

Household and Community Disaster Preparedness in Japanese Provincial City: A Population-Based Household Survey

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Abstract

Household- and community-level preparedness have been re-emphasized after recent major earthquakes and tsunamis in Japan. The paper examines the prevalence and the determinants of disaster preparedness among the residents of a provincial city in Japan at both levels. Furthermore, it seeks to uncover the associations between household- and community-level preparedness activities to test the hypothesis that a complementary relationship exists between them. We used a subset of a population-based household questionnaire survey of 4000 randomly sampled households in Komoro City in the Nagano Prefecture of Japan in February and March of 2011. The questionnaire included specific questions to measure disaster the preparedness status at both the household and community levels. The characteristics and associations of household- and community-level preparedness were analyzed with multivariable logistic regression models. We found insufficient disaster preparedness at both household and community levels. Older, female, and better educated household heads were associated with better household preparedness, while length at residence, non-single status, presence of an elderly household member, and farming occupations were associated with better community preparedness. Households with one or more household-level preparedness measures were more likely to receive community assistance than those lacking them. The relationship between household and community preparedness was not complementary. Hence, a large proportion of the households were unprepared at both the community and household levels.

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Keywords

Disaster Preparedness, Community, Household, Population-Based Study, Japan

1. Introduction

Strengthening disaster preparedness is a top priority of disaster management programs at both national and local levels (United Nations International Strategy for Disaster Reduction, 2007). However, recent disasters have revealed limitations in the timing and mobility of government assistance to the public. Therefore, preparedness plans for households that are based on the individual and/or household responsibility and those for communities that are based on the mutual assistances within the community, have been highlighted as areas for improvement (Central Disaster Management Council, 2011). The emergency responses of local and national governments often cannot reach affected populations immediately after an event, especially when a disaster strikes a large area at the same time. Hence, the preparedness of individuals, households, and communities, along with that of the government, is crucial for improving community resilience in the face of a disaster (Central Disaster Management Council, 2011; Diekman, Kearney, O'Neil, & Mack, 2007; Kapucu, 2008; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008). Several events associated with the Great East Japan Earthquake (March 2011) have confirmed the importance of community preparedness (e.g., mutual aid in neighborhoods, schools, and communities) (Japanese Red Cross Society, 2011; Matanle, 2011; Nakahara, 2011).

Previous studies (Bethel, Foreman, & Burke, 2011; Eisenman et al., 2006; Kapucu, 2008; Tomio, Sato, & Mizumura, 2010, 2011; Uscher-Pines et al., 2009) have assessed various determinants of household preparedness, including the level of risk awareness (Eisenman et al., 2006; Murphy, Cody, Frank, Glik, & Ang, 2009) and the age of household heads (Baker, 2011; Eisenman et al., 2006; Murphy et al., 2009), indicating that preparedness activities at the household level are typically not undertaken, although some studies provide mixed results. Individual citizens should plan for real disasters in order to help not only their families but also their friends and neighbors when a catastrophe or an emergency strikes (Kapucu, 2008). However, previous findings have revealed that many households are not ready for a disaster. For example, adequate supplies of food and water are not present in them. To ensure that individual households achieve an adequate level of preparedness, those who are poorly organized must rely on community-level preparedness. For example, they must be able to identify someone in the neighborhood who can provide assistance in the event of a disaster. Accordingly, there should be a complementary relationship between household- and community-level preparedness, i.e., a lower level of household preparedness would be associated with a higher level of community preparedness, and vice versa. Some studies indicate common predictors of different levels of preparedness, such as people's subjective norms (Motoyoshi, Takao, & Ikeda, 2008; Paek, Hilyard, Freimuth, Barge, & Mindlin, 2010), and concern about disasters (Eisenman et al., 2006; Motoyoshi et al., 2008), and connectedness to a story-telling network (Kim & Kang, 2010), indicating a positive rather than a complementary relationship between the two types of preparedness. However, the association has not been fully understood. Identifying the pattern of the association between household- and community-level preparedness should provide relevant information for community and local authorities when they decide to approach local residents.

