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REGULAR ARTICLE

Disparity in disaster preparedness among rheumatoid arthritis patients with various general health, functional, and disability conditions

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Abstract
Objectives To describe disaster preparedness among chronically ill patients and to examine how differences in health, functional, and disability conditions are associated with disaster preparedness, focusing on rheumatoid arthritis (RA) patients with various functional and disability levels.
Methods In 2007, 1,477 members of a nationwide RA patient group in Japan who lived in municipalities affected by natural disasters between 2004 and 2006 were asked to participate in a questionnaire survey. Three medical preparedness indicators, namely, medication stockpiles, the carrying of medications, and the carrying of prescription/treatment records, and three general preparedness indicators, namely, having emergency packs, emergency communication plans, and emergency evacuation plans, were used as dependent variables. Multivariable logistic models were applied to examine the associations of health-related vulnerability variables with the preparedness variables.
Results Of the 553 subjects included into the analysis, only one-half had taken medical preparedness measures and only one-quarter had taken general preparedness measures. Although physical disability and poorer functional level were associated positively with the medical preparedness, those with poorer perceived health were less likely to carry medications and prescription/treatment records, and those receiving the highest long-term care levels were less likely to carry medications than their healthier counterparts.
Conclusions Among the population of chronically ill RA patients surveyed, disaster preparedness was insufficient, and their preparedness status varied with health, functional, and disability conditions. We suggest that policy-makers should give careful thought to the targets they set for disaster preparedness.

Keywords Disaster preparedness · Chronic diseases · Rheumatoid arthritis · Disability · Medication treatment

Introduction

Recent natural disasters have had a disproportionate negative effect on the medically vulnerable segment of the general population, including those with chronic diseases and physical disabilities [1–6]. Since both the number of people in these subgroups and the risk of natural disasters are increasing [7, 8], the disaster preparedness of medically vulnerable populations must be addressed. Previous studies have indicated that following a disaster, those with chronic diseases often experience negative health consequences [1, 2, 5]. Based on the lessons learned from Hurricane Katrina and other such events, key preparedness activities have been identified to insure the continuity of health care after a disaster, including the stockpiling of medications and the preparation of emergency evacuation plans [9, 10].

It is important to understand the differences in preparedness level/activity required of various subpopulations because different public health messages, programs, and

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distribution channels may be necessary to improve the preparedness of these different subgroups [11]. A recent study that used the survey data of the Behavioral Risk Factor Surveillance System (BRFSS) in the USA concluded that vulnerable populations were more likely to have a supply of medication but less likely to have an emergency evacuation plan than their healthier counterparts [12]. These findings are not consistent with those of other studies in which the preparedness activities and vulnerability variables investigated varied between study [11, 13–15]. In addition, in these studies, differences in preparedness status according to the level of vulnerability, such as disability level and functional status, among the medically vulnerable populations chosen for study were not fully examined, even though understanding the preparedness status at a specific level of vulnerability is essential for more effective and efficient public health interventions.

Despite its high prevalence in the Western countries [16] and Japan [17], rheumatoid arthritis (RA) is not mentioned as frequently as other chronic diseases, such as hypertension and diabetes, in the context of disaster preparedness activities. RA patients generally require continuous treatment to achieve and maintain their remission; without such treatment, flare-ups can occur, resulting in a deteriorating functional status and possibly causing severe complications [18, 19]. Thus, RA patients require special support during disaster situations [20]. RA can produce a wide range of physical disabilities, and some RA patients may be classified as being physically disabled.

Under such circumstances, we hypothesized that the disaster preparedness activities would not be sufficiently prevalent among RA patients in Japan and that a lower preparedness status would be found among those in the most vulnerable subgroups, including the elderly and those with a poorer functional condition. We also hypothesized that better preparedness status would be found among those who had experienced a natural disaster than those did not.

The objectives of this study were to describe medical and general disaster preparedness among chronically ill patients, focusing on RA patients with various functional and disability levels, and to examine how differences in health and functional status, as well as socio-demographic factors, are associated with disaster preparedness.

