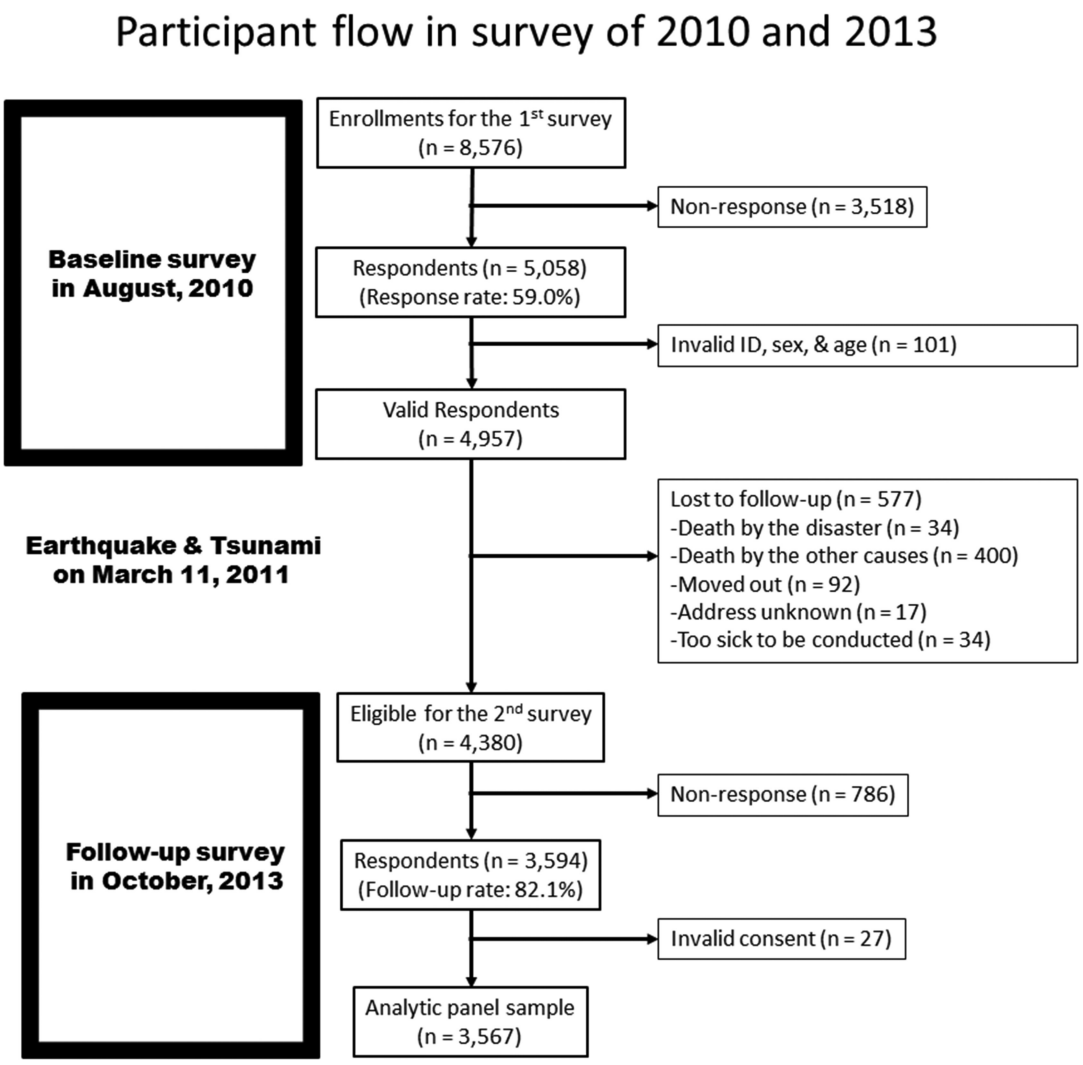

Figure 2.

Participant flow in survey of 2010 and 2013. The East Japan Earthquake and Tsunami struck on March 11th, 2011. We utilized two surveys waves of the Japan Gerontological Evaluation Study (JAGES), cohort conducted in 2010 (baseline) and in 2013 (in the aftermath of the East Japan Earthquake).

