Household preparedness for natural disasters:Impact of disaster experience and implications for future disaster risks in Japan

Onuma, Hiroki and Shin, Kong Joo and Managi, Shunsuke

November 2016

Household preparedness for natural disasters
-Impact of disaster experience and implications for future disaster risks in Japan-

Hiroki ONUMA*, Kong Joo SHIN, and Shunsuke MANAGI

Graduate School of Engineering, Kyushu University, 744 Motooka, Nish-ku, Fukuoka, 819-0395 Japan

November 2016

Abstract

This paper analyzes the impact of disaster experience on household preparation of emergency supplies for natural disasters using originally collected Japanese data from 2013. The data cover more than 20,000 households from all parts Japan and include areas with recent disaster experiences as well as areas with low disaster risks. We generate indices for three categories of preparedness using data on household preparation of nine emergency items: Basic Preparedness (*BP*), Energy/Heat Preparedness (*EHP*), and Evacuation Preparedness (*EP*). We use regression analyses to measure the effect of disaster experiences on the preparation of categories of emergency supplies. The results show that experience with disaster damage increases preparedness, but the magnitude of the impact varies among the item categories. Additionally, evacuation experience has a positive impact on the preparation of items from the BP and EP categories. Moreover, the people who experienced damage from the Great East Japan Earthquake (GEJE) in 2011 are relatively more prepared, but evacuation experience in the GEJE does not have a significant impact on preparedness. Furthermore, we find that some regions with higher future risk of large-scale earthquakes are less prepared compared to other regions. This result suggests the importance of policy makers' efforts to raise awareness of disaster risks and to combat insufficient preparedness to reduce future disaster damages.

Keywords: Natural disaster; household preparedness; emergency supplies; disaster experience

* Tel.: +81 (0)92-802-3405, *E-mail address:* hirokionuma122@gmail.com

1. Introduction

Natural disasters can be extremely costly and are difficult to prevent. Hence, the risks involved with and the occurrences of natural disasters have consistently been major concerns for policy makers at national and local levels, especially in disaster-prone regions and countries. At the time of an emergency, insufficient preparation can increase disaster damage in terms of injuries and deaths. In order to reduce disaster damage, governments commit to the preparation of emergency supplies as part of an effective disaster management plan. However, despite the efforts of administrators, the victims of catastrophic disasters often do not receive adequate relief supplies when they are most needed.(1)

Given that public stocks may not be immediately available, it is important to be prepared at the household level for emergencies. Donahue(2) concisely summarized the importance of household-level preparedness as follows: "Citizens share responsibility for their own protection, by taking protective actions and avoiding the harms that may befall them. The more prepared people are, the less harm they will suffer when disaster strikes." While household-level preparation of emergency supplies is recognized as important by both researchers and policy makers to secure living conditions in a post-disaster period, previous studies have provided evidence of individuals' tendency to underinvest in disaster prevention and damage mitigation.(3,4) Hence, in this study, we analyze preparation of emergency items at the household level and analyze the factors that affect the level of preparedness using Japanese household survey data.

According to the Federal Emergency Management Agency(5), disaster (or emergency) management can be categorized into four stages: (1) Prevention/Mitigation, (2) Preparedness, (3) Response, and (4) Recovery. The Prevention/Mitigation and Preparedness phases are components of pre-disaster management, which are often called *hazard adjustments* in the context of the literature, mainly in the area of social psychology. To prepare for the post-impact phases, governments and individuals can prepare for the occurrence of disasters and the subsequent damage in two main ways: by buying insurance[1] and by gathering and storing emergency supplies (e.g., supplies of food and water, a radio, energy sources and medicine).(9) This paper focuses on the latter – the stockpiling of emergency supplies.

Over the past few decades, many studies have investigated the relationship between

[1] Disaster insurance is an important preparation tool to facilitate a smooth recovery phase, and several studies have focused on this aspect.(6,7) While insurance is useful in the recovery process for those who acquired it pre-disaster, compensation payouts take time due to the required damage evaluation. Botzen *et al.*(8) provided evidence that people prefer to pay to live in low-risk, elevated locations rather than pay for damage insurance. This result implies that people weigh various options to address life and property damage and do not necessarily invest in disaster insurance, depending on their preference.

preparedness for natural disasters and the factors that promote the adoption of protective measures. In related studies, social scientists have tried to predict and explain the levels of adjustment using theoretical models from behavioral sciences and psychology[2]. Empirical studies have based their estimation models on theoretical studies and have provided empirical evidence on a wide range of factors that influence the adoption of disaster preparedness measures, including disaster experience, disaster awareness, and socio-demographic characteristics such as income, education, household composition, and location of residence (e.g., for a review of seismic risks, see Lindell and Perry[(3)]; Solberg *et al.*[(16)]).

Of the various factors that may influence disaster preparedness, the impact of disaster experience has been extensively studied. The results, however, are not necessarily consistent in their implications. Several studies have reported significant positive effects on hazard adjustments for earthquakes[(17–20)] and floods and/or storms[(21–25)]. On the other hand, other studies have found limited or insignificant effects of disaster experience on preparedness[(6,19,26–28)].

According to Lindell and Hwang[(22)], a possible explanation for the conflicting empirical results on the impact of disaster experience on preparedness is that the effect of hazard experience on hazard adjustment adoption may be mediated by perceived personal risk. Because mediation involves the product of two causal path coefficients, the results may be sensitive to sampling fluctuations between studies. Moreover, as suggested by Lindell and Prater[(29)], hazard experience has both an indirect effect (via perceived personal risk) and a direct effect on hazard adjustment adoption; thus, the mediation of the effect through personal perception of risk is partial rather than complete.

In this study, we focus on quantifying the direct effect of disaster experience on the preparation of emergency items at the household level. We use originally collected survey data that cover more than 20,000 households in Japan. The emergency preparedness indices that we use in the analysis are generated from information on the collection of nine emergency items.

Although most of the previous studies have focused on disaster-prone areas or areas with recent disaster experience, our study covers all areas of a country that varies in disaster risks and experiences[3]. Selection bias is likely to occur in the restricted samples used in many of

---

[2] Examples of these models are the theory of reasoned action[(10)], the theory of planned behavior[(11)], protection motivation theory[(12)], person relative to event theory[(13)], and the protective action decision model (PADM)[(14,15)].

[3] Osberghaus[(24)] is a notable example of a study with a large representative sample for Germany. His data cover

the previous studies because households located in specific areas are likely to share special characteristics that may cause bias in the estimation results.[(24)] Using data with national coverage allows us to avoid such bias and analyze the impact of disaster experience because the respondents are not selected based upon on their experience. Moreover, although Japan is generally known as a natural disaster-prone country, especially in terms of earthquakes, future disaster risks are shown to vary by region. The analysis of these data allows us to determine the relative preparedness by region and to identify 'high alert' regions with relatively high future disaster risks but relatively lower preparedness levels.

In addition, we capture different effects of two types of experiences: direct damage experience and evacuation experience. Thus, we attempt to clarify the possible different effects of experience depending on its characteristics. Furthermore, we present policy implications for discussion to improve the preparation of emergency supplies for future disaster risks.

The remainder of the paper is structured as follows: Section 2 describes our survey data and the variables used in the empirical analyses. Section 3 provides the estimation model and the results. Section 4 presents the discussion, including relevant policy implications. Section 5 concludes.

2. **Data and Variables**

2.1. Survey

We collected 20,726 household samples across all areas of Japan from January 26 to March 15, 2013 through an Internet survey. Individual representatives of households were asked to answer the questionnaire to avoid duplicated samples of the same household. The data cover all 47 prefectures in Japan, and we divided the prefectures into 14 commonly used geographic sub-regions (see the list in Appendix A). The gender and age distribution of the data collected from each sub-region matched the national distribution of the Japanese population aged between 20 and 69[4]. Some observations are missing information regarding household income, geographic location, and housing type because some respondents

---

4,272 households.