Materials and methods

Study subjects and data collection

The study subjects formed part of a nationwide RA patient group in Japan. This patient group is one of the largest patient groups in Japan, with members throughout the country, and agreed to cooperate in our study. Of the 17,834 members in January 2007, 1,477 (9%) individuals who had registered their addresses in those municipalities where the Disaster Relief Act (DRA) had been enacted between January 2004 and December 2006 were enrolled in the study. The DRA defines the framework for governmental support of relief activities for a designated disaster event to protect victims and maintain social order. For the 16 disaster events in the 3 years from 2004 to 2006, the DRA was enacted in 113 municipalities in 21 prefectures, out of the total 1,839 municipalities and 47 prefectures in Japan. The estimated population of these 113 municipalities at the beginning of 2007 was about 11 million (9% of the national population), which corresponds to the proportion of enrolled subjects to total members of the RA patient group (9%). Of the 16 events, nine occurred in 2004, two in 2005, and five in 2006; two were major earthquakes and 14 were meteorological disasters, including eight typhoons, three torrential rains, one heavy snow fall, and one tornado. Self-administered questionnaires were sent by mail in February 2007 to the registered address of each subject and collected by mail by the end of March 2007. The subjects were asked about disaster preparedness status at the time of survey as well as whether and how they were affected by the 16 DRA-applied events listed on the questionnaire. The details of the survey are explained elsewhere [6]. The study protocol and the questionnaire were reviewed and approved by the Institutional Review Board of Toyo University, which is responsible for the ethical standards of the institute. The purposes of the study were explained in the cover letter of the questionnaire, and only those subjects who agreed to them were requested to complete and return the questionnaire.

Dependent variables

Three medical and three general preparedness variables were included in the analysis as dependent variables. The medical preparedness variables indicated that the respondents (1) had a 7-day stockpile of medication, (2) carried medications with them, and (3) carried their prescriptions and/or treatment records with them. The second and third variables were aimed at examining the preparedness behavior of having these items available at all times—and not just having a stockpile or records. Responses to two questions, i.e., (1) "do you carry your prescription records with you?" and (2) "do you carry your treatment records with you?" were used to create the third variable. A dichotomous variable was created for responding "yes" to one of these questions compared to responding "no" to both questions. General preparedness variables indicated that the respondents (1) have an emergency pack, (2) have a plan to get in contact with family members (emergency communication plan), and (3) have an emergency

evacuation plan. The third variable was created using responses to three questions, i.e., (1) "are you sure of the route to the designated evacuation center in your area?"; (2) "do you have someone to help you evacuate?"; and (3) "have you registered yourself on the official list of those who need special assistance during a disaster?". A dichotomous variable was created for responding "yes" to one of these questions compared to responding "no" to all three questions. The first two variables were developed to evaluate preparedness at the individual or household level, and the third variable was to evaluate preparedness at the community level.

Independent variables

Considering the various health and functional conditions of RA patients, we included the following five variables to measure the vulnerability of the patients, i.e., (1) perceived status of general health, (2) comorbid chronic conditions, (3) functional status, (4) physical disability status, and (5) the level of long-term care needed. The perceived health status was determined using a five-grade scale, i.e., excellent, very good, good, fair, or poor, and a dichotomous variable was created by combining the excellent, very good, and good responses because a relatively small number of respondents selected "excellent" or "very good" and by combining the fair and poor responses because relatively few respondents selected "poor." Their comorbid chronic conditions were regarded as positive when they suffered from at least one of 16 common chronic diseases, including hypertension, cardiovascular diseases, and diabetes. Functional status was measured using a modified Health Assessment Questionnaire (MHAQ) score, which is a clinically validated and widely used measure of RA-specific functional status that comprises eight questions on the patient's ability to perform basic daily activities, such as dressing, eating, and walking [21–23]. The score takes a semi-continuous value between 0 (intact) and 3 (severely impaired), and subjects were divided into three subgroups at the tertile values. Physical disability status was classified according to the physically disabled person's certificate grade into three subgroups, i.e., (1) not disabled, (2) mildly to moderately disabled (classes 3–6), and severely disabled (classes 1–2). The level of long-term care needed was also classified into three subgroups, i.e., (1) no need, (3) low care levels (support-required or care levels 1–2), and (3) high care levels (care levels 3–5), based on the long-term care insurance service in Japan. We also determined whether their healthcare behaviors included routinely keeping records of their prescriptions and treatments.

