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# Post-disaster mental health and dietary patterns among older survivors of an earthquake and tsunami

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## Abstract

**Objectives:** Research suggests that cardiometabolic disease risks are elevated among survivors of natural disasters, possibly mediated by changes in diet. Using the Brief Dietary History Questionnaire, we examined (1) dietary patterns among older survivors of the 2011 Great East Japan Earthquake and Tsunami, and (2) the contribution of posttraumatic stress symptoms (PTSS)/ depressive symptoms, as well as relocation to temporary housing on dietary patterns and (3) gender differences in the associations.

**Design, setting and participants:** Data came from a prospective cohort study of 1,375 survivors aged 65–89 years (44.6% male).

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**Conflicts of interest**: None

Ethical standards

The study was approved by the Human Subjects Committee of the Harvard T.H. Chan School of Public Health (CR-23143-09), and the Institutional Review Boards of Chiba University (protocol #3442), and Tokyo Medical & Dental University (D2021-025).

**Measurements:** PTSS/depression onset was evaluated in 2013, 2.5 years after the disaster. Dietary data was collected with a self-administered brief-type diet history questionnaire in 2020. A principal component analysis identified three posterior dietary patterns.

**Results:** Diet 1 consisted of high intake of vegetables, soy products, and fruits; Diet 2 consisted of carbohydrate-rich foods and snacks/sweets; Diet 3 consisted of high intake of alcoholic beverages, meat, and seafood. Least-squares linear regression revealed that individuals with PTSS/depression were less likely to exhibit Diet 1, while individuals with PTSS were more likely to exhibit Diet 2&3. Especially, males who had depression showed an unhealthy dietary pattern. Those who have lived in a trailer-style temporary housing reported less consumption of Diet 3.

**Conclusion:** Survivors of disaster with symptoms of mental illness tended to exhibit less healthy dietary patterns after 9 years. Diet varied by type of post-disaster mental illness, gender, and current social circumstances. We lacked pre-disaster BDHQ data, which is a limitation.

### Keywords

PTSD; Depression; Disaster; Diet; BDHQ

## Introduction

The experience of natural disasters has been linked to both acute and chronic increases in cardiometabolic risk (1 – 3). In a seminal study, Armenian et al. (4) followed up survivors of the 1988 Earthquake in Armenia for four years and found increased rates of heart disease, which were associated with the intensity of exposure to disaster damages and losses. In Japan, Nakagawa et al. (5) showed an increase in mortality due to acute myocardial infarction three years after the Niigata-Chuetsu earthquake.

Several mechanisms have been postulated for the association between disaster experiences and elevated cardiometabolic risk, including interruption of medical care, the effects of traumatic stress stemming from the loss of property and social connections, as well as changes in lifestyle behaviors, including diet, physical activity, sleep, and alcohol consumption (6 – 8).

Changes in diet among disaster survivors may occur for different reasons. For example, symptoms of mental illness such as post-traumatic stress symptoms (PTSS) and depression may directly affect dietary patterns (9). Post-traumatic stress disorders (PTSD) and depression are the most frequently observed mental illness symptoms among survivors of natural disasters (10, 11). Even outside the context of disasters, mental disorders such as PTSD and depression have been linked to less healthy dietary patterns (12, 13).

The effects of mental illness symptoms on diet may be further compounded by the loss of spouse or family members in a disaster. In the non-disaster setting, the loss of a spouse (e.g., via widowhood or divorce) has been shown to deleteriously affect dietary quality (14, 15). Furthermore, changes in diet following spousal loss are likely to be gendered because women are more likely to perform grocery shopping and preparation of daily meals (14, 16). A 2019 survey in Japan revealed that 86.6% of Japanese men in their 60s do not prepare

dinner on their own (17). Hence, males may experience more unhealthy changes in diet after losing their female partner from the disaster.

Residential relocation to temporary housing (following property damage) is also associated with changes in the food environment which could influence diet through changes in proximity to groceries, supermarkets, or fast-food outlets (18). Living in temporary housing itself may change food preparation habits due to the inconvenience of cooking meals in cramped, trailer-style homes. Relocation to temporary housing may also modify the effects of mental illness symptoms on diet, potentially affecting men and women differently, since the ability to adapt to changes in the dietary environment (i.e., relocation) is thought to be lower among men than women, which seems to be even lower among men with depressive symptoms.

Despite the foregoing plausible reasons linking disaster experiences to diet, few studies have attempted to rigorously evaluate dietary intake among survivors, particularly beyond the acute phase of disaster. Most studies have focused on the first year after the disaster. Nishi et al. (19) investigated dietary patterns among survivors 6 to 11 months after the Great East Japan Earthquake and Tsunami and found that those living in economically difficult circumstances were less likely to be consuming seafood, soy products, fruits and vegetables. However, the authors did not investigate the association with disaster-related variables, such as history of residential relocation or mental illness symptoms. Uemura et al. (20) evaluated the frequency of consumption of food items one year after the Great East Japan Earthquake and Tsunami and found that PTSD was associated with lower frequency of consuming rice and bread, fish, meat, vegetables, and dairy products, but higher consumption of vegetable-and-fruit juices.

A previous study by our research team have already shown an increased cardiometabolic risks (BMI and waist circumference) among disaster survivors, especially among those who experienced relocation to temporary shelters (3). In the present study, we sought to examine dietary patterns among older disaster survivors nine years after the 2011 Great East Japan Earthquake and Tsunami. In particular, we focused on the contribution of mental illness symptoms (PTSS/depressive symptoms) and relocation history to temporary housing on dietary patterns and checked for gender differences in the associations.

## Methods

### Data

We used data from the Iwanuma Study, which is a subset of a nationwide cohort study of Japanese older adults, called the Japan Gerontological Evaluation Study (JAGES) (21). Iwanuma city was one of the field sites of the JAGES located in Miyagi Prefecture (population 44,187 in 2010), approximately 80 km (128 miles) from the epicenter of the 2011 Great East Japan Earthquake. Importantly, the baseline survey of the Iwanuma Study was conducted in August 2010, seven months before the disaster onset. JAGES conducted a census of all residents ≥65 years old in Iwanuma city ($n$ = 8,576) and obtained valid responses from 4,957 residents (response rate = 57.8%). Comparison of

the study participants and Census data has been provided elsewhere (22), demonstrating representativeness of our respondent sample relative to Iwanuma as a whole.

On March 11, 2011, the Great East Japan Earthquake and Tsunami (the Richter scale: 9.0) hit the city, resulting in loss of lives of 180 residents, loss or damages of 5,542 houses, and inundation of 48% of the land area of Iwanuma city. Many of the survivors were forced to move into temporary trailer housings provided by the city or subsidized apartments on the private rental market.

The first follow-up survey was conducted in 2013, approximately 2.5 years after the disaster for all survivors from the baseline cohort. Of the 4,380 eligible survivors who lived in Iwanuma city, 3,567 people responded to the mailed survey (follow-up rate: 81.4%). The present study additionally used the dietary data obtained in follow-up survey conducted in January 2020, approximately 9 years after the disaster ($n$ = 2,573; follow-up rate 79.6%). In total, 1,531 individuals participated in both 2010 and 2013 surveys and completed the dietary survey in 2020. After excluding those who did not provide information on weight and height ($n$ = 4), those with a reported energy intake less than half of the energy requirement for the lowest physical activity category according to the Dietary Reference Intakes for Japanese, 2010 (23) (<725 kcal/day; $n$ = 7), or more than 1.5 times of the energy requirement for the highest physical activity category (>3300 kcal/day; $n$ = 118) (24), we were left with an analytical sample of 1,375 for PTSS. Those who already reported depressive symptoms before the disaster were excluded from the analysis for onset of depressive symptoms ($n$ for analysis = 927). The flow of the sampling strategy is summarized in Figure 1.

