ORIGINAL RESEARCH

Factors Related to Furniture Anchoring: A Method for Reducing Harm During Earthquakes

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ABSTRACT

Objective: Fatalities and injuries during an earthquake can be reduced by taking preemptive measures beforehand, and furniture anchoring is an important safety measure for all residents. This study sought to clarify the factors associated with furniture anchoring within the home.

Methods: A self-administered mail survey was completed from July to August 2010 by 3500 men and women between the ages of 20 and 69 years who were chosen at random from an official government resident registry of 2 cities in Japan.

Results: Of the 1729 valid responses, 37.1% reported furniture anchoring. An association with furniture anchoring was observed for having viewed earthquake intensity maps or damage predictions (odds ratio [OR] 1.92, 95% CI 1.54-2.39), expressing concern about a future earthquake (OR 2.07, 95% CI 1.36-3.15), feelings of urgency (OR 1.90, 95% CI 1.47-2.45), accuracy of the government disaster preparedness information (OR 1.68, 95% CI 1.17-2.42), knowledge of the meaning of emergency earthquake warnings (OR 1.67, 95% CI 1.12-2.48), and participation in voluntary disaster preparedness activities (OR 1.40, 95% CI 1.12-1.75).

Conclusions: Furniture anchoring was found to be associated with risk awareness, risk perception, disaster preparedness information provided by government to residents, knowledge of earthquakes, participation in voluntary disaster preparedness activities, nonwooden structures, and marital status. An increase in furniture anchoring is important and can be achieved through education and training in daily life.

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Key Words: earthquakes, furniture anchoring, risk awareness, risk perception, government disaster preparedness information

Japan is located on the Pacific Ring of Fire and has a considerable amount of seismic activity. Between 1994 and 2003, 20% of earthquakes worldwide with a magnitude of 6.0 or higher occurred in or close to Japan. Furthermore, between 1993 and 2009, 18 earthquakes with a magnitude of 6.0 or higher occurred in Japan, resulting in 6788 deaths and missing persons.[1] In March 2011, the Great East Japan Earthquake and the subsequent tsunami left 19 845 dead or missing.[2]

Given these circumstances, national and regional organizations such as governmental departments, related institutions, and citizen groups regularly engage in efforts related to disaster mitigation to reduce earthquake damage by the greatest extent possible. Disaster mitigation encompasses a range of techniques including furniture anchoring, which entails securing furniture and large home appliances to prevent them from falling over. Furniture anchoring is a disaster mitigation technique that reduces harm to people when an earthquake occurs; past earthquakes have demonstrated that falling furniture is a factor in many fatalities and injuries. In the Great Hanshin Awaji Earthquake that struck Kobe, Japan, in 1995, 87.8% of the 5202 deaths and many of the 43 800 injuries were caused by falling furniture or collapsing rooftops.[3] Moreover, of the main earthquakes that occurred in Japan between July 2003 and June 2008, falling furniture was a factor in approximately 30% to 50% of injuries.[4] According to research of the 1990 Luzon, Philippines, Great Earthquake, 34% of injuries were caused by falling bookshelves, and another 30% were caused by people being crushed under heavy objects.[5] Because fatalities and injuries during an earthquake can be reduced by taking preemptive measures, furniture anchoring is an important task for all residents of Japan.

Similar to countermeasures for falling furniture, architectural design and retrofitting based on new earthquake-resistant building codes are also under way in Japan and the United States to address causes of harm from collapsing rooftops. However, buildings with earthquake-resistant designs are constructed to flex and sway to circumvent structural failure and collapse; evidence from the Northridge Earthquake suggests that the danger of harm is actually greater in such buildings due to falling objects and shaking.[6] Therefore, furniture anchoring has become even more important for reducing the chance

of harm to people in buildings featuring current earthquake-resistant designs.

Government and community organizations in Japan are currently promoting furniture anchoring through various risk communication activities. These activities provide public service messages, education, and training to residents and are designed to communicate knowledge and techniques related to risks of future earthquakes.

Risk communication is defined as an interactive process of exchanging information and opinions among risk assessors, risk managers, and other interested parties.[7] Rowan proposed a model describing phases of risk communication designed for promoting risk mitigation behavior.[8] These phases involve establishing credibility, raising awareness of risk, deepening understanding of risk, gaining understanding of solutions, and enacting risk prevention techniques.

