Hypertension Research

Impact of lifestyle or psychosocial factors on onset of hypertension after the Great East Japan Earthquake: A 7-year follow-up of the Fukushima Health Management Survey

Journal:	*Hypertension Research*
Manuscript ID	HTR-2022-0052.R2
Manuscript Type:	Article
Date Submitted by the Author:	10-May-2022
Complete List of Authors:	Kobari, Eri; Fukushima Medical University School of Medicine, Department of Nephrology and Hypertension Tanaka, Kenichi; Fukushima Medical University School of Medicine, Department of Nephrology and Hypertension; Fukushima Medical University School of Medicine, Division of Advanced Community Based Care for Lifestyle Related Diseases Nagao, Masanori; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Epidemiology Okazaki, Kanako; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Epidemiology Hayashi, Fumikazu; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Epidemiology Kazama, Sakumi; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Division of Advanced Community Based Care for Lifestyle Related Diseases Ohira, Tetsuya; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Epidemiology Yasumura, Seiji; Fukushima Medical University School of Medicine, Department of Public Health Shimabukuro, Michio; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Division of Advanced Community Based Care for Lifestyle Related Diseases; Fukushima Medical University School of Medicine, Department of Diabetes, Endocrinology, and Metabolism Maeda, Masaharu; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Disaster Psychiatry Sakai, Akira; Fukushima Medical University, Radiation Medical Science

	Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Radiation Life Sciences Yabe, HIrooki; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Neuropsychiatry Hosoya, Mitsuaki; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Pediatrics Takahashi, Atsushi; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Gastroenterology Harigane, Mayumi; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Department of Public Health Ohto, Hitoshi; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey Kamiya, Kenji; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Hiroshima University, Research Institute for Radiation Biology and Medicine Kazama, Junichiro; Fukushima Medical University School of Medicine, Departments of Nephrology and Hypertension; Fukushima Medical University, Radiation Medical Science Center for the Fukushima Health Management Survey; Fukushima Medical University School of Medicine, Division of Advanced Community Based Care for Lifestyle Related Diseases
Keyword:	Earthquake, Evacuation, Hypertension, Lifestyle, Survivor
Category:	Epidemiology

Do lifestyle and living environment affect risk of hypertension in survivors of a major earthquake in the long-term?

Objective: Tested associations of lifestyle and living environment with hypertension onset after the earthquake

Methods and Cohort

- Observational Cohort Study
- Fukushima Health Management Survey
- Survivors of the Great East Japan Earthquake on 11 March 2011
- Age 39-89 y
- Without hypertension at baseline
- 7-year follow up (2011-2018)
- 10,861 residents
  near the Fukushima Daiichi Nuclear Power Plant
  Met eligibility criteria

Findings

Adjusted HR (95% CI) for hypertension onset

1.38 (1.21-1.57)
Heavy drinker
(alcohol ≥ 44 g/day)

1.27 (1.19-1.37)
Obesity
(BMI ≥ 25)

1.14 (1.02-1.27)
Evacuation
(among men)

- Physical activity
- Sleep satisfaction
- Smoking status
- Changes in work situation
- Psychological distress

were not significantly associated with hypertension onset

Conclusions: Lifestyle habits, such as drinking and obesity, and evacuation in men had significant effects on hypertension onset in the long term after the earthquake

Manuscript Title:

Impact of lifestyle or psychosocial factors on onset of hypertension after the Great East Japan Earthquake: A 7-year follow-up of the Fukushima Health Management Survey

Authors:

Eri Kobari[1], Kenichi Tanaka[1,4], Masanori Nagao[2,3], Kanako Okazaki[2,3], Fumikazu Hayashi[2,3], Sakumi Kazama[2,4], Tetsuya Ohira[2,3], Seiji Yasumura[5], Michio Shimabukuro[2,4,6], Masaharu Maeda[2,7], Akira Sakai[2,8], Hirooki Yabe[2,9], Mitsuaki Hosoya[2,10], Atsushi Takahashi[2,11], Mayumi Harigane[2,5], Hitoshi Ohto[2], Kenji Kamiya[2,12], and Junichiro James Kazama[1,2,4]

Affiliations

[1] Department of Nephrology and Hypertension, Fukushima Medical University School of Medicine

[2] Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University

[3] Department of Epidemiology, Fukushima Medical University School of Medicine

[4] Division of Advanced Community Based Care for Lifestyle Related Diseases, Fukushima Medical University School of Medicine

[5] Department of Public Health, Fukushima Medical University School of Medicine

[6] Department of Diabetes, Endocrinology, and Metabolism, Fukushima Medical

University School of Medicine

[7] Department of Disaster Psychiatry, Fukushima Medical University School of Medicine

[8] Department of Radiation Life Sciences, Fukushima Medical University School of Medicine

[9] Department of Neuropsychiatry, Fukushima Medical University School of Medicine

[10] Department of Pediatrics, Fukushima Medical University School of Medicine

[11] Department of Gastroenterology, Fukushima Medical University School of Medicine

[12] Research Institute for Radiation Biology and Medicine, Hiroshima University

(Running head: Hypertension after a natural disaster)

Correspondence:

Kenichi Tanaka, M.D., Ph.D.

Department of Nephrology and Hypertension, Fukushima Medical University

1 Hikarigaoka, Fukushima City 960-1295, Japan

Phone: +81-24-547-1206; Fax: +81-24-548-3044

Email: kennichi@fmu.ac.jp

Number of Tables: 5, supplemental Tables: 4

Number of Figures: 1

Word count of the abstract: 223 words

Word count of the main text (including Abstract, Introduction, Methods, Results,

and Discussion): 3,734 words

Abstract

Natural disasters force many evacuees to change several aspects of their lifestyles. This longitudinal study aimed to investigate whether factors such as living environment and lifestyle habits were related to the new onset of hypertension in survivors of the Great East Japan Earthquake over a long term of up to 7 years after the earthquake. The present study examined data collected from 29,025 Japanese participants aged 39 to 89 years, sourced from general health checkups and the Fukushima Mental Health and Lifestyle Survey conducted in 13 communities between 2011 and 2018. A total of 10,861 participants received follow-up examinations. During a median follow-up of 4.3 years, 3,744 participants (1,588 men, 41.4%, 2,156 women, 30.7%) newly developed hypertension. Heavy drinking (adjusted hazard ratio 1.38, 95% confidence interval 1.21-1.57, $p < 0.001$) and obesity (adjusted hazard ratio 1.27, 95% confidence interval 1.19-1.37, $p < 0.001$) were significantly associated with the new onset of hypertension after the disaster in multivariate-adjusted analysis. Furthermore, evacuation experience after the disaster was also significantly associated with the risk of new onset of hypertension in men (adjusted hazard ratio 1.14, 95% confidence interval 1.02-1.27, $p = 0.016$). The present study indicated that lifestyle habits, such as drinking and obesity, and evacuation experience in men had significant effects on the risk of new onset hypertension in the long term after the earthquake.

Key words: Earthquake, Evacuation, Hypertension, Lifestyle, Survivor.

Introduction

At 14:46 on 11 March 2011, Tohoku, in the northeast region of the main Japanese island of Honshu, was struck by a major earthquake measuring 9.0 on the moment magnitude scale. It was later labeled the Great East Japan Earthquake. The earthquake was followed by a massive tsunami and a huge nuclear accident at the Fukushima Daiichi Nuclear Power Plant, resulting in radioactive elements being released into the environment. Consequently, more than 160,000 residents who lived in the area with high radioactive concentration in Fukushima prefecture were forced to evacuate.

The health of major earthquake and other natural disaster victims has long been known to be affected by the associated psychological stress and changes in their environment, and previous studies have found such victims to have increased mortality from cardiovascular diseases, such as acute coronary syndrome, stroke, and pulmonary embolism[1, 2], so-called "disaster-related deaths"[3]. Hence, along with immediate care and support of disaster victims, it is important to minimize the occurrence of these long term effects after natural disasters. Previous studies demonstrated that the major cause of disaster-related deaths is psychological stress and the resultant sympathetic activation, which causes elevated blood viscosity, impaired glucose metabolism, and induction of an inflammatory response, thus promoting cardiovascular events[4]. In particular, elevated blood pressure is likely to be an important factor in the increase in the incidence of cardiovascular diseases after a disaster[3-5]. Disaster-related hypertension is thought to be related to psychological stress and sympathetic activation in the acute phase after a disaster[6], which continues until both the living environment and lifestyle habits are improved and stabilized[6]. After the Great Hanshin-Awaji earthquake on January 17, 1995

in Japan, the increase in mean blood pressure tended to be greater in residents living in areas with active faults than in residents living in the areas surrounding the active fault[7], and the elevation in blood pressure was directly proportional to the severity of the earthquake. Additionally, a previous report related to the Great East Japan Earthquake demonstrated that evacuation was significantly associated with the new onset of hypertension in the short term up to 2 years after the earthquake[8]. However, to date, there are no reports of whether factors such as the living environment and lifestyle habits of victims are related to the new onset of hypertension, and no studies have reported on the new onset of hypertension in the long term up to 7 years after a disaster.

Therefore, we studied the factors associated with the new onset of hypertension after a disaster in the long term, using longitudinal data of a 7-year follow-up, called the Fukushima Health Management Survey.

Methods

Study design and participants

The Fukushima Health Management Survey was conducted by Fukushima Prefecture to investigate the long term health of residents of 13 municipalities near the Fukushima Daiichi Nuclear Power Plant. Detailed survey methods have been described in previous literature[9]. The Fukushima Health Management Survey consists of a basic survey and 4 detailed surveys, namely the thyroid ultrasound examination, comprehensive health check, mental health and lifestyle survey, and pregnancy and birth survey. The comprehensive health check was completed by 40,099 participants (16,954 men and 23,145 women), while 56,774 participants (25,228 men and 31,546 women) completed

the mental health and lifestyle survey. The present study comprised a total of 29,025 participants (12,382 men and 16,643 women) who completed both the comprehensive health check and the mental health and lifestyle survey of the Fukushima Health Management Survey.