Several socio-demographic variables were included, such as age (<65, 65–74, and ≥75 years), gender, education (≤high school, ≥some college education), occupation (unemployed/retired, employed/self-employed), and annual household income (<3 million, ≥3 million Japanese yen; three million Japanese yen is equivalent to 25.8 thousand U.S. dollars at the annual average rate in 2006). A variable of household status was created and divided into the following four categories: (1) baseline, the number of household members (NHM) ≥3 or NHM = 2, and the partner does not need any aid; (2) frail, NHM = 2, and either both are aged ≥65 years or the partner needs aid; (3) younger-single, NHM = 1, and the person is aged <65 years; (4) older-single, NHM = 1, and the person is aged ≥65 years. Three dichotomous variables reflecting the patients' past experiences of disasters and disaster drills were included. These were measured separately by asking the respondents (1) if they had been affected by the events listed in the survey for which the DRA had been enacted, (2) if they were affected by any disasters other than the listed events, and (3) if they had ever participated in a disaster drill.

Statistical analysis

The prevalence of six preparedness actions according to the RA patients' characteristics was described. The proportions of those who had a 7-day stockpile and also carried medications, of those who routinely kept prescription records and who also carried prescription records, and of those who routinely kept treatment records and who also carried treatment records were also calculated. To analyze the associations between health-related factors and preparedness, we performed five sets of multivariable logistic regression analysis for each six dependent variables of preparedness. To analyze the associations between health-related factors and preparedness, we performed five sets of multivariable logistic regression analyses for each of the six dependent variables of preparedness. The multivariable models independently examined the association of the five health-related vulnerability variables with the six preparedness variables and provided adjusted odds ratios (ORs) after controlling for the effects of socio-demographic and disaster-related factors. Finally, we performed a separate, multivariable logistic regression analysis for each of the six preparedness variables, with all five vulnerability variables and all of the socio-demographic and disaster-related variables included in the model. All statistical analyses were performed using Stata ver. 10.1 (StataCorp, College Station, TX).

Results

Of the 1,477 subjects enrolled, 665 (45%) returned the questionnaire and provided valid information about age

and gender. Of these, 571 (86%) were receiving medication for RA at the time of the survey. Among the 571 respondents, 553 who provided health-related information were analyzed. Geographical distribution of the study subjects was similar to that of the target population based on their responses on residential areas. The characteristics of the subjects are shown in Table 1. Most (93%) of the subjects were women; 45% of the subjects were aged ≥65 years; 12% lived alone (7% were aged ≥65 years); 82% were unemployed or retired; 71% had not graduated from high school. Of the 553 subjects whose data were analyzed, 52% had been affected by the events listed for which a DRA had

Table 1 Characteristics and disaster preparedness profiles of the study subjects ($n = 553$)

Variable	*n* (%)	Medical preparedness (%)			General preparedness (%)		
		Medication stockpile	Carrying medication	Carrying medical records	Emergency pack	Emergency communication plan	Emergency evacuation plan
Overall		46	50	47	25	22	26
Socio-demographic factors							
Gender							
Female	514 (93)	47	51	48	26	22	26
Male	39 (7)	33	31*	41	15	26	23
Age (years)							
<65	300 (54)	46	47	41	23	21	22
65–74	184 (33)	49	54	54**	29	24	34**
≥75	69 (12)	43	49	55*	26	22	20
Household status[a]							
Baseline	381 (69)	45	48	45	25	23	25
Frail	106 (19)	47	57	55	25	26	28
Younger-single	28 (5)	68*	46	29	21	7	14
Older-single	38 (7)	47	50	63*	34	16	34
Annual household income[b] (Japanese Yen)							
<3 million	186 (37)	49	51	53	29	22	29
≥3 million	320 (63)	44	49	43*	23	23	23
Occupational status[b]							
Unemployed/retired	445 (82)	46	52	49	26	23	26
Employed/self-employed	99 (18)	48	39*	35*	24	19	21
Highest educational level[b]							
≤high school	378 (71)	43	53	53	26	24	28
≥some college education	155 (29)	55*	42*	35***	25	17	22
Disaster-related factors							
Affected by the DRA-applied event (2004–2006)							
Yes	285 (52)	47	53	48	28	23	28
No	268 (48)	46	46	47	23	21	23
Other disaster experience							
Yes	76 (14)	58	63	53	28	18	24
No	477 (86)	45*	48*	46	25	23	26
Past participation in disaster drill							
Yes	126 (23)	47	53	46	34	30	41
No	427 (77)	46	49	48	23**	20*	21***
Health-related factors							
Perceived general health status							
Good–excellent	235 (43)	44	52	47	28	24	27
Fair-poor	318 (57)	48	48	47	23	21	25
Comorbid chronic conditions							
0 (none)	308 (56)	43	44	38	27	19	23

