

# Factors related to preparedness for emergency hemodialysis in the event of a natural disaster

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## Abstract

This study aimed to explore patients' preparedness for emergency hemodialysis in the event of a natural disaster and to determine the factors affecting such preparedness.

A cross-sectional study was conducted in undergoing hemodialysis at dialysis facilities in Sapporo, Hokkaido. The participants were a cohort of 256 outpatients aged 20 years or older, 186 (72.7%) were male, and the average age was 61.9 ± 10.9 years. The participants were divided into those who had prepared for emergency dialysis treatment and those who had not. Cross tabulations were performed on the 2 groups using the following participant attributes: preparedness for dialysis during a disaster, knowledge of how to protect themselves during a disaster, and intention to dialyze and evacuate during a disaster, followed by binomial logistic regression analysis.

Of the 256 study patients, 184 (71.9%) were not prepared for dialysis treatment. In logistic regression models, patients who were not prepared for dialysis treatment were found to have higher odds of being employed (odds ratio (OR): 2.469; 95% confidence interval (CI): 1.205-5.058), not being aware of disaster information acquisition methods in the event of a disaster (OR: 4.580, 95%; CI: 2.048-10.241), did not receive explanations on proper disaster response from dialysis facility staff (OR: 2.557, 95%; CI: 1.319-4.954), and believing that their family away from home would not be concerned about them (OR: 2.021; 95% CI: 1.062-3.847).

Disaster preparedness in patients undergoing dialysis remain inadequate. Dialysis facilities need to strengthen their explanations of disaster response, particularly with regard to working, middle-aged people.

**Abbreviations:** CI = confidence interval, JSDT = The Japanese Society for Dialysis Therapy, OR = odds ratio.

**Keywords:** disaster preparedness, disasters, hemodialysis, emergency

## 1. Introduction

Japan is located in the Circum-Pacific Mobile Belt, where seismic and volcanic activity occur constantly. Additionally, 70% of the mountain ranges that cover the country combined with global warming make it prone to typhoons, torrential rains, and heavy snowfall.<sup>[1]</sup> In recent years, owing to the expansion of the disaster scale, lengthening of the disaster period, and widening of the disaster area, conventional disaster countermeasures have become insufficient.

Hemodialysis is usually conducted 3 times a week, and if dialysis opportunities are lost, the mortality rate of patients increases.<sup>[2]</sup>

If their regular dialysis facilities are not available because of a disaster, dialysis opportunities for the patients are lost; as more loss is incurred, their mortality rate increases. Hemodialysis is highly dependent on water, electricity, and transportation. Therefore, the procedure cannot be easily performed during a disaster, rendering dialysis patients vulnerable to infrastructure disruptions.<sup>[3,4]</sup>

Dialysis facilities cater to 87.9% of patients in Japan, who require renal replacement therapy.<sup>[5]</sup> Therefore, it is necessary for dialysis patients to consistently visit dialysis facilities. If the patient regularly presented their dialysis conditions to the dialysis facility, smooth dialysis treatment would be possible.

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

All relevant data are within the paper and its Supporting Information files.

The authors have no funding and conflicts of interest to disclose.

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How to cite this article: Nihonyanagi R, Tsukasaki K, Itatani T, Nakai H, Toda D. Factors related to preparedness for emergency hemodialysis in the event of a natural disaster. *Medicine* 2022;101:24(e29288).

Received: 5 December 2021 / Received in final form: 25 March 2022 / Accepted: 25 March 2022

<http://dx.doi.org/10.1097/MD.00000000000029288>

The continuity of care is enhanced when medical and dialysis treatment records are readily available.<sup>[6]</sup>

Local governments and individual dialysis facilities in Japan, have formulated guidelines and manuals for disaster countermeasures.<sup>[7]</sup> However, the explanation regarding disaster preparedness for dialysis patients is inadequate.<sup>[8]</sup> After the Great Hanshin-Awaji Earthquake of 1995, many affected dialysis patients were unprepared. Based on this experience, many experts began to create a “disaster patient card” that describes the patient’s dialysis treatment conditions. Unfortunately, very few people carried them, despite experiencing the Great East Japan Earthquake.<sup>[9]</sup>

Improving disaster preparedness among hemodialysis patients requires that they understand the need to be prepared for emergency dialysis treatments. This study aimed to identify the characteristics of patients who were unprepared for emergency dialysis treatments during a disaster. Based on the results, we examined the preparedness of these patients in the event of a natural disaster.