## Measurements

**Mental health—**Post-disaster mental health status was evaluated in 2013. PTSS were evaluated using the Screening Questionnaire for Disaster Mental Health (22, 25). The questionnaire was originally developed to screen for PTSS among Japanese older adults affected by the Hanshin-Awaji Earthquake (1995), and has been validated against the Clinician Administered PTSD Scale and the Impact of Event Scale-Revised (25). The responses to each of the nine binary (yes/no) items were summed (range: 0 – 9), and then dichotomized with a score of 4 or more indicating mild-to-severe PTSS (25).

Depressive symptoms were evaluated using the Japanese version of the Geriatric Depression Scale (26 – 28) in 2010 and 2013 to define the post-disaster onset of depression. The responses to each of the 15 binary (yes/no) items were summed (range: 0 – 15), and then dichotomized with a score of 5 or more indicating mild-to-severe depressive symptoms following a previous validation study (29). This cut-point has been used as a screening tool for depressive symptoms among older adults and validated against the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised (sensitivity: 92%; specificity: 81%) (30). New onset of depression was defined as those who were free from depression in 2010 but reported symptoms in 2013.

**Relocation history—**History of relocation after the disaster —either to temporary trailer homes built by the city (*kasetsu jutaku*), or to subsidized apartments on the private rental

market (*minashi kasetsu*) or a new house—was self-reported in 2013. The reference group comprised individuals who stayed in their original homes.

**Diet—**Dietary intake was evaluated using the Brief Dietary History Questionnaire (BDHQ), which is a validated self-administered food frequency questionnaire based on the consumption frequency of 58 food and beverage items during the preceding month (31 – 33). Food and beverage items listed in the BDHQ were selected from foods commonly consumed in Japan. BDHQ is a short version of a comprehensive self-administered diet history questionnaire (DHQ: 150-item semi-quantitative questionnaire) developed for uses in large-scale epidemiologic research. The validity of nutrient intake measured by BDHQ was established against DHQ using semi-weighed 16-day dietary records as the reference (4 days sampled during each season). Short-term test-retest reliability of eating habits has also been established (34). A principal component analysis (PCA) based on the energy-adjusted food intake (g food/1000 kcal/day) was performed to identify posterior dietary patterns. Among 58 food items, 52 items excluding 6 items (i.e., sugar added to coffee and tea, soy sauce and Japanese brown sauce used during meals, noodle broth, cooking salt, cooking oil, and cooking sugar) were used for PCA following previous research (35). We considered the components with an eigenvalue greater than 1, the scree plot, and the interpretability of the factors to determine the number of factors to be retained. From factors showing eigenvalue >1, three factors were retained since the scree plots decreased considerably after the third factor and remained similar thereafter. The scores for each dietary pattern were calculated by summing the intakes of the food items weighted by their factor loadings.

**Pre-disaster covariates—**Using data from the pre-disaster wave in 2010, we assessed age in years, marital status (married or not), education (9 years or less; 10 to 12 years 13 years or more), equivalent income (less than 2 million yen; 2 to 4 million yen; more than 4 million yen [1 million yen = 10,750 USD as of January 1, 2010]), employment (currently employed; retired; never), body mass index (BMI) ($kg/m^2$, continuous), self-rated health (poor; fair; good; excellent), instrumental activities of daily living (IADL) score (0 – 13), smoking (never; stopped 5 or more years ago; stopped within the past 4 years; current smoker), alcohol consumption (yes, used to drink, no), intake of foods rich in protein such as mean and fish (once a week or less; 2 to 3 times a week; 4 to 6 times a week; once a day; 2 times a day or more), and vegetable intake (2 to 3 times a week or less; 4 to 6 times a week; once a day; 2 times a day or more). IADL was measured by the 13-item Tokyo Metropolitan Institute of Gerontology Index of Competence, which captures the physical, cognitive, and social independence of older adults (36). Intake of foods rich in protein was obtained through the question “How often did you have meat or fish during the past month?” while vegetable intake was obtained through the question “How often did you have fruits or vegetables during the past month?” (not at all; less than once a week; once a week; 2 to 3 times a week; 4 to 6 times a week; once a day; more than 2 times a day); some categories were combined as indicated above due to a small sample size.

## Statistical analysis

A least-squares linear regression was conducted to investigate the association between PTSS/depression, relocation history, and the scores of each dietary pattern identified

in PCA. Models with PTSS included age, marital status, education, equivalent income, employment, BMI, self-rated health, IADL, smoking, alcohol consumption, protein intake, vegetable intake, and pre-disaster depression as covariates, while models with depression included all variables except for depression since the model excluded those who already had depressive symptoms in 2010.

Given that relocation is also likely to affect men's and women's psychological health differently, three-way interaction terms for gender x PTSS/depression x relocation history were added to the model. Additionally, we checked three-way interactions between living arrangement as of 2020 (living alone vs. not) x gender x PTSS/depression, pre-post disaster change in marital status (e.g., due to loss of spouse in the disaster) x gender x PTSS/depression, as well as change in marital status x gender x relocation as *post hoc* analyses since the effect of living alone and widowhood are also likely to influence dietary habits differently for males and females (37). The analysis for change in marital status excluded marital status in 2010 as a covariate.

Missing values of the questions were imputed by the Markov chain Monte Carlo methods to generate 20 data sets (38). The level of statistical significance was set at $p < 0.05$ (two-tailed) including analyses for interaction terms. All the variables were imputed for those who provided dietary data. All statistical analyses were conducted using Stata 16.1 (StataCorp, College Station, TX, USA).

## Results

Table 1 summarizes the pre-disaster characteristics of the participants obtained in 2010. The mean age was 70.9 (standard deviation [SD] 4.5), and 44.6% were male. About 24.6% of the participants already reported mild to severe depressive symptoms preceding the disaster. Among the analytical sample, 26.8% had PTSS and 17.6% showed onset of depressive symptoms after the disaster, respectively.

PCA identified three dietary patterns (Table 2); Diet 1 consists of a high intake of vegetables, soy products, and fruits which is a traditional Japanese diet (i.e., healthy diet); Diet 2 consists of a high intake of snacks/sweets, bread, and noodles (i.e., high carbohydrate diet); Diet 3 consists of a high intake of alcoholic beverages, meat and seafood, processed foods (e.g., ham and salted fish), and noodles (i.e., alcohol and protein diet).

Table 3 shows the result of a least-squares linear regression linking PTSS in 2013 to dietary patterns in 2020. Results show that those with PTSS were less likely to exhibit Diet 1 (i.e., healthy diet) (coef. = −0.31, 95%CI −0.56, −0.05) and more likely to exhibit Diet 2 (i.e., high carbohydrate diet) (coef. = 0.19, 95%CI −0.01, 0.39) and Diet 3 (i.e., alcohol and protein diet) (coef. = 0.28, 95%CI 0.10, 0.47). Those who lived in a trailer-style temporary housing (*kasetsu jutaku*) showed lower consumption of Diet 3 (diet high in alcohol, meat, and seafood) compared to those who did not move. When we included the three-way interaction term for gender x PTSS x relocation, we did not found evidence of interaction for any dietary pattern.

Table 4 shows the results of a least-squares linear regression linking onset of depression in 2013 to dietary patterns in 2020. Those who had new onset of depression were less likely to exhibit Diet 1 (i.e., healthy diet) (coef. = −0.46, 95%CI −0.88, −0.03). When we added the three-way interaction for gender x depression onset x relocation, we found no evidence of interaction for any dietary pattern, while there was a significant two-way interaction between depression and gender on Diet 3 ($p$ for interaction = 0.019), i.e., males with depressive symptoms tended score higher on Diet 3 (i.e., high alcohol and protein intake) (Figure 2).