The objectives of the present study are to examine the prevalence and the determinants of disaster preparedness among the residents of a provincial city in Japan at both household and community levels and to analyze the associations between these two levels of preparedness to test the hypothesis that they have a complementary relationship.

2. Materials and Methods

2.1. Survey and Study Setting

In the present study, we used a subset of a population-based household survey conducted in Komoro City in Nagano Prefecture of Japan in February 2011. The survey was designed to describe citizen attitudes toward injury and disaster prevention and citizen consciousness of safety and security as part of the city's new safety

promotion policy. Komoro is a small-sized city in central Honshu, the main island of Japan, with a population of approximately 44,000 as of September 2011. Its total area is 98.66 km², and the city is situated at the foot of Mount Asama, an active complex volcano. Some rivers run through the city, and the major natural hazards of the area include earthquakes, volcanic eruptions, and floods. Fortunately, a lengthy period has transpired since a disastrous event affected the area (Komoro Municipal Disaster Management Council, 2010).

The survey's target population comprised 17,300 households, covering all but one street in Komoro City. Of the total number of households, 4000 were sampled randomly and proportionately by street, using the Basic Resident Registration System, Japan's official means of recording residents, as of September 1, 2010. The survey questionnaires were mailed to the 4000 randomly selected households in February 2011. The head of each household was asked to complete the questionnaire (anonymously) and return it to the Komoro City Hall by the end of February. A separate survey was conducted with all 406 households in Yachihara, the area designated as the target for the all-household survey and exempted from the original survey. The same questionnaire and methods were used, but the second survey was administered in March 2011, just after the Great East Japan Earthquake of March 11 and the North Nagano Prefecture Earthquake of March 12 (magnitude of 6.7 on the Richter scale, with an epicenter 70 km north of Komoro City). The local government of Komoro City and the Ethical Committee of St. Marianna University School of Medicine and Toyo University reviewed and approved the protocol for conducting the study and the questionnaire.

2.2. Study Variables

The questionnaire included two specific questions originally developed to measure disaster preparedness at both household and community levels. Respondents chose one or more appropriate responses from the following basic preparedness activities to describe the household preparedness level: 1) securing furniture; 2) stockpiling food and water; 3) locating the designated evacuation center; 4) preparing an emergency kit; and 5) discussing disaster responses with family members. We established that a household had also adopted procedures reflecting community-level preparedness by determining if its head answered "yes" to the following question: "Do you have any neighborhood inhabitants who would help each other in times of disaster?"

The survey included questions regarding the basic characteristics of households, including area of residence (central or suburb), presence or absence of an officially accredited voluntary disaster preparedness organization (VDPO) that engages the community in disaster drills and other preparedness activities, length of residence (<5 years, 5 - 19 years, or 20+ years), and household size (single or not). Further, respondents were asked to indicate the presence of household member(s) under 15 and over 74 years of age, those requiring special assistance due to disabilities, and those receiving long-term care. Households were identified as concerned about natural disasters if they indicated "natural disaster" as one of the top 3 of 15 items that would be relevant for their members in the next five years in terms of safety promotion, such as traffic accidents or criminal activities. Some relevant characteristics of the household heads, including gender, age (under 50, 50 - 64, or 65 years or older), educational level (college graduate or not), and occupational status (employed/self-employed, farmer, or unemployed/retired/housewife), were also collected.