## 2. Methods

### 2.1. Sample

This was a cross-sectional study. We asked dialysis facilities in Sapporo, Hokkaido, Japan, to introduce the survey to the subjects. Consent for research cooperation was obtained from 10 dialysis facilities. The selection criteria were as follows: outpatients, aged 20 years or older, and had undergone hemodialysis for at least 1 year. The cause or disease that led to the initiation of hemodialysis was not considered. The exclusion criteria were inpatients, peritoneal dialysis, home hemodialysis, dementia, mental illness diagnosis, or a dialysis facility manager, indicating that they would not cooperate.

### 2.2. Survey procedure

An anonymous questionnaire survey was also conducted. The procedure for obtaining informed consent was as follows. The

researchers asked the department head of the dialysis facility to select candidates who met the selection criteria. The dialysis department head provided the candidates with a verbal overview of the study. The researchers explained the purpose, methods, and ethical considerations of the study to candidates who agreed to listen to the researcher’s explanation. Additionally, they were asked to look at the survey form. The researchers asked candidates to submit completed survey forms only if they were willing to participate in the survey. Candidates who agreed to participate received the survey form along with an envelope to submit it in. The envelope with the completed survey form was sealed by the candidates themselves, submitted to the dialysis facility staff, and later collected by the researchers. The data collection period was from September 2017 to September 2018.

### 2.3. Survey form

A preliminary survey was conducted on 7 dialysis patients. The survey was revised to reflect feedback from the draft survey patients by correcting difficult-to-understand sentences and content.

### 2.4. Survey items

**2.4.1. Participant attributes (Table 1).** The measured attributes of the participants were age, dialysis history, sex, employment outside the home, family composition, evacuation experience, and daily outdoor activities.

**2.4.2. Dialysis-specific disaster preparedness (Table 2).** The survey items for dialysis-specific disaster preparedness were created based on the National Kidney Foundation’s Emergency Plan<sup>[10]</sup> and the Japanese Society for Dialysis Therapy’s (JSDT) announcement, “For patients undergoing dialysis-preparedness for disasters”.<sup>[11]</sup>

There were 10 dialysis-specific disaster preparedness items: whether the patients had prepared methods to acquire disaster information in a disaster; prepared oral medications (in case of emergency relocation), prepared a drug history book, prepared a

**Table 1**  
Subjects’ attribute differences and activities of daily living according to whether dialysis treatment conditions were prepared (n = 256).

		All (n = 256)	Dialysis treatment conditions		Test statistic	P value
			Prepared (n = 72)	Not prepared (n = 184)		
Age	Over 65 (Elderly)	115 (44.9)	45 (62.5)	70 (38.0)	$\chi^2 = 12.510$	<.001 1)***
	Younger than 65	141 (55.1)	27 (37.5)	114 (62.0)		
Dialysis history (yrs)		10.5 ± 9.9	9.1 ± 9.2	11.1 ± 10.1	t = -1.462	.145 2)
Sex	Male	186 (72.7)	52 (72.2)	134 (72.8)	$\chi^2 = 0.009$	.922 1)
	Female	70 (27.3)	20 (27.8)	50 (27.2)		
Availability of work	Working	118 (46.1)	20 (27.8)	98 (53.3)	$\chi^2 = 13.525$	<.001 1)***
	Not working	138 (53.9)	52 (72.2)	86 (46.7)		
Family composition	Households ≥ 2 people	196 (76.6)	56 (77.8)	140 (76.1)	$\chi^2 = 0.082$	.774 1)
	Alone	60 (23.4)	16 (22.2)	44 (23.9)		
Evacuation experience	No experience	230 (89.8)	66 (91.7)	164 (89.1)	$\chi^2 = 0.365$	.546 1)
	Experienced	26 (10.2)	6 (8.3)	20 (10.9)		
Moving outdoors	Alone	242 (94.5)	64 (88.9)	178 (96.7)	.027	3)*
	Not alone	14 (5.5)	8 (11.1)	6 (3.3)		

Data given as means ± SD or as the number of subjects in each group, with percentages in parenthesis as appropriate.