*Post hoc* analysis showed that those who lived alone as of 2020 tended to score lower on Diet 1 (Model 1, eTable 1 & 2). There was a significant three-way interaction between PTSS x living alone x gender on Diet 2 & 3 (Model 4 & 6, eTable 1) ($p$ for interaction = 0.024, 0.014, respectively); men with PTSS who lived alone showed higher score on Diet 2 & 3 (eFigure 1). Similarly, those who have lost their spouse between 2010 to 2020 were less likely to exhibit a healthy diet (Diet 1) than those who were married regardless of gender (Model 1, eTable3 & 4). There was a significant interaction between pre-post disaster change in marital status, gender, and PTSS (Model 6, eTable3) ($p$ for interaction = 0.018 for men with PTSS who were single/widowed before the disaster); as shown in eFigure 2, males who were single/widowed before the disaster and developed PTSS were more likely to exhibit Diet 3. We did not find evidence on the combined effect of gender, relocation, and change in marital status on any dietary pattern (eTable 5).

## Discussion

### Summary of findings

To our knowledge, this is the first study to characterize dietary patterns among older disaster survivors using a previously validated dietary food frequency questionnaire. We found that both post-disaster PTSS and depressive symptoms were associated with less consumption of healthy dietary pattern (i.e., traditional Japanese diet). In addition, PTSS was associated with an unhealthy dietary pattern (less consumption of fruits/vegetables, higher consumption of carbohydrate-rich food, alcohol and protein, including processed food). Depressive symptoms showed a gendered association with diet quality; specifically, males who had depression showed an unhealthy dietary pattern (higher intake of alcohol, proteins including processed food, e.g., ham and salted fish). Those who have lived in a trailer-style temporary housing reported less consumption of diet high in alcohol, meat, and seafood nine years after the disaster.

### PTSS and diet

We found that those with PTSS had a lower intake of healthy diet characterized by high intake of vegetables, fruit, and soy products, and at the same time, higher intake of carbohydrate-rich food such as one-dish meals (e.g., noodles), sweets and snacks, as well as alcohol and protein including processed foods (e.g., ham and salted fish). This is in line with some previous studies in a non-disaster context. For example, Browne et al. (39) have shown that older veterans with PTSD consumed added sugar in excess of U.S. dietary guideline recommendations as well as less whole grains, fruits/vegetables/legumes, fiber, calcium, and dairy. Talbot et al. (40) found that individuals with PTSD engaged in more “emotional

eating", which is characterized by increased intake of comfort foods (i.e., foods high in fat and/or sugar) compared to participants without PTSD (41). Alcohol misuse is frequently observed among those suffer from PTSD with the prevalence ranged from 9.8 to 61.3 % in a systematic review (42). Kim et al. (43) analyzed prospective cohort data form the Nurses' Health Study and showed that PTSD is associated with a less healthy trend in overall diet quality (as measured by the Alternative Healthy Eating Index) over 20 years. In turn, PTSD has been linked to increased risk of cardiovascular disease incidence (44), so that the nexus between PTSD and diet may be one pathway linking exposure to disaster and increased long-term cardiometabolic risks (45).

### Onset of depression and diet

Those who had depression after the earthquake had a lower intake of healthy diet characterized by high intake of vegetables, fruit, and soy products. This is in line with a previous finding in Japan; Suzuki et al. (46) showed that the Japanese traditional dietary pattern, which is similar to Diet 1 in the present study, was associated with lower depressive symptoms in a Japanese working-age population (i.e., young and middle-aged adults).

Studies suggest that the association between diet and depression is likely to be bidirectional (47). For example, there seems to be a protective effect of plant-based and anti-inflammatory dietary patterns on the risk of developing depression (48); at the same time, dietary choices seem to be prompted by depressive symptoms (49, 50). Although we lacked pre-disaster BDHQ data, we do have a crude estimate of the pre-disaster frequency of consumption of alcohol, protein sources (meat and fish), fruits and vegetables, and confirmed that there was no difference in pre-disaster diet between those who developed post-disaster PTSS/depressive symptoms versus those who remained symptom-free.

### Relocation to temporary housing and diet

Nozue et al. (51) previously reported that three years after the Great East Japan Earthquake and Tsunami, females who *did not* live in temporary housing were more likely to have a better diet. In our study, those who have lived in a temporary housing showed less consumption of diet high in alcohol, meat and seafood nine years after the earthquake and tsunami. Previously, we reported in the same cohort that the prevalence of overweight increased dramatically between 2010 (pre-disaster) and 2013 (the first post-disaster survey wave) among survivors who relocated to temporary housing (18, 52). Unfortunately, we did not perform a detailed dietary assessment at that time, so that we cannot exclude the possibility that survivors experienced a temporary deterioration in their diet quality while they were living in temporary homes. The temporary trailer-type houses were closed down by the municipality in 2016 and all residents were relocated to permanent housing, so that by the time our dietary assessment was conducted in 2020, any impediments to cooking in the cramped quarters would have been removed by then. On the other hand, lower consumption of alcohol, meat and seafood may indicate the relatively worse economic situation among those who moved to trailer-style temporary housing after the disaster (i.e., people who lost their home in the tsunami and could not afford rental housing or new homes).

### Gender differences

The impact of a disaster on dietary habits appeared to vary by gender and post-disaster experiences. Specifically, males who had post-disaster mental illness symptoms, especially those who lived alone, and were single/widowed since before the earthquake, had higher risk of having an unhealthy diet. A previous study found dietary diversity decreased after the Great East Japan Earthquake and Tsunami only among men (53). Our *post hoc* analysis found that males who live alone and have PTSS tend to exhibit Diet 2&3, while females did not show such trends (eFigure 1). Similarly, single/widowed males who have PTSS tended to score higher on Diet 3 (i.e., high in alcohol, meat, and seafood). As mentioned in the introduction, more than 80% of men in their 60s do not prepare dinner on their own in Japan (17). Hence, men would seem to be more vulnerable to a change in the food preparation environment – and especially in the absence of a spouse – more likely to consume ready-to-eat processed foods and alcoholic beverages especially when they suffer from symptoms of PTSS.

### Strength and limitations

This study used unique data incorporating pre- and post-disaster assessment of depressive symptoms, and disaster specific PTSS to examine dietary patterns among older survivors. It is the first study to find such a long-term effect of disasters on survivors' diets (i.e., 9 years). Some important limitations should be noted. First, we lacked pre-disaster BDHQ data. On the other hand, we controlled for the crude pre-disaster dietary data on protein sources, fruit and vegetables. Second, we did not assess diet during the period (2011–2016) when participants were living in temporary housing, so that we may have missed a contemporaneous association between living in trailer-style homes and dietary quality. Third, the surveys did not specifically inquire about the use of medication to treat psychiatric disorders, which could be a potential confounder for the observed associations between depression/PTSD and diet. Lastly, selective attrition due to non-participation in the follow-up survey may have resulted in selection bias.

### Conclusion

Mental illness symptoms in the wake of disaster, especially PTSS, appears to deleteriously affect dietary habits in the long term. Dietary patterns also appeared to vary according to gender and social circumstances. Interventions to promote recovery of older populations affected by disaster should focus on the intersection of gender and mental health, for example by promoting increased vegetable intake and easy-to-prepare meals targeted to older men who live alone. Understanding the persistent consequences of disaster experiences on diet may help to clarify the long-term consequences of disaster for cardiometabolic health.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## References