2.3. Statistical Analysis

To describe the status of preparedness, we calculated the proportion of households that had adopted household and community levels preparedness measures. Five activities of household-level preparedness were summarized and categorized as follows: *none*, *one*, or *two* or *more*. They were categorized dichotomously, however, when treating preparedness at the household level as a dependent variable in the logistic regression model. Associations among the household characteristics described above and both household- and community-level preparedness were analyzed with multivariable logistic regression models to determine possible predictors of each level of preparedness. The association between household- and community-level preparedness was analyzed with the chi-squared test, followed by the application of a multivariable logistic regression model that controlled for household-related characteristics. Additionally, we analyzed the data from the Yachihara area, collected after the major events of March 2011, using the above-mentioned methods to identify any major changes in preparedness status immediately after the event. All statistical analyses were performed using Stata version 11.2 (StataCorp, College Station, TX).

3. Results

Overall, 1985 (50%) valid responses regarding preparedness status were obtained from the targeted 4000 households. Of these, 41% lived in the center of the city, 57% in a street with VDPO, 15% in single households, 24% with children under 15 years, 19% with elderly aged 75 years or older, 17% with one or more family members requiring special assistance; 75% had lived in the city for 20 years or longer, and 26% indicated concern about natural disaster (**Table 1**). A majority of the heads of households were men, aged 50 years or older, with education levels below that of college graduate; they were generally employees or self-employed.

Table 1. Disaster preparedness and characteristics of the study subjects (n = 1985).

Variable	n (%)
Household level preparedness	
Measures to secure furniture	365 (18)
Food and water stockpiling	542 (27)
Identifying the designated evacuation center	651 (33)
Preparing emergency pack	224 (11)
Discussing disaster response with family	197 (10)
Potential mutual aid in the neighborhood	1105 (56)
Area of residence*	
Center	777 (41)
Suburb	1127 (59)
Voluntary disaster preparedness organization*	1002 (57)
Years of residence*, year	
<5	147 (7)
5 - 20	341 (17)
20+	1481 (75)
Single household*	288 (15)
Living with children under age 15	486 (24)
Living with someone aged 75 years or older	369 (19)
Living with those requiring special assistance	345 (17)
Male*	1401 (71)
Age*, year	
<50	611 (31)
50 - 64	786 (40)
65+	583 (29)
College graduate*	690 (35)
Occupational status*	
Employee/self-employed	1249 (63)
Farming	187 (9)
Unemployed/retired/housewife	538 (27)
Concerned about natural disasters	508 (26)

*Variables include some missing data.

Concerning household-level preparedness, 18% had secured their furniture and 27% had stockpiled food and water; 33% correctly identified the designated evacuation center; 11% had prepared emergency kits; and 10% had discussed disaster response with family members (Table 1). More than half of the households (56%) reported that they could rely on their neighbor(s) for potential mutual aid in case of a disaster.

Households were more likely to be prepared at the household level when the heads of household were women (Odds ratio [OR] 1.40, 95% confidence interval [CI] 1.11 - 1.77), older (OR 1.43, 95% CI 1.03 - 1.97 for 50 - 64 years and OR 1.97, 95% CI 1.35 - 2.87 for 65 years or older), or college graduates (OR 1.55, 95% CI 1.22 - 1.96) than their counterparts (Table 2). However, those with longer years of residence (OR 1.65, 95% CI 1.03 - 2.62 for 5 - 19 years, and OR 3.08, 95% CI 1.99 - 4.76 for 20+ years) and who lived with persons aged 75 years or older (OR 1.40, 95% CI 1.06 - 1.83) were more likely to have neighbors on whom they could rely for potential mutual aid than their counterparts. Single households, however, were less likely to rely on neighbors for potential aid (OR 0.59, 95% CI 0.44 - 0.80). Regarding the occupational status of the heads of households, farmers were more likely to have someone they could rely on for potential mutual aid than employees and the self-employed (OR 2.64, 95% CI 1.70 - 4.10).

The proportion of households with access to potential mutual aid during a disaster increased according to the household preparedness level. More than two-thirds of the households that had described two or more activities relevant to household-level preparedness were aware of possible community resources, while less than half of those that had not engaged in such activities ($P < 0.001$) felt they had access to community resources for aid (Table 3). The associations were also found after controlling for the effects of household-related factors and the socio-demographic status of the household heads. Households with either one item and/or two or more items

Table 2. Associations between household characteristics and disaster preparedness at the household level and potential mutual aid (n = 1728).