1)  $\chi^2$  test.

2) *t* test.

3) Fisher exact test.

\*  $P < .05$ .

\*\*\*  $P < .001$ .

**Table 2**  
**Dialysis-specific differences in disaster preparedness according to whether dialysis treatment conditions were prepared (n=256).**

		Dialysis treatment conditions			Test statistic	P value	
		All (n=256)	Prepared (n=72)	Not prepared (n=184)			
Prepared methods to acquire disaster information when needed	Considered	170 (66.4)	62 (86.1)	108 (58.7)	$\chi^2 = 17.435$	<.001	1)***
	Not considered	86 (33.6)	10 (13.9)	76 (41.3)			
Prepared oral medication	Prepared for a few days or ready to take them immediately	222 (86.7)	67 (93.1)	155 (84.2)	$\chi^2 = 3.493$	.062	1)
	Not prepared	34 (13.3)	5 (6.9)	29 (15.8)			
Prepared drug history book	Prepared	139 (54.3)	53 (73.6)	86 (46.7)	$\chi^2 = 15.059$	<.001	1)***
	Not prepared	117 (45.7)	19 (26.4)	98 (53.3)			
Prepared medical examination ticket	Prepared	93 (36.3)	41 (56.9)	52 (28.3)	$\chi^2 = 18.407$	<.001	1)***
	Not prepared	163 (63.7)	31 (43.1)	132 (71.7)			
Contact information of dialysis facilities	Prepared	243 (94.9)	71 (98.6)	172 (93.5)		.119	2)
	Not prepared	13 (5.1)	1 (1.4)	12 (6.5)			
Consulted dialysis facilities about proper disaster procedures	Discussing	38 (14.8)	19 (26.4)	19 (10.3)	$\chi^2 = 10.563$	.001	1)**
	Not discussing	218 (85.2)	53 (73.6)	165 (89.7)			
Determined alternate routes for dialysis facilities' mobility	Already determined	58 (22.7)	26 (36.1)	32 (17.4)	$\chi^2 = 10.349$	.001	1)**
	Not yet determined	198 (77.3)	46 (63.9)	152 (82.6)			
Participated in disaster training at dialysis facility	Participated	56 (21.9)	20 (27.8)	36 (19.6)	$\chi^2 = 2.042$	.153	1)
	Not participated	200 (78.1)	52 (72.2)	148 (80.4)			
Received explanations on proper disaster response from dialysis facility's staff	Explained	68 (26.6)	31 (43.1)	37 (20.1)	$\chi^2 = 13.969$	<.001	1)***
	Not explained or don't remember	188 (73.4)	41 (56.9)	147 (79.9)			
I think my family away from home will be concerned about me	Yes	128 (50.0)	45 (62.5)	83 (45.1)	$\chi^2 = 6.261$	.012	1)*
	No	128 (50.0)	27 (37.5)	101 (54.9)			

Data given as the number of subjects in each group, with percentages in parenthesis as appropriate.

1)  $\chi^2$  test.

2) Fisher exact test.

\*  $P < .05$ .

\*\*  $P < .01$ .

\*\*\*  $P < .001$ .

medical examination ticket, assembled contact information of dialysis facilities, consulted dialysis facilities about proper disaster procedures, determined alternative transport routes and means to use if necessary during a disaster; participated in disaster training at a dialysis facility; received explanations on proper disaster response from dialysis facility staff; and their opinion about the statement, "I think my family away from home will be concerned about me."

**2.4.3. Knowledge on how to protect themselves in a disaster (Table 3).** The survey items covering the patients' knowledge about protecting themselves in a disaster were created based on the National Kidney Foundation's Emergency Plan<sup>[10]</sup> and the JSDT's announcement, "For patients undergoing dialysis-preparedness for disasters".<sup>[11]</sup>

There were 13 items on knowledge relating to protect themselves in a disaster: knowledge of how many kilograms they would normally gain from dry weight; knowledge of

contraindicated drugs; knowledge of their own blood test results for hepatitis B and C; knowledge that dialysis time could be shortened in the event of a disaster; knowledge that they would hold the blood circuit during dialysis in an earthquake; knowledge that they would use a futon during dialysis in an earthquake; knowledge that they would grab the bed fence during dialysis in an earthquake; knowledge that they would sleep in the bed while swaying in an earthquake; knowledge on how to urgently withdraw from dialysis in the event of a disaster; knowledge on the evacuation route for the dialysis facility; knowledge of the proper energy intake if they cannot perform dialysis as usual; knowledge of the proper salt intake if they cannot perform dialysis as usual; and knowledge of the proper potassium intake if they cannot perform dialysis as usual.