Table 1

Main Characteristics in 2010 and Geriatric Depression Scale (GDS) among the Study Participants (N=3,464)

	n	(%)	GDS in 2010		GDS in 2013		Change in GDS	
			Average	SD	Average	SD	Average	SD
Sex								
Men	1,513	43.7	3.53	3.4	3.7	3.4	0.17	2.9
Women	1,951	56.3	3.9	3.5	3.95	3.4	0.05	2.9
in total	3,464	100	3.74	3.5	3.84	3.4	0.1	2.9
Age (years old)								
65-74	2,091	60.4	3.42	3.3	3.42	3.2	-0.002	2.7
75 or older	1,371	39.6	4.22	3.6	4.49	3.6	0.27	3.2
Marital status								
Married	2,413	69.7	3.44	3.3	3.55	3.3	0.11	2.8
Windowed	806	23.3	4.29	3.7	4.44	3.5	0.15	3.1
Divorced	85	2.5	4.98	4.3	4.98	4.3	0.002	3.2
Education (years)								
<6	45	1.3	5.38	3.7	5.65	3.2	0.27	3.9
6-9	1,145	33.1	4.28	3.7	4.31	3.5	0.03	3.3
10-12	1,457	42.1	3.52	3.3	3.61	3.3	0.09	2.7
13 or more	702	20.3	3.16	3.3	3.29	3.4	0.14	2.6
Equivalized household income (JPY, Japanese yen)[a]								
< 2million	1,391	40.2	4.29	3.7	4.25	3.5	−0.04	3.1
2-4 million	1,189	34.3	3.06	3	3.27	3.2	0.21	2.6
> 4million	275	7.9	2.7	3	3.01	3.1	0.32	2.6
Body mass index (kg/m^2)								
<18.5	151	4.4	4.72	4	5	3.8	0.27	3.3
18.5-25	2,186	63.1	3.58	3.4	3.66	3.4	0.08	2.9
>25	929	26.8	3.83	3.5	3.85	3.3	0.01	2.8
Drinking habit								
Drinker	1,249	36.1	3.2	3.2	3.34	3.2	0.14	2.6
Former drinker	120	3.5	4.77	4	4.15	3.5	−0.62	3.3
Rarely drink	2,026	58.5	3.98	3.5	4.13	3.5	0.14	3
Having past/present psychiatric diseases								
Present	43	1.2	7.27	4.3	6.7	3.5	−0.57	3.4
No	2,620	75.6	3.88	3.5	4.01	3.4	0.12	3
Having any chronic diseases or conditions								
Present	2,678	77.3	3.94	3.5	4.05	3.5	0.11	3
No	720	20.8	2.99	3	3.17	3.2	0.19	2.6

Note. GDS: Geriatric Depression Scale. SD: standard deviation.

[a]JPY=Japanese Yen, 120 JPY is approximately equal to 1 USD (US dollar) in Aug 2015.

Table 2

Disaster Damage and Geriatric Depression Scale (GDS) among the Study Participants (N=3,464)

	n	(%)	GDS in 2010		GDS in 2013		Change in GDS	
			average	SD	average	SD	Average	SD
Loss of family and friends								
No loss	2,165	62.5	3.77	3.5	3.84	3.4	0.06	2.9
Loss of family members	762	22.0	3.74	3.5	4.01	3.5	0.27	3.0
Loss of friends	382	11.0	3.50	3.4	3.59	3.4	0.09	2.8
Both	155	4.5	3.82	3.6	3.70	3.2	−0.12	2.9
Loss of pet(s)								
Had no pets	2,457	70.9	3.69	3.5	3.82	3.4	0.13	2.8
No pet loss	733	21.2	3.84	3.5	3.78	3.4	−0.06	3.1
Lost dog(s)	68	2.0	4.40	3.5	4.38	3.5	−0.02	3.2
Lost cat(s)	52	1.5	3.94	3.4	5.02	3.6	1.08	3.7
Lost other pets	17	0.5	5.79	4.2	4.68	3.4	−1.11	2.8
Lost cat(s) & other pets	2	0.1	6.00	2.8	6.00	1.4	0.00	1.4
Lost dog(s) & other pets	1	0.0	5.00	.	7.00	.	2.00	.
Lost dog(s) & cat(s)	8	0.2	4.63	3.7	4.13	3.3	−0.50	3.6
(missing)	126	3.6	3.28	3.1	3.71	3.3	0.43	2.8
House damage								
Entirely destroyed	153	4.4	4.43	3.7	5.39	3.4	0.96	3.3
Largely destroyed	126	3.6	3.65	3.2	4.12	3.3	0.47	3.3
Half destroyed	244	7	3.79	3.4	4.15	3.5	0.36	3
Partly destroyed	1,473	42.5	3.75	3.5	3.82	3.4	0.07	2.9
No damage	1,380	39.8	3.57	3.4	3.55	3.3	−0.03	2.8
Car damage								
Lost cars	437	12.6	3.86	3.4	4.24	3.4	0.38	3
Did not have cars at that time	396	11.4	4.44	3.9	4.70	3.8	0.26	3.2
No damage of cars	2,551	73.6	3.58	3.4	3.60	3.3	0.02	2.8
Job loss								
Lost jobs, but have restarted the same job	52	1.5	3.54	3	4.01	3.2	0.47	3.1

	n	(%)	GDS in 2010		GDS in 2013		Change in GDS	
			average	SD	average	SD	Average	SD
Have lost jobs	134	3.9	4.42	3.7	4.97	3.4	0.55	3.2
Have not been working	2,165	62.5	3.86	3.5	4.01	3.5	0.15	2.9
Have been working	654	18.9	3.08	3.1	2.89	2.9	−0.19	2.7
Have started a new job after the disaster	28	0.8	3.18	3.7	3.50	3.1	0.32	3.2
Disruption of access to Psychiatry								
No	3,447	99.5	3.72	3.4	8.24	4.2	0.09	2.9
Yes	17	0.5	6.26	5.2	8.24	4.2	1.98	5.0

Note. GDS: Geriatric Depression Scale. SD: standard deviation.