The comprehensive health check, which was conducted between June 2011 and March 2012, evaluated subjective symptoms, family history, smoking and drinking history, and laboratory findings such as blood counts, liver function, kidney function, and lipid levels. The mental health and lifestyle survey was conducted between January 2012 and October 2012 among the residents of these communities, based on self-administrated questionnaire surveys, to evaluate changes in mental status and living conditions after the disaster, such as psychological distress, sleep satisfaction, perception of risk of delayed health effects of radiation, participation in recreational activities, evacuation experience, and change in work situation.

We excluded participants who had hypertension at the time of the health checkup in 2011 (n=15,868). In addition, 2,296 subjects who never underwent health checkups from April 2012 to March 2018 (n=2,263) or had insufficient data on the diagnoses of hypertension (n=33) were excluded from the analysis. Ultimately, 10,861 participants (3,834 men and 7,027 women) were eligible for the present study. There was a significantly higher prevalence of underweight and obesity in 2,296 excluded subjects than in 10,861 participants in men (supplemental Table S1). Physical activity, smoking status, and participates in recreational activities differed significantly between the excluded subjects and the participants in both men and women. The percentage of those who experienced evacuation after the earthquake was significantly lower in the excluded subjects than in the participants in both men and women (supplemental Table S2).

The follow-up examinations were conducted from June 2011 through March 2018 as part of the Fukushima Health Management Survey; the methods are detailed in a previous report[9]. The primary end point of the present study was the new onset of hypertension. A detailed definition of hypertension is described below.

Ethical approval

This study protocol was approved by the Ethics Committee of the Fukushima Medical University School of Medicine (approval numbers 1319, 2020-239, 29064) and conformed to the ethical guidelines of the 1975 Declaration of Helsinki. Informed consent was obtained from community representatives to conduct an epidemiological study, based on the guidelines of the Council for International Organizations of Medical Science[10].

Data collection and definitions

Body weight and height were measured with the participants bare-footed and wearing light clothing. Body mass index (BMI) was calculated as weight (kg) divided by the square of height (m). Waist circumference was measured above the navel at minimal respiration. Systolic and diastolic blood pressures were measured by trained technicians. All measurements were taken at the same sitting using an aneroid device, after 5 min of rest.

Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg[11], or being treated for hypertension. Dyslipidemia was defined as low-density lipoprotein cholesterol (LDL-C) ≥ 140 mg/dL, fasting triglyceride ≥ 150 mg/dL, and/or high-density lipoprotein cholesterol (HDL-C) < 40 mg/dL, or being treated for dyslipidemia. Diabetes was defined as fasting blood glucose ≥ 126 mg/dL or casual

blood glucose ≥ 200 mg/dL, and/or hemoglobin A1c (HbA1c) ≥ 6.5%, or being treated for diabetes. Hyperuricemia was defined as serum uric acid > 7.0 mg/dL. Abnormal liver function was defined as AST ≥ 31 U/L, ALT ≥ 31 U/L, or γ-GT ≥ 51 U/L. Abnormal renal function was defined as an estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73 m^2 or urine protein ≥ +1. The eGFR was calculated using the estimation equation for Japanese patients with CKD. This equation calculates the eGFR from serum creatinine, age, and sex using the following formula: (eGFR mL/min/1.73 m^2 = 194 × $age^{-0.287}$ × $serum\ creatinine^{-1.094}$ × 0.739 for women)[12]. Obesity and underweight were defined as BMI ≥ 25 kg/m^2 and BMI < 18 kg/m^2, respectively.

Evacuees were defined as residents of the municipalities whose entire area was evacuated or having a self-reported experience of moving into shelters or temporary housing. We defined psychological distress as corresponding to the Japanese version of the Kessler 6-item scale (K6) score of ≥ 13[13, 14].

Statistical analysis

To compare the baseline characteristics between subjects with and without hypertension, we used the Mann-Whitney U-test for continuous variables and χ^2 test for categorical variables.

We calculated sex-combined and sex-specific hazard ratios (HRs) and 95% confidence intervals (95% CIs) for the incidence of hypertension using Cox proportional hazard analysis in multivariate models. Model 1 was adjusted for sex and age at baseline (continuous). Model 2 was adjusted for sex, age at baseline, obesity, underweight, physical activity (≥ 2 times a week or not), sleep satisfaction merged from four categories into two categories: “satisfied and slightly dissatisfied” vs. “quite dissatisfied and very

dissatisfied or have not slept at all"), alcohol intake habit (never-, former-, current-drinker; less than 44 g of ethanol a day or more), smoking habit (never-, former, current-smoker), evacuation experience (yes or no), change in work situation (yes or no), psychological distress (K6 ≥ 13 or < 13), perception of risk of delayed health effects of radiation ("likely" or "unlikely"), participation in recreational activities (local activities such as Karaoke, gate ball, and festivals) merged from three categories into two categories: "often and sometimes participated" vs. "rarely or never participated"), diabetes, dyslipidemia, hyperuricemia, systolic blood pressure, diastolic blood pressure, and eGFR. The categorial data of physical activity, sleep satisfaction, and participates in recreational activities were merged into two categories in order to calculate hazard ratios as binary. All variables obtained in the present study which could to be related to the new onset of hypertension were put into the multivariate Cox models. Missing data of these covariates were treated as dummy variables and used for the Cox analyses.

Statistical data were analyzed using SAS version 9.4 software (SAS Institute, Cary, North Carolina). All probability values for statistical tests were two-tailed, and $p < 0.05$ was considered statistically significant.

Results

A total of 10,861 participants, including 3,834 men and 7,027 women, met the conditions of this study (Figure 1).

The results of the subjects' comprehensive health check at baseline in 2011 stratified by sex and the development of hypertension during the follow-up period is shown in Table 1. During the median follow-up period of 4.3 years, 3,744 participants (1,588 men and

2,156 women, 41.4% and 30.7% of the total men and women, respectively) newly met the criteria for hypertension. There was a significantly higher prevalence of obesity, abnormal liver function, and abnormal renal function in the hypertension group than in the non-hypertension group in both men and women (obesity: 32.4% vs. 28.1%, $p = 0.005$ in men; 29.8% vs. 16.3%, $p < 0.001$ in women, abnormal liver function: 42.3% vs. 37.8%, $p = 0.006$ in men; 18.5% vs. 13.9%, $p < 0.001$ in women, abnormal renal function: 14.0% vs. 9.5%, $p < 0.001$ in men; 13.4% vs. 7.7%, $p < 0.001$ in women, respectively). There was a significantly lower prevalence of underweight participants in the hypertension group than in the non-hypertension group in both men and women (1.9% vs. 4.0%, $p < 0.001$ in men; 4.8% vs. 9.3%, $p < 0.001$ in women, respectively).

Table 2 shows the results of the mental health and lifestyle survey in fiscal year 2011 in participants stratified according to sex and the subsequent development of hypertension. Physical activity, smoking status, and drinking status differed significantly between the hypertension and non-hypertension groups in both men and women. The percentage of participants who experienced evacuation after the earthquake was significantly higher in the hypertension group than in the non-hypertension group in men, but not in women. Psychological distress did not differ significantly between the hypertension and non-hypertension groups in both men and women.

Clinical, biochemical, and lifestyle characteristics of the participants according to evacuation experience were shown in supplemental Table S3 and S4. In evacuees, compared with non-evacuees, there was a significantly higher prevalence of obesity in men and a significantly higher prevalence of abnormal liver function in both men and women (Table S3). Sleep satisfaction, smoking status, change in work situation, perception of risk of delayed health effects due to radiation, and participates in

recreational activities differed significantly between evacuees and non-evacuees in both men and women (Table S4). Evacuees had significantly lower sleep satisfaction and recreational activities and higher psychological distress and perception of risk of delayed health effects due to radiation. Over 70% of the evacuees have experienced changes in their work situation after the earthquake.

Table 3 shows the association between the risk of new onset of hypertension and disaster-related factors in the entire cohort. In multivariate analysis (adjusted for sex, age at baseline, obesity, underweight, physical activity, sleep satisfaction, drinking status, smoking status, evacuation experience, change in work situation, psychological distress, perception of risk of delayed health effects of radiation, participation in recreational activities, diabetes, dyslipidemia, hyperuricemia, systolic blood pressure, diastolic blood pressure, and eGFR), age, obesity, current drinking (≥ 44 g/day), evacuation experience, dyslipidemia, hyperuricemia, systolic blood pressure, and diastolic blood pressure were significantly associated with the risk of new onset of hypertension. Conversely, being underweight was significantly associated with a lower risk of new onset of hypertension. Psychological distress was not significantly associated with the risk of new onset of hypertension.

Tables 4A and 4B show the association between the new onset of hypertension and disaster-related factors in men and women, respectively. Age, current drinking (≥ 44 g/day), hyperuricemia, systolic blood pressure, and diastolic blood pressure were significantly associated with the risk of new onset of hypertension in multivariate-adjusted analysis in men (Table 4A). Although obesity had a significant effect on the higher risk of new onset of hypertension in the crude and age-adjusted analyses, the significant effect disappeared after multivariate-adjustment in men. Age, obesity, current

drinking (≥ 44 g/day), diabetes, dyslipidemia, hyperuricemia, and systolic blood pressure, and diastolic blood pressure were significantly associated with new onset hypertension in multivariate-adjusted analysis in women (Table 4B). Evacuation experience was significantly associated with the risk of new onset hypertension after the earthquake in men (adjusted HR 1.14, 95% CI 1.02-1.27, p = 0.016), but not in women (adjusted HR 1.05, 95% CI 0.96-1.15, p = 0.247).

Discussion

The present study aimed to elucidate the relationships between living environment, lifestyle habits and the risk of new onset of hypertension in the long term up to 7 years after the Great East Japan Earthquake. The present results suggested that drinking status and obesity are significantly associated with the risk of new onset of hypertension after the earthquake. Furthermore, evacuation after the earthquake had a significant effect on the increased risk of hypertension among men in the long term after the earthquake. To the best of our knowledge, the present study is the first to show the factors, including living environment, lifestyle habits, and evacuation, associated with the new onset of hypertension after a major earthquake with such long term observation.