**2.4.4. Intention to dialyze and evacuate in the event of a disaster (Table 3).** The survey items on the intention to dialyze and evacuate in the event of a disaster were created based on the

**Table 3****Differences in disaster preparedness: knowledge on how to protect themselves in a disaster and intentions to continue dialysis and evacuate (n = 256).**

		All (n = 256)	Dialysis treatment conditions		Test statistic	P value
			Prepared (n = 72)	Not prepared (n = 184)		
Knowledge of how to protect self in a disaster						
Knows how many kilograms they would normally gain from dry weight	I know	246 (96.1)	69 (95.8)	177 (96.2)		1 1)
	I don't know	10 (3.9)	3 (4.2)	7 (3.8)		
Knows about their own contraindicated drugs	I know	121 (47.3)	40 (55.6)	81 (44.0)	$\chi^2 = 2.762$	.097 2)
	I don't know	135 (52.7)	32 (44.4)	103 (56.0)		
Knows their own blood test results for hepatitis B and C	I know	150 (58.6)	46 (63.9)	104 (56.5)	$\chi^2 = 1.158$	.282 2)
	I don't know	106 (41.4)	26 (36.1)	80 (43.5)		
Knows dialysis time could be shortened in a disaster	I know	139 (54.3)	46 (63.9)	93 (50.5)	$\chi^2 = 3.714$	.054 2)
	I don't know	117 (45.7)	26 (36.1)	91 (49.5)		
Knows they would hold the blood circuit during dialysis in an earthquake	I know	49 (19.1)	22 (30.6)	27 (14.7)	$\chi^2 = 8.434$	.004 2)**
	I don't know	207 (80.9)	50 (69.4)	157 (85.3)		
Knows they would use a futon during dialysis in an earthquake	I know	41 (16.0)	18 (25.0)	23 (12.5)	$\chi^2 = 6.012$	.014 2)*
	I don't know	215 (84.0)	54 (75.0)	161 (87.5)		
Knows they would grab the bed fence during dialysis in an earthquake	I know	42 (16.4)	19 (26.4)	23 (12.5)	$\chi^2 = 7.279$	.007 2)**
	I don't know	214 (83.6)	53 (73.6)	161 (87.5)		
Knows they would sleep in bed while swaying in an earthquake	I know	75 (29.3)	26 (36.1)	49 (26.6)	$\chi^2 = 2.246$	.134 2)
	I don't know	181 (70.7)	46 (63.9)	135 (73.4)		
Knows how to urgently withdraw from dialysis in a disaster	I know	78 (30.5)	27 (37.5)	51 (27.7)	$\chi^2 = 2.338$	.126 2)
	I don't know	178 (69.5)	45 (62.5)	133 (72.3)		
Knows the evacuation route for the dialysis facility	I know	115 (44.9)	43 (59.7)	72 (39.1)	$\chi^2 = 8.869$	.003 2)**
	I don't know	141 (55.1)	29 (40.3)	112 (60.9)		
Knows proper energy intake if they cannot perform dialysis as usual in the evacuation center.	Increase or keep same	142 (55.5)	40 (55.6)	102 (55.4)	$\chi^2 = 0.000$	.986 2)
	Reduce or I don't know	114 (44.5)	32 (44.4)	82 (44.6)		
Knows proper salt intake if they cannot perform dialysis as usual in the evacuation center.	Reduce	186 (72.7)	51 (70.8)	135 (73.4)	$\chi^2 = 0.168$	.682 2)
	Increase or keep same or I don't know	70 (27.3)	21 (29.2)	49 (26.6)		
Knows proper potassium intake if they cannot perform dialysis as usual in the evacuation center.	Reduce	184 (71.9)	52 (72.2)	132 (71.7)	$\chi^2 = 0.006$	.938 2)
	Increase or keep same or I don't know	72 (28.1)	20 (27.8)	52 (28.3)		
The intention to dialyze and evacuate in the event of disasters						
Do you want to tell the medical staff at the disaster shelter that you are on dialysis?	Yes, I do	233 (91.0)	67 (93.1)	166 (90.2)	$\chi^2 = 0.510$	.475 2)
	No, I don't or I don't know	23 (9.0)	5 (6.9)	18 (9.8)		
Do you want to undergo dialysis at another facility if the dialysis facility was damaged?	Yes, I do	224 (87.5)	60 (83.3)	164 (89.1)	$\chi^2 = 1.590$	.207 2)
	No, I don't or I don't know	32 (12.5)	12 (16.7)	20 (10.9)		
Do you want to evacuate if "preparation for evacuation/start of evacuation for the elderly" was announced?	"Want to evacuate" or "Want to evacuate if there is support"	215 (84.0)	67 (93.1)	148 (80.4)	$\chi^2 = 6.128$	.013 2)*
	"Don't want to evacuate" or "Give up on evacuation"	41 (16.0)	5 (6.9)	36 (19.6)		