[4] With respect to the household and demographic characteristics, we observed that the average household income level in our sample was 6.314 million yen, which is higher than the 5.372 million yen reported based on the National Comprehensive Survey of Living. Moreover, the distribution deviated from the general demographic distribution in terms of age (the distribution in our sample was skewed to the right) and education (respondents had a higher number of years of education in the sample).

answered incorrectly or did not provide an answer. Thus, we were left with 19,318 observations that included all of the information we needed for the regression analysis.

To our knowledge, these survey data represent the largest household survey on household preparation of emergency supplies that covers all areas of Japan. Given that many empirical analyses on household preparedness efforts have used local data[(9,23,30,31)], this dataset allows us to tackle the issue of data availability and to improve the quality of disaster preparedness data. In addition, these data were collected after the Great East Japan Earthquake (GEJE) in 2011, which resulted in considerable damage to *Tohoku* and nearby regions, thus allowing us to analyze the impact of experiencing the GEJE separately from other disaster experiences.

2.2 Variables

2.2.1 Household preparation of emergency supplies

The main dependent variable in this analysis is the preparedness level of emergency supplies, where the unit of analysis is the household. In our survey, we collected data on the preparation of nine different categories of emergency supply items and utility substitutes. The list of items was based on previous studies related to the preparation of emergency kits and/or water/food supplies.[(9,23)]

In the survey, respondents were asked whether they have each of the following nine emergency supplies: emergency food, drinking water, battery, radio, first-aid kit, fuel, heating equipment, helmet, and disaster prevention hood[5]. We coded the preparation of each type of supply as a dummy variable.

Given that the supplies fall under similar categories of emergency supplies, we used exploratory factor analysis (EFA) to aggregate latent related categories of the nine emergency supplies. The EFA results are shown in Table I. From the factor loading values, we were able to classify the nine emergency supplies into three categories of preparedness: Basic Preparedness (*BP*), Energy/Heat Preparedness (*EHP*), and Evacuation Preparedness (*EP*). The *BP* category consists of five items: emergency food, emergency water, battery, radio, and first-aid kit. The *EHP* category comprises the fuel and heating equipment, and the *EP* category includes the helmet and disaster prevention hood. We used predicted values of these three emergency supply categories as the measures of preparedness.

---

5 A disaster prevention hood is the traditional Japanese hood for emergency evacuation. In an elementary school, the hood is generally used as a cushion for a student's chair when there is no disaster.

Table I: Factor loadings of emergency items on factor variables

Variable	Basic Preparedness	Energy/Heat Preparedness	Evacuation Preparedness	Uniqueness
Emergency Food	0.725	0.033	0.055	0.425
Drinking Water	0.708	-0.085	0.041	0.528
Battery	0.822	0.019	-0.072	0.339
First Aid Kit	0.587	0.137	0.047	0.544
Radio	0.779	-0.017	-0.047	0.422
Fuel	-0.015	0.909	-0.005	0.188
Heating Equipment	0.023	0.891	-0.025	0.196
Helmet	0.017	0.093	0.662	0.520
Disaster Hood	-0.038	-0.073	0.842	0.325

2.2.2 Disaster experiences and other control variables

To measure the impact of disaster experience on household preparation of emergency supplies, we use two experience-related variables. One is the Damage Experience (*EX-DMG*), which was coded as 1 if a respondent's household suffered direct/indirect damage from a natural disaster, including the GEJE. The other variable is Evacuation Experience (*EX-EVC*), which was coded as 1 if respondents evacuated due to the occurrence of a natural disaster, regardless of whether they experienced direct/indirect damage. In addition, we generate a dummy variable specifically for GEJE experience, which allows us to examine whether experience with a recent catastrophic natural disaster had an additional impact on household preparedness.

Respondent-specific characteristics include several disaster-related variables. We control for respondents' knowledge about the response time for relief supplies to arrive at the nearest emergency shelter if an emergency does occur in their area. This variable is denoted as *Information on Response Time*. We also control for whether respondents' have participated in emergency drills. *Emergency Drill* was coded as 1 if respondents had participated in emergency disaster drills during the five years leading up to March 11, 2011. These variables are used to capture the impact of the respondents' awareness of disaster risks. As for the other individual characteristics, we control for respondents' education, age and gender. *Education* refers to the number of post junior high years of schooling.

Furthermore, we control for various household and respondent attributes that may affect the preparation of emergency supplies. Household attributes include household income (*Income*), household composition, housing type, car ownership, and frequency of eating out. Household composition includes four binary measures that were coded as 1 if a household fit the following conditions: there were children under five years of age (*Small Children*), there were children from six to 10 years of age (*Children, 6-10*), there were children from 11 to 19 years of age (*Children, 11-19*), and there were elderly people older than 60 years of age (*Elderly*). We also controlled for the number of people living at the same residence (*Household Size*). *Housing Type* is a dummy variable, which was coded as 1 if respondents lived in apartments and 0 if they lived in detached housing. In addition, we used postal codes to identify the residential location of the respondents. The regional variation in the sample may account for regional disaster risks and variation in terms of risk perception and awareness of the residents.

2.3 Descriptive Statistics

Table II shows the descriptive statistics of the variables used in the empirical analyses. The

Table II: Summary Statistics

Variable	Obs (N)	Mean	Std. Dev.	Min	Max
Emergency Food	20,726	0.579	0.494	0	1
Drinking Water	20,726	0.658	0.474	0	1
Battery	20,726	0.612	0.487	0	1
Fuel	20,726	0.203	0.402	0	1
Heating Equipment	20,726	0.233	0.423	0	1
First Aid Kit	20,726	0.381	0.486	0	1
Radio	20,726	0.579	0.494	0	1
Helmet	20,726	0.114	0.318	0	1
Disaster Hood	20,726	0.046	0.210	0	1
Unprepared	20,726	0.207	0.405	0	1
Basic Preparedness	20,726	1.716	1	0	3.002
Energy/Heat Preparedness	20,726	1.156	1	0	4.064
Evacuation Preparedness	20,726	0.735	1	0	6.065
Information on Response Time	20,726	0.521	0.500	0	1
Disaster Damage Experience	20,726	0.165	0.372	0	1
Evacuation Experience	20,726	0.098	0.298	0	1
Emergency Drill	20,726	0.166	0.372	0	1
Income	20,605	631.4	391.6	100	2000
Education	20,726	5.136	2.657	0	10
Gender (Female = 1)	20,726	0.516	0.500	0	1
Age	20,726	46.90	13.06	20	69
Small Children (0 - 5)	20,726	0.117	0.322	0	1
Children (6 - 10)	20,726	0.106	0.307	0	1
Children (11 - 19)	20,726	0.164	0.370	0	1
Elderly (60 and above)	20,726	0.437	0.496	0	1
Household Size	20,726	2.776	1.475	1	46
Housing Type (Apartment = 1)	20,639	0.418	0.493	0	1
Location Identification	20,036				

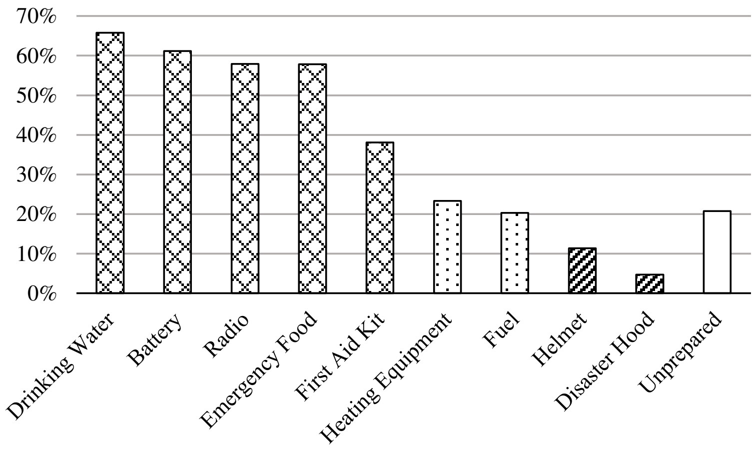

Figure 1: Shares of Household Prepared with an Emergency Item

Note. The mesh, dot, and slash in each bar indicate the category *BP*, *EHP*, and *EP* respectively.