Table 1 continued

Variable	*n* (%)	Medical preparedness (%)			General preparedness (%)		
		Medication stockpile	Carrying medication	Carrying medical records	Emergency pack	Emergency communication plan	Emergency evacuation plan
≥1	245 (44)	49	55***	54***	23	25	27
MHAQ score (0: intact, 3: severely impaired)							
0–0.375	193 (35)	42	44	38	25	18	24
0.5–1.25	196 (35)	46	49	47	29	24	24
1.375–3	164 (30)	51	58*	59***	21	25	28
Physical disability							
Not disabled	175 (32)	34	40	39	24	19	22
Class 3–6	110 (20)	55***	53*	45	29	28	29
Class 1–2	268 (48)	51***	55***	54**	25	22	26
Long-term care level							
Not received	382 (69)	43	49	42	25	23	24
Support-level 1–2	145 (26)	57*	55	64***	28	21	30
Level 3–5	26 (5)	38	35	35	19	23	19

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, with the Chi-square test, in comparison to the value at the top of each variable

DRA Disaster Relief Act, *MHAQ* modified Health Assessment Questionnaire

[a] Household status: baseline, the number of household members (NHM) ≥3 or NHM = 2 and the partner does not need any aid; frail, NHM = 2, and either both are ≥65 years or the partner needs aid; younger-single, NHM = 1, and the person is <65 years; older-single, NHM = 1, and the person is ≥65 years

[b] Including missing values

been enacted; 14% had been affected by an event(s) other than those listed; 23% had participated in a disaster drill. In terms of the vulnerability status, 57% perceived their health status to be poor to fair, 45% had at least one comorbid chronic condition other than RA, and 30% reported that their MHAQ scores were ≥1.375. Forty-eight percent were certified as severe classes of physical disability, while smaller percentages received some form of long-term care (26% for mild or moderate levels of physical disability and 5% for more severe levels). More than 70% of the patients had kept track of their prescribed medications and/or treatments received (not shown on the table). The age and sex distributions of the study subjects were not very much different from those of the patient group according to the results of its in-house questionnaire survey in 2005, e.g., 62% were aged ≥60 years and 93% were women.

Overall, about one-half of the respondents reported having adopted measures of medical preparedness, while about one-fourth adopted general preparedness measures (Table 1). Those who were categorized at higher vulnerability levels were more likely to have stockpiled medication(s), whereas those with high long-term care levels were less likely to have medication stockpiles. Among those who had stockpiles, 53% carried medications with them at all times, while only 50% of those who carried medications with them had a 7-day stockpile. Among those who had kept track of their prescriptions and treatments, only 51 and 42% kept prescription and treatment records, respectively.

The multivariable models for medical preparedness indicated that those with poorer perceived health status were less likely to carry medications with them [OR 0.57, 95% confidence interval (CI) 0.37–0.87; Table 2] or to carry prescription/treatment records (OR 0.58, 95% CI 0.38–0.90). On the other hand, those with comorbid chronic conditions were more likely to carry prescription/treatment records (OR 1.72, 95% CI 1.18–2.50), and those in the highest tertile of the MHAQ score were more likely than those in the lowest tertile to carry their medications (OR 2.19, 95% CI 1.14–4.21) and prescription/treatment records (OR 2.26, 95% CI 1.17–4.38) with them. Those with a physical disability were generally more likely to have medication stockpiles than their counterparts, as evidenced by the higher ORs for having medication stockpiles among those with mild to moderate disabilities (OR 2.32, 95% CI 1.35–3.99) than those with the most severe disabilities (OR 1.94, 95% CI 1.15–3.26). Those with low long-term care levels were more likely to have stockpiles (OR 1.79, 95% CI 1.11–2.90) and to carry prescription/treatment records (OR 1.61, 95% CI 0.98–2.62) than those who had not received such long-term care services. However, those at the highest long-term care level