1. Bazoukis G, Tse G, Naka KK, et al. Impact of major earthquakes on the incidence of acute coronary syndromes - A systematic review of the literature. Hellenic J Cardiol. 2018;59(5):262–267. doi:10.1016/j.hjc.2018.05.005 [PubMed: 29807192]
2. Ghazanchaei E, Khorasani-Zavareh D, Aghazadeh-Attari J, Mohebbi I. Identifying and Describing Impact of Disasters on Non-Communicable Diseases: A Systematic Review. Iran J Public Health. 2021;50(6):1143–1155. doi:10.18502/ijph.v50i6.6413 [PubMed: 34540735]
3. Shiba K, Hikichi H, Aida J, Kondo K, Kawachi I. Long-Term Associations Between Disaster Experiences and Cardiometabolic Risk: A Natural Experiment From the 2011 Great East Japan Earthquake and Tsunami. American Journal of Epidemiology. 2019;188(6):1109–1119. doi:10.1093/aje/kwz065 [PubMed: 30874714]
4. Armenian HK, Melkonian AK, Hovanesian AP. Long term mortality and morbidity related to degree of damage following the 1998 earthquake in Armenia. Am J Epidemiol. 1998;148(11):1077–1084. doi:10.1093/oxfordjournals.aje.a009585 [PubMed: 9850130]
5. Nakagawa I, Nakamura K, Oyama M, et al. Long-term effects of the Niigata-Chuetsu earthquake in Japan on acute myocardial infarction mortality: an analysis of death certificate data. Heart. 2009;95(24):2009–2013. doi:10.1136/hrt.2009.174201 [PubMed: 19541690]
6. Rubeis VD, Lee J, Anwer MS, et al. Impact of disasters, including pandemics, on cardiometabolic outcomes across the life-course: a systematic review. BMJ Open. 2021;11(5):e047152. doi:10.1136/bmjopen-2020-047152
7. Babaie J, Pashaei Asl Y, Naghipour B, Faridaalaee G. Cardiovascular Diseases in Natural Disasters; a Systematic Review. Arch Acad Emerg Med. 2021;9(1):e36. doi:10.22037/aaem.v9i1.1208 [PubMed: 34027431]
8. Ohira T, Nakano H, Nagai M, et al. Changes in Cardiovascular Risk Factors After the Great East Japan Earthquake: A Review of the Comprehensive Health Check in the Fukushima Health Management Survey. Asia Pac J Public Health. 2017;29(2_suppl):47S–55S. doi:10.1177/1010539517695436 [PubMed: 28330394]
9. Hall KS, Hoerster KD, Yancy WS Jr. Post-Traumatic Stress Disorder, Physical Activity, and Eating Behaviors. Epidemiologic Reviews. 2015;37(1):103–115. doi:10.1093/epirev/mxu011 [PubMed: 25595169]
10. Neria Y, Nandi A, Galea S. Post-traumatic stress disorder following disasters: a systematic review. Psychol Med. 2008;38(4):467–480. doi:10.1017/S0033291707001353 [PubMed: 17803838]
11. Beaglehole B, Mulder RT, Frampton CM, Boden JM, Newton-Howes G, Bell CJ. Psychological distress and psychiatric disorder after natural disasters: systematic review and meta-analysis. The British Journal of Psychiatry. 2018;213(6):716–722. doi:10.1192/bjp.2018.210 [PubMed: 30301477]
12. van den Berk-Clark C, Secrest S, Walls J, et al. Association between Posttraumatic Stress Disorder and lack of exercise, poor diet, obesity and co-occuring smoking: A Systematic Review and Meta-analysis. Health Psychol. 2018;37(5):407–416. doi:10.1037/hea0000593 [PubMed: 29698016]

13. Flórez KR, Dubowitz T, Ghosh-Dastidar MB, Beckman R, Collins RL. Associations between depressive symptomatology, diet, and body mass index among participants in the supplemental nutrition assistance program. J Acad Nutr Diet. 2015;115(7):1102–1108. doi:10.1016/j.jand.2015.01.001 [PubMed: 25769748]
14. Eng PM, Kawachi I, Fitzmaurice G, Rimm EB. Effects of marital transitions on changes in dietary and other health behaviours in US male health professionals. J Epidemiol Community Health. 2005;59(1):56–62. doi:10.1136/jech.2004.020073 [PubMed: 15598728]
15. Lee S, Cho E, Grodstein F, Kawachi I, Hu FB, Colditz GA. Effects of marital transitions on changes in dietary and other health behaviours in US women. Int J Epidemiol. 2005;34(1):69–78. doi:10.1093/ije/dyh258 [PubMed: 15231759]
16. Vesnaver E, Keller HH, Sutherland O, Maitland SB, Locher JL. Food Behavior Change in Late-Life Widowhood: A Two-Stage Process. Appetite. 2015;95:399–407. doi:10.1016/j.appet.2015.07.027 [PubMed: 26232138]
17. Middle-Aged Japanese Men and Their Expectations of Homemade Meals. nippon.com. Published July 29, 2019. Accessed February 23, 2022. https://www.nippon.com/en/japan-data/h00499/middle-aged-japanese-men-and-their-expectations-of-homemade-meals.html
18. Hikichi H, Aida J, Kondo K, Tsuboya T, Kawachi I. Residential relocation and obesity after a natural disaster: A natural experiment from the 2011 Japan Earthquake and Tsunami. Sci Rep. 2019;9(1):1–11. doi:10.1038/s41598-018-36906-y [PubMed: 30626917]
19. Nishi N, Yoshimura E, Ishikawa-Takata K, et al. Relationship of Living Conditions With Dietary Patterns Among Survivors of the Great East Japan Earthquake. Journal of Epidemiology. 2013;23(5):376–381. doi:10.2188/jea.JE20130025 [PubMed: 23933622]
20. Uemura M, Ohira T, Yasumura S, et al. Association between psychological distress and dietary intake among evacuees after the Great East Japan Earthquake in a cross-sectional study: the Fukushima Health Management Survey. BMJ Open. 2016;6(7):e011534. doi:10.1136/bmjopen-2016-011534
21. Kondo K, Rosenberg M, World Health Organization. Advancing Universal Health Coverage through Knowledge Translation for Healthy Ageing: Lessons Learnt from the Japan Gerontological Evaluation Study. World Health Organization; 2018. Accessed April 9, 2021. https://apps.who.int/iris/handle/10665/279010
22. Hikichi H, Aida J, Tsuboya T, Kondo K, Kawachi I. Can Community Social Cohesion Prevent Posttraumatic Stress Disorder in the Aftermath of a Disaster? A Natural Experiment From the 2011 Tohoku Earthquake and Tsunami. Am J Epidemiol. 2016;183(10):902–910. doi:10.1093/aje/kwv335 [PubMed: 27026337]
23. Dietary Reference Intakes for Japanese 2010: Energy. Accessed May 4, 2022. https://www.jstage.jst.go.jp/article/jnsv/59/Supplement/59_S26/_article/-char/ja/
24. Kobayashi S, Asakura K, Suga H, Sasaki S. High protein intake is associated with low prevalence of frailty among old Japanese women: a multicenter cross-sectional study. Nutr J. 2013;12:164. doi:10.1186/1475-2891-12-164 [PubMed: 24350714]
25. Fujii S, Kato H, Maeda K. A Simple Interview-Format Screening Measure for Disaster Mental Health: An Instrument Newly Developed after the 1995 Great Hanshin Earthquake in Japan- The Screening Questionnaire for Disaster Mental; 2007.
26. Sheikh JI, Yesavage JA. Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. Clinical Gerontologist: The Journal of Aging and Mental Health. 1986;5(1–2):165–173. doi:10.1300/J018v05n01_09
27. Niino N A Japanese translation of the Geriatric Depression Scale. Clin Gerontol. 1991;10:85–87.
28. Sugishita K, Sugishita M, Hemmi I, Asada T, Tanigawa T. A Validity and Reliability Study of the Japanese Version of the Geriatric Depression Scale 15 (GDS-15-J). Clin Gerontol. 2017;40(4):233–240. doi:10.1080/07317115.2016.1199452 [PubMed: 28452641]
29. Nyunt MSZ, Fones C, Niti M, Ng TP. Criterion-based validity and reliability of the Geriatric Depression Screening Scale (GDS-15) in a large validation sample of community-living Asian older adults. Aging Ment Health. 2009;13(3):376–382. doi:10.1080/13607860902861027 [PubMed: 19484601]

30. Lyness JM, Noel TK, Cox C, King DA, Conwell Y, Caine ED. Screening for depression in elderly primary care patients. A comparison of the Center for Epidemiologic Studies-Depression Scale and the Geriatric Depression Scale. Arch Intern Med. 1997;157(4):449–454. [PubMed: 9046897]