BP, *EHP*, and *EP* scores that were calculated using the factor analysis results indicate the level of preparedness for each category. As shown in Figure 1, the five emergency items that belong to the *BP* category were relatively more prepared than the other four items that belong to the *EHP* category and the *EP* category. In particular, more than half of the respondents answered that they had stored emergency food and drinking water for disaster purposes. Figure 2 shows the average *BP* score for the 14 sub-regions. The map is colored such that higher scores are indicated in green and regions with lower scores are shown in red. It is clear that regions in East Japan tend to have a higher level of preparedness compared to the regions in West Japan, and the *Tohoku* region, which experienced the GEJE, has the highest level of preparedness in terms of basic emergency supplies.

With respect to the three risk perception-related proxies, almost half of the respondents were familiar with the length of the response time for external help to arrive in the case of a disaster emergency. In addition, 16.5% and 9.8% of the respondents answered that they had experienced disaster damage and evacuation, respectively. Table III describes the differences in the level of preparedness according to the type of experience: damage, evacuation and none. People with disaster-related experience seemed to be better prepared in terms of emergency supplies compared to those without experience. Furthermore, among those who had experienced damage or evacuation due to a disaster, those who experienced the GEJE seemed to have a comparatively higher level of preparation of emergency supplies compared to the victims of other disasters (see Appendix B). Given this visible difference, we controlled for the additional GEJE impact in the empirical specification using an interaction variable.

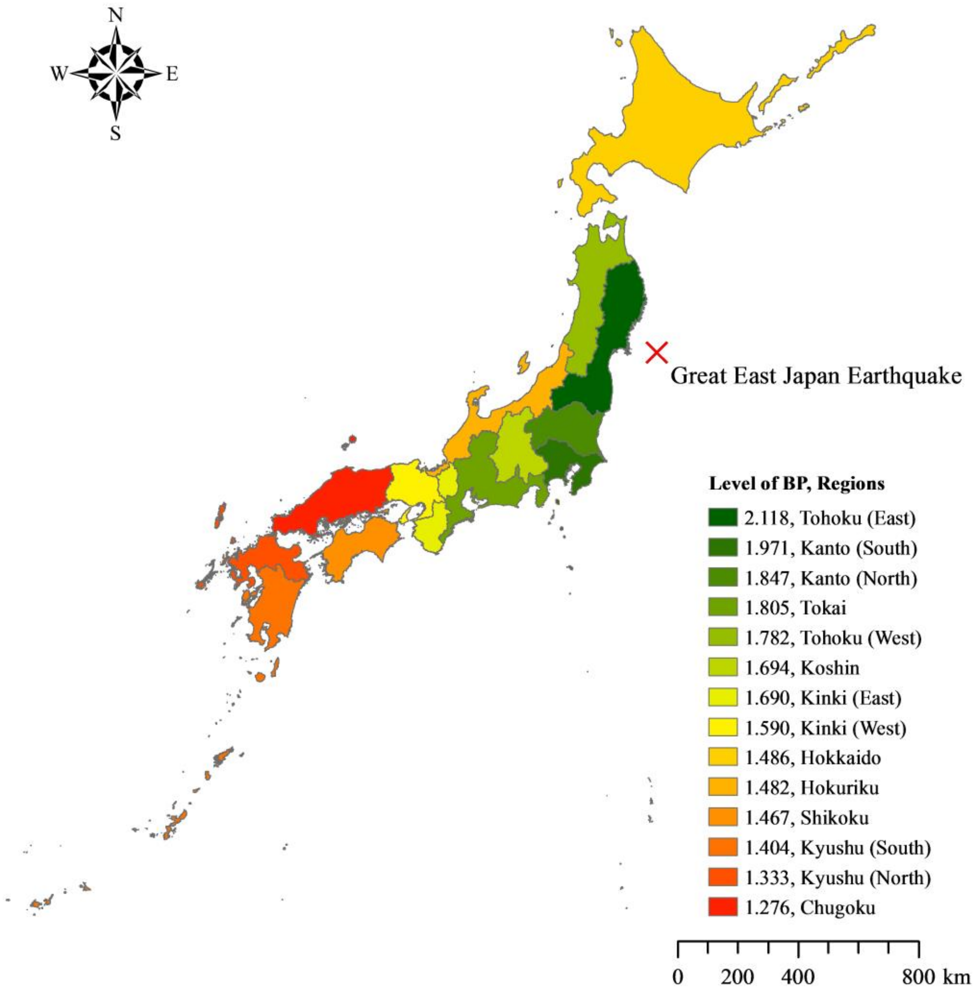

Figure 2: Level of Basic Preparedness by Sub-regions in Japan

Table III: Differences in Preparedness Levels by Disaster Experience Types

Experience	BP	EHP	EP	Observations
		EX-DMG		
YES	1.945	1.378	0.781	3,428
NO	1.670	1.112	0.726	17,298
		EX-DMG×Tohoku (East)		
YES	2.198	1.826	0.717	555
NO	1.710	1.146	0.737	19,481
		EX-EVC		
YES	1.937	1.338	0.855	2,039
NO	1.692	1.136	0.722	18,687
		EX-EVC×Tohoku (East)		
YES	2.279	1.861	0.799	269
NO	1.715	1.155	0.736	19,767

3. **Method of Analysis and Results**

3.1 Empirical Strategy

To identify the factors that explain the variation in emergency supply preparedness among households, we used ordinary least squares (OLS) regressions[6] based on the following equation:

$$Preparedness_i = \beta_0 + \boldsymbol{\beta}_n^{\prime} \boldsymbol{Experience}_i + \boldsymbol{\beta}_m^{\prime} \boldsymbol{Experience}_i \times Tohoku(East)_i$$
$$+\boldsymbol{\beta}_l^{\prime} \boldsymbol{Region}_i + \boldsymbol{\beta}_k^{\prime} \boldsymbol{Awareness}_i + \boldsymbol{\beta}_j^{\prime} \boldsymbol{X}_i + \varepsilon_i. \quad (1)$$

$Preparedness_i$ is a measure of emergency supply preparedness for household i, which is measured by the preparedness indicator for three categories of emergency supplies: *BP*, *EHP*, and *EP*. $\boldsymbol{Experience_i}$ is a set of experience variables: disaster damage experience and evacuation experience. We also controlled for regional variation in the level of preparedness using $\boldsymbol{Region_i}$, which is a set of 14 sub-region dummy variables. In addition, we controlled for the GEJE impact on preparedness using an interaction variable based on disaster experience and the *Tohoku (East)* variables. This interaction effect accounted for the magnified impact of a recent large-scale disaster. $\boldsymbol{Awareness_i}$ is a set of disaster awareness variables: knowledge regarding the time for relief supplies to arrive in the case of a disaster and participation in emergency drills. Finally, $\boldsymbol{X}_i$ is the set of control variables mentioned in the previous sub-section, and ε_i is the error term. All specifications (including the probit regressions in Appendix C) were estimated using cluster-robust standard errors at the municipality level.

3.2 Results

Table IV shows the results of the OLS regressions. Overall, the results indicate that the experience variables have a positive and statistically significant impact on the preparedness level, but there is variation in their impacts on preparedness. We found similar positive impacts of disaster damage experience on all categories of emergency supplies and of evacuation experience on all categories of emergency supplies with the exception of the

[6] In addition to OLS regressions, we employed a probit model for the nine specific emergency supplies that were considered as binary dependent variables. The probit regressions indicate the marginal effect of the determinants of the dependent variables.