Data given as the number of subjects in each group, with percentages in parenthesis as appropriate.

1) Fisher exact test.

2)  $\chi^2$  test.\*  $P < .05$ .\*\*  $P < .01$ .

National Kidney Foundation's Emergency Plan<sup>[10]</sup> and the JSDT's announcement, "For patients undergoing dialysis-preparedness for disasters."<sup>[11]</sup>

There were 3 items on the intention to dialyze and evacuate in the event of a disaster: "Do you want to tell the medical staff at the disaster shelter that you are on dialysis?"; "Do you want to undergo dialysis at another facility if your usual dialysis facility is damaged?"; and "Do you want to evacuate if "preparation for evacuation/start of evacuation for the elderly" was announced?".

### 2.5. Analyses

In this study, preparedness for emergency dialysis treatment was the dependent variable. The individual treatment specifications were the type of dialyzer, dialysate, blood access, anticoagulant, puncture site, blood flow rate, and dialysis time.

The participants were divided into 2 groups: those who had prepared for emergency dialysis treatment and those who had not. For both groups, cross-tabulation was performed using the participants' demographic attributes, dialysis-specific disaster preparedness, knowledge on how to protect themselves in a disaster, and intention to dialyze and evacuate in a disaster. Chi-square and Fisher exact tests were used for the statistical analyses.

Binomial logistic regression analysis was performed after adjusting for age and sex. The dependent variable was whether the patient had prepared for emergency dialysis treatment (1: not prepared, 0: prepared). The independent variables were the following items, for which significant differences were observed in the cross-tabulation: age (over 65, younger than 65); sex (male, female); availability of work (working, not working); prepared disaster information acquisition methods (considered, not considered); determined alternate routes/transport to the dialysis facilities if the usual route could not be used (have determined, have not determined); received explanations on how to respond to disasters from dialysis facility staff (explained, not explained); opinion on the statement, "I think my family away from home will be concerned about me"; knowledge that they would hold the blood circuit during dialysis in an earthquake; knowledge on the evacuation route in the dialysis facility; and response to the question, "Do you want to evacuate if "preparation for evacuation/start of evacuation for the elderly" is announced?".

A stepwise method was used for the binomial logistic regression analysis. The  $\phi$  coefficient between the independent variables was used in the logistic regression analysis and no multicollinearity was confirmed.

SPSS for Windows, Version 26.0 (SPSS Inc., Chicago, IL) was used for all data input and statistical analyses. The significance level was set at  $P < .05$ . To achieve 80% power to detect an effect size, it would be sufficient to have a total sample size of  $n = 104$  or  $n/2 = 57$  in each group.

### 2.6. Ethical considerations

This study was approved by the Kanazawa University Medical Ethics Review Committee (Examination No. 675) and the Hokkaido University of Science Ethics Committee (Application No. 188).

## 3. Results

A total of 363 survey forms were distributed to 363 respondents, of which 335 participants submitted the forms. A total of 256 (76.4%) participants responded to all questions in the survey form.