Slovic has described perceptions of risk as 2 types of subjective factors: dread risk factors and unknown risk factors.[9,10] However, no research has elucidated the factors associated with actual furniture anchoring behavior and the influence on factors. Thus, the purpose of the study was to reveal the factors associated with the practice of furniture anchoring.

METHODS

Participants

The participants in this study were 3500 men and women between the ages of 20 and 69 years who were randomly chosen from an official government resident registry for 2 cities in Shizuoka Prefecture, Japan. Anonymous questionnaires were mailed to each participant, and the questionnaires were collected by mail after being completed by the participants. Owing to missing or changed addresses, surveys could not be delivered to 54 individuals, resulting in a final figure of 3446 who were actually surveyed. The survey period ranged from July to August 2010.

The Shizuoka area was selected for this study for several reasons. Current research holds that a large-scale earthquake, exceeding magnitude 8.0, will occur with its epicenter at the boundary of tectonic plates in the ocean region of Suruga Bay, which lies in Shizuoka, a prefecture of Japan's Tokai region. This predicted earthquake, which has tentatively been named the Tokai Earthquake, is expected because strain energy has accumulated in the earth's crust in the Suruga Bay region. Also, 150 years have elapsed since the last major earthquake in this region, which has witnessed a major earthquake every 100 to 150 years. Therefore, a massive earthquake is expected to occur in this area at any time.[11] The anticipated damage from such an earthquake is expected to extend over a large area, with a maximum number of fatalities ranging from 7900 to 9200.[12] On the basis of these predictions, the Shizuoka area was selected as the study site, given its location within a targeted anti-earthquake zone, featuring a potentially high rate of furniture anchoring.

The survey contains questions on basic information and about the Tokai Earthquake. Basic information includes sex, age, occupation, educational attainment, household composition, marital status, subjective economic status, type of residence, whether the respondent personally requires special assistance, whether other members of the respondent's household require special assistance, whether the respondent's place of residence is in a high-risk area, whether the respondent engages in furniture anchoring, and, if not, reason for not anchoring. High-risk areas refer to the communities of respondents that had a high collection of buildings, steep land including cliffs, close proximity to the ocean or rivers, or soft ground. Based on Japanese Cabinet guidelines, "residents requiring special assistance" are defined as the elderly ($\geq$75 years old), those requiring nursing care, foreign nationals, infants, and pregnant women.[13]

Items associated with a future earthquake covered earthquake risk awareness, risk perception, earthquake knowledge (earthquake intensity, earthquake prediction information, and emergency earthquake warnings), disaster preparedness information from government to residents, the status of regional disaster preparedness activities, and the status of disaster preparedness activities at places of work and schools. Risk awareness was discerned by assessing whether the participant had viewed an earthquake intensity map or damage predictions, and whether the participant knew the estimated earthquake intensity and the potential damage within the neighborhood. Perceptions of risk were assessed by looking at the respondent's concern about a future earthquake, feelings of anxiety, feelings of urgency, feelings of fear, predicted time frame in which an earthquake is most likely to occur, predicted material damage to their dwelling, and predicted human damage to themselves and their families. For the disaster preparedness information provided by the government to residents, the credibility, accuracy, and level of understanding of government information, as well as whether the residents obtained ample information, were asked.

Earthquake prediction information was acquired from information relating to the Tokai Earthquake from tectonic plate strain monitors for plate slippage.[11] Furthermore, emergency earthquake warnings referred to predictions and warnings based on observed data from earthquake monitors near the epicenter of an earthquake; these warnings are quickly dispatched to areas that are calculated to be hit by strong tremors and are used to predict the intensity and estimated arrival time of such tremors.[11] This research was conducted with the consent of the Hamamatsu University School of Medicine Ethics Committee (No. 22-23).

Analysis

After computing some basic statistics, χ^2 tests were performed to assess the associations between the various items and furniture anchoring. Furthermore, crude and adjusted odds ratios (ORs) and 95% CIs were calculated using logistic regression analysis; sex, age, educational attainment, household composition, subjective economic status, and possession of residence were included in the models for the adjusted ORs. The level of significance was $P < .05$.

The statistical analysis software package SPSS for Windows (version 17.0) was used for the analysis.

RESULTS

Of the 1735 questionnaires returned, there were 1729 valid responses; 6 were excluded because of missing responses, giving an effective response rate of 50.2%.