Table IV: Results of OLS regressions

	(1) BP	(2) EHP	(3) EP
EX-DMG	0.207***	0.178***	0.0621***
	(0.0204)	(0.0229)	(0.0229)
EX-DMG*Tohoku (East)	0.159**	0.228**	0.0165
	(0.0691)	(0.0914)	(0.0805)
EX-EVC	0.0716***	0.0279	0.0729**
	(0.0236)	(0.0284)	(0.0288)
EX-EVC*Tohoku (East)	0.0508	0.0786	0.0607
	(0.0672)	(0.0811)	(0.0748)
Hokkaido	-0.273***	-0.242***	-0.0738
	(0.0732)	(0.0816)	(0.0576)
Tohoku (West)	-0.0321	0.0507	-0.0749
	(0.0852)	(0.0895)	(0.0657)
Kanto (North)	-0.0340	-0.220**	0.0123
	(0.0812)	(0.0959)	(0.0689)
Kanto (South)	0.104	-0.188**	0.328***
	(0.0686)	(0.0775)	(0.0592)
Koshin	-0.171**	-0.238**	0.198**
	(0.0869)	(0.102)	(0.0866)
Hokuriku	-0.382***	-0.380***	0.00728
	(0.0746)	(0.0853)	(0.0655)
Tokai	-0.0930	-0.282***	0.265***
	(0.0697)	(0.0792)	(0.0616)
Kinki (West)	-0.270***	-0.408***	-0.00996
	(0.0701)	(0.0779)	(0.0578)
Kinki (East)	-0.176**	-0.355***	0.0417
	(0.0813)	(0.0858)	(0.0689)
Chugoku	-0.529***	-0.467***	-0.0977*
	(0.0725)	(0.0791)	(0.0578)
Shikoku	-0.316***	-0.355***	0.0640
	(0.0826)	(0.0877)	(0.0748)
Kyushu (North)	-0.452***	-0.409***	-0.0644
	(0.0746)	(0.0814)	(0.0600)
Kyushu (South)	-0.361***	-0.464***	-0.0710
	(0.0803)	(0.0839)	(0.0601)
Information on Response Time	0.229***	0.126***	0.126***
	(0.0138)	(0.0137)	(0.0145)
Emergency Drill	0.303***	0.261***	0.343***
	(0.0162)	(0.0234)	(0.0258)
Log (Income)	0.172***	0.119***	0.0724***
	(0.0111)	(0.0105)	(0.0121)
Education	0.0241***	0.00844***	0.00430*
	(0.00254)	(0.00271)	(0.00247)
Gender	0.210***	0.151***	0.0531***
	(0.0127)	(0.0143)	(0.0146)
Age	0.0140***	0.0132***	0.00270***
	(0.000632)	(0.000578)	(0.000697)

Small Children (0 - 5)	0.122***	0.0680***	0.0291
	(0.0251)	(0.0254)	(0.0255)
Children (6 - 10)	0.108***	0.0554**	0.118***
	(0.0264)	(0.0259)	(0.0283)
Children (11 - 19)	0.0748***	0.0339	0.0713***
	(0.0214)	(0.0228)	(0.0221)
Elderly (60 and above)	0.153***	-0.0179	0.120***
	(0.0193)	(0.0186)	(0.0208)
Household Size	-0.0150**	-0.00219	-0.00698
	(0.00703)	(0.00669)	(0.00815)
Housing Types	-0.0669***	-0.112***	-0.0365**
	(0.0160)	(0.0157)	(0.0173)
Constant	-0.360***	-0.153	-0.210**
	(0.0977)	(0.0994)	(0.0984)
Observations	19,318	19,318	19,318
F Value	190.9	67.63	30.31
Adjusted R2	0.179	0.0961	0.0745

Note. *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses; these are corrected by clustering at the municipality level.

Energy and Heat-related emergency supplies.

The results of the interaction variables between *Tohoku (East)* and the disaster experience variables varied depending on the experience type. The interaction variable between *EX-DMG* and the *Tohoku (East)* region dummy was positive and statistically significant for *BP* and *EHP*. This result indicates that GEJE disaster victims who experienced direct/indirect damage are better prepared compared to victims of other disasters. On the other hand, we did not find statistically significant additional impact of evacuation experience for GEJE victims in the *Tohoku (East)* region.

The results for the regional dummy variables show that the reference region is *Tohoku (East)*, which was the area most affected by the GEJE. Compared to the *Tohoku (East)* region, all of the other regions with the exception of *Tohoku (West)*, *Kanto (North)*, *Kanto (South)* and *Tokai* were less prepared in terms of *BP* after controlling for other relevant experience and demographic factors. In particular, we found that the *Chugoku* region is one of the least prepared regions in Japan.

With respect to the other household characteristics and demographic control variables, the *Information on Response Time*, *Emergency Drill*, *Income*, *Education*, *Gender*, *Age*, *Small Children (0-5)*, and *Children (6-10)* coefficients were positive and statistically significant. The *Housing Types* coefficient was negative and statistically significant in the specification where *BP* and *EHP* were used as the dependent variables. For the specification where *EP* was used as the dependent variable, the *Small Children (0-5)* coefficient was not statistically significant.

Elderly (60 and above) and *Children (11-19)* had a positive and statistically significant effect on *BP* and *EP* but not on *EHP*. The *Household Size* coefficient was negative and statistically significant for *BP* but not for the other categories of emergency supplies.

Table C-I in Appendix C presents the results of the probit regressions with the dummy variables for each type of emergency supply used as dependent variables. The results confirm the robustness of the results presented above. The *EX-DMG* coefficients were positive and statistically significant for the preparation of all items except the disaster hood. In addition, the *EX-EVC* coefficients were positive and statistically significant for five items: drinking water, battery, first-aid kit, radio, and disaster hood. The interaction variable between *Tohoku (East)* and *EX-DMG* was positive and statistically significant for the preparation of four items categorized as *BP* and *EHP*: drinking water, first-aid kit, fuel, and fire kit. The interaction variable between *Tohoku (East)* and *EX-EVC* was positive and statistically significant for the preparation of emergency food.

4. Discussion

4.1 Disaster experience and household preparation of emergency items

The results of the empirical analyses indicate a robust, positive effect of disaster experience on household preparedness. Moreover, experience with the GEJE seems to have an additional impact on the preparation of emergency items.

According to the Lindell and Prater(29), disaster experience has both an indirect effect and a direct effect on hazard adjustment adoption. The authors suggest that the indirect effect is through an increased perceived personal risk. People with disaster experience may be more alert to disaster risks and hence relatively well prepared to avoid the possible damages from disaster events compared to their counterparts.(22) In addition, there are previous empirical studies(18,23,29,34,35) that provide evidence for a positive relationship between disaster experience and the level of perceived risk. In a flood study, Ruin *et al.*(32) reported that individuals without disaster experience tend to underestimate the danger, whereas individuals with direct experience tend to overestimate the danger. Victims who experienced considerable personal damage resulting from landslides perceived a higher occurrence rate of these hazards, considered them to be life threatening, and had a greater sense of dread than those with less experience.(36) Thus, the combined empirical evidence provided by some studies that supports a positive relationship between risk perception and preparedness [22,23,28,32,33] can explain how disaster experience improves the level of household preparedness indirectly via an increase in risk perception.

However, there is also empirical evidence that shows no relationship or a negative relationship between risk perception and preparedness.[37-40] Mileti and O'Brien[41] provided a possible reason why those who have experienced little or no loss from a disaster may respond less to warnings and continue to have a low risk perception: they are likely to think that "The first impact did not affect me negatively, therefore, subsequent impacts will also avoid me." Hence, peoples' risk perceptions are not based on whether they were present in the area affected by the disaster[40-45] but on whether they experienced the consequences of the disaster in some way, and the effects on their future risk perceptions depend on the degree of the consequences.