31. Sasaki S, Yanagibori R, Amano K. Self-administered diet history questionnaire developed for health education: a relative validation of the test-version by comparison with 3-day diet record in women. J Epidemiol. 1998;8(4):203–215. doi:10.2188/jea.8.203 [PubMed: 9816812]

32. Kobayashi S, Murakami K, Sasaki S, et al. Comparison of relative validity of food group intakes estimated by comprehensive and brief-type self-administered diet history questionnaires against 16 d dietary records in Japanese adults. Public Health Nutr. 2011;14(7):1200–1211. doi:10.1017/S1368980011000504 [PubMed: 21477414]

33. Kobayashi S, Honda S, Murakami K, et al. Both comprehensive and brief self-administered diet history questionnaires satisfactorily rank nutrient intakes in Japanese adults. J Epidemiol. 2012;22(2):151–159. doi:10.2188/jea.je20110075 [PubMed: 22343326]

34. Yatsuya H, Ohwaki A, Tamakoshi K, et al. Reproducibility and validity of a simple checklist-type questionnaire for food intake and dietary behavior. J Epidemiol. 2003;13(5):235–245. doi:10.2188/jea.13.235 [PubMed: 14604218]

35. Akter S, Nanri A, Pham NM, Kurotani K, Mizoue T. Dietary patterns and metabolic syndrome in a Japanese working population. Nutrition & Metabolism. 2013;10(1):30. doi:10.1186/1743-7075-10-30 [PubMed: 23537319]

36. Koyano W, Shibata H, Nakazato K, Haga H, Suyama Y. Measurement of competence: reliability and validity of the TMIG Index of Competence. Arch Gerontol Geriatr. 1991;13(2):103–116. doi:10.1016/0167-4943(91)90053-s [PubMed: 15374421]

37. van den Hoonaard DK. Experiences of Living Alone: Widows' and Widowers' Perspectives. Housing Studies. 2009;24(6):737–753. doi:10.1080/02673030903203015

38. Sterne JAC, White IR, Carlin JB, et al. Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls. BMJ. 2009;338:b2393. doi:10.1136/bmj.b2393 [PubMed: 19564179]

39. Browne J, Morey MC, Beckham JC, et al. Diet quality and exercise in older veterans with PTSD: a pilot study. Transl Behav Med. 2021;11(12):2116–2122. doi:10.1093/tbm/ibab116 [PubMed: 34487181]

40. Talbot LS, Maguen S, Epel ES, Metzler TJ, Neylan TC. Posttraumatic Stress Disorder Is Associated With Emotional Eating. Journal of Traumatic Stress. 2013;26(4):521–525. doi:10.1002/jts.21824 [PubMed: 23893425]

41. Zellner DA, Loaiza S, Gonzalez Z, et al. Food selection changes under stress. Physiol Behav. 2006;87(4):789–793. doi:10.1016/j.physbeh.2006.01.014 [PubMed: 16519909]

42. Debell F, Fear NT, Head M, et al. A systematic review of the comorbidity between PTSD and alcohol misuse. Soc Psychiatry Psychiatr Epidemiol. 2014;49(9):1401–1425. doi:10.1007/s00127-014-0855-7 [PubMed: 24643298]

43. Kim Y, Roberts AL, Rimm EB, et al. Posttraumatic stress disorder and changes in diet quality over 20 years among US women. Psychol Med. 2021;51(2):310–319. doi:10.1017/S0033291719003246 [PubMed: 31769371]

44. Edmondson D, von Känel R. Posttraumatic Stress Disorder and Cardiovascular Disease. Lancet Psychiatry. 2017;4(4):320–329. doi:10.1016/S2215-0366(16)30377-7 [PubMed: 28109646]

45. Hardy DS, Garvin JT, Xu H. Carbohydrate quality, glycemic index, glycemic load and cardiometabolic risks in the US, Europe and Asia: A dose–response meta-analysis. Nutrition, Metabolism and Cardiovascular Diseases. 2020;30(6):853–871. doi:10.1016/j.numecd.2019.12.050

46. Suzuki T, Miyaki K, Tsutsumi A, et al. Japanese dietary pattern consistently relates to low depressive symptoms and it is modified by job strain and worksite supports. J Affect Disord. 2013;150(2):490–498. doi:10.1016/j.jad.2013.04.044 [PubMed: 23759276]

47. Elstgeest LEM, Visser M, Penninx BWJH, Colpo M, Bandinelli S, Brouwer IA. Bidirectional associations between food groups and depressive symptoms: longitudinal findings from the Invecchiare in Chianti (InCHIANTI) study. British Journal of Nutrition. 2019;121(4):439–450. doi:10.1017/S0007114518003203 [PubMed: 30588894]

48. Lai JS, Hiles S, Bisquera A, Hure AJ, McEvoy M, Attia J. A systematic review and meta-analysis of dietary patterns and depression in community-dwelling adults. The American Journal of Clinical Nutrition. 2014;99(1):181–197. doi:10.3945/ajcn.113.069880 [PubMed: 24196402]

49. Jacka FN, Cherbuin N, Anstey KJ, Butterworth P. Does reverse causality explain the relationship between diet and depression? Journal of Affective Disorders. 2015;175:248–250. doi:10.1016/j.jad.2015.01.007 [PubMed: 25658499]

50. Payne ME, Steck SE, George RR, Steffens DC. Fruit, Vegetable, and Antioxidant Intakes Are Lower in Older Adults with Depression. Journal of the Academy of Nutrition and Dietetics. 2012;112(12):2022–2027. doi:10.1016/j.jand.2012.08.026 [PubMed: 23174689]

51. Nozue M, Nishi N, Tsubota-Utsugi M, et al. Combined associations of physical activity and dietary intake with health status among survivors of the Great East Japan Earthquake. Asia Pac J Clin Nutr. 2017;26(3):556–560. doi:10.6133/apjcn.042016.08 [PubMed: 28429923]

52. Shiba K, Aida J, Kondo K, et al. Mediation of the relationship between home loss and worsened cardiometabolic profiles of older disaster survivors by post-disaster relocation: A natural experiment from the Great East Japan earthquake and tsunami. Health & Place. 2020;66:102456. doi:10.1016/j.healthplace.2020.102456 [PubMed: 33010662]

53. Tsubota-Utsugi M, Yonekura Y, Tanno K, et al. Association between health risks and frailty in relation to the degree of housing damage among elderly survivors of the great East Japan earthquake. BMC Geriatr. 2018;18(1):133. doi:10.1186/s12877-018-0828-x [PubMed: 29898680]