Table 2 Associations between medical preparedness and patients' characteristics ($n = 524$)

Variable	Medication stockpile OR (95% CI)	Carry medication OR (95% CI)	Carry prescription/treatment record OR (95% CI)
Health-related factors			
Perceived general health status (Reference: Good-excellent)			
Fair–poor	1.31 (0.86–1.99)	0.57 (0.37–0.87)**	0.58 (0.38–0.90)*
Comorbid chronic conditions (Reference: 0, none)			
≥1	1.13 (0.78–1.64)	1.29 (0.89–1.87)	1.72 (1.18–2.50)**
MHAQ score (0, intact; 3, severely impaired) (Reference: 0–0.375)			
0.5–1.25	0.72 (0.43–1.19)	1.24 (0.75–2.06)	1.41 (0.85–2.33)
1.375–3	0.69 (0.36–1.33)	2.19 (1.14–4.21)*	2.26 (1.17–4.38)*
Physical disability (Reference: Not disabled)			
Class 3–6	2.32 (1.35–3.99)**	1.44 (0.84–2.47)	0.95 (0.55–1.64)
Class 1–2	1.94 (1.15–3.26)*	1.52 (0.91–2.54)	1.18 (0.70–1.98)
Long-term care level (Reference: Not received)			
Support-level 1–2	1.79 (1.11–2.90)*	0.84 (0.52–1.36)	1.61 (0.98–2.62)
Level 3–5	0.81 (0.31–2.10)	0.29 (0.11–0.79)*	0.44 (0.17–1.17)
Socio-demographic factors			
Gender (Reference: Female)			
Male	0.55 (0.26–1.16)	0.50 (0.23–1.06)	0.98 (0.47–2.02)
Age (years) (Reference: <65)			
65–74	1.17 (0.71–1.93)	1.10 (0.67–1.81)	1.12 (0.68–1.85)
≥75	1.16 (0.59–2.26)	1.04 (0.53–2.04)	1.16 (0.59–2.28)
Household status[a] (Reference: Baseline)			
Frail	0.98 (0.57–1.67)	1.45 (0.84–2.49)	1.25 (0.73–2.15)
Younger-single	2.17 (0.87–5.42)	1.08 (0.45–2.60)	0.49 (0.19–1.30)
Older-single	0.75 (0.33–1.70)	1.05 (0.46–2.38)	1.71 (0.73–2.15)
Annual household income (Japanese Yen) (Reference: <3 million)			
≥3 million	0.78 (0.51–1.20)	1.17 (0.76–1.80)	0.95 (0.62–1.46)
Occupational status (Reference: Unemployed/retired)			
Employed/self-employed	1.26 (0.76–2.09)	0.66 (0.40–1.09)	0.85 (0.50–1.42)
Highest educational level (Reference: ≤high school)			
≥some college education	2.07 (1.35–3.18)**	0.66 (0.43–1.01)	0.55 (0.36–0.85)**
Disaster-related factors			
Affected by the DRA-applied event (2004–2006) (Reference: No)			
Yes	0.94 (0.65–1.37)	1.34 (0.93–1.95)	1.20 (0.82–1.76)
Other disaster experience (Reference: No)			
Yes	1.89 (1.11–3.22)*	1.62 (0.95–2.78)	1.15 (0.67–1.95)
Past participation in disaster drill (Reference: No)			
Yes	1.03 (0.65–1.61)	1.34 (0.86–2.11)	1.16 (0.74–1.84)

* $P < 0.05$, ** $P < 0.01$ with multivariable logistic regression analysis adjusted for health-related, socio-demographic, and disaster-related factors