Nevertheless, it is difficult to provide strong conclusions about the indirect impact of disaster experience on preparedness through risk perception from our empirical results (see Wachinger et.al.[46] for a review on the risk perception paradox), given the robust positive impact of disaster experience on the preparedness level. These results suggest that even if we assume that an indirect impact via an increase in risk perceptions does not exist, the direct effect of hazard adjustments are indeed present and effective.

Moreover, the results suggest that experiencing damage has a stronger impact compared to an evacuation experience that may not be accompanied by physical damages. These results suggest that the impact of a disaster experience depends on the disaster type and its magnitude. We see that the experience of the GEJE, which caused massive physical destruction, had a significantly positive impact on household preparedness even after controlling for other disaster experiences.

4.2 Regional Characteristics and Implications for Future Disasters in Japan

The regional differences in household-level preparation of emergency supplies have important implications for disaster management in Japan. A recent earthquake occurred in *Kumamoto* prefecture in April 2016, which was the largest earthquake since the GEJE in 2011. Immediately after the disaster, 180,000 people were evacuated, while others were trapped in a remote area, cut off from the outside world for days. The evacuees also had trouble securing water, food and other basic necessities. According to our results, the *Kyushu* region, which includes *Kumamoto* prefecture, was relatively less prepared compared to the *Tohoku*, *Kanto*, and *Tokai* regions. Given that the area has mild weather with the exception of typhoons and no history of notable earthquakes prior to this one in 2016, the residents' risk perceptions may have been relatively low, and the region was hit by the disaster when the residents were significantly underprepared compared to most other regions.

With respect to future disaster risks, two major earthquakes are predicted to occur in the near future: the *Tokyo* Inland Earthquake and the *Nankai* Trough Earthquake. As mentioned in the results, people who live in the southern *Kanto* region who may potentially be heavily affected by the *Tokyo* Inland Earthquake have the same preparedness level as households in eastern *Tohoku*, which was hit hardest by the GEJE.

On the other hand, the preparedness level of households in the areas with a high risk of damage from the *Nankai* Trough Earthquake is generally low compared to the preparedness levels in other regions. The eastern *Kinki, Shikoku,* and southern *Kyushu* regions are comparatively less prepared, which is a rather serious issue based on the probability that an earthquake rated *'lower 6 or stronger'* on the Japanese intensity scale will occur within 30 years, as calculated by the National Research Institute for Earth Science and Disaster Resilience. As shown in Figure 3, the potential likelihood of the occurrence of a large-scale earthquake in the *Kinki*, *Shikoku*, and *Kyushu* areas is relatively high, and the recently updated report published in June 2016 showed an increased risk in these areas.

To prepare to mitigate the damages in the case of future large disasters, policy makers may want to take measures to improve households' preparedness levels in regions that are relatively less prepared despite the high risk of occurrence of a disaster. According to the results in Appendix Table C-I, people who have greater knowledge of the response time for help to reach them in the case of a disaster are approximately 7.7%-10.8% more likely to prepare basic emergency items compared to people without such knowledge. Additionally, people who have participated in emergency drills are approximately 9.5%-15.8% more likely to prepare basic emergency items compared with non-participants. Hence, policy makers should provide platforms that expedite and expand detailed information on disaster risks, taking regional differences into account, to raise awareness of natural hazard risks and promote household-level preparation of emergency supplies. In addition, to bolster the level of preparedness, the national government, local governments, and community-level organizations should conduct or encourage more frequent emergency drills and improve attendance.

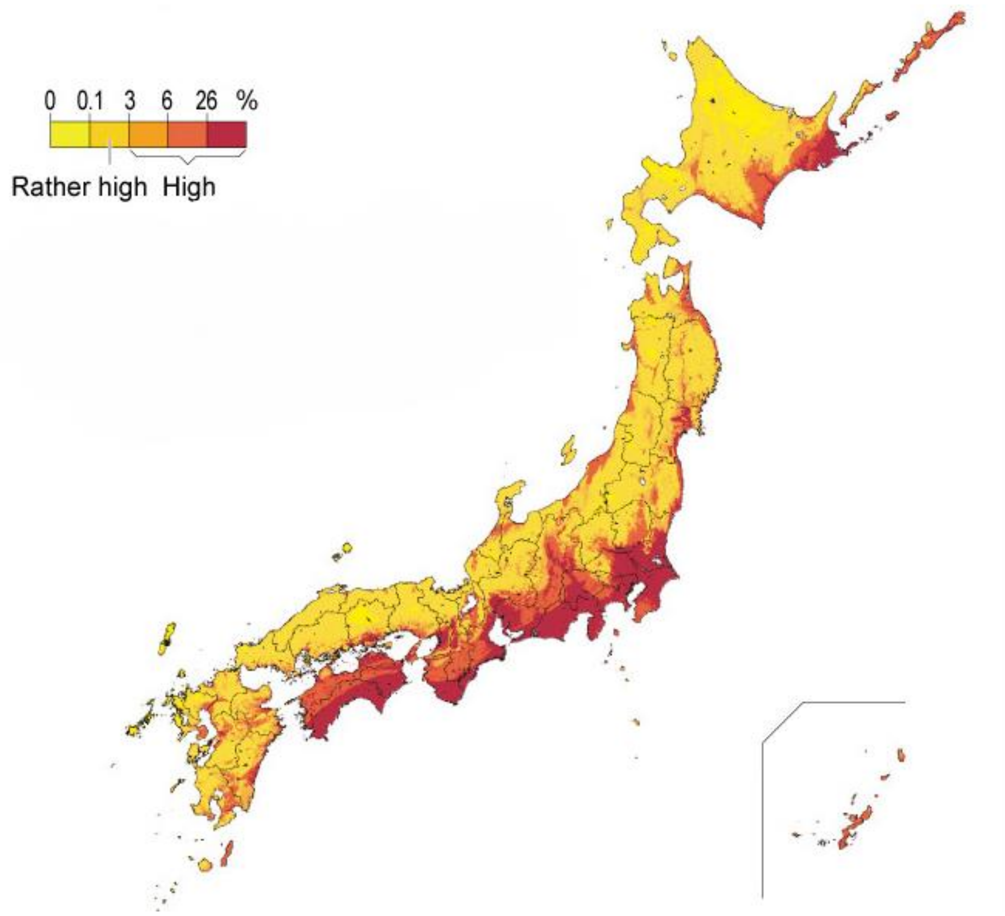

Figure 3: Probability of large scale Earthquake within 30 Years (2016-)
Source. The Japan Seismic Hazard Information Station of the National Research Institute for Earth Science and Disaster Resilience (http://www.j-shis.bosai.go.jp/en/).

4.3. Socio-demographic Characteristics

In addition to the interpretation of the key explanatory variables, the regression analysis provided insights into the effects of socio-demographic factors on preparedness levels for emergency supplies. According to the empirical results, those who live in apartments, have relatively low income and education, are males, and are relatively younger are comparatively less likely to be prepared compared with their counterparts. In addition, relatively large households are less likely to be prepared despite the fact that more people would be affected if a disaster occurred. The possible reasons for these results may include limited financial resources to spend on preparing for an emergency, low awareness regarding disaster risks and comparatively less experience with large-scale disasters. Education and gender (female) are factors that are known to have positive effects on risk perceptions, and it makes sense that people in these groups are relatively well-prepared.[47,48] These household and individual characteristics are not easy to change in the short term or perhaps cannot be changed. However, the results identify social groups that public administrators can focus on in providing resources to raise the overall level of preparedness. Policy makers may consider the direct distribution of stockpiles of emergency supplies at the household level for those with severe financial constraints.