Table 1 shows the attribute differences and activities of daily living according to the preparedness for emergency dialysis treatment conditions. Of these, "younger than 65 years of age", "working group", and "able to move outdoors alone" were significantly related to participants who had not been prepared for emergency dialysis treatment. The number of male participants were 186 (72.7%), which is higher than the percentage of male dialysis patients in Japan (65.7%). Of these, 118 (46.1%) were working; of these 118 workers, 91 (77.1%) were younger than 65.

Table 2 shows the dialysis-specific differences in disaster preparedness according to emergency dialysis treatment conditions. Of these, no preparedness of methods to acquire disaster information when needed were significantly related to participants who had not been prepared for emergency dialysis treatment. The lack of preparation for drug history books and medical examination tickets also affected preparedness for emergency dialysis treatment. Participants who had not consulted their dialysis facility about proper disaster procedures were significantly less prepared for emergency dialysis than those who had, and those who had not determined alternate routes for dialysis facilities' mobility were significantly less prepared than those who had. Explanations of proper disaster response from dialysis facility staff were significantly associated with preparedness for emergency dialysis treatment. Those who did not think their family away from home would be concerned about them were significantly less prepared for emergency dialysis than those who did.

Of those with knowledge of how to protect oneself in a disaster, those who did not know how to "hold a blood circuit", "use a futon", and "grab a bed fence" during an earthquake were significantly less prepared for emergency dialysis than those who did know how to do so. Not knowing the evacuation route for a dialysis facility also affected emergency dialysis preparedness. Among the intentions to dialyze and evacuate in the event of disasters, only reluctance to evacuate when an announcement was made to prepare for/start evacuation of the elderly was significantly associated with preparedness for emergency dialysis (Table 3).

Table 4 shows factors related to preparedness for dialysis condition. The dependent variable was "prepared/not prepared for emergency dialysis treatment conditions". A total of 184 (71.9%) patients had not been prepared, while 72 (28.1%) had been prepared.

The independent variable showed a significant difference in cross-tabulation. The following variables were excluded: variables with 20% or more cells, with a minimum expected frequency of less than 5, variables not specific to disaster preparedness, and variables not specific to dialysis.

The variables for which the partial regression coefficient was significant were: "availability of work" (odds ratio (OR): 2.469; 95% confidence interval (CI): 1.205-5.058), "prepared disaster information acquisition methods in the event of a disaster" (OR: 4.580, 95%; CI: 2.048-10.241); "received explanations on how to respond to disasters from dialysis facility staff" (OR: 2.557, 95%; CI: 1.319-4.954); and opinion of the statement, "I think my family away from home will be concerned about me" (OR: 2.021; 95% CI: 1.062-3.847).

**Table 4**  
**Result of binomial logistic regression analysis with dialysis treatment conditions (1: not prepared 0: prepared) as the dependent variable (n = 256).**

Variables	Comparison category/base category	B	Odds ratio	95% confidence intervals	P value
Age	0: Over 65 (Elderly) 1: Younger than 65	0.589	1.803	0.914-3.558	.089
Sex	0: Male; 1: Female	0.582	1.789	0.853-3.753	.124
Availability of work	0: Working; 1: Not working	0.904	2.469	1.205-5.058	.014
Prepared means of acquiring disaster information in a disaster	0: Considered; 1: Not considered	1.522	4.580	2.048-10.241	<.001
Determined alternate route to the dialysis facilities if the usual route could not be used	0: Have already determined 1: Have not determined	0.681	1.976	0.998-3.912	.051
Received explanations on how to respond to disasters from a dialysis facility's staff	0: Explained 1: Not explained/I don't remember	0.939	2.557	1.319-4.954	.005
I think my family away from home will be concerned about me	0: Yes; 1: No	0.704	2.021	1.062-3.847	.032

Contribution (R2 value): 0.290; Accuracy: 77.7 using Hosmer and Lemeshow test; chi-square = 10.045 ( $P = .262$ ,  $df = 8$ ).

Adjusted for age and sex.

Independent variable not contained in the table.

Consulted the dialysis facilities about what to do in a disaster (0: Discussed; 1: Not Discussed).

Do you want to evacuate if "preparation for evacuation/start of evacuation for the elderly" is announced? (0: "Want to evacuate" or "Want to evacuate if there is support"; 1: "Don't want to evacuate" or "Give up on evacuation").