Table 1 lists the basic items of the survey and the status of furniture anchoring. Respondents were 51.9% men and 48.1% women, and the average age with standard deviation was 50.1 ± 12.6 years. Furniture anchoring was reported by 37.1% of the applicants. The top 3 reasons for not anchoring were apathy due to the hassle involved (22.5%), monetary costs (11.0%), and potential scratching of furniture to rooms (10.3%).

Table 2 shows the association of furniture anchoring with basic information items. Furniture anchoring was higher for owned homes than for rented ones (39.9% vs 28.9%) and higher for nonwooden structures than for wooden structures (41.3% vs 36.9%). Married respondents, cohabiting husband and wife, and those with higher income reported a higher rate of furniture anchoring (40.0%, 41.2%, and 41.4%, respectively).

Table 3 shows the association of furniture anchoring with earthquake-related items. A high incidence of furniture anchoring was observed for respondents who had viewed earthquake intensity maps or damage predictions (48.5%), those who knew estimated earthquake intensity in their residential neighborhood (44.4%), and those who knew potential damage to their residential neighborhood (43.9%). A high incidence of furniture anchoring was also reported for those expressing a sense of urgency about earthquakes (40.9%), anxiety (38.8%), concern about earthquakes (38.6%), and fear of an earthquake occurring (37.7%). When asked about the time frame in which an earthquake is most likely to occur, the highest response was within 9 years (43.7%). A high incidence of furniture anchoring was reported by respondents who understood the meaning of emergency earthquake warnings (38.0%) and the meaning of earthquake intensity, earthquake magnitude, and seismic fault activity (37.8%). It was also reported by those who received ample information on government disaster preparedness (42.2%), and those who reported that the information is credible (38.4%) and accurate (38.4%), and that they understand the information (38.1%). Furthermore, a high incidence of furniture anchoring was found for those who reported having participated in voluntary and workplace disaster preparedness activities (41.6% and 39.7%, respectively).

Table 4 shows the ORs of the basic information items for furniture anchoring. Multivariate adjustment revealed that the items showing a statistically significant association with furniture anchoring were marital status (OR 1.39, 95% CI 1.05-1.84) and non-wooden structures (OR 1.40, 95% CI 1.10-1.80).

TABLE 1

Basic Information Items and the Incidence of Furniture Anchoring

Basic Information Item	n	%
Sex		
Male	888	51.9
Female	823	48.1
Age (Mean±SD)	50.1 ± 12.6	
Status of furniture anchoring		
Presently anchoring	625	37.1
Presently not anchoring		
Intend to anchor furniture in future	832	49.3
Do not intend to anchor furniture in future	229	13.6
Reasons for not anchoring (n = 1061 multiple answers)		
Apathy due to the hassle involved	187	22.5
Monetary costs	91	11.0
Potential scratching of furniture and damage to rooms	86	10.3
Not allowed to modify rented dwelling	83	10.0
No sense of urgency	82	9.9
Not knowing how to anchor furniture	61	7.3
Unclear whether furniture anchoring is helpful	41	4.9
Furniture anchoring is unnecessary	36	4.3
Appearance worsens	27	3.2
No object needs to be anchored	12	1.4
Other	53	6.4
No reason	72	8.7

Table 5 lists ORs of earthquake-related items for furniture anchoring. Items with statistically significant ORs after multivariate adjustment were having viewed an earthquake intensity map or damage predictions (OR 1.92, 95% CI 1.54-2.39), followed by knowing estimated earthquake intensity (OR 1.73, 95% CI 1.40-2.14) and potential earthquake damage (OR 1.54, 95% CI 1.24-1.91) in their residential neighborhood.

For risk perception, high ORs were found for respondents with concern about earthquakes (OR 2.07, 95% CI 1.36-3.15), a sense of urgency about a future earthquake (OR 1.90, 95% CI 1.47-2.45), anxiety about an earthquake occurring (OR 1.79, 95% CI 1.27-2.51), and expecting an earthquake to occur within the next 9 years (OR 1.65, 95% CI 1.33-2.04).