Variable	Household preparedness		Potential mutual aid	
	Adjusted OR (95% CI)		Adjusted OR (95% CI)	
Living in suburb	0.86 (0.69 - 1.08)		1.22 (0.99 - 1.51)	
VDPO	1.05 (0.84 - 1.31)		1.13 (0.93 - 1.39)	
Length of residence, years	<5	Reference	Reference	
	5 - 19	1.15 (0.68 - 1.93)	1.65 (1.03 - 2.62)*	
	20+	1.07 (0.66 - 1.74)	3.08 (1.99 - 4.76)**	
Single household	0.87 (0.62 - 1.21)		0.59 (0.44 - 0.80)**	
Living with children under age 15	0.95 (0.69 - 1.29)		1.06 (0.80 - 1.39)	
Living with someone aged 75 or older	1.21 (0.91 - 1.61)		1.40 (1.06 - 1.83)*	
Living with those requiring special assistance	0.92 (0.69 - 1.24)		0.86 (0.66 - 1.13)	
Female	1.28 (1.00 - 1.64)*		0.95 (0.76 - 1.19)	
Age, year	<50	Reference	Reference	
	50 - 64 yr	1.43 (1.03 - 1.97)*	1.00 (0.75 - 1.33)	
	65 yr+	1.97 (1.35 - 2.87)**	1.31 (0.93 - 1.85)	
College graduate	1.55 (1.22 - 1.96)**		1.22 (0.93 - 1.52)	
Occupational status	Employee/self-employed	Reference	Reference	
	Farming	1.01 (0.67 - 1.51)	2.64 (1.70 - 4.10)**	
	Unemployed/ retired/ housewife	1.01 (0.76 - 1.35)	0.79 (0.61 - 1.04)	
Concerned about natural disaster	1.05 (0.83 - 1.34)		1.18 (0.94 - 1.48)	

* $P < 0.05$, ** $P < 0.01$. Household preparedness was regarded as positive when the households adopted two or more activities. The reference value of the odds ratio for each bivariate variable is the counterpart value. VDPO: voluntary disaster preparedness organization; OR: odds ratio; CI: confidence interval.

Table 3. Association between household preparedness status and potential mutual aid.

Number of adopted household preparedness activities		Households with potential mutual aid		Adjusted OR (95% CI)
Number of activities	n	n (%)		
None	770	365 (47)		Reference
1	703	390 (55)		1.40 (1.11 - 1.77)*
2+	512	350 (68)		2.31 (1.78 - 3.00)*

* $P < 0.001$ with multivariable logistic regression model adjusted for the characteristics of the households and household heads shown in [Table 2](#).

associated with household-level preparedness were more likely to receive community assistance than those with no evidence of household preparedness (OR 1.40, 95% CI 1.11 - 1.77, and OR 2.31, 95% CI 1.78 - 3.00, respectively).

A greater proportion of households in Yachihara (where the data was collected immediately following the catastrophe of March 11, 2011) were prepared for disasters, that is, they had adopted two or more activities associated with household-level preparedness, compared to the rest of the city (43% and 26%, respectively). However, no difference between the residents of Yachihara and the rest of Komoro City was found in terms of access to mutual aid (56% for both). Similar to the findings on the households in the rest of the city, our results indicated that households characterized by either two or more activities or one preparedness activity were more likely to receive mutual aid than those with no household-level preparedness activity (OR 5.09, 95% CI 1.71 - 15.12, and OR 3.27, 95% CI 1.08 - 9.86, respectively).