OR odds ratio, *CI* confidence interval

[a] Household status: baseline, the number of household members (NHM) ≥3 or NHM = 2 and the partner does not need any aid; frail, NHM = 2 and either both are ≥65 years of age or the partner needs aid; younger-single, NHM = 1 and that person is <65 years of age; older-single, NHM = 1 and that person is ≥65 years of age

were generally less likely to be medically prepared than those not receiving long-term care services at all although statistical significance was only found for carrying medications (OR 0.29, 95% CI 0.11–0.79). Higher educational level was associated positively with medication stockpiles (OR 2.07, 95% CI 1.35–3.18), but negatively associated with carrying medications (OR 0.66, 95% CI 0.43–1.01) and prescription/treatment records (OR 0.55, 95% CI

0.36–0.85). Whether or not the subjects had been affected by the disaster event in which the DRA had been enacted was not clearly associated with medical preparedness, although a positive association was found between past disaster experience and medication stockpiling (OR 1.89, 95% CI 1.11–3.22).

As for general preparedness, those with poorer perceived health status were generally less prepared and the associations were statistically significant for the emergency communication plan (OR 0.60, 95% CI 0.37–1.00, Table 3). While, a positive association was found for those with a higher MHAQ score (OR 2.41, 95% CI 1.10–5.30). Those aged 65–74 years were more likely to have an emergency pack (OR 1.71, 95% CI 0.99–2.95) and an evacuation plan (OR 1.86, 95% CI 1.07–3.25) than younger subgroups. Those with higher education levels were less likely to be generally prepared than their counterparts, especially in terms of emergency communication plans (OR 0.52, 95% CI 0.31–0.89). Positive associations of past participation in drills were found on all the three general preparedness activities, while such associations were not distinct for the disaster experience.

Discussion

In this study, we examined disaster preparedness status among chronically ill patients with various health and functional conditions, focusing on patients with RA. The percentages of these patients who adopted medical and general preparedness measures were generally similar to or lower than those reported in previous studies, although each of these earlier studies used slightly different definitions of the variables [11–13, 15]. Because the subjects belonged to a patient group, the percentages could be much lower among the general population of RA patients. Therefore, public health providers, patients, and their caregivers should seriously consider these results in future planning for disaster preparedness.

One-half of the RA patients who responded to the survey questionnaire carried medication and prescription/treatment records with them, even those who had stockpiled their medications and kept records. Also, 50% of those who carried medications did not have medication stockpiles, which means that these individuals could possibly run out of medications in the case of an evacuation. Even though a relatively high percentage of the subjects kept track of their prescription/treatment records, only about 50% carried these records with them. These results suggest that people should be educated about the importance of these preparedness activities because having these records would enable them to receive their normal regimens of medications and treatment under an emergency situation [9, 10, 24].

Preparedness status varied across vulnerability status. A poorer general health was negatively associated with all of the preparedness activities except for medication stockpiling, although only carrying medications, carrying prescription/treatment records, and having an emergency communication plan were statistically significant in the multivariable analyses. These results are generally consistent with those of two prior studies [12, 13]. These results may suggest that even though those individuals with poor general health recognize their vulnerability, they may be unable to manage preparedness activities, with the exception of stockpiling their medication(s) [13].

Comorbid chronic conditions were positively associated with all of the preparedness activities, with carrying prescription/treatment records being statistically significant. This result is partially consistent with the findings of an earlier study [12], perhaps due to increased vulnerability awareness among those with multiple conditions or due to more care-dependent conditions, such as cardiac, respiratory, and renal diseases.

The increasing severity of the functional status measured by the MHAQ score was associated positively with carrying medications and prescription/treatment records, while such an association was not found for medication stockpiles. One possible reason was that those with worse functional conditions depended on their medications more than those with better functional levels. At the same time, the former see their physicians more frequently than less symptomatic patients, thereby decreasing the need for stockpiling medications.

Disability status was positively associated with medical and general preparedness, although statistical significance was achieved only for medication stockpiling. With respect to long-term care level, those with low care levels were more likely to have stockpiled their medication(s) and to carry prescription/treatment records than those who did not receive care. However, those with high care levels were generally less prepared than those who did not receive care, especially in terms of carrying medication records.

In general, older subjects were better prepared than their younger counterparts, as has been reported in previous studies [11, 13]. However, while such associations were true for the young-old (aged 65–74 years) subgroup for all preparedness activities, they were not true for the old–old (aged $\geq$75 years) for some activities, such as an evacuation plan. The young-old might be healthier than the old-old. Also, since all of the older subjects are in their post-retirement period, they might have more opportunities to communicate with physicians and others than those aged $<$65 years.