Knows they would hold the blood circuit during dialysis in an earthquake (0: I know; 1: I don't know).

Knows the evacuation route for dialysis facility (0: I know; 1: I don't know).

\*  $P < .05$ .

\*\*  $P < .01$ .

\*\*\*  $P < .001$ .

## 4. Discussion

### 4.1. Working people in the middle-aged group were not prepared for emergency dialysis treatment

Approximately 70% of hemodialysis patients have not prepared emergency dialysis treatment conditions. In a study conducted in North Carolina,<sup>[12]</sup> only about 42% of patients undergoing dialysis had made adequate preparations for emergency dialysis, similar to the findings of the present study.

Disasters impose a heavy long-term burden on patients with end-stage renal failure who require hemodialysis. For example, in a disaster such as a nuclear disaster, where mandatory evacuation orders are issued, people are forced to relocate multiple times to receive dialysis. Furthermore, in rural areas, access to health care for dialysis is suboptimal in the long term, indicating vulnerability to exogenous factors such as heavy snowfall.<sup>[13]</sup>

Working people were less likely to have prepared emergency dialysis treatments than were non-working people. Most of the working people were presumed to be middle-aged (younger than 65). In this study, the proportion of working people was higher in the middle-aged group than in the elderly group; younger people tended to be less prepared for disasters. The White Paper on Disaster Prevention (2016),<sup>[14]</sup> which summarized Japan's existing disaster prevention plans and measures, showed that the older the age group, the more likely they were to prepare for disasters. The results of this study concur with this finding. A possible reason for this is that workers in the middle-aged group felt that they did not have time to prepare.

According to the Basic Survey on Social Life, men in their 30s to 50s spend approximately one-third of their day at work. Patients spend a lot of time on dialysis visits.<sup>[15]</sup> According to the

Japan Dialysis Medical Association Statistical Survey Report (2019), 87.9% of patients underwent outpatient hemodialysis. The data reported here were obtained from the JSDT.<sup>[5]</sup> The interpretation and reporting of these data are the responsibility of the authors and should not be interpreted as an official policy or an interpretation of the JSDT.

In a survey on Japanese people's thoughts about time, 67.9% of the elderly group (aged 65 and over) answered the question, "Do you feel you have plenty of time?" by saying, "I have plenty of time" or "If anything, I have time".<sup>[16]</sup> However, among those aged 30 to 49 years, only 29.5% felt that they had "plenty of time", and among those aged 50 to 64 years, 43.0% felt that they had "plenty of time". Thus, we can infer that the low proportion of working people in this study who had prepared for emergency dialysis treatment was due to their perception that they did not have sufficient time to prepare. Therefore, to promote disaster preparedness for emergency dialysis treatment, we need to find ways to streamline the preparation process to accommodate the patients' limited free time.

### 4.2. How can disaster preparedness for dialysis patients be strengthened?

The National Kidney Foundation in the United States issued guidelines for dialysis patients to prepare for emergencies related to dialysis treatment. The guidelines recommend keeping a copy of the patient's important medical information at home and at work (if they work outside the home). The foundation recommends using and regularly updating the form of treatment information. In Japan, JSDT recommends carrying a "dialysis notebook" and a "medicine notebook". Furthermore, local governments and dialysis facilities could issue their own dialysis cards, dialysis logs, medication checklists, or notebooks.<sup>[17]</sup>

However, at present, the use of dialysis notebooks is up to the individual in both the United States and Japan. Workers in the middle-aged group are likely to feel that they lack sufficient time to prepare and maintain a dialysis notebook independently. Thus, dialysis facilities, agencies, and governments should be encouraged to promote preparedness. They should provide downloadable templates that individuals could use to record their data and disaster-preparedness checklists that patients undergoing dialysis can follow to prepare and protect themselves.<sup>[18]</sup>

#### 4.3. What kind of work is needed?

Research shows that it is effective for dialysis facilities to clearly explain to patients what information they should have readily accessible in the event of a disaster. In this study, those who answered that they had not received or did not remember any disaster response or preparedness information from the dialysis facility were not prepared for emergency dialysis treatment. Sugisawa et al<sup>[8]</sup> revealed that those who had received an explanation of earthquake preparedness from a dialysis facility were better prepared for earthquakes than those who had not. Those who believe they have insufficient free time to prepare should be given assistance and provided with simple forms and instructions to streamline the process. For example, they should ensure that their dialysis logs are updated during dialysis sessions. Disaster-preparedness education through e-learning during the sessions could also help.