In the present study, heavy drinking (≥ 44 g/day) was significantly associated with the new onset of hypertension after the earthquake in both men and women. The known common causes of hypertension are salt excess[15], obesity[16], drinking[17], and smoking. Although the mechanism through which alcohol raises blood pressure remains elusive, it is thought to be associated with the central nervous system, enhanced sympathetic activity[18], stimulation of the renin-angiotensin-aldosterone system, and loss of

vasorelaxation due to inflammation and oxidative injury to the endothelium by angiotensin II, leading to inhibition of endothelium-dependent nitric oxide production[19]. This last mechanism, is, in particular, the major contributor to alcohol-induced hypertension. Previous reports have shown that alcohol consumption increases after a disaster because of psychological distress[20], which increases the risk of hypertension[21]. Immediate post-disaster heavy drinkers were previously reported to be likely to continue heavy drinking[22], suggesting that heavy drinkers at baseline in the present study might have continued heavy drinking, which would have increased their risk of hypertension.

Obesity was also significantly associated with the new onset of hypertension after the earthquake in the present study, both in the entire cohort and in women. High BMI and increased body weight are reportedly related to the risk of hypertension[16, 23]. Excessive accumulation of visceral fat is thought to elevate blood pressure via the expression of adipose tissue angiotensinogen and eventual insulin resistance. The quality of food being eaten deteriorates significantly after a disaster, and the meals supplied at evacuation shelters are not always healthy, including, for example, sweet buns, snacks, and rice balls, all of which are high in carbohydrates[24]. In addition, a previous survey reported that living in non-home conditions, such as evacuation shelters or temporary housing, is associated with poor dietary intake due to shortage of cooking equipment and utilities or some form of food shortage after a disaster[25]. Hence, the meals served at evacuation shelters or temporary housing should not only be low in salt, but also low in calories in order to minimize the risk of secondary health damage and hypertension in survivors after a natural disaster.

A previous study showed that the experience of evacuation was associated with an increased risk of hypertension among men in the two years after the Great East Japan

Earthquake[8]. In the present study, the experience of evacuation continued to have a significant and independent effect on an increased risk of hypertension among men in the long term up to 7 years after the earthquake. Although the mechanism is not fully understood, the psychological stress of a change in lifestyle, changes in work situation, and insufficient sleep might be associated with the risk of hypertension among the evacuees[8]. However, reasons for a sexual difference in the risk of hypertension after the earthquake is still unclear. The proportion of obese subjects among evacuees also reportedly increased after the earthquake, and the increase was significantly higher in men than in women[8]. Since obesity is one of the major risk factors for hypertension, as mentioned above, an increase in the proportion of obese people among men due to evacuation after the earthquake could have contributed to the observed sex-based difference in the correlation between evacuation and the new onset of hypertension. Detailed mechanisms of hypertension among evacuees after a natural disaster and the reasons for the sexual difference need to be examined in the future.

Emergency responses for injured people are the highest priority in the acute phase after a disaster. However, since evacuation after a natural disaster is reportedly associated with an increased risk of lifestyle-related diseases, such as diabetes[26], metabolic syndrome[27], and hyperuricemia[28], in addition to hypertension in the long term, in the event of a major earthquake or other natural disaster, the next most important step after the initial work to secure and prepare evacuation centers and temporary housing is early recovery, that is returning victims to living environments that are as similar to their former circumstances as possible. In September 2017, more than six years after the Great East Japan Earthquake, nearly 56,000 people remained in evacuation in Fukushima prefecture, although their number had declined by about 108,000 compared to May 2012. Some evacuation orders

instated after the nuclear accident have been lifted, and interventions by the government and private companies, such as maintaining public housing and job creation in Fukushima prefecture, have enabled evacuees to reconstruct their lifestyles. However, our results suggest that the experience of evacuation, drinking habits, and obesity had long term effects on the risk of new onset of hypertension in survivors, and hence, continuous interventions related to their lifestyle, such as drinking habits, eating habits, and physical activity, in addition to immediate reconstruction of their living environment, might be important to minimize secondary health effects in survivors after a natural disaster.

There are several limitations to the present study. First, as alcohol consumption and obesity were measured only at baseline, we were unable to assess the changes in alcohol consumption and body weight throughout the observation period. Second, as alcohol consumption was self-reported, the data might not be completely accurate. Third, dietary habits, including salt intake, were not incorporated in the analysis. Accurate data on salt intake were not available in the present study, despite the fact that hypertension is closely associated with diet, especially salt intake[29]. Fourth, the present study did not evaluate other psychosocial and economic factors, including anger, social support, and income, which could affect the association between evacuation and the new onset of hypertension. Fifth, as the number of female participants was approximately 1.8 times that of male participants, the results of whole cohort could have been affected by the disproportionate ratio of sex distribution. Sixth, the comprehensive health check, a baseline survey of the present study, was conducted after the earthquake on March 2011 between June 2011 and March 2012, and participants who had hypertension at baseline were excluded from the analysis. So, participants with new onset of hypertension in the acute or sub-acute phase after the earthquake might have been excluded in the present study. In other words, the

present study might have selected survivors who did not developed disaster hypertension by acute psychological stress. Seventh, although heart rate could be a confounding factor, data of heart rate were not available in the present study. Finally, the observational nature of the analyses allows for the detection of associations but does not demonstrate causality. These limitations of the present study need to be addressed in future studies.

The experience of evacuation is still associated with the new onset of hypertension in the long term, up to 7 years after disasters, among men, and the results of the present study indicate that lifestyle habits, such as drinking and obesity, have stronger effects on hypertension. Further research is still needed to elucidate whether interventions to improve lifestyle, especially for evacuees, decrease the risk of new onset of hypertension and adverse secondary health effects in the long term after a natural disaster.

Conflicts of Interest

None of the authors have any conflicts of interest or financial disclosures.

Acknowledgement

We thank the expert committee members, advisors, and staff of the Fukushima Health Management Survey Group for conducting the present survey and for their support.

Funding

This survey was supported by the National Health Fund for Children and Adults Affected by the Nuclear Incident, as was the design and conduct of the study.

References

1 Trichopoulos D, Katsouyanni K, Zavitsanos X, Tzonou A, Dalla-Vorgia P. Psychological stress and fatal heart attack: the Athens (1981) earthquake natural experiment. *Lancet* 1983; **1**: 441-444.

2 Leor J, Poole WK, Kloner RA. Sudden cardiac death triggered by an earthquake. *N Engl J Med* 1996; **334**: 413-419.

3 Tanaka K, Nakayama M, Kanno M, Kimura H, Watanabe K, Hayashi Y, Asahi K, Watanabe T. Aftercare for the prevention of a secondary health disaster in survivors of major earthquakes. *Hypertens Res* 2013; **36**: 759-761.

4 Kario K, Matsuo T, Kobayashi H, Yamamoto K, Shimada K. Earthquake-induced potentiation of acute risk factors in hypertensive elderly patients: possible triggering of cardiovascular events after a major earthquake. *J Am Coll Cardiol* 1997; **29**: 926-933.

5 Kario K. Disaster hypertension - its characteristics, mechanism, and management. *Circ J* 2012; **76**: 553-562.

6 Narita K, Hoshide S, Tsoi K, Siddique S, Shin J, Chia YC, Tay JC, Teo BW, Turana Y, Chen CH, Cheng HM, Sogunuru GP, Wang TD, Wang JG, Kario K. Disaster hypertension and cardiovascular events in disaster and COVID-19 pandemic. *J Clin Hypertens (Greenwich)* 2021; **23**: 575-583.

7 Saito K, Kim JI, Maekawa K, Ikeda Y, Yokoyama M. The great Hanshin-Awaji earthquake aggravates blood pressure control in treated hypertensive patients. *Am J Hypertens* 1997; **10**: 217-221.

8 Ohira T, Hosoya M, Yasumura S, Satoh H, Suzuki H, Sakai A, Ohtsuru A, Kawasaki Y, Takahashi A, Ozasa K, Kobashi G, Hashimoto S, Kamiya K, Yamashita S, Abe M. Evacuation and Risk of Hypertension After the Great East Japan Earthquake: The Fukushima Health Management Survey. *Hypertension* 2016; **68**: 558-564.

9 Yasumura S, Hosoya M, Yamashita S, Kamiya K, Abe M, Akashi M, Kodama K, Ozasa K. Study

protocol for the Fukushima Health Management Survey. *J Epidemiol* 2012; **22**: 375-383.

10 . International guidelines for ethical review of epidemiological studies. *Law Med Health Care* 1991; **19**: 247-258.

11 Umemura S, Arima H, Arima S, Asayama K, Dohi Y, Hirooka Y, Horio T, Hoshide S, Ikeda S, Ishimitsu T, Ito M, Ito S, Iwashima Y, Kai H, Kamide K, Kanno Y, Kashihara N, Kawano Y, Kikuchi T, Kitamura K, Kitazono T, Kohara K, Kudo M, Kumagai H, Matsumura K, Matsuura H, Miura K, Mukoyama M, Nakamura S, Ohkubo T, Ohya Y, Okura T, Rakugi H, Saitoh S, Shibata H, Shimosawa T, Suzuki H, Takahashi S, Tamura K, Tomiyama H, Tsuchihashi T, Ueda S, Uehara Y, Urata H, Hirawa N. The Japanese Society of Hypertension Guidelines for the Management of Hypertension (JSH 2019). *Hypertens Res* 2019; **42**: 1235-1481.

12 Matsuo S, Imai E, Horio M, Yasuda Y, Tomita K, Nitta K, Yamagata K, Tomino Y, Yokoyama H, Hishida A. Revised equations for estimated GFR from serum creatinine in Japan. *Am J Kidney Dis* 2009; **53**: 982-992.

13 Kessler RC, Barker PR, Colpe LJ, Epstein JF, Gfroerer JC, Hiripi E, Howes MJ, Normand SL, Manderscheid RW, Walters EE, Zaslavsky AM. Screening for serious mental illness in the general population. *Arch Gen Psychiatry* 2003; **60**: 184-189.

14 Furukawa TA, Kawakami N, Saitoh M, Ono Y, Nakane Y, Nakamura Y, Tachimori H, Iwata N, Uda H, Nakane H, Watanabe M, Naganuma Y, Hata Y, Kobayashi M, Miyake Y, Takeshima T, Kikkawa T. The performance of the Japanese version of the K6 and K10 in the World Mental Health Survey Japan. *Int J Methods Psychiatr Res* 2008; **17**: 152-158.