Table 3 Associations between general preparedness and patients' characteristics (n = 524)

Variable	Emergency pack OR (95% CI)	Emergency communication plan OR (95% CI)	Emergency evacuation plan OR (95% CI)
Health-related factors			
Perceived general health status (Reference: Good-excellent)			
Fair-poor	0.77 (0.48–1.23)	0.60 (0.37–1.00)*	0.77 (0.47–1.25)
Comorbid chronic conditions (Reference: 0, none)			
≥1	1.19 (0.78–1.81)	1.41 (0.90–2.19)	1.05 (0.69–1.62)
MHAQ score (0, intact; 3, severely impaired) (Reference: 0–0.375)			
0.5–1.25	1.27 (0.73–2.21)	1.63 (0.89–2.97)	0.96 (0.54–1.71)
1.375–3	0.95 (0.45–2.00)	2.41 (1.10–5.30)*	1.59 (0.75–3.37)
Physical disability (Reference: Not disabled)			
Class 3–6	1.06 (0.58–1.91)	1.69 (0.91–3.14)	1.29 (0.70–2.39)
Class 1–2	0.93 (0.52–1.65)	1.03 (0.55–1.92)	1.08 (0.59–1.97)
Long-term care level (Reference: Not received)			
Support-level 1–2	1.04 (0.61–1.78)	0.85 (0.48–1.50)	1.03 (0.53–1.97)
Level 3–5	0.89 (0.29–2.77)	1.01 (0.34–2.94)	0.62 (0.20–1.91)
Socio-demographic factors			
Gender (Reference: Female)			
Male	0.41 (0.16–1.06)	1.40 (0.61–3.19)	0.83 (0.35–1.95)
Age (years) (Reference: <65)			
65–74	1.71 (0.99–2.95)	0.93 (0.52–1.64)	1.86 (1.07–3.25)*
≥75	1.45 (0.69–3.05)	0.81 (0.37–1.77)	0.83 (0.37–1.84)
Household status [a] (Reference: Baseline)			
Frail	0.83 (0.45–1.50)	1.30 (0.70–2.39)	1.13 (0.62–2.05)
Younger-single	0.74 (0.25–2.17)	0.13 (0.02–1.03)	0.68 (0.21–2.20)
Older-single	0.89 (0.38–2.11)	0.66 (0.24–1.88)	1.10 (0.46–2.64)
Annual household income (Japanese Yen) (Reference: <3 million)			
≥3 million	0.67 (0.41–1.07)	1.12 (0.68–1.86)	0.76 (0.47–1.23)
Occupational status (Reference: Unemployed/retired)			
Employed/self-employed	1.05 (0.59–1.87)	0.87 (0.47–1.62)	0.90 (0.49–1.62)
Highest educational level (Reference: ≤high school)			
≥some college education	0.99 (0.62–1.59)	0.52 (0.31–0.89)*	0.72 (0.44–1.18)
Disaster-related factors			
Affected by the DRA-applied event (2004–2006) (Reference: No)			
Yes	1.22 (0.80–1.85)	1.10 (0.71–1.71)	1.28 (0.83–1.96)
Other disaster experience (Reference: No)			
Yes	1.01 (0.56–1.80)	0.55 (0.29–1.06)	0.71 (0.38–1.32)
Past participation in disaster drill (Reference: No)			
Yes	1.68 (1.04–2.71)*	2.01 (1.21–3.33)**	3.42 (2.10–5.56)***

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$ with multivariable logistic regression analysis adjusted for health-related, socio-demographic, and disaster-related factors

OR odds ratio, *CI* confidence interval

[a] Household status: see footnote to Table 2

In terms of household status, the younger-single subgroup was generally less prepared than other subgroups, except for the very high prevalence of those who had stockpiled their medication(s). This may be because the former were too busy managing their everyday lives to have time for more practical preparedness activities other than stockpiling medications. With respect to an emergency communication plan, it is natural that single subgroups were less prepared, but this predetermined lack of aid at the household level was not compensated by support at the community level, such as the preparation of an evacuation plan.