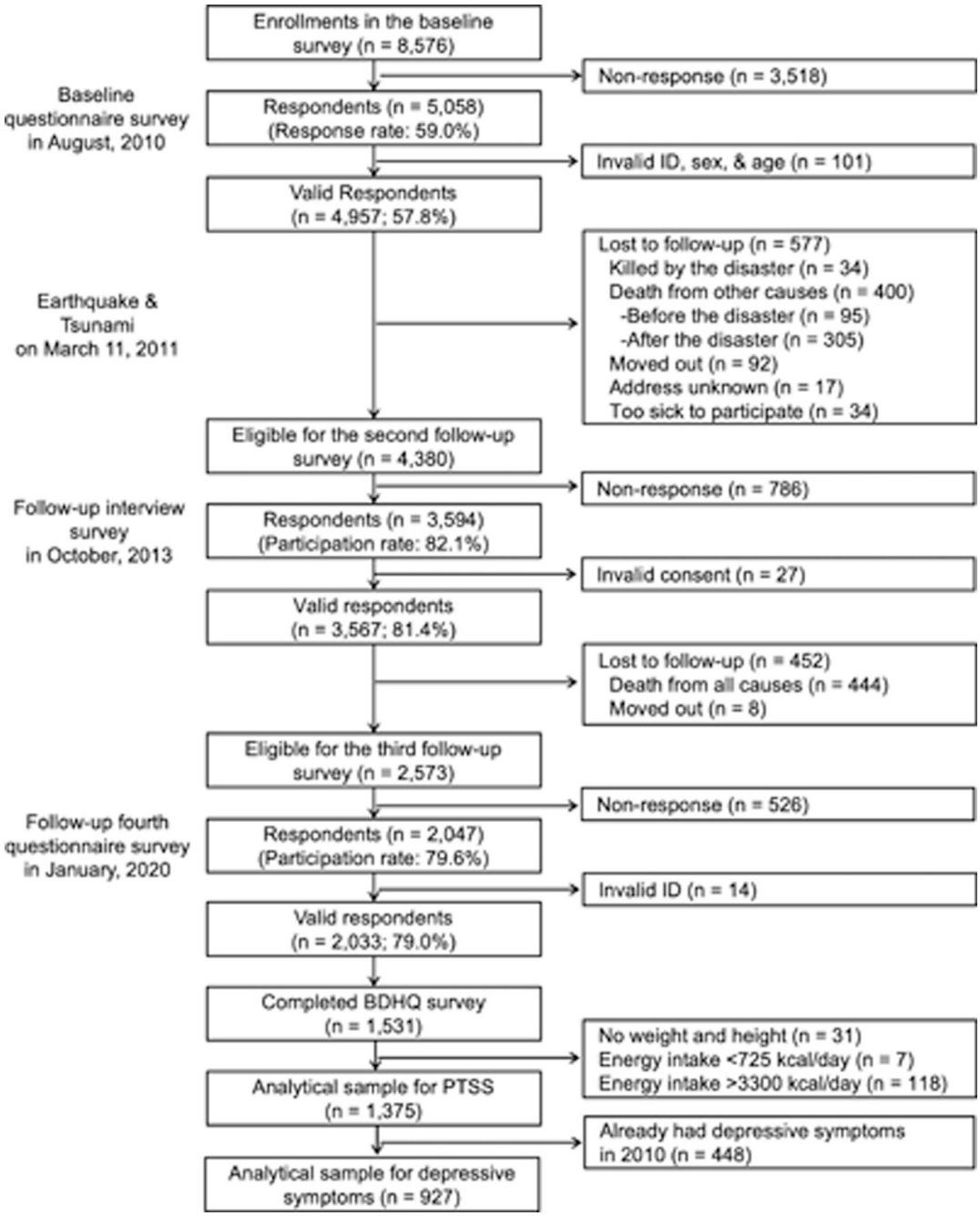


**Figure 1.**
Flow of the sampling strategy

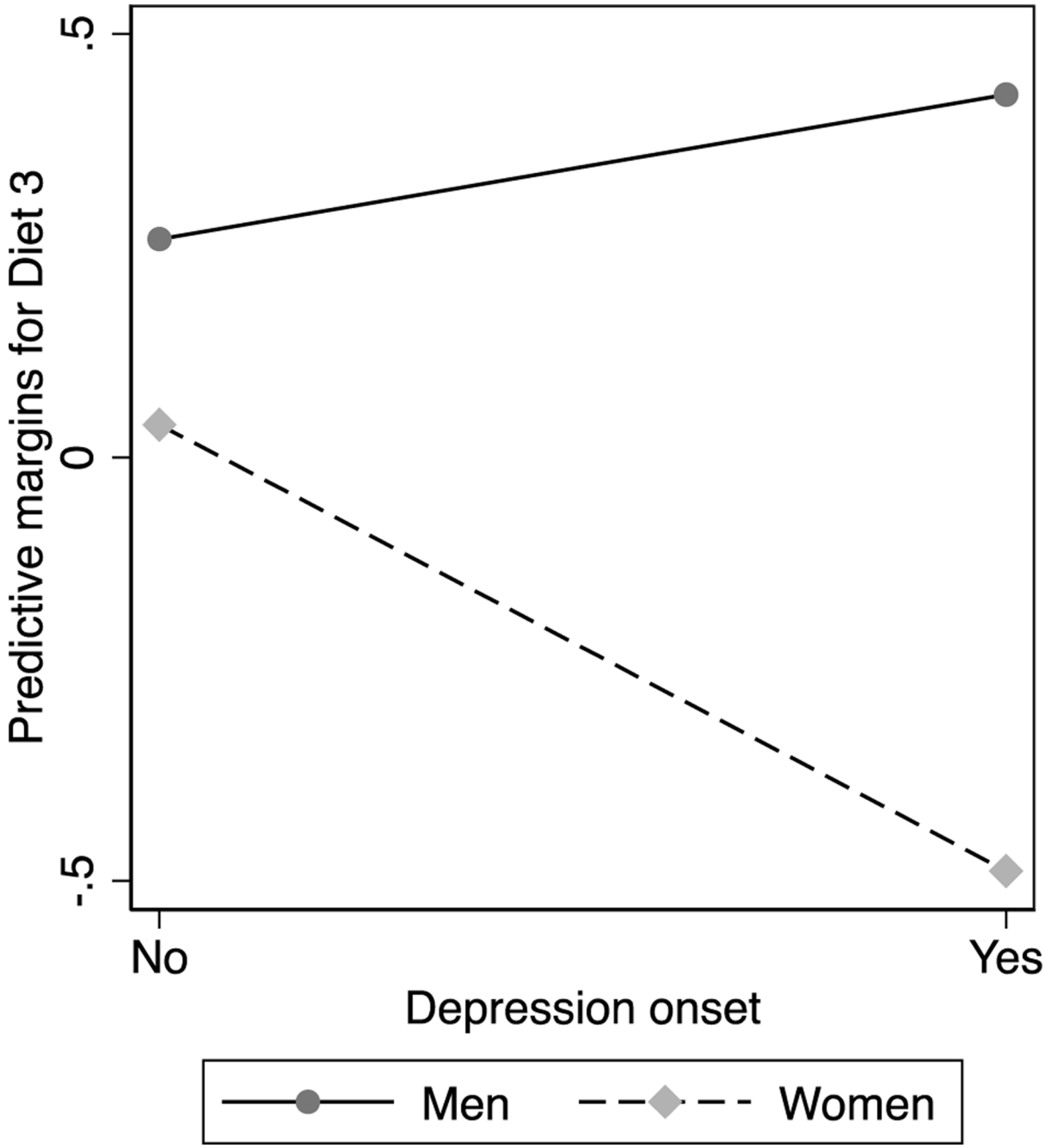


**Figure 2.**
Two-way interaction between gender and depression onset on Diet 3

**Table 1.**

Baseline characteristics of the study participants in 2010 (*n*=1,375)