15 . Intersalt: an international study of electrolyte excretion and blood pressure. Results for 24 hour urinary sodium and potassium excretion. Intersalt Cooperative Research Group. *Bmj* 1988; **297**: 319-328.

16 Chei CL, Iso H, Yamagishi K, Tanigawa T, Cui R, Imano H, Kiyama M, Kitamura A, Sato S, Shimamoto T. Body fat distribution and the risk of hypertension and diabetes among Japanese

men and women. *Hypertens Res* 2008; **31**: 851-857.

17 Nakamura K, Okamura T, Hayakawa T, Hozawa A, Kadowaki T, Murakami Y, Kita Y, Okayama A, Ueshima H. The proportion of individuals with alcohol-induced hypertension among total hypertensives in a general Japanese population: NIPPON DATA90. *Hypertens Res* 2007; **30**: 663-668.

18 Saunders JB, Beevers DG, Paton A. Factors influencing blood pressure in chronic alcoholics. *Clin Sci (Lond)* 1979; **57 Suppl 5**: 295s-298s.

19 Husain K, Ansari RA, Ferder L. Alcohol-induced hypertension: Mechanism and prevention. *World J Cardiol* 2014; **6**: 245-252.

20 Nordløkken A, Pape H, Wentzel-Larsen T, Heir T. Changes in alcohol consumption after a natural disaster: a study of Norwegian survivors after the 2004 Southeast Asia tsunami. *BMC Public Health* 2013; **13**: 58.

21 Ohmori S, Kiyohara Y, Kato I, Kubo M, Tanizaki Y, Iwamoto H, Nakayama K, Abe I, Fujishima M. Alcohol intake and future incidence of hypertension in a general Japanese population: the Hisayama study. *Alcohol Clin Exp Res* 2002; **26**: 1010-1016.

22 Orui M, Ueda Y, Suzuki Y, Maeda M, Ohira T, Yabe H, Yasumura S. The Relationship between Starting to Drink and Psychological Distress, Sleep Disturbance after the Great East Japan Earthquake and Nuclear Disaster: The Fukushima Health Management Survey. *Int J Environ Res Public Health* 2017; **14**.

23 Field AE, Coakley EH, Must A, Spadano JL, Laird N, Dietz WH, Rimm E, Colditz GA. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. *Arch Intern Med* 2001; **161**: 1581-1586.

24 Kishimoto M, Noda M. The Great East Japan Earthquake: Experiences and Suggestions for Survivors with Diabetes (perspective). *PLoS Curr* 2012; **4**: e4facf9d99b997.

25 Zhang W, Ohira T, Abe M, Kamiya K, Yamashita S, Yasumura S, Ohtsuru A, Masaharu M,

Harigane M, Horikoshi N, Suzuki Y, Yabe H, Yuuki M, Nagai M, Takahashi H, Nakano H. Evacuation after the Great East Japan Earthquake was associated with poor dietary intake: The Fukushima Health Management Survey. *J Epidemiol* 2017; **27**: 14-23.

26 Satoh H, Ohira T, Hosoya M, Sakai A, Watanabe T, Ohtsuru A, Kawasaki Y, Suzuki H, Takahashi A, Kobashi G, Ozasa K, Yasumura S, Yamashita S, Kamiya K, Abe M. Evacuation after the Fukushima Daiichi Nuclear Power Plant Accident Is a Cause of Diabetes: Results from the Fukushima Health Management Survey. *J Diabetes Res* 2015; **2015**: 627390.

27 Hashimoto S, Nagai M, Fukuma S, Ohira T, Hosoya M, Yasumura S, Satoh H, Suzuki H, Sakai A, Ohtsuru A, Kawasaki Y, Takahashi A, Ozasa K, Kobashi G, Kamiya K, Yamashita S, Fukuhara SI, Ohto H, Abe M, Fukushima Health Management Survey G. Influence of Post-disaster Evacuation on Incidence of Metabolic Syndrome. *J Atheroscler Thromb* 2017; **24**: 327-337.

28 Honda K, Okazaki K, Tanaka K, Kazama JJ, Hashimoto S, Ohira T, Sakai A, Yasumura S, Maeda M, Yabe H, Suzuki Y, Hosoya M, Takahashi A, Nakano H, Hayashi F, Nagao M, Ohira H, Shimabukuro M, Ohto H, Kamiya K. Evacuation after the Great East Japan Earthquake is an independent factor associated with hyperuricemia: The Fukushima Health Management Survey. *Nutr Metab Cardiovasc Dis* 2021; **31**: 1177-1188.

29 Hoshide S, Nishizawa M, Okawara Y, Harada N, Kunii O, Shimpo M, Kario K. Salt Intake and Risk of Disaster Hypertension Among Evacuees in a Shelter After the Great East Japan Earthquake. *Hypertension* 2019; **74**: 564-571.

1 Figure legends

2 Figure 1 Flowchart of participant selection in the study

Table 1. Clinical and biochemical characteristics of the 10,861 participants at baseline

	Men				Women			
	Total	Hypertension		p	Total	Hypertension		p
		Not incident	Incident			Not incident	Incident	
n (%)	3,834 (100)	2,246 (58.6)	1,588 (41.4)		7,027 (100)	4,871 (69.3)	2,156 (30.7)	
Age (years)	60.9 (10.9)	59.0 (10.9)	63.6 (10.3)	<0.001	58.0 (10.4)	56.0 (10.0)	62.6 (9.8)	<0.001
BMI (kg/m^2)	23.6 (2.9)	23.3 (3.0)	23.9 (2.8)	<0.001	22.5 (3.2)	22.1 (3.0)	23.4 (3.3)	<0.001
Underweight (BMI < 18.5 kg/m^2), n (%)	119 (3.1)	89 (4.0)	30 (1.9)	<0.001	554 (7.9)	451 (9.3)	103 (4.8)	<0.001
Obesity (BMI ≥ 25 kg/m^2), n (%)	1,146 (29.9)	632 (28.2)	514 (32.4)	0.005	1,434 (20.4)	792 (16.3)	642 (29.8)	<0.001
Systolic blood pressure (mmHg)	123 (10)	120 (10)	127 (8)	<0.001	120 (11)	118 (11)	126 (9)	<0.001
Diastolic blood pressure (mmHg)	76 (8)	75 (8)	78 (7)	<0.001	73 (8)	72 (8)	76 (8)	<0.001
Fasting blood glucose (mg/dL)	102 (22)	101 (20)	104 (24)	<0.001	95 (16)	94 (15)	98 (18)	<0.001
HbA1c (%)	5.5 (0.8)	5.5 (0.7)	5.5 (0.8)	0.001	5.4 (0.6)	5.4 (0.6)	5.5 (0.6)	<0.001
Diabetes, n (%)	437 (11.4)	241 (10.7)	196 (12.4)	0.118	305 (4.4)	159 (3.3)	146 (6.8)	<0.001
HDL-C (mg/dL)	56 (14)	56 (15)	55 (14)	0.329	65 (15)	66 (15)	63 (15)	<0.001
LDL-C (mg/dL)	126 (33)	126 (33)	127 (33)	0.350	131 (32)	129 (32)	136 (33)	<0.001
Triglyceride (mg/dL)	103 (73-148)	101 (71-145)	106 (75-151)	0.036	84 (62-117)	80 (59-111)	93 (70-129)	<0.001
Dyslipidemia, n (%)	2,088 (54.5)	1,202 (53.5)	886 (55.9)	0.149	3,661 (52.2)	2,329 (47.9)	1,332 (61.9)	<0.001
Uric acid (mg/dL)	5.7 (1.2)	5.6 (1.2)	5.8 (1.2)	<0.001	4.2 (0.9)	4.2 (0.9)	4.4 (1.0)	<0.001
Hyperuricemia, n (%)	496 (12.9)	265 (11.8)	231 (14.5)	0.013	41 (0.6)	19 (0.4)	22 (1.0)	0.001
AST (U/L)	23 (20-28)	23 (19-28)	24 (20-29)	<0.001	21 (18-24)	20 (17-24)	21 (19-25)	<0.001
ALT (U/L)	21 (16-30)	21 (16-30)	21 (16-30)	0.870	15 (12-21)	15 (12-20)	16 (13-22)	<0.001
γ-GT (U/L)	30 (20-49)	29 (20-47)	31 (21-52)	<0.001	17 (13-25)	16 (13-24)	19 (14-27)	<0.001
Abnormal liver function, n (%)	1,521 (39.7)	850 (37.8)	671 (42.3)	0.006	1,077 (15.3)	678 (13.9)	399 (18.5)	<0.001
eGFR (mL/min/1.73 m^2)	74 (13)	75 (13)	73 (13)	<0.001	76 (13)	77 (13)	73 (13)	<0.001
Abnormal renal function, n (%)	435 (11.4)	213 (9.5)	222 (14.0)	<0.001	663 (9.5)	375 (7.7)	288 (13.4)	<0.001

The values in the table indicate the average value (standard deviation) or the number (%). triglyceride, AST, ALT, and γ-GT are reported as the median (25-75% percentile). Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, or being treated for hypertension. Diabetes was defined as fasting blood glucose ≥ 126 mg/dL or casual blood glucose ≥ 200 mg/dL, and/or hemoglobin A1c (HbA1c) ≥ 6.5%, or being treated for diabetes. Dyslipidemia was defined as low-density lipoprotein cholesterol (LDL-C) ≥ 140 mg/dL, fasting triglyceride ≥ 150 mg/dL, and/or high-density lipoprotein cholesterol (HDL-C) < 40 mg/dL, or being treated for dyslipidemia. Hyperuricemia was defined as serum uric acid > 7.0 mg/dL. Abnormal liver function was defined as AST ≥ 31 U/L, ALT ≥ 31 U/L, or γ-GT ≥ 51 U/L. Abnormal renal function was defined as an estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73 m^2 or urine protein ≥ +1. BMI: body mass index, HbA1c: glycosylated hemoglobin A1c, HDL-C: high-density lipoprotein cholesterol, LDL-C: low-density lipoprotein cholesterol, AST: aspartate aminotransferase, ALT: alanine aminotransferase, γ-GT: gamma-glutamyl transpeptidase, eGFR: estimated glomerular filtration rate.