The positive association of higher education level with stockpiling is consistent with previous studies [11, 25]. However, for other preparedness activities, especially carrying prescription/treatment records and an emergency communication plan, the opposite associations were observed. Those with higher educational levels might not be willing to prepare for such activities because they fully understand their prescriptions and/or treatments without any written forms, and they may feel fully self-sufficient without the help of their families.

Past disaster experience had a limited effect on disaster preparedness. This finding was inconsistent with that of research carried out in the UK, in which the investigators concluded that prior experience with flooding increased individual preparedness [26]. The associations of our study may have been diluted somewhat because a subgroup that was not affected directly by a disaster may have been influenced indirectly because they lived in the same municipality that was affected by the events. On the other hand, disaster drills may improve general disaster preparedness, although this association was not found for medical preparedness. The results suggest that including medical preparedness items in plans for disaster drills could improve medical preparedness among those who need special care, including patients with chronic diseases.

Our study had a number of strengths with respect to previous studies. First, our dependent variable included the operational variables of carrying medication(s) and carrying prescription/treatment records, which had not been examined previously. Reports on experiences during Hurricane Katrina pointed out that a significant percentage of the evacuees came to shelters with no prescribed medication and/or experience with running out of medications [2, 5, 27]. Other reports have indicated that a lack of information on prescriptions and treatments during a disaster event is a barrier to refilling medications and maintaining the appropriate regimen [2]. These findings underscore the fact that it is very important for evacuees to take their medications and key medical records with them, rather than just having a stockpile of their medications, to ensure the continuity of health care during and after a disaster. Second, we subdivided the key risk factors in order to be able to more specifically identify higher risk subgroups. Previous studies commonly used dichotomous variables for disability and household status, and elderly subjects were categorized into a single subgroup of $\geq$65 years [11–13, 15]. Such rough categorizations will not provide effective information for implementing specific plans, especially in disaster-prone societies with aging populations, such as Japan and a number of other developed countries. In fact, our results suggest that the relationships between preparedness status and vulnerability factors, such as long-term care level, age, and household status, are not straightforward.

Despite these strengths, our study also has several limitations. First, the subjects were selected from a patient group, so they might be better aware of their disease and treatment compliance than other RA patients. Thus, the preparedness status among the general population of RA subjects might be worse than that presented here. Second, the causal relationships between the patient characteristics and preparedness status could not confirmed in the our study because of the cross-sectional study design. Third, data that were reported by the study subjects themselves could include some misclassifications of preparedness status, disability status, and comorbid chronic conditions. Fourth, the low response rate could have affected the findings, although the distributions of living place, sociodemographic characteristics, and disability levels of the subjects were similar to overall distributions of the patient group. Finally, since each preparedness item and vulnerability variable used in our study is different from those used in other related studies, care must be exercised in comparing our results with those of other studies.

Policy-makers can use these results to identify specific groups that need support. Enhancing mutual and/or public level preparedness as well as individual preparedness would be important for the most vulnerable subgroups, such as those with high long-term care levels, to compensate for insufficient individual preparedness. Medical and general preparedness could be improved by educating patients. The target groups of such educational programs should include hard-to-reach subgroups, such as non-elderly single and less symptomatic patients. The effects of higher educational levels and past disaster experience should not be overestimated. Since drills may be effective tools, providers should design them for those who will need special care.

Due to the chronic and progressive nature of the disease, most RA patients have experienced exacerbations and remissions. Increased pain and joint swelling as a consequence of treatment interruption could easily make these patients realize their vulnerability [28]. The insufficient level of preparedness even among the RA patients suggests a possibility of poorer preparedness among those with less symptomatic diseases, including hypertension, diabetes, and chronic renal diseases, because they would have less chance of realizing their vulnerability than those with RA [29]. Thus, the findings of this study may be applicable to other chronic conditions, although further disease-specific research is required.

This study showed that disaster preparedness was insufficient among chronically ill patients with RA, despite increasing concern about the potential threat of a disaster to medically vulnerable populations. The associations between levels of vulnerability and disaster preparedness varied with preparedness activities as well as with the

measures of vulnerability. Policy-makers and healthcare providers should give careful thought to the targets they set for disaster preparedness.

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Conflict of interest None.

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