5. Conclusions

In this study, we have provided empirical evidence on the factors that affect household preparation of emergency items using original, large-scale Japanese survey data. We use information on the preparation of nine emergency items that are divided into three categories using factor analysis. In particular, we focus on the impact of two different types of disaster experience, disaster damage and evacuation, on each category of items: Basic Preparedness (*BP*), Energy/Heat Preparedness (*EHP*), and Evacuation Preparedness (*EP*).

Our results indicate a robust, positive impact of disaster experience on household-level preparation of emergency items. Moreover, we found that people who experienced damage caused by recent large-scale disasters, in our case, the Great East Japan Earthquake (GEJE) in 2011, were relatively well prepared compared to respondents with experience from other disasters. The impact of experience differs depending on the item categories. Damage experience increases the level of preparedness in all categories, but evacuation experience affects only the *BP* and *EP* categories and has no statistically significant impact on the preparation of fuel and heating equipment. Moreover, damage experience has a larger impact on preparedness compared to evacuation experience. Furthermore, the results show that the additional positive impact on preparedness of the GEJE experience is significant only for damage experience and not for evacuation experience. Hence, overall damage experience seems to have a more robust and greater impact on the preparation of emergency items.

Donahue(2) correctly suggested that the more self-sufficient a society is and the less it requires government intervention, the more that society can efficiently address disasters because public organizations can concentrate on restoring public services and infrastructure and can therefore increase their efficiency by avoiding the costs associated with large bureaucracies. Hence, being prepared at the household level can not only improve immediate disaster responses but also lead to more efficient responses by the government.

To effectively mitigate the adverse impacts of disasters, there are several possible ways to increase preparedness at the private household level. Our results suggest that public administrators should exert more effort providing information about potential disaster risks and the immediate responses in times of crisis. Policy makers also should encourage the frequent implementation of emergency drills and increase the number of participants. In addition, our results identify certain underprepared social groups and particular regions that policy makers may want to target to improve household preparedness. Japan is known as a natural disaster-prone country, especially in terms of earthquakes; however, future disaster risks are shown to vary by region. The results indicate that even after controlling for disaster experience and other household characteristics, some areas that are considered to be at high risk of near-term, large-scale earthquakes are the least prepared regions in Japan. This information can be used to allocate funds, particularly to those areas in which the predicted risk of a large-scale natural disaster is high but the relative level of preparedness is low.

In the future, a similar exercise to this study would be useful, especially in other disaster-prone countries, because survey data allow us to identify the impact of personal disaster experience, risk perceptions and the regions that need improvement given the disaster risk. We expect to see variations in policy implications with regard to how policy makers should proceed to improve the preparation of emergency supplies in areas that require a relatively higher level of preparation.

Acknowledgement

This work was supported by the following Grant in Aid from the Ministry of Education, Culture, Sports, Science and Technology in Japan (MEXT): Grant in Aid for Specially Promoted Research 26000001. Any opinions, findings, and conclusions expressed in this material are those of the authors and do not necessarily reflect the views of the MEXT.

References

[1] Paul AJ, Hariharan G. Location-allocation planning of stockpiles for effective disaster mitigation. Annals of Operations Research. 2012;196:469–490.

[2] Donahue AK, Eckel CC, Wilson RK. Ready or Not? How Citizens and Public Officials Perceive Risk and Preparedness. American Review of Public Administration. 2014;44(4):89–111.

[3] Lindel MK, Perry RW. Household adjustment to earthquake hazard: A review research. Environment and Behavior. 2000;32(4):461–501.

[4] Neumayer E, Plümper T, Barthel F. The political economy of natural disaster damage. Global Environmental Change. 2014;24:8–19.

[5] FEMA (Federal Emergency Management Agency). Guide for All-Hazard Emergency Operations Planning, State and Local Guide SLG-101. Washington, DC: Federal Emergency Management Agency. 1996. (https://www.fema.gov/pdf/plan/slg101.pdf)

[6] Botzen WJW, Aerts JCJH, van den Bergh JCJM. Willingness of homeowners to mitigate climate risk through insurance. Ecological Economics. 2009 Mar;68:2265–2277.

[7] Botzen WJW, van den Bergh JCJM. Risk attitudes to low-probability climate change risks: WTP for flood insurance. Journal of Economic Behavior and Organization. 2012;82:151–166.

[8] Botzen WJW, Aerts JCJH, van den Bergh JCJM. Individual preferences for reducing flood risk to near zero through elevation. Mitigation and Adaptation Strategies for Global Change. 2013;18:229–244.

[9] Spittal MJ, Walkey HF, McClure J, Siegert RJ, Ballantyne KE. The earthquake readiness scale: The development of a valid and reliable unifactorial measure. Natural Hazards. 2006;39:15–29.

[10] Fishbein MF, Ajzen I. Belief, attitude, intention, and behavior: An introduction to theory and research. Reading, MA: Addison-Wesley. 1975.

[11] Ajzen I. The theory of planned behavior. Organizational Behavior and Human Decision Processes. 1991;50:179–211.

[12] Rogers RW. A protection motivation theory of fear appeals and attitude change. Journal of Psychology, 1975;91:93–114.

[13] Mulilis J-P, Duval TS. Negative threat appeals and earthquake preparedness: A person-relative-to-event (PrE) model of coping with threat. Journal of Applied Social Psychology. 1995;25:1319-1339.

[14] Lindell MK, Perry RW. Behavioral foundations of community emergency management. Washington D.C., Hemisphere Publishing Corp. 1992.

[15] Lindell MK, Perry RW. The protective action decision model: Theoretical modifications and additional evidence. Risk Analysis. 2012;32(4):616–632.

[16] Solberg C, Rossetto T, Joffe H. The social psychology of seismic hazard adjustment: re-evaluating the international literature. Natural Hazards and Earth System Sciences. 2010;10:1663–1677.

[17] Heller K, Alexander DB, Gatz M, Knight BG, Rose T. Social and personal factors as

predictors of earthquake preparation: The role of support provision, network discussion, negative affect, age, and education. Journal of Applied Social Psychology. 2005;35:399–422.
[18] Jackson EL. Response to earthquake hazard: The west coast of North America. Environment and Behavior. 1981;13:387–416.
[19] Russell LA, Goltz JD, Bourque LB. Preparedness and hazard mitigation actions before and after two earthquakes. Environment and Behavior. 1995;27:744–770.
[20] Turner RH, Nigg JM, Paz D. Waiting for disaster: Earthquake watch in California. Berkeley, CA: University of California Press. 1986.
[21] Faupel CE, Styles SP. Disaster education, household preparedness, and stress responses following Hurricane Hugo. Environment and Behavior. 1993;25:228–249.
[22] Lindell MK, Hwang SN. Households' perceived personal risk and responses in a multihazard environment. Risk Analysis. 2008;28(2):539–556.
[23] Miceli R, Sotgiu I, Settanni M. Disaster preparedness and perception of flood risk: A study in an alpine valley in Italy. Journal of Environmental Psychology. 2008;28:164–173.
[24] Osberghaus D. The determinants of private flood mitigation measures in Germany – Evidence from a nationwide survey. Ecological Economics. 2015;110:36–50.
[25] Preston V, Taylor SM, Hedge DC. Homeowner adaptation to flooding: An application of the general hazards coping theory. Environment and Behavior. 1983;15:143–164.
[26] Mileti DS, O'Brien PW. Warnings during disaster: Normalizing communicated risk. Social Problems. 1992;39(1):40–57.
[27] Mileti DS, Darlington JD. The role of searching in shaping reactions to earthquake risk information. Social Problems. 1997;44(1):89–103.
[28] Koerth J, Vafeidis AT, Hinkel J, Sterr H. What motivates coastal households to adapt pro-actively to sea-level rise and increasing flood risk? Regional Environmental Change. 2013;13:897–909.
[29] Lindell MK, Prater CS. Household adoption of seismic adjustments: A comparison of research in two states. International Journal of Mass Emergencies and Disasters. 2000;18(2):317–338.
[30] Mishra S, Mazumdar S, Suar D. Place attachment and flood preparedness. Journal of Environmental Psychology. 2010;30:187–197.
[31] Spittal MJ, Mcclure J, Siegert RJ, Walkey FH. Predictors of two types of earthquake

preparation. Environment and Behavior. 2008;40(6):798–817.