Table 2. Lifestyle characteristics of the 10,861 participants at baseline

		Men				Women			
		Total	Hypertension		p	Total	Hypertension		p
			Not incident	Incident			Not incident	Incident	
n (%)		3,834 (100)	2,246 (58.6)	1,588 (41.4)		7,027 (100)	4,871 (69.3)	2,156 (30.7)	
Physical activity					<0.001				<0.001
	Every day	744 (19.7)	422 (19.0)	322 (20.6)		922 (13.4)	588 (12.3)	334 (15.9)	
	2-4 times a week	801 (21.2)	410 (18.5)	391 (25.1)		1,535 (22.3)	971 (20.3)	564 (26.8)	
	Once a week	541 (14.3)	313 (14.1)	228 (14.6)		1,006 (14.6)	686 (14.3)	320 (15.2)	
	None	1,691 (44.8)	1,072 (48.4)	619 (39.7)		3,435 (49.8)	2,550 (53.2)	885 (42.1)	
Sleep satisfaction					0.637				0.094
	Satisfied	1,273 (40.8)	750 (40.3)	523 (41.4)		1,594 (27.3)	1,115 (27.2)	479 (27.6)	
	Slightly dissatisfied	1,334 (42.7)	804 (43.2)	530 (42.0)		2,877 (49.3)	2,027 (49.5)	850 (49.0)	
	Quite dissatisfied	421 (13.5)	254 (13.7)	167 (13.2)		1,054 (18.1)	758 (18.5)	296 (17.1)	
	Very dissatisfied or have not slept at all	94 (3.0)	51 (2.7)	43 (3.4)		307 (5.3)	198 (4.8)	109 (6.3)	
Drinking status					<0.001				<0.001
	Never drinker	1,132 (29.7)	725 (32.4)	407 (25.8)		4,639 (67.3)	3,150 (65.7)	1,489 (71.0)	
	Quit drinking	185 (4.8)	102 (4.6)	83 (5.3)		73 (1.1)	60 (1.3)	13 (0.6)	
	Drinks < 44 g/day	1,873 (49.1)	1,083 (48.4)	790 (50.1)		2,064 (29.9)	1,510 (31.5)	554 (26.4)	
	Drinks ≥ 44 g/day	627 (16.4)	329 (14.7)	298 (18.9)		118 (1.7)	77 (1.6)	41 (2.0)	
Smoking status					0.001				<0.001
	Never smoker	1,016 (26.8)	598 (26.9)	418 (26.6)		5,820 (85.4)	3,996 (84.1)	1,824 (88.5)	
	Quit smoking	1,625 (42.8)	903 (40.5)	722 (46.0)		461 (6.8)	332 (7.0)	129 (6.3)	
	Current smoker	1,155 (30.4)	726 (32.6)	429 (27.3)		534 (7.8)	426 (9.0)	108 (5.2)	
Evacuation experience	Yes	2,126 (55.5)	1,198 (53.3)	928 (58.4)	0.002	3,969 (56.5)	2,735 (56.1)	1,234 (57.2)	0.397
Changes in work situation	Yes	2,204 (59.5)	1,291 (59.1)	913 (60.0)	0.577	3,892 (58.8)	2,790 (60.4)	1,102 (55.3)	<0.001
Psychological distress (K6)	K6 ≥ 13	404 (11.1)	223 (10.4)	181 (12.0)	0.118	1,124 (17.0)	767 (16.5)	357 (17.9)	0.176
Perception of risk of delayed health effects due to radiation	Likely	1,667 (45.1)	958 (44.1)	709 (46.6)	0.126	3,336 (49.8)	2,309 (49.3)	1,027 (50.9)	0.244
Participates in recreational activities					0.021				<0.001
	Often	452 (12.0)	248 (11.2)	204 (13.0)		525 (7.6)	321 (6.7)	204 (9.7)	
	Sometimes	1,177 (31.2)	665 (30.1)	512 (32.7)		1,968 (28.6)	1,309 (27.4)	659 (31.4)	
	Rarely or never	2,143 (56.8)	1,295 (58.7)	848 (54.2)		4,392 (63.8)	3,154 (65.9)	1,238 (58.9)	

K6: Kessler 6-item scale.

Table 3. Cox regression analyses of the factors associated with the new onset of hypertension

Variables	Ref.	Crude		Model 1		Model 2	
		HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p
Sex							
Men	Women	1.54 (1.44-1.64)	<0.001	1.32 (1.24-1.41)	<0.001	1.04 (0.95-1.14)	0.363
Age (years)	Continuous	1.05 (1.05-1.05)	<0.001	1.05 (1.04-1.05)	<0.001	1.04 (1.04-1.04)	<0.001
BMI (kg/m^2)							
Underweight (BMI < 18.5)	18.5 ≤ BMI < 25.0	0.59 (0.50-0.70)	<0.001	0.62 (0.52-0.74)	<0.001	0.78 (0.65-0.93)	0.006
Obesity (BMI ≥ 25)	18.5 ≤ BMI < 25.0	1.56 (1.45-1.67)	<0.001	1.53 (1.43-1.65)	<0.001	1.27 (1.19-1.37)	<0.001
Physical activity							
≥ Twice a week	< Once a week	1.39 (1.30-1.48)	<0.001	0.99 (0.92-1.06)	0.756	1.02 (0.95-1.09)	0.635
Sleep satisfaction							
Satisfied/slightly dissatisfied	Quite dissatisfied/very dissatisfied or have not slept at all	1.05 (0.96-1.15)	0.292	0.97 (0.89-1.07)	0.574	0.98 (0.89-1.08)	0.678
Drinking status							
Quit drinking	Never drinker	1.20 (0.98-1.47)	0.082	0.89 (0.72-1.10)	0.272	0.95 (0.77-1.17)	0.626
Current drinker < 44 g/day	Never drinker	1.05 (0.98-1.12)	0.190	1.05 (0.98-1.13)	0.193	1.04 (0.97-1.13)	0.269
≥ 44 g/day	Never drinker	1.57 (1.40-1.77)	<0.001	1.58 (1.39-1.79)	<0.001	1.38 (1.21-1.57)	<0.001
Smoking status							
Quit smoking	Never smoker	1.36 (1.25-1.47)	<0.001	1.04 (0.94-1.14)	0.474	1.00 (0.91-1.11)	0.983
Current smoker	Never smoker	1.04 (0.94-1.14)	0.456	1.02 (0.92-1.14)	0.657	1.05 (0.94-1.17)	0.414
Evacuation experience							
Yes	No	1.02 (0.95-1.09)	0.589	1.07 (1.01-1.15)	0.033	1.08 (1.01-1.16)	0.028
Changes in work situation							
Yes	No	0.91 (0.85-0.97)	0.006	1.05 (0.98-1.12)	0.151	1.03 (0.96-1.10)	0.461
Psychological distress							
K6 ≥ 13	K6 < 13	1.04 (0.95-1.14)	0.403	1.09 (1.00-1.20)	0.054	1.05 (0.95-1.16)	0.351
Perception of risk of delayed health effects due to radiation							
Likely	Unlikely	1.05 (0.99-1.12)	0.127	1.08 (1.01-1.16)	0.019	1.07 (1.00-1.14)	0.053
Participates in recreational activities							
Often/sometimes	Rarely or never	1.23 (1.16-1.32)	<0.001	1.01 (0.95-1.08)	0.668	1.02 (0.96-1.10)	0.488
Baseline disease							
Diabetes	Without diabetes	1.57 (1.40-1.75)	<0.001	1.21 (1.08-1.35)	<0.001	1.06 (0.95-1.19)	0.296
Dyslipidemia	Without dyslipidemia	1.35 (1.27-1.44)	<0.001	1.22 (1.14-1.30)	<0.001	1.10 (1.03-1.18)	0.004
Hyperuricemia	Without hyperuricemia	1.60 (1.41-1.82)	<0.001	1.39 (1.22-1.59)	<0.001	1.31 (1.14-1.50)	<0.001
Systolic blood pressure (mmHg)	Continuous	1.07 (1.07-1.07)	<0.001	1.06 (1.06-1.06)	<0.001	1.05 (1.04-1.05)	<0.001
Diastolic blood pressure (mmHg)	Continuous	1.06 (1.06-1.07)	<0.001	1.06 (1.05-1.06)	<0.001	1.02 (1.02-1.03)	<0.001
eGFR (mL/min/1.73 m^2)	Continuous	0.99 (0.98-0.99)	<0.001	1.00 (1.00-1.00)	0.666	1.00 (1.00-1.00)	0.841

Model 1: adjusted for sex and age, Model 2: adjusted for sex, age, obesity, underweight, physical activity, sleep satisfaction, drinking status, smoking status, evacuation experience, change of job, psychological distress, perception of risk of delayed health effects due to radiation, participation in recreational activities, diabetes, dyslipidemia, hyperuricemia, systolic blood pressure, diastolic blood pressure, and eGFR. HR: hazard ratio, CI: confidence interval, BMI: body mass index, K6: Kessler 6-item scale, eGFR: estimated glomerular filtration rate.