Table 3

Multivariable Adjusted Association of Each Disaster Damage with Change in Geriatric Depression Scale (GDS) among the Survivors from the Disaster (N=3,464) in Japan

Characteristics	Coefficient	SE	95%CI			*p-value*
Loss of family and friends						
No loss		**reference**				
Loss of family members	0.23	0.11	0.02	,	0.44	*0.035*
Loss of friends	0.04	0.14	−0.24	,	0.32	*0.78*
Both	−0.04	0.21	−0.46	,	0.38	*0.84*
Loss of pet(s)						
Had no pets	0.08	0.11	−0.13	,	0.29	*0.46*
No pet loss		**reference**				
Lost dog(s)	0.23	0.33	−0.41	,	0.87	*0.48*
Lost cat(s)	1.05	0.37	0.32	,	1.77	*0.0047*
Lost other pets	−0.18	0.63	−1.41	,	1.06	*0.78*
Lost dog(s) & cat(s)	−0.23	0.91	−2.02	,	1.55	*0.80*
Lost cat(s) & other pets	0.24	1.81	−3.31	,	3.80	*0.89*
Lost dog(s) & other pets	1.07	2.59	−4.00	,	6.15	*0.68*
House damage						
Entirely destroyed	1.40	0.22	0.96	,	1.83	*<.0001*
Largely destroyed	0.54	0.24	0.077	,	1.01	*0.023*
Half destroyed	0.53	0.18	0.18	,	0.88	*0.0031*
Partly destroyed	0.20	0.10	0.016	,	0.39	*0.034*
No damage		**reference**				
Car damage						
Lost cars	0.47	0.14	0.21	,	0.74	*0.0005*
Did not have cars at that time	0.31	0.14	0.029	,	0.60	*0.031*
No damage of cars		**reference**				
Job loss						
Lost jobs, but have restarted the same job	0.90	0.37	0.18	,	1.63	*0.014*
Have lost jobs	1.14	0.24	0.66	,	1.62	*<.0001*
Have not been working	0.42	0.12	0.19	,	0.65	*0.0003*
Have been working		**reference**				
Have started a new job after the disaster	0.65	0.50	−0.33	,	1.62	*0.19*
Disruption of access to psychiatry	2.51	0.63	1.28	,	3.74	*<.0001*

Note. GDS: Geriatric Depression Scale. CI: confidence interval. SE: standard error.

[a]. Age (continuous), sex, marital status, education, income, self-rated health, body mass index, smoking status, drinking status, having past/present psychiatric diseases, having any chronic diseases or conditions, frequency of informal socializing, and GDS score in 2010 were adjusted in the model.

[b]. Other types of disaster damage were not simultaneously included in the same model.

Table 4

Stratified Multivariate Adjusted Association of Selected Disaster Damage with Change in Geriatric Depression Scale(GDS) among the Survivors from the Disaster (N=3,464) in Japan

Characteristics	Coefficient	SE	95%CI			*p-value*	*P for interaction*
Entirely destroyed							
Stratified by sex[c]							
Men	1.89	0.33	1.24	,	2.55	*<.0001*	
Women	0.76	0.28	0.21	,	1.31	*0.007*	*0.013*
Stratified by age in 2010							
Age under 75	1.33	0.26	0.82	,	1.84	*<.0001*	
75 or older	1.04	0.37	0.31	,	1.77	*0.0049*	*0.24*
Stratified by having psychiatric diseases in 2010[d]							
Present	5.61	2.02	1.66	,	9.56	*0.0054*	
No	1.24	0.22	0.81	,	1.66	*<.0001*	*0.16*
Disruption of access to psychiatry							
Stratified by having psychiatric diseases in 2010[d]							
Present	3.88	2.36	−0.75	,	8.51	*0.10*	
No	2.55	0.67	1.24	,	3.86	*0.0001*	*0.87*

Note. GDS: Geriatric Depression Scale. CI: confidence interval. SE: standard error.

[a]. Age (continuous), sex, marital status, education, income, self-rated health, body mass index, smoking status, drinking status, having past/present psychiatric diseases, having any chronic diseases or conditions, frequency of informal socializing, and GDS score in 2010 were adjusted in the model.

[b]. Other types of disaster damage were not simultaneously included in the same model.

[c]."Sex" is not included in the analysis.

[d]."Having past/present psychiatric diseases" is not adjusted in the analysis.