After Hurricane Sandy, approximately 80% of dialysis patients at the local US facilities that distributed dialysis emergency packets, such as dialysis unit phone numbers, alternative dialysis center phone numbers, and home drug lists, were able to maintain prepared emergency dialysis treatments at home.<sup>[19]</sup> Therefore, providing patients with a list of items that need to be prepared can enhance their preparedness.

Patients undergoing dialysis are particularly vulnerable to disasters. The 2016 White Paper on Disaster Prevention published statistics on how to grasp the possibility of disaster occurrence and gain awareness of disaster preparedness.<sup>[14]</sup> According to the report, people who believe that a disaster is “not very likely” are less prepared for one. Conversely, those who were aware of the possibility of an earthquake had both supplies and plans in place for a disaster.<sup>[20]</sup> We need to educate hemodialysis patients on how to respond to disasters.

We also believe that it is necessary to focus on cognitive factors related to disaster preparedness. According to a study that investigated the level of disaster preparedness and its related factors in dialysis facilities in Japan, the self-efficacy of key persons in disaster preparedness in dialysis facilities had a significant impact on the 4 domains (patient, administration, network, and safety) of disaster preparedness. Furthermore, support from key persons in disaster preparedness in dialysis facilities in Japan had significant influences on 3 dimensions, excluding the safety domain. The results suggest the need to strengthen the system to improve the cognitive factors of key persons in disaster preparedness in dialysis facilities.<sup>[21]</sup>

In this study, those who did not expect safety confirmation from family members living separately were not prepared for dialysis treatment. Sugisawa et al<sup>[8]</sup> found that information provided by family and friends had a significant impact on compliance with more earthquake preparedness items.<sup>[8]</sup> These results suggest that close relationships with family members who

do not necessarily live together could play a role in disaster preparedness among dialysis patients.

This study found that those who had not thought about how to obtain disaster information were not prepared for emergency dialysis treatment. Knowledge on obtaining information about an ongoing disaster was investigated, and it was clear that many patients undergoing hemodialysis did not know how to stay apprised when power was lost, broadcasts (radio, television) were disrupted, and cell phones and the Internet were not working. The methods for obtaining information differ depending on the scale and location of the disaster. Future surveys are needed to clarify the effectiveness of each method for obtaining information.

This study had several limitations. First, the sample size was small. Second, the people who responded to the questionnaire may have given their preferred answers rather than truthful answers. This may have introduced bias in the results of this study. Finally, the results of this study are based on a population living in 1 area. Therefore, it is not possible to generalize the results to different populations.

## 5. Conclusions

Disaster preparedness in patients undergoing dialysis is inadequate. It is necessary to encourage dialysis facilities and local governments to promote and assist with preparedness, rather than leave it entirely up to individuals. Dialysis facilities need to strengthen their explanations of disaster response, particularly for working middle-aged people. Dialysis centers should consider developing templates of simple, downloadable forms for recording dialysis specifics (e.g., the type of dialyzer, dialysate, blood access, anticoagulant, puncture site, blood flow rate, and dialysis times), medication lists (e.g., current medications, contraindicated medications, etc), and contact information and directions (e.g., dialysis centers, transportation, emergency services, etc). They should also provide training on disaster preparedness, dialysis record keeping, and other related information that can be shared during dialysis sessions.

We must do more to help dialysis patients prepare for dialysis treatments during disasters. Patients undergoing dialysis are especially vulnerable in the event of a disaster because their treatments are dependent on technology and infrastructure, such as electricity, water, and transportation. Because disasters occur frequently and can happen anytime and anywhere, patients undergoing hemodialysis must be educated on how to respond to them.

## Acknowledgments

We would like to thank the participants undergoing dialysis and the dialysis facilities for their cooperation in the survey. We would like to thank Editage (www.editage.com) for the English language editing. In addition, this thesis is an application for degree of Doctor of Philosophy.

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