Table 4A. Cox regression analyses of the factors associated with the new onset of hypertension in men

Variables	Ref.	Crude		Model 1		Model 2	
		HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p
Age (years)	Continuous	1.03 (1.03-1.04)	<0.001	1.03 (1.03-1.04)	<0.001	1.03 (1.02-1.03)	<0.001
BMI (kg/m^2)							
Underweight (BMI < 18.5)	18.5 ≤ BMI < 25.0	0.64 (0.45-0.93)	0.018	0.63 (0.44-0.90)	0.012	0.93 (0.65-1.35)	0.719
Obesity (BMI ≥ 25)	18.5 ≤ BMI < 25.0	1.19 (1.08-1.33)	<0.001	1.26 (1.13-1.40)	<0.001	1.07 (0.96-1.20)	0.224
Physical activity							
≥ Twice a week	< Once a week	1.25 (1.13-1.38)	<0.001	1.01 (0.91-1.12)	0.849	1.05 (0.94-1.17)	0.375
Sleep satisfaction							
Satisfied/slightly dissatisfied	Quite dissatisfied/very dissatisfied or have not slept at all	0.99 (0.86-1.15)	0.943	0.93 (0.80-1.08)	0.314	0.97 (0.83-1.13)	0.689
Drinking status							
Quit drinking	Never drinker	1.31 (1.04-1.66)	0.025	1.16 (0.91-1.47)	0.225	1.14 (0.90-1.46)	0.270
Current drinker < 44 g/day	Never drinker	1.21 (1.07-1.36)	0.002	1.24 (1.10-1.40)	<0.001	1.16 (1.03-1.32)	0.015
≥ 44 g/day	Never drinker	1.43 (1.23-1.66)	<0.001	1.63 (1.40-1.90)	<0.001	1.38 (1.17-1.61)	<0.001
Smoking status							
Quit smoking	Never smoker	1.10 (0.98-1.24)	0.113	1.07 (0.95-1.21)	0.277	0.99 (0.88-1.12)	0.873
Current smoker	Never smoker	0.90 (0.79-1.03)	0.138	1.03 (0.90-1.18)	0.668	1.04 (0.90-1.19)	0.617
Evacuation experience							
Yes	No	1.12 (1.01-1.24)	0.027	1.15 (1.04-1.27)	0.007	1.14 (1.02-1.27)	0.016
Changes in work situation							
Yes	No	1.04 (0.94-1.15)	0.460	1.15 (1.03-1.27)	0.010	1.11 (0.99-1.23)	0.069
Psychological distress							
K6 ≥ 13	K6 < 13	1.14 (0.97-1.33)	0.104	1.18 (1.01-1.38)	0.036	1.06 (0.90-1.26)	0.461
Perception of risk of delayed health effects due to radiation							
Likely	Unlikely	1.08 (0.97-1.19)	0.143	1.09 (0.99-1.21)	0.095	1.07 (0.97-1.19)	0.178
Participates in recreational activities							
Often/sometimes	Rarely or never	1.10 (0.99-1.21)	0.064	1.00 (0.90-1.10)	0.976	1.05 (0.94-1.16)	0.373
Baseline disease							
Diabetes	Without diabetes	1.16 (1.00-1.34)	0.057	1.06 (0.91-1.23)	0.473	0.95 (0.81-1.11)	0.504
Dyslipidemia	Without dyslipidemia	1.06 (0.96-1.17)	0.239	1.09 (0.99-1.20)	0.094	1.05 (0.95-1.16)	0.376
Hyperuricemia	Without hyperuricemia	1.22 (1.06-1.41)	0.005	1.32 (1.15-1.52)	<0.001	1.26 (1.09-1.46)	0.002
Systolic blood pressure (mmHg)	Continuous	1.06 (1.06-1.07)	<0.001	1.06 (1.05-1.07)	<0.001	1.05 (1.05-1.06)	<0.001
Diastolic blood pressure (mmHg)	Continuous	1.05 (1.04-1.06)	<0.001	1.05 (1.04-1.06)	<0.001	1.02 (1.01-1.03)	<0.001
eGFR (mL/min/1.73 m^2)	Continuous	0.99 (0.99-1.00)	<0.001	1.00 (1.00-1.00)	0.923	1.00 (1.00-1.00)	0.881

Model 1: adjusted for age, Model 2: adjusted for age, obesity, underweight, physical activity, sleep satisfaction, drinking status, smoking status, evacuation experience, change of job, psychological distress, perception of risk of delayed health effects due to radiation, participation in recreational activities, diabetes, dyslipidemia, hyperuricemia, systolic blood pressure, diastolic blood pressure, and eGFR. HR: hazard ratio, CI: confidence interval, BMI: body mass index, K6: Kessler 6-item scale, eGFR: estimated glomerular filtration rate.

Table 4B. Cox regression analyses of the factors associated with the new onset of hypertension in women

Variables	Ref.	Crude		Model 1		Model 2	
		HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p
Age (years)	Continuous	1.06 (1.05-1.06)	<0.001	1.06 (1.05-1.06)	<0.001	1.05 (1.04-1.05)	<0.001
BMI (kg/m^2)							
Underweight (BMI < 18.5)	18.5 ≤ BMI < 25.0	0.65 (0.53-0.79)	<0.001	0.64 (0.52-0.78)	<0.001	0.77 (0.63-0.94)	0.010
Obesity (BMI ≥ 25)	18.5 ≤ BMI < 25.0	1.80 (1.64-1.98)	<0.001	1.77 (1.61-1.94)	<0.001	1.46 (1.33-1.61)	<0.001
Physical activity							
≥ Twice a week	< Once a week	1.43 (1.31-1.56)	<0.001	0.98 (0.89-1.07)	0.607	1.00 (0.91-1.10)	0.965
Sleep satisfaction							
Satisfied/slightly dissatisfied	Quite dissatisfied/very dissatisfied or have not slept at all	1.01 (0.91-1.13)	0.825	1.02 (0.91-1.14)	0.725	0.99 (0.88-1.11)	0.851
Drinking status							
Quit drinking	Never drinker	0.51 (0.30-0.89)	0.017	0.57 (0.33-0.98)	0.041	0.62 (0.36-1.08)	0.093
Current drinker < 44 g/day	Never drinker	0.80 (0.72-0.88)	<0.001	0.98 (0.88-1.08)	0.622	0.98 (0.88-1.08)	0.650
≥ 44 g/day	Never drinker	1.14 (0.84-1.55)	0.410	1.83 (1.34-2.50)	<0.001	1.79 (1.30-2.47)	<0.001
Smoking status							
Quit smoking	Never smoker	0.88 (0.74-1.05)	0.163	1.14 (0.95-1.36)	0.165	1.14 (0.95-1.37)	0.168
Current smoker	Never smoker	0.65 (0.53-0.78)	<0.001	0.93 (0.77-1.14)	0.487	0.98 (0.80-1.20)	0.820
Evacuation experience							
Yes	No	0.97 (0.89-1.05)	0.427	1.03 (0.94-1.12)	0.562	1.05 (0.96-1.15)	0.247
Changes in work situation							
Yes	No	0.83 (0.76-0.91)	<0.001	0.98 (0.90-1.08)	0.735	0.96 (0.87-1.05)	0.389
Psychological distress							
K6 ≥ 13	K6 < 13	1.07 (0.96-1.20)	0.221	1.04 (0.93-1.16)	0.526	1.06 (0.94-1.20)	0.360
Perception of risk of delayed health effects due to radiation							
Likely	Unlikely	1.07 (0.98-1.17)	0.138	1.07 (0.98-1.17)	0.125	1.05 (0.96-1.15)	0.276
Participates in recreational activities							
Often/sometimes	Rarely or never	1.27 (1.17-1.39)	<0.001	1.01 (0.93-1.11)	0.762	0.99 (0.91-1.09)	0.905
Baseline disease							
Diabetes	Without diabetes	1.89 (1.60-2.23)	<0.001	1.50 (1.26-1.77)	<0.001	1.25 (1.06-1.49)	0.010
Dyslipidemia	Without dyslipidemia	1.58 (1.45-1.72)	<0.001	1.27 (1.16-1.38)	<0.001	1.12 (1.02-1.23)	0.012
Hyperuricemia	Without hyperuricemia	1.92 (1.26-2.93)	0.002	1.52 (1.00-2.31)	0.053	1.74 (1.13-2.67)	0.012
Systolic blood pressure (mmHg)	Continuous	1.07 (1.06-1.07)	<0.001	1.06 (1.05-1.06)	<0.001	1.04 (1.04-1.05)	<0.001
Diastolic blood pressure (mmHg)	Continuous	1.06 (1.06-1.07)	<0.001	1.06 (1.05-1.07)	<0.001	1.03 (1.02-1.03)	<0.001
eGFR (mL/min/1.73 m^2)	Continuous	0.98 (0.98-0.99)	<0.001	1.00 (1.00-1.00)	0.819	1.00 (1.00-1.00)	0.670

Model 1: adjusted for age, Model 2: adjusted for age, obesity, underweight, physical activity, sleep satisfaction, drinking status, smoking status, evacuation experience, changes in work situation, psychological distress, perception of risk of delayed health effects due to radiation, participation in recreational activities, diabetes, dyslipidemia, hyperuricemia, systolic blood pressure, diastolic blood pressure, and eGFR. HR: hazard ratio, CI: confidence interval, BMI: body mass index, K6: Kessler 6-item scale, eGFR: estimated glomerular filtration rate.

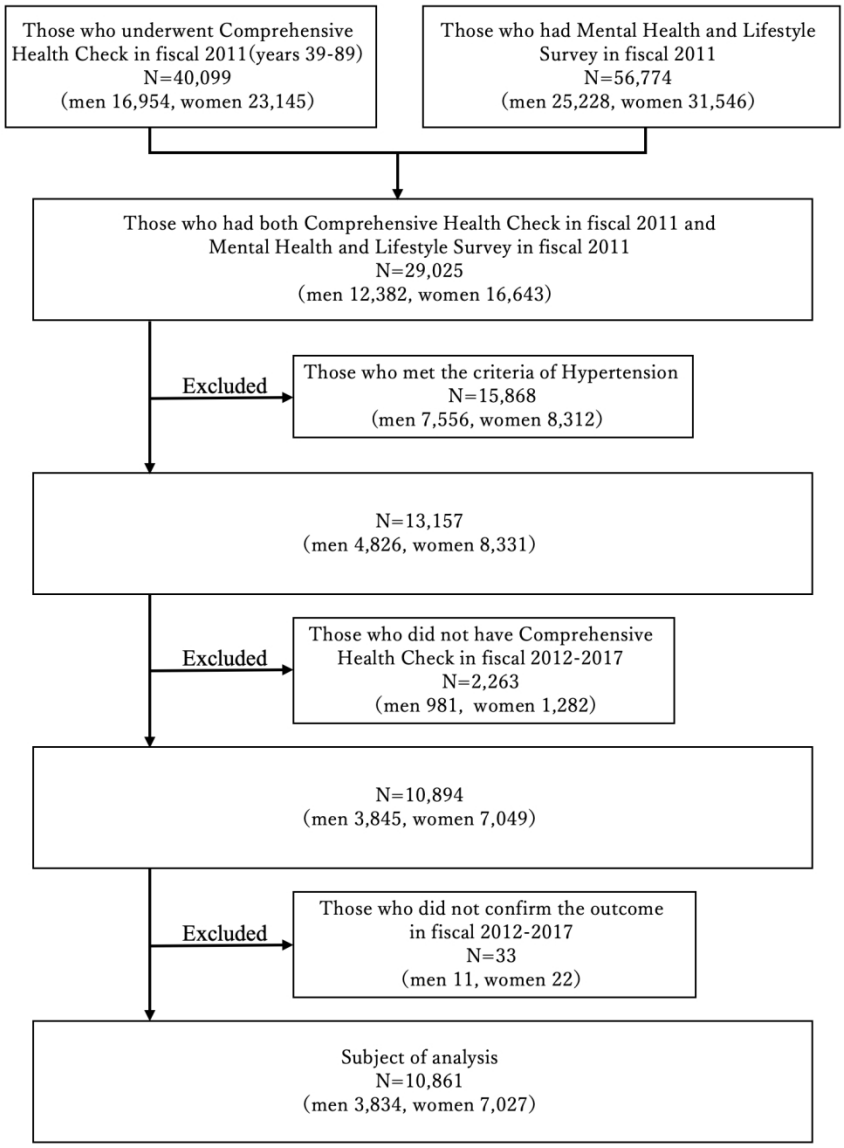

Fig.1

292x375mm (144 x 144 DPI)

Supplemental Table 1. Clinical and biochemical characteristics according to participation status among 13,157 subjects who without hypertension at baseline.