| | Total (*n*=1,375) | No PTSS (*n*=1,006) | Mild to severe PTSS (*n*=369) | No depression 2010 – 2020 (*n*=764) | Onset depression (*n*=163) | Had depression in 2010 (*n*=448) |
|---|---|---|---|---|---|---|
| Age (*n*=1,375) | 70.9 [4.5] | 70.9 [4.5] | 71.1 [4.6] | 70.8 [4.4] | 70.9 [4.7] | 71.2 [4.5] |
| Gender (Males) (*n*=1,375) | 613 (44.6) | 493 (49.0) | 120 (32.5) | 354 (46.3) | 70 (42.9) | 189 (42.2) |
| Married (*n*=1,355) | 1,070 (79.0) | 791 (79.5) | 279 (77.5) | 601 (79.6) | 134 (82.2) | 335 (76.7) |
| Education (*n*=1,375) | | | | | | |
| Less than 10 years | 363 (26.4) | 239 (23.8) | 124 (33.6) | 169 (22.1) | 53 (32.5) | 141 (31.5) |
| 10 to 12 years | 678 (49.3) | 511 (50.8) | 167 (45.3) | 391 (51.2) | 76 (46.6) | 211 (47.1) |
| 13 years or more | 334 (24.3) | 256 (25.5) | 78 (21.1) | 204 (26.7) | 34 (20.9) | 96 (21.4) |
| Equivalent income (*n*=1,375) | | | | | | |
| Less than 200 million yen | 547 (39.8) | 387 (38.5) | 160 (43.4) | 260 (34.0) | 60 (36.8) | 227 (50.7) |
| 200 to 399 million yen | 553 (40.2) | 406 (40.4) | 147 (39.8) | 348 (45.6) | 74 (45.4) | 131 (29.2) |
| More than 400 million yen | 275 (20.0) | 213 (21.2) | 62 (16.8) | 156 (20.4) | 29 (17.8) | 90 (20.1) |
| Depression (*n*=1,375) | | | | | | |
| No | 927 (67.4) | 719 (71.5) | 208 (56.4) | 764 (55.6)[a] | 163 (11.9)[a] | - |
| Mild | 240 (17.5) | 162 (16.1) | 78 (21.1) | - | - | 240 (17.5)[a] |
| Severe | 208 (15.1) | 125 (12.4) | 83 (22.5) | - | - | 208 (15.1)[a] |
| Employment (*n*=1,274) | | | | | | |
| Yes | 294 (23.1) | 221 (23.2) | 73 (22.6) | 168 (23.2) | 38 (25.5) | 88 (21.9) |
| Retired | 803 (59.4) | 611 (64.3) | 192 (59.4) | 456 (63.1) | 95 (63.8) | 252 (62.7) |
| Never | 177 (13.9) | 119 (12.5) | 58 (18.0) | 99 (13.7) | 16 (10.7) | 62 (15.4) |
| BMI (*n*=1,344) | 23.5 [3.0] | 23.5 [2.9] | 23.7 [3.3] | 23.6 [2.9] | 23.2 [3.1] | 23.6 [3.2] |
| Self-rated health (*n*=1,375) | | | | | | |
| Poor | 13 (1.0) | 5 (0.5) | 8 (2.2) | 0 (0.0) | 1 (0.6) | 12 (2.7) |
| Fair | 129 (9.4) | 81 (8.1) | 48 (13.1) | 45 (5.9) | 11 (6.8) | 73 (16.3) |
| Good | 1,024 (74.5) | 753 (74.9) | 271 (73.4) | 577 (75.5) | 133 (81.6) | 314 (70.1) |
| Excellent | 209 (15.2) | 167 (16.6) | 42 (11.4) | 142 (18.6) | 18 (11.0) | 49 (10.9) |
| IADL score (*n*=1,375) | 12.1 [1.4] | 12.1 [1.3] | 12.1 [1.5] | 12.4 [1.1] | 12.0 [1.4] | 11.7 [1.6] |
| Smoking (*n*=1,306) | | | | | | |
| Never | 809 (61.9) | 563 (58.7) | 246 (70.9) | 446 (60.9) | 97 (62.6) | 266 (63.6) |
| Has stopped ≥5 years ago | 294 (22.5) | 229 (23.9) | 65 (18.7) | 176 (24.0) | 34 (21.9) | 84 (20.1) |
| Has stopped within 4 years | 61 (4.7) | 49 (5.1) | 12 (3.5) | 30 (4.1) | 7 (4.5) | 24 (5.7) |
| Current smoker | 142 (10.9) | 118 (12.3) | 24 (6.9) | 81 (11.1) | 17 (11.0) | 44 (10.5) |
| Alcohol drinking (*n*=1,361) | | | | | | |
| Never | 751 (55.2) | 514 (51.7) | 237 (64.6) | 407 (53.7) | 85 (52.5) | 259 (58.7) |

| | Total (*n*=1,375) | No PTSS (*n*=1,006) | Mild to severe PTSS (*n*=369) | No depression 2010 – 2020 (*n*=764) | Onset depression (*n*=163) | Had depression in 2010 (*n*=448) |
|---|---|---|---|---|---|---|
| Stopped | 32 (2.4) | 22 (2.2) | 10 (2.7) | 15 (2.0) | 2 (1.2) | 15 (3.4) |
| Current drinker | 578 (42.5) | 458 (46.1) | 120 (32.7) | 336 (44.3) | 75 (46.3) | 167 (37.9) |
| Protein consumption (*n*=1,375) | | | | | | |
| Less than once a week | 65 (4.7) | 45 (4.5) | 20 (5.4) | 31 (4.1) | 6 (3.7) | 28 (6.3) |
| Two to three times a week | 332 (24.2) | 236 (23.5) | 96 (26.0) | 177 (23.2) | 49 (30.1) | 106 (23.7) |
| Four to six times a week | 286 (20.8) | 210 (20.9) | 76 (20.6) | 158 (20.7) | 25 (15.3) | 103 (23.0) |
| Once a day | 528 (38.4) | 397 (39.5) | 131 (35.5) | 303 (39.7) | 66 (40.5) | 159 (35.5) |
| Twice or more a day | 164 (11.9) | 118 (11.7) | 46 (12.5) | 95 (12.4) | 17 (10.4) | 52 (11.6) |
| Fruit and vegetable consumption (*n*=1,375) | | | | | | |
| Two to three times a week or less | 67 (4.9) | 41 (4.1) | 26 (7.1) | 24 (3.1) | 10 (6.1) | 33 (7.4) |
| Four to six times a week | 127 (9.2) | 93 (9.2) | 34 (9.2) | 69 (9.0) | 12 (7.4) | 46 (10.3) |
| Once a day | 400 (29.1) | 294 (29.2) | 106 (28.7) | 205 (26.8) | 51 (31.3) | 144 (32.1) |
| Twice or more a day | 781 (56.8) | 578 (57.5) | 203 (55.0) | 466 (61.0) | 90 (55.2) | 2265 (50.2) |

Mean [standard deviation] / n (%) are shown.

[a]These numbers add up to 100%.

**Table 2.**

Factor loading matrix for dietary patterns detected from principal component analysis

| Food items | Diet 1 | Diet 2 | Diet 3 |
|---|---|---|---|
| Low fat milk | 0.00 | 0.03 | 0.10 |
| Full fat milk | 0.03 | 0.12 | 0.05 |
| Poultry | 0.07 | 0.12 | **0.17** |
| Pork/beef | 0.07 | 0.09 | 0.14 |
| Ham/sausages/bacon | 0.06 | 0.10 | **0.17** |
| Liver | 0.04 | 0.00 | **0.22** |
| Squid/Octopus/Shrimp/Clams | 0.06 | 0.04 | **0.18** |
| Small fish with bones | 0.10 | 0.05 | **0.16** |
| Canned tuna | 0.08 | 0.08 | **0.20** |
| Dried fish/salted fish | 0.05 | 0.03 | **0.18** |
| Oily fish | 0.12 | 0.00 | **0.19** |
| Non-oily fish | 0.10 | 0.07 | 0.13 |
| Eggs | 0.07 | **−0.18** | 0.06 |
| Tofu/tofu products | **0.19** | **−0.16** | 0.01 |
| Natto | 0.08 | **−0.18** | 0.04 |
| Potatoes | **0.18** | −0.10 | −0.09 |
| Salted green and yellow vegetable pickles | **0.17** | −0.07 | −0.02 |
| Other salted vegetable pickles | 0.03 | −0.06 | **−0.18** |
| Raw vegetables used in salad (Cabbage and lettuce) | **0.23** | 0.07 | 0.03 |
| Green leafy vegetables | **0.24** | 0.03 | 0.01 |
| Cabbage and Chinese cabbage | **0.30** | −0.08 | 0.00 |
| Carrots and pumpkins | **0.33** | −0.06 | −0.04 |
| Radishes and turnips | **0.31** | −0.14 | −0.07 |
| Other root vegetables | **0.32** | −0.05 | −0.02 |
| Tomatoes | **0.17** | **0.18** | 0.00 |
| Mushrooms | **0.25** | 0.06 | 0.00 |
| Seaweeds | **0.24** | −0.03 | −0.05 |
| Western sweets | −0.10 | **0.22** | **−0.33** |
| Japanese sweets | −0.03 | **0.24** | **−0.15** |
| Rice crackers | −0.05 | **0.24** | **−0.31** |
| Ice cream | −0.05 | 0.11 | 0.03 |
| Citrus fruit | 0.11 | 0.13 | **−0.23** |
| Persimmons/strawberry | 0.08 | 0.13 | **−0.20** |
| Other fruits | **0.17** | **0.16** | **−0.25** |
| Mayonnaise | 0.11 | 0.11 | 0.04 |
| Bread | −0.08 | **0.18** | −0.02 |
| Buckwheat noodles | 0.01 | **0.15** | **0.15** |
| Japanese wheat noodles | −0.02 | 0.14 | 0.13 |
| Instant noodles and Chinese noodles | −0.11 | 0.03 | 0.07 |