[32] Ruin I, Gaillard JC, Lutoff C. How to get there? Assessing motorists' flash flood risk perception on daily itineraries. Environmental Hazards. 2007;7:235–244.

[33] Hung HV, Shaw H, Kobayashi M. Flood risk management for the RUA of Hanoi: Importance of community perception of catastrophic flood risk in disaster risk planning. Disaster Prevention and Management. 2007;16:245–258.

[34] Grothmann T, Reusswig F. People at risk of flooding: Why some residents take precautionary action while others do not. Natural Hazard. 2006;38:101–120.

[35] Heitz C, Spaeter S, Auzet AV, Glatron S. Local stakeholders' perception of muddy flood risk and implications for management approaches: A case study in Alsace (France). Land Use Policy. 2009;26:443–451.

[36] Ming-Chou H, Shaw D, Shuyeu L, Yau-Chu C. How do disaster characteristics influence risk perception? Risk Analysis. 2008; 28(3):635–645.

[37] Karanci N, Bahattin A, Gulay D. Impact of a community disaster awareness training program in Turkey: Does it influence hazard-related cognitions and preparedness behaviors? Social Behavior and Personality. 2005;33(3):243–258.

[38] Siegrist M, Gutscher H. Flooding risks: A comparison of lay people's perceptions and expert's assessments in Switzerland. Risk Analysis. 2006;26(4):971–979.

[39] Hall TE, Slothower M. Cognitive factors affecting homeowners' reactions to defensible space in the Oregon coast range. Society and Natural Resources. 2009;22:95–110.

[40] Jóhannesdóttir G, Gísladóttir G. People living under threat of volcanic hazard in southern Iceland: Vulnerability and risk perception. Natural Hazards and Earth System Sciences. 2010;10:407–420.

[41] Mileti DS, O'Brien P. Public response to aftershock warnings. US Geological Survey Professional Paper. 1993;1553-B:31–42.

[42] Deeming H. Increasing resilience to storm surge flooding: risks, social networks and local champions. In: Samuels P, Huntington S, Allsop W, Harrop J, editors. Flood Risk Management: Research and Practice. London: CRC Press; 2008. P. 925-931.

[43] Green CH, Tunstall SM, Fordham MH. The risks from flooding: Which risks and whose perception? Disasters. 1991;15:227–236.

[44] Halpern-Felsher BL, Millstein SG, Ellen JM, Adler NE, Tschann JM, Biehl M. The role of behavioral experience in judging risks. Health Psychology. 2001;20(2):120–126.

[45] Scolobig A, De Marchi B, Borga M. The missing link between flood risk awareness and

preparedness: Findings from case studies in an Alpine Region. Natural Hazards. 2012;63(2):499–520.

[46] Wachinger G, Renn O, Begg C, Kuhlicke C. The Risk Perception Paradox –Implications for Governance and Communication of Natural Hazards. Risk Analysis. 2013;33(6):1049–1065.

[47] Ho M-C, Shaw D, Lin S, Chiu Y-C. How do disaster characteristics influence risk perception? Risk Analysis. 2008;28(3):635–643.

[48] Kung Y-W, Chen S-H. Perception of Earthquake Risk in Taiwan: Effects of Gender and Past Earthquake Experience. Risk Analysis. 2012;32:1535–1546.

Appendix

Appendix A

Table A-I: List of Regional Groupings

Region	Sub-Region	Prefecture	Region	Sub-Region	Prefecture
Hokkaido		Hokkaido	Kinki	Kinki (West)	Kyoto
Tohoku	Tohoku (West)	Aomori			Osaka
		Akita			Hyogo
		Yamagata		Kinki (East)	Shiga
	Tohoku (East)	Iwate			Nara
		Miyagi			Wakayama
		Fukushima	Chugoku	Chugoku	Tottori
Kanto	Kanto (North)	Ibaraki			Shimane
		Gumma			Okayama
		Tochigi			Hiroshima
	Kanto (South)	Saitama			Yamaguchi
		Tokyo	Shikoku	Shikoku	Kagawa
		Chiba			Ehime
		Kanagawa			Tokushima
Chubu	Koshin	Yamanashi			Kochi
		Nagano	Kyushu	Kyushu (North)	Fukuoka
	Hokuriku	Niigata			Saga
		Fukui			Nagasaki
		Toyama			Oita
		Ishikawa		Kyushu (South)	Kumamoto
	Tokai	Shizuoka			Miyazaki
		Gifu			Kagoshima
		Aichi			Okinawa
		Mie			

Appendix B

Table B-I: Shares of Respondents with Disaster Experiences by Region

Sub-Region	Observations	EX-DMG	EX-EVC
Hokkaido	1,114	8.1%	7.0%
Tohoku (West)	469	22.2%	9.6%
Tohoku (East)	748	74.2%	36.0%
Kanto (North)	560	38.6%	13.9%
Kanto (South)	6,368	12.0%	7.9%
Koshin	395	9.1%	9.4%
Hokuriku	714	16.9%	13.3%
Tokai	2,689	9.6%	8.7%
Kinki (West)	2,908	25.3%	11.5%
Kinki (East)	483	8.5%	8.5%
Chugoku	1,145	9.2%	5.6%
Shikoku	597	9.0%	8.0%
Kyushu (North)	1,270	13.3%	7.1%
Kyushu (South)	576	11.8%	10.9%
Total	20,036	16.6%	9.9%

Appendix C

Table C-I: Results of Probit Regressions (Average Marginal Effects)