	Men				Women			
	Total	Participation		p	Total	Participation		p
		Excluded subjects	Participants			Excluded subjects	Participants	
n (%)	4,826 (100)	992 (20.6)	3,834 (79.4)		8,331 (100)	1,304 (15.7)	7,027 (84.3)	
Age (years)	59.7 (11.3)	55.2 (11.7)	60.9 (10.9)	<0.001	57.4 (10.8)	53.8 (11.9)	58.0 (10.4)	<0.001
BMI (kg/m^2)	23.6 (3.0)	23.7 (3.2)	23.6 (2.9)	0.316	22.5 (3.2)	22.6 (3.5)	22.5 (3.2)	0.552
Underweight (BMI < 18.5 kg/m^2), n (%)	168 (3.5)	49 (4.9)	119 (3.1)	0.005	667 (8.0)	113 (8.7)	554 (7.9)	0.334
Obesity (BMI ≥ 25 kg/m^2), n (%)	1,479 (30.7)	333 (33.6)	1,146 (29.9)	0.025	1,724 (20.7)	290 (22.3)	1,434 (20.4)	0.129
Systolic blood pressure (mmHg)	123.0 (10.0)	122.0 (11.0)	123.0 (10.0)	<0.001	120.0 (12.0)	119.0 (12.0)	120.0 (11.0)	<0.001
Diastolic blood pressure (mmHg)	76 (8)	76 (8)	76 (8)	0.834	73 (8)	73 (9)	73 (8)	0.136
Fasting blood glucose (mg/dL)	102 (22)	101 (22)	102 (22)	0.001	95 (17)	95 (19)	95 (16)	0.207
HbA1c (%)	5.5 (0.8)	5.5 (0.8)	5.5 (0.8)	0.005	5.4 (0.6)	5.4 (0.7)	5.4 (0.6)	<0.001
Diabetes, n (%)	554 (11.5)	117 (11.8)	437 (11.4)	0.722	367 (4.4)	62 (4.8)	305 (4.4)	0.497
HDL-C (mg/dL)	56 (14)	55 (14)	56 (14)	0.204	65 (15)	66 (15)	65 (15)	0.411
LDL-C (mg/dL)	127 (33)	127 (34)	126 (33)	0.866	130 (33)	127 (33)	131 (32)	<0.001
Triglyceride (mg/dL)	103 (73-149)	103 (73-156)	103 (73-148)	0.432	83 (62-116)	80 (59-112)	84 (62-117)	0.002
Dyslipidemia, n (%)	2,622 (54.4)	534 (53.9)	2,088 (54.5)	0.745	4,205 (50.6)	544 (41.8)	3,661 (52.2)	<0.001
Uric acid (mg/dL)	5.7 (1.2)	5.8 (1.2)	5.7 (1.2)	0.162	4.2 (1.0)	4.2 (1.0)	4.2 (0.9)	0.578
Hyperuricemia, n (%)	637 (13.2)	141 (14.2)	496 (12.9)	0.290	53 (0.6)	12 (0.9)	41 (0.6)	0.160
AST (U/L)	23 (20-28)	23 (19-28)	23 (20-28)	0.096	21 (18-24)	19 (17-23)	21 (18-24)	<0.001
ALT (U/L)	21 (16-30)	22 (16-32)	21 (16-30)	0.014	15 (12-21)	15 (11-20)	15 (12-21)	<0.001
γ-GT (U/L)	30 (21-50)	32 (21-54)	30 (20-49)	0.001	17 (13-25)	17 (13-24)	17 (13-25)	0.056
Abnormal liver function, n (%)	1,934 (40.1)	413 (41.7)	1,521 (39.7)	0.254	1,258 (15.1)	181 (13.9)	1,077 (15.3)	0.180
eGFR (mL/min/1.73 m^2)	75 (13)	76 (13)	74 (13)	<0.001	76 (13)	77 (14)	76 (13)	<0.001
Abnormal renal function, n (%)	532 (11.0)	97 (9.8)	435 (11.4)	0.163	781 (9.4)	118 (9.1)	663 (9.5)	0.701

The values in the table indicate the average value (standard deviation) or the number (%). Triglyceride, AST, ALT, and γ-GT are reported as the median (25-75% percentile). Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, or being treated for hypertension. Diabetes was defined as fasting blood glucose ≥ 126 mg/dL or casual blood glucose ≥ 200 mg/dL, and/or hemoglobin A1c (HbA1c) ≥ 6.5%, or being treated for diabetes. Dyslipidemia was defined as low-density lipoprotein cholesterol (LDL-C) ≥ 140 mg/dL, fasting triglyceride ≥ 150 mg/dL, and/or high-density lipoprotein cholesterol (HDL-C) < 40 mg/dL, or being treated for dyslipidemia. Hyperuricemia was defined as serum uric acid > 7.0 mg/dL. Abnormal liver function was defined as AST ≥ 31 U/L, ALT ≥ 31 U/L, or γ-GT ≥ 51 U/L. Abnormal renal function was defined as an estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73 m^2 or urine protein ≥ +1. BMI: body mass index, HbA1c: glycosylated hemoglobin A1c, HDL-C: high-density lipoprotein cholesterol, LDL-C: low-density lipoprotein cholesterol, AST: aspartate aminotransferase, ALT: alanine aminotransferase, γ-GT: gamma-glutamyl transpeptidase, eGFR: estimated glomerular filtration rate.

Supplemental Table 2. Lifestyle characteristics according to participation status among 13,157 subjects who without hypertension at baseline.

		Men				Women			
		Total	Participation		p	Total	Participation		p
			Excluded subjects	Participants			Excluded subjects	Participants	
n (%)		4,826 (100)	992 (20.6)	3,834 (79.4)		8,331 (100)	1,304 (15.7)	7,027 (84.3)	
Physical activity					<0.001				<0.001
	Every day	866 (18.2)	122 (12.6)	744 (19.7)		1,047 (12.8)	125 (9.8)	922 (13.4)	
	2-4 times a week	943 (19.9)	142 (14.6)	801 (21.2)		1,695 (20.8)	160 (12.6)	1,535 (22.3)	
	Once a week	671 (14.1)	130 (13.4)	541 (14.3)		1,148 (14.1)	142 (11.2)	1,006 (14.6)	
	None	2,268 (47.8)	577 (59.4)	1,691 (44.8)		4,278 (52.4)	843 (66.4)	3,435 (49.8)	
Sleep satisfaction					0.104				0.065
	Satisfied	1,576 (39.9)	303 (36.7)	1,273 (40.8)		1,915 (27.7)	321 (29.6)	1,594 (27.3)	
	Slightly dissatisfied	1,716 (43.5)	382 (46.2)	1,334 (42.7)		3,415 (49.4)	538 (49.6)	2,877 (49.3)	
	Quite dissatisfied	530 (13.4)	109 (13.2)	421 (13.5)		1,240 (17.9)	186 (17.2)	1,054 (18.1)	
	Very dissatisfied or have not slept at all	126 (3.2)	32 (3.9)	94 (3.0)		346 (5.0)	39 (3.6)	307 (5.3)	
Drinking status					0.226				0.083
	Never drinker	1,412 (29.5)	280 (28.7)	1,132 (29.7)		5,462 (66.9)	823 (64.5)	4,639 (67.3)	
	Quit drinking	239 (5.0)	54 (5.5)	185 (4.8)		90 (1.1)	17 (1.3)	73 (1.1)	
	Drinks < 44 g/day	2,332 (48.6)	459 (47.0)	1,873 (49.1)		2,467 (30.2)	403 (31.6)	2,064 (29.9)	
	Drinks ≥ 44 g/day	811 (16.9)	184 (18.8)	627 (16.4)		150 (1.8)	32 (2.5)	118 (1.7)	
Smoking status					<0.001				<0.001
	Never smoker	1,209 (25.3)	193 (19.6)	1,016 (26.8)		6,799 (84.1)	979 (77.1)	5,820 (85.4)	
	Quit smoking	2,001 (41.9)	376 (38.3)	1,625 (42.8)		573 (7.1)	112 (8.8)	461 (6.8)	
	Current smoker	1,569 (32.8)	414 (42.1)	1,155 (30.4)		712 (8.8)	178 (14.0)	534 (7.8)	
Evacuation experience	Yes	2,572 (53.3)	446 (45.0)	2,126 (55.5)	<0.001	4,560 (54.7)	591 (45.3)	3,969 (56.5)	<0.001
Changes in work situation	Yes	2,755 (59.1)	551 (57.5)	2,204 (59.5)	0.254	4,559 (58.1)	667 (54.1)	3,892 (58.8)	0.002
Psychological distress (K6)	K6 ≥ 13	504 (11.0)	100 (10.5)	404 (11.1)	0.639	1,301 (16.6)	177 (14.6)	1,124 (17.0)	0.042
Perception of risk of delayed health effects due to radiation	Likely	2,106 (45.2)	439 (45.7)	1,667 (45.1)	0.733	3,976 (50.2)	640 (52.4)	3,336 (49.8)	0.096
Participates in recreational activities					0.001				0.003
	Often	531 (11.2)	79 (8.1)	452 (12.0)		595 (7.3)	70 (5.5)	525 (7.6)	
	Sometimes	1,473 (31.0)	296 (30.5)	1,177 (31.2)		2,306 (28.2)	338 (26.4)	1,968 (28.6)	
	Rarely or never	2,740 (57.8)	597 (61.4)	2,143 (56.8)		5,263 (64.5)	871 (68.1)	4,392 (63.8)	

K6: Kessler 6-item scale.