| Food items | Diet 1 | Diet 2 | Diet 3 |
|---|---|---|---|
| Spaghetti and macaroni | 0.01 | **0.18** | **0.15** |
| Green tea | 0.08 | −0.10 | **−0.16** |
| Black and oolong tea | 0.01 | 0.09 | 0.02 |
| Coffee | −0.06 | 0.13 | −0.03 |
| Coke | −0.08 | 0.10 | 0.10 |
| 100% fruit juice | 0.02 | 0.05 | 0.11 |
| Rice | **−0.15** | **−0.44** | −0.14 |
| Miso soup | −0.08 | **−0.37** | −0.07 |
| Japanese sake | −0.07 | −0.08 | 0.11 |
| Beer | −0.13 | −0.02 | **0.18** |
| Shochu | −0.06 | −0.12 | 0.11 |
| Whiskey | −0.07 | 0.00 | **0.17** |
| Wine | 0.01 | −0.04 | 0.07 |

Factor loading less than ±0.15 are shown in bald. Energy-adjusted intakes (g/1000kcal) were used in the analysis.

**Table 3.**

Linear regression analysis between PTSS in 2013 and scores of dietary patterns detected by principal component analysis in 2020 ($n$=1,375)

| | Diet 1 | | Diet 2 | | Diet 3 | |
|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** | **Model 6** |
| PTSS | −0.31 (−0.56, −0.05) | −0.13 (−0.57, 0.31) | 0.19 (−0.01, 0.39) | 0.14 (−0.22, 0.49) | 0.28 (0.10, 0.47) | 0.45 (0.13, 0.78) |
| Relocation (ref. No) | | | | | | |
| Lived in a TH | 0.40 (−0.45, 1.26) | 1.19 (−0.58, 2.96) | −0.49 (−1.2, 0.22) | −1.1 (−2.6, 0.36) | −0.63 (−0.13, −0.001) | −0.48 (−1.8, 0.83) |
| Moved to a new house | −0.15 (−0.85, 0.55) | 1.01 (−0.55, 2.56) | 0.08 (−0.48, 0.64) | 0.59 (−0.72, 1.9) | −0.13 (−0.67, 0.40) | −0.61 (−1.8, 0.56) |
| Gender (ref. men) | 0.63 (0.29, 0.97) | 0.70 (0.34, 1.05) | 0.17 (−0.10, 0.44) | 0.17 (−0.12, 0.45) | −0.57 (−0.82, −0.32) | −0.51 (−0.77, −0.24) |
| Two−way interaction | | | | | | |
| PTSS x TH | | −0.44 (−3.6, 2.7) | | 0.33 (−2.1, 2.8) | | 0.29 (−2.0, 2.6) |
| PTSS x new house | | −1.4 (−3.7, 0.97) | | 0.47 (−1.5, 2.4) | | 0.60 (−1.2, 2.4) |
| PTSS x female | | −0.23 (−0.77, 0.31) | | 0.05 (−0.38, 0.48) | | −0.30 (−0.70, 0.10) |
| TH x female | | −0.45 (−2.8, 1.9) | | 0.54 (−1.3, 2.4) | | −0.40 (−2.1, 1.3) |
| New house x female | | −1.8 (−3.9, 0.17) | | −0.82 (−2.5, 0.83) | | 0.18 (−1.3, 1.7) |
| Three−way interaction | | | | | | |
| PTSS x TH x female | | −0.89 (−4.7, 2.9) | | 0.37 (−2.6, 3.3) | | −0.001 (−2.8, 2.8) |
| PTSS x new house x female | | 2.1 (−0.88, 5.1) | | −0.70 (−3.1, 1.7) | | 0.29 (−1.9, 2.5) |

PTSS: Posttraumatic stress symptoms; TH: Trailer-style temporary housing

Regression coefficients and 95% CI for the association between PTSS, history of relocation, gender and dietary pattern scores (continuous) for Diet 1 to 3 are shown. A positive regression coefficient indicates an association between the exposure and a higher score for a particular dietary pattern. A negative coefficient indicates an inverse association between the exposure and outcome. Covariates were evaluated in 2010: age, marital status, education, equivalent income, depression, employment, BMI, self-rated health, IADL, smoking, alcohol consumption, intake of foods rich in protein, and vegetable intake.

**Table 4.**

Linear regression analysis between depression onset in 2013 and scores of dietary patterns detected by principal component analysis in 2020 ($n$=927)

| | Diet 1 | | Diet 2 | | Diet 3 | |
|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** | **Model 6** |
| Depression onset | −0.46 (−0.88, −0.03) | −0.12 (−0.76, 0.53) | 0.12 (−0.21, 0.45) | 0.23 (−0.27, 0.73) | −0.20 (−0.51, 0.11) | 0.21 (−0.24, 0.66) |
| Relocation (ref. No) | | | | | | |
| Lived in a TH | 0.52 (−0.63, 1.7) | 1.26 (−2.5, 5.0) | −0.42 (−1.3, 0.50) | −0.45 (−3.6, 2.7) | −0.71 (−1.6, 0.13) | −2.2 (−4.9, 0.53) |
| Moved to a new house | −0.20 (−1.1, 0.67) | 0.42 (−1.2, 2.0) | 0.30 (−0.38, 0.98) | 1.2 (−0.13, 2.5) | 0.03 (−0.59, 0.65) | −0.12 (−1.3, 1.1) |
| Gender (ref. men) | 0.48 (0.07, 0.90) | 0.56 (0.13, 0.98) | 0.33 (0.01, 0.65) | 0.35 (0.02, 0.68) | −0.30 (−0.60, −0.004) | −0.23 (−0.53, 0.08) |
| Two−way interaction | | | | | | |
| Depression x TH | | −1.2 (−6.5, 4.2) | | −1.3 (−5.7, 3.0) | | 1.4 (−2.4, 5.3) |
| Depression x new house | | 0.49 (−3.6, 4.6) | | −0.32 (−3.3, 2.7) | | −1.8 (−6.1, 2.4) |
| Depression x female | | −0.57 (−1.5, 0.32) | | −0.14 (−0.82, 0.53) | | −0.66 (−1.3, −0.06) |
| TH x female | | −0.44 (−4.5, 3.7) | | 0.11 (−3.3, 3.5) | | 1.8 (−1.2, 4.7) |
| New house x female | | −0.94 (−3.0, 1.1) | | −1.2 (−2.8, 0.41) | | 0.68 (−0.81, 2.2) |
| Three−way interaction | | | | | | |
| Depression x TH x female | | −0.39 (−5.6, 6.4) | | 1.6 (−3.3, 6.4) | | −1.7 (−6.1, 2.7) |
| Depression x new house x female | | −0.54 (−5.4, 4.3) | | −0.29 (−3.9, 3.3) | | 0.63 (−3.9, 5.2) |

TH: Trailer-style temporary housing

Regression coefficients and 95% CI for the association between depression onset, history of relocation, and gender and dietary pattern scores (continuous) for Diet 1 to 3 are shown. A positive regression coefficient indicates an association between the exposure and a higher score for a particular dietary pattern. A negative coefficient indicates an inverse association between the exposure and outcome. Covariates were evaluated in 2010: age, marital status, education, equivalent income, employment, BMI, self-rated health, IADL, smoking, alcohol consumption, intake of foods rich in protein, and vegetable intake.