4. Discussion

The results of the population-based survey administered in a provincial city in Japan revealed insufficient disaster preparedness at both household and community levels. Older age, female, and better-educated household heads were associated with better household preparedness, while length of residence (at least five years), non-single status, the presence of an elderly household member, and farming occupations were associated with better community preparedness. The relationship between household and community preparedness was not complementary; hence, a large proportion of the households were unprepared at both the community and household levels.

Household disaster preparedness has been assessed in various settings by different measures. Previous studies and surveys have reported a low occurrence of preventive measures in communities. Our findings were similar to the Special Opinion Poll on Disaster Preparedness for Earthquake conducted by the Cabinet Office of Japan in 2007 on the country's general population, which indicated that 36% of respondents had stockpiled food and water, 24% had stabilized furniture, and 23% were prepared to carry valuables and other supplies with them if forced to evacuate (Cabinet Office, 2007). Several recent studies conducted in Japan (Mimaki, Takeuchi, & Shaw, 2009), the US (Eisenman et al., 2006), and Italy (Miceli, Sotgiu, & Settanni, 2008) have reported similar levels of preparedness activities in these countries. Other studies have, however, showed better preparedness levels. For example, an American study that utilized the Behavioral Risk Factor Surveillance System (BRFSS) indicated that over 80% of the households has stockpiled food (Bethel et al., 2011). A study conducted in a hurricane-prone area in Florida (Baker, 2011) arrived at similar results. The preparedness of the present study's Japanese subjects can be characterized as within the normal range; however, the fact that less than a third of the households adopted basic preparedness activities should be regarded as insufficient, considering the high risk of disasters in Japan.

The results of the multivariable logistic regression analysis suggested that older age, female, and better-educated household heads are potential predictors of better household preparedness. These results support several previous findings (Baker, 2011; Eisenman et al., 2006; Levac, Toal-Sullivan, & O Sullivan, 2011; Murphy et al., 2009); however, they may be confounded by other factors, especially financial status, which has been indicated as a strong predictor of material preparedness at the household level (Baker, 2011; Levac et al., 2011; Murphy et al., 2009). Financial status is generally higher when the household head is older in Japan (Ministry of Internal Affairs and Communications, 2010).

Potential resources for mutual aid were found in more than half of the households, though we cannot make a relative evaluation of this result because previous studies did not investigate the status of mutual aid at the community level. The results of multivariable logistic regression analysis indicated that households in which residents had lived for at least five years and those with two or more family members, elderly family members, and farmers as heads of households were likely to receive mutual aid in the event of a disaster. In fact, these variables were considered as predictors of a “neighborhood bond”, according to the results of the National Survey on Lifestyle Preferences 2007 conducted by the Cabinet Office of Japan ([Quality-of-Life Policy Bureau \(Cabinet Office\), 2007](#)). “Neighborhood belonging”, similar in concept to the neighborhood bond, was found to be a possible predictor of the actual preparedness actions of the community affected by Hurricane Ivan in 2004 ([Kim & Kang, 2010](#)). Thus, the strength of the neighborhood bond may be regarded as a forecaster of potential mutual aid in a community based on the household characteristics listed above. At the same time, the local government should pay special attention to single residents and/or those who live in the community for short periods, as they could be at high risk for slipping through the network of community preparedness.

The existence of a VDPO in the community was not associated with the higher preparedness of households and communities, and this finding is contrary to a previous report on a local coastal city in Japan ([Mimaki et al., 2009](#)). Although a VDPO may have beneficial effects that were not measured in the present inquiry, some studies argue that certain VDPOs are not rooted in the community and have become ineffective ([Takahashi, 1995](#)). The role of VDPOs in disaster preparedness should therefore be re-examined.