Supplemental Table 3. Clinical and biochemical characteristics of the 10,861 participants according to evacuation experience at baseline.

	Men				Women			
	Total	Evacuation experience		p	Total	Evacuation experience		p
		Yes	No			Yes	No	
n (%)	3,834 (100)	2,126 (55.5)	1,708 (44.5)		7,027 (100)	3,969 (56.5)	3,058 (43.5)	
Age (years)	60.9 (10.9)	60.5 (10.9)	61.4 (10.9)	0.009	58.0 (10.4)	57.5 (10.3)	58.8 (10.5)	<0.001
BMI (kg/m^2)	23.6 (2.9)	23.7 (3.0)	23.3 (2.8)	<0.001	22.5 (3.2)	22.6 (3.3)	22.4 (3.0)	0.042
Underweight (BMI < 18.5 kg/m^2), n (%)	119 (3.1)	62 (2.9)	57 (3.3)	0.457	554 (7.9)	320 (8.1)	234 (7.7)	0.521
Obesity (BMI ≥ 25 kg/m^2), n (%)	1,146 (29.9)	685 (32.2)	461 (27.0)	<0.001	1,434 (20.4)	829 (20.9)	605 (19.8)	0.249
Systolic blood pressure (mmHg)	123.0 (10.0)	123.0 (11.0)	123.0 (10.0)	0.412	120.0 (11.0)	120.0 (11.0)	121.0 (11.0)	<0.001
Diastolic blood pressure (mmHg)	76 (8)	76 (8)	76 (8)	0.098	73 (8)	73 (8)	74 (8)	<0.001
Fasting blood glucose (mg/dL)	102 (22)	102 (22)	102 (22)	0.236	95 (16)	95 (17)	95 (15)	0.002
HbA1c (%)	5.5 (0.8)	5.5 (0.8)	5.5 (0.8)	0.569	5.4 (0.6)	5.4 (0.6)	5.4 (0.6)	0.004
Diabetes, n (%)	437 (11.4)	238 (11.2)	199 (11.7)	0.659	305 (4.4)	164 (4.1)	141 (4.6)	0.320
HDL-C (mg/dL)	56 (14)	56 (15)	56 (14)	0.178	65 (15)	65 (15)	65 (15)	0.611
LDL-C (mg/dL)	126 (33)	127 (33)	126 (32)	0.336	131 (32)	132 (34)	130 (31)	0.186
Triglyceride (mg/dL)	103 (73-148)	106 (74-152)	100 (70-143)	0.001	84 (62-117)	85 (63-119)	82 (62-113)	0.010
Dyslipidemia, n (%)	2,088 (54.5)	1,183 (55.7)	905 (53.0)	0.102	3,661 (52.2)	2,055 (51.8)	1,606 (52.7)	0.435
Uric acid (mg/dL)	5.7 (1.2)	5.8 (1.2)	5.6 (1.2)	<0.001	4.2 (0.9)	4.2 (1.0)	4.2 (0.9)	0.127
Hyperuricemia, n (%)	496 (12.9)	295 (13.9)	201 (11.8)	0.053	41 (0.6)	24 (0.6)	17 (0.6)	0.790
AST (U/L)	23 (20-28)	24 (20-29)	23 (20-28)	0.013	21 (18-24)	21 (18-24)	21 (18-24)	0.081
ALT (U/L)	21 (16-30)	22 (16-31)	20 (15-27)	<0.001	15 (12-21)	16 (12-22)	15 (12-20)	0.143
γ-GT (U/L)	30 (20-49)	31 (21-51)	28 (20-46)	<0.001	17 (13-25)	17 (13-26)	17 (13-25)	<0.001
Abnormal liver function, n (%)	1,521 (39.7)	900 (42.4)	621 (36.4)	<0.001	1,077 (15.3)	646 (16.3)	431 (14.1)	0.012
eGFR (mL/min/1.73 m^2)	74 (13)	75 (14)	74 (12)	0.031	76 (13)	76 (13)	74 (13)	<0.001
Abnormal renal function, n (%)	435 (11.4)	243 (11.4)	192 (11.2)	0.848	663 (9.5)	339 (8.6)	324 (10.6)	0.004

The values in the table indicate the average value (standard deviation) or the number (%). Triglyceride, AST, ALT, and γ-GT are reported as the median (25-75% percentile). Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, or being treated for hypertension. Diabetes was defined as fasting blood glucose ≥ 126 mg/dL or casual blood glucose ≥ 200 mg/dL, and/or hemoglobin A1c (HbA1c) ≥ 6.5%, or being treated for diabetes. Dyslipidemia was defined as low-density lipoprotein cholesterol (LDL-C) ≥ 140 mg/dL, fasting triglyceride ≥ 150 mg/dL, and/or high-density lipoprotein cholesterol (HDL-C) < 40 mg/dL, or being treated for dyslipidemia. Hyperuricemia was defined as serum uric acid > 7.0 mg/dL. Abnormal liver function was defined as AST ≥ 31 U/L, ALT ≥ 31 U/L, or γ-GT ≥ 51 U/L. Abnormal renal function was defined as an estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73 m^2 or urine protein ≥ +1. BMI: body mass index, HbA1c: glycosylated hemoglobin A1c, HDL-C: high-density lipoprotein cholesterol, LDL-C: low-density lipoprotein cholesterol, AST: aspartate aminotransferase, ALT: alanine aminotransferase, γ-GT: gamma-glutamyl transpeptidase, eGFR: estimated glomerular filtration rate.

Supplemental Table 4. Lifestyle characteristics of the 10,861 participants according to evacuation experience at baseline.

		Men				Women			
		Total	Evacuation experience		p	Total	Evacuation experience		p
			Yes	No			Yes	No	
n (%)		3,834 (100)	2,126 (55.5)	1,708 (44.5)		7,027 (100)	3,969 (56.5)	3,058 (43.5)	
Physical activity					0.191				0.117
	Every day	744 (19.7)	404 (19.3)	340 (20.2)		922 (13.4)	530 (13.6)	392 (13.1)	
	2-4 times a week	801 (21.2)	450 (21.5)	351 (20.9)		1,535 (22.3)	889 (22.8)	646 (21.6)	
	Once a week	541 (14.3)	280 (13.4)	261 (15.5)		1,006 (14.6)	536 (13.7)	470 (15.7)	
	None	1,691 (44.8)	960 (45.8)	731 (43.4)		3,435 (49.8)	1,946 (49.9)	1,489 (49.7)	
Sleep satisfaction					<0.001				<0.001
	Satisfied	1,273 (40.8)	606 (34.9)	667 (48.1)		1,594 (27.3)	708 (21.5)	886 (34.8)	
	Slightly dissatisfied	1,334 (42.7)	763 (44.0)	571 (41.1)		2,877 (49.3)	1,643 (50.0)	1,234 (48.5)	
	Quite dissatisfied	421 (13.5)	297 (17.1)	124 (8.9)		1,054 (18.1)	711 (21.6)	343 (13.5)	
	Very dissatisfied or have not slept at all	94 (3.0)	68 (3.9)	26 (1.9)		307 (5.3)	225 (6.8)	82 (3.2)	
Drinking status					0.191				0.002
	Never drinker	1,132 (29.7)	631 (29.8)	501 (29.5)		4,639 (67.3)	2,572 (66.1)	2,067 (68.8)	
	Quit drinking	185 (4.8)	102 (4.8)	83 (4.9)		73 (1.1)	46 (1.2)	27 (0.9)	
	Drinks < 44 g/day	1,873 (49.1)	1,015 (47.9)	858 (50.5)		2,064 (29.9)	1,187 (30.5)	877 (29.2)	
	Drinks ≥ 44 g/day	627 (16.4)	371 (17.5)	256 (15.1)		118 (1.7)	84 (2.2)	34 (1.1)	
Smoking status					0.036				<0.001
	Never smoker	1,016 (26.8)	568 (27.0)	448 (26.5)		5,820 (85.4)	3,219 (83.5)	2,601 (87.8)	
	Quit smoking	1,625 (42.8)	866 (41.1)	759 (44.9)		461 (6.8)	278 (7.2)	183 (6.2)	
	Current smoker	1,155 (30.4)	672 (31.9)	483 (28.6)		534 (7.8)	356 (9.2)	178 (6.0)	
Changes in work situation	Yes	2,204 (59.5)	1,454 (71.0)	750 (45.3)	<0.001	3,892 (58.8)	2,643 (70.8)	1,249 (43.4)	<0.001
Psychological distress (K6)	K6 ≥ 13	404 (11.1)	279 (13.8)	125 (7.7)	<0.001	1,124 (17.0)	771 (20.6)	353 (12.2)	<0.001
Perception of risk of delayed health effects due to radiation	Likely	1,667 (45.1)	968 (47.4)	699 (42.3)	0.002	3,336 (49.8)	1,966 (52.3)	1,370 (46.6)	<0.001
Participates in recreational activities					<0.001				<0.001
	Often	452 (12.0)	161 (7.7)	291 (17.4)		525 (7.6)	208 (5.3)	317 (10.6)	
	Sometimes	1,177 (31.2)	574 (27.4)	603 (36.0)		1,968 (28.6)	968 (24.9)	1,000 (33.4)	
	Rarely or never	2,143 (56.8)	1,360 (64.9)	783 (46.7)		4,392 (63.8)	2,719 (69.8)	1,673 (56.0)	

K6: Kessler 6-item scale.