	(1) Emergency Food	(2) Drinking Water	(3) Battery	(4) First Aid Kit	(5) Radio	(6) Fuel	(7) Fire Kit	(8) Helmet	(9) Disaster Hood
Information on Response Time	0.108***	0.0928***	0.0880***	0.0794***	0.0766***	0.0473***	0.0502***	0.0331***	0.0137***
	(0.00764)	(0.00724)	(0.00771)	(0.00678)	(0.00746)	(0.00571)	(0.00588)	(0.00444)	(0.00245)
EX-DMG	0.102***	0.0781***	0.0785***	0.0733***	0.0663***	0.0728***	0.0713***	0.0245***	0.00511
	(0.0115)	(0.0110)	(0.0114)	(0.0114)	(0.0106)	(0.00962)	(0.0104)	(0.00707)	(0.00406)
EX-DMG* Tohoku (East)	0.0682	0.124***	0.0141	0.0941**	0.0548	0.0655*	0.0690**	-0.0136	0.0127
	(0.0465)	(0.0298)	(0.0451)	(0.0468)	(0.0533)	(0.0385)	(0.0350)	(0.0228)	(0.0321)
EX-EVC	0.0220	0.0251**	0.0319**	0.0347**	0.0221	0.0113	0.0116	0.00662	0.0117**
	(0.0136)	(0.0127)	(0.0139)	(0.0147)	(0.0142)	(0.0109)	(0.0117)	(0.00806)	(0.00515)
EX-EVC* Tohoku (East)	0.103***	0.0501	0.0227	-0.00819	-0.00870	0.00443	0.0307	0.0358	0.00400
	(0.0373)	(0.0446)	(0.0422)	(0.0412)	(0.0556)	(0.0267)	(0.0294)	(0.0314)	(0.0153)
Hokkaido	-0.130***	-0.0250	-0.158***	-0.0210	-0.172***	-0.0606***	-0.0806***	-0.0470***	-0.00863
	(0.0484)	(0.0406)	(0.0431)	(0.0474)	(0.0521)	(0.0233)	(0.0217)	(0.0129)	(0.0184)
Tohoku (West)	-0.0115	-0.0527	0.0127	-0.00500	0.00491	0.00769	0.0286	-0.0260	-0.00789
	(0.0503)	(0.0467)	(0.0475)	(0.0490)	(0.0607)	(0.0317)	(0.0311)	(0.0176)	(0.0198)
Kanto (North)	0.0231	0.0747*	-0.0898*	0.0177	-0.0900	-0.0665***	-0.0614**	-0.0251	0.0237
	(0.0483)	(0.0408)	(0.0476)	(0.0495)	(0.0558)	(0.0241)	(0.0308)	(0.0157)	(0.0374)
Kanto (South)	0.0813*	0.180***	-0.0501	0.0622	-0.0635	-0.0420*	-0.0736***	0.0322*	0.0787**
	(0.0431)	(0.0338)	(0.0403)	(0.0470)	(0.0498)	(0.0255)	(0.0236)	(0.0166)	(0.0399)
Koshin	-0.0447	0.0106	-0.176***	0.0430	-0.161***	-0.0615**	-0.0844***	0.0304	0.0604
	(0.0558)	(0.0422)	(0.0511)	(0.0526)	(0.0556)	(0.0299)	(0.0256)	(0.0243)	(0.0546)
Hokuriku	-0.153***	-0.0898**	-0.221***	-0.0573	-0.207***	-0.113***	-0.114***	-0.00919	0.0145
	(0.0463)	(0.0437)	(0.0436)	(0.0473)	(0.0513)	(0.0175)	(0.0205)	(0.0175)	(0.0311)
Tokai	0.0123	0.0913***	-0.151***	0.0174	-0.155***	-0.0769***	-0.101***	0.0490**	0.0604
	(0.0444)	(0.0350)	(0.0421)	(0.0473)	(0.0505)	(0.0219)	(0.0204)	(0.0195)	(0.0450)
Kinki (West)	-0.110**	0.00350	-0.173***	-0.0105	-0.223***	-0.112***	-0.139***	-0.0343***	0.0196
	(0.0457)	(0.0387)	(0.0421)	(0.0464)	(0.0496)	(0.0190)	(0.0179)	(0.0128)	(0.0299)
Kinki (East)	-0.0630	0.0394	-0.115**	0.00777	-0.218***	-0.0893***	-0.118***	-0.0118	0.0268
	(0.0508)	(0.0413)	(0.0464)	(0.0544)	(0.0532)	(0.0220)	(0.0184)	(0.0198)	(0.0371)
Chugoku	-0.221***	-0.140***	-0.264***	-0.0686	-0.288***	-0.127***	-0.151***	-0.0477***	-0.0145
	(0.0449)	(0.0441)	(0.0421)	(0.0440)	(0.0476)	(0.0154)	(0.0153)	(0.0112)	(0.0152)

Shikoku	-0.107**	-0.0208	-0.218***	-0.0234	-0.219***	-0.0927***	-0.115***	-0.00685	0.0305
	(0.0523)	(0.0445)	(0.0457)	(0.0514)	(0.0515)	(0.0190)	(0.0226)	(0.0183)	(0.0412)
Kyushu (North)	-0.191***	-0.0860**	-0.252***	-0.0585	-0.256***	-0.112***	-0.135***	-0.0474***	-0.000375
	(0.0463)	(0.0423)	(0.0420)	(0.0451)	(0.0499)	(0.0177)	(0.0175)	(0.0127)	(0.0232)
Kyushu (South)	-0.186***	-0.0217	-0.197***	-0.0387	-0.235***	-0.132***	-0.135***	-0.0508***	0.00489
	(0.0479)	(0.0432)	(0.0468)	(0.0483)	(0.0524)	(0.0143)	(0.0197)	(0.0131)	(0.0263)
Emergency Drill	0.158***	0.0948***	0.110***	0.134***	0.120***	0.0830***	0.0825***	0.0893***	0.0267***
	(0.00962)	(0.00928)	(0.00953)	(0.00994)	(0.0100)	(0.00918)	(0.00949)	(0.00735)	(0.00406)
Log (Income)	0.0685***	0.0847***	0.0678***	0.0658***	0.0501***	0.0502***	0.0525***	0.0148***	0.0100***
	(0.00605)	(0.00552)	(0.00582)	(0.00602)	(0.00587)	(0.00465)	(0.00499)	(0.00366)	(0.00221)
Education	0.0115***	0.0117***	0.00874***	0.00728***	0.00688***	0.00325***	0.00360***	0.000830	0.000286
	(0.00141)	(0.00139)	(0.00144)	(0.00128)	(0.00144)	(0.00113)	(0.00125)	(0.000828)	(0.000443)
Gender	0.136***	0.0864***	0.0769***	0.0755***	0.0404***	0.0557***	0.0691***	-0.0147***	0.0158***
	(0.00724)	(0.00714)	(0.00727)	(0.00684)	(0.00735)	(0.00596)	(0.00645)	(0.00422)	(0.00236)
Age	0.00323***	0.00337***	0.00746***	0.00467***	0.00787***	0.00517***	0.00586***	0.00154***	0.000104
	(0.000345)	(0.000334)	(0.000337)	(0.000357)	(0.000353)	(0.000274)	(0.000285)	(0.000216)	(0.000111)
Small Children (0 - 5)	0.0623***	0.0592***	0.0515***	0.0441***	0.0169	0.0270**	0.0429***	0.00542	0.00483
	(0.0136)	(0.0114)	(0.0129)	(0.0133)	(0.0140)	(0.0117)	(0.0126)	(0.00823)	(0.00511)
Children (6 - 10)	0.0618***	0.0321**	0.0510***	0.0520***	0.0131	0.0313***	0.0265**	0.000986	0.0306***
	(0.0138)	(0.0128)	(0.0140)	(0.0135)	(0.0138)	(0.0111)	(0.0118)	(0.00791)	(0.00626)
Children (11 - 19)	0.0341***	0.0268**	0.00475	0.0432***	0.0367***	0.0183*	0.0204**	-0.0101	0.0212***
	(0.0121)	(0.0110)	(0.0121)	(0.0118)	(0.0121)	(0.00965)	(0.00996)	(0.00650)	(0.00464)
Elderly (60 and above)	0.0344***	0.0505***	0.0675***	0.0615***	0.0802***	-0.00270	-0.0178**	0.0272***	0.0167***
	(0.0108)	(0.0100)	(0.00955)	(0.00985)	(0.0103)	(0.00796)	(0.00778)	(0.00616)	(0.00347)
Household Size	-0.0124***	-0.0120***	-0.00646*	-0.00417	0.00498	-0.00186	-0.00151	0.000544	-0.00154
	(0.00403)	(0.00358)	(0.00383)	(0.00376)	(0.00381)	(0.00275)	(0.00301)	(0.00217)	(0.00119)
Housing Types	-0.0240***	-0.00730	-0.0353***	-0.0203**	-0.0406***	-0.0491***	-0.0358***	-0.0237***	0.000999
	(0.00882)	(0.00809)	(0.00868)	(0.00866)	(0.00880)	(0.00619)	(0.00698)	(0.00479)	(0.00287)
Observations	19,318	19,318	19,318	19,318	19,318	19,318	19,318	19,318	19,318
Log Likelihood	-11,912	-11,222	-11,721	-12,103	-11,905	-9,027	-9,766	-6,261	-3,249
Pseudo-R2	0.0937	0.0945	0.0894	0.0591	0.0927	0.0823	0.0755	0.0848	0.102

Note. *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses; these are corrected by clustering at the municipality level.