Interestingly, respondents in our study who expressed concern about natural disasters did not prepare more for a major event than those who expressed less concern. Previous studies have indicated that higher risk awareness and higher risk perception predicted better household preparedness ([Eisenman et al., 2006](#); [Kapucu, 2008](#); [Murphy et al., 2009](#)). Although the concern about disasters measured in the present study could be partially translated into risk awareness, it may be merely a vague feeling of anxiety that would not lead to preparedness behavior. Risk awareness and perception translate into preparedness action when they are based on individual understandings of the hazard ([Kapucu, 2008](#)). Thus, further research should investigate hazards and vulnerability to understand the reasons for individual concerns and the role of disaster risk communications.

Contrary to our hypothesis on the existence of a complementary relationship between household and community preparedness, we observed that households exhibiting readiness were more likely to have access to potential resources for mutual aid in times of disaster. The supplemental analysis revealed the same pattern of association among residents in the Yachihara area.

Intuitively, people promote community and/or public emergency preparedness in order to seek help from neighbors and local authorities when they cannot take appropriate prepare at the household level. The results of the present study showed a positive interaction between preventive measures at the household and community levels rather than a complementary relationship. [Murphy et al.](#) have reported a similar positive interaction between individual and public preparedness, indicating that increased confidence in the ability of local health care systems to handle emergencies appeared to correlate with the proactive activities of individuals ([Murphy et al., 2009](#)).

Some possible explanations for this positive relation can be proposed. People living in well-prepared households may build networks of mutual aid among neighbors. Moreover, people living in a neighborhood with existing mutual aid may more easily obtain information about household preparedness. In addition, other common root causes may exist at both levels of preparedness, although the present study did not find a common predictor. Earlier research has found that a person’s subjective norms or his or her beliefs of the sort of behaviors that significant others (e.g., family members and close friends) expect determined preparedness ([Motoyoshi, Takao, & Ikeda, 2004](#); [Motoyoshi et al., 2008](#); [Paek et al., 2010](#)). [Motoyoshi et al.](#) have observed the influence of subjective norms on the attitudes of Japanese residents toward household and community preparedness, although they did not examine the association between the two levels ([Motoyoshi et al., 2008](#)). This finding implies the existence of discrepancy in the subjective norms for disaster preparedness among local residents. Further studies need to examine this assumption.

Supplemental analyses of the Yachihara area have shown an increased level of household preparedness after major earthquakes; however, no significant change was observed for the households with potential mutual aid. Although the present study could not measure the effect of major events, this observation suggests that the experiential effect of a major event may differ according to the level of preparedness. Thus, separate approaches might be required to improve the different types of preparedness, even though they share some common root causes.

This study has several limitations. First, a high response rate was not achieved, although the community survey had a 50% response rate from a sample group that was demographically similar to the target population. Second, because of the nature of the cross-sectional data, the findings reflect associations rather than causation. Third, preparedness activities included in the survey were not comprehensive, and they were not analyzed qualitatively. Community preparedness, for example, was measured only by the existence of potential mutual aid; other measures, such as participation in disaster drills, were not examined. Fourth, the study did not control for some known predictors of preparedness, including financial status and disaster risk perception. Lastly, the survey was conducted in an inland provincial city in Japan; therefore, the results might not be applicable to locations with different geographical characteristics, such as large cities, coastal areas, and areas that are highly or minimally prone to disasters.

5. Conclusion

In summary, we found that community-level preparedness did not appear to complement preparedness at the household level. Instead, the findings suggested the polarization of disaster preparedness in the community. Policy makers should be aware of high-risk subgroups that are poorly prepared for disasters at both household and community levels. Although we did not find common determinants of poor preparedness at both levels, we suggest that focusing on easily detectable high-risk individuals, e.g., those who have recently started to live in a city and those who are single, could be a good starting point for intervention. Local authorities should be encouraged to develop educational programs that promote preparedness behaviors based on sound disaster risk awareness. In addition, each community should be required to identify publicly key community members, such as social workers, who could provide support to neighbors in the event of a disaster. We highly recommend that further research examines the determinants of poor preparedness and the quality of preventive activities and identify effective approaches for improving preparedness at all levels.

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