A tendency to engage in furniture anchoring was observed in respondents expressing fear about an earthquake occurring. Knowledge of the meaning of emergency earthquake warnings (OR 1.67, 95% CI 1.12-2.48) and of the meaning of earthquake intensity (OR 1.54, 95% CI 1.01-2.35) was statistically significant. Furthermore, the practice of anchoring furniture was associated with the perceived accuracy of disaster prevention information released by governments to residents (OR 1.68: 95% CI 1.17-2.42). The practice was also associated with credibility (OR 1.67: 95% CI 1.17-2.39), understanding the information (OR 1.59: 95% CI 1.08-2.33), and receiving ample information (OR 1.52: 95% CI 1.23-1.88). An association with furniture anchoring was also observed for respondents having reported voluntarily participating in local disaster prepared-

TABLE 2

Association of Furniture Anchoring With Basic Information Items

Basic Information Item	Furniture-Anchoring Incidence n	%	*P*
Sex			
Female	305	37.9	.54
Male	315	36.4	
Age, y			
20-39	137	34.9	.18
40-49	141	38.3	
50-59	139	34.2	
60-69	197	40.5	
Education			
Junior high school, high school	333	36.2	.22
Technical school, junior college	118	35.4	
University, graduate school, or higher	166	40.7	
Marital status			
Married	501	40.0	<.001
Not married (single, widowed, divorced)	115	28.0	
Household composition			
Living alone	30	25.9	<.001
Cohabiting husband and wife	153	41.2	
Household where 2 generations live together	320	38.7	
Household where 3 generations live together	88	39.6	
Household where ≥4 generations live together	7	33.3	
Other	19	18.6	
Occupation			
Part-time employment	94	35.1	.64
Full-time employment	260	36.5	
Full-time homemaker, student, unemployed	178	39.5	
Self-employed, freelance profession, agriculture and forestry, fishery	90	36.7	
Economic status			
Higher income	289	41.4	<.001
Lower income	332	34.1	
Possession of residence			
Rent	90	28.9	<.001
Own	534	39.9	
Type of residence			
Apartment, apartment complex	103	32.4	.08
Single-family house (2 or more stories)	444	38.9	
Single-family house (1 story)	78	34.8	
Structure of residence			
Nonwooden structure	198	41.3	.02
Wooden structure	412	36.9	
Unknown	13	25.0	
Respondent requires special assistance[a]			
Yes	29	37.2	1.0
No	583	37.1	
Household member requires special assistance[b]			
Yes	268	36.9	.6
No	319	38.2	
Respondent's place of residence is in a high-risk area[c]			
Yes	386	36.6	.6
No	235	38.0	

[a] Pregnant women, those requiring nursing care in everyday life, those requiring assistance in everyday life, and people with disabilities.

[b] Infants, pregnant women, elderly persons (≥75 y), those requiring nursing care in everyday life, those requiring assistance in everyday life, people with disabilities, and foreign nationals.

[c] High-risk areas refer to communities of respondents that had a high collection of buildings, steep land including cliffs, close proximity to the ocean or rivers, or soft ground.

ness activities within the past 5 years (OR 1.40, 95% CI 1.12-1.75). However, no association was observed for respondents living with a person who requires special assistance.

COMMENT

Results from a random survey of the general population revealed several factors associated with furniture anchoring. These factors included risk awareness, risk perception, disaster preparedness information provided by government to residents, knowledge of earthquakes, participation in local disaster preparedness activities, nonwooden structures, and marital status.

Risk Awareness

Having viewed an earthquake intensity map or damage predictions, knowing estimated earthquake intensity, and knowing potential damage were found to have an association with furniture anchoring. The general population can understand earthquake risks in their residential neighborhoods and the potential effects of earthquakes, because government agencies make wide use of public messages aimed at the general population via the Internet, flyers, and publications with regard to earthquake intensity maps, damage predictions, estimated earthquake intensity, and potential damage. Erdik et al have suggested that in the context of planning and mitigating earthquake damage, estimated urban earthquake damage data should be disseminated to increase the awareness of the general public.[14] By recognizing estimated earthquake intensity and predicted damage, individuals could gain awareness of earthquake risk within their local communities. By understanding this risk, the individuals would recognize the need for furniture anchoring and would hence engage in such safety measures. The results presented here demonstrate the importance of engaging in activities that lead to risk awareness among the general population.

Risk Perception

In terms of a great future earthquake that could occur at any time, concern about earthquake, anxiety, urgency, expecting an earthquake within the next 9 years, and fear were found to be associated with furniture anchoring. These findings were in agreement with the results of Hirose et al, in which a positive association existed between feelings of anxiety about an earthquake and taking actual action to prepare for a disaster.[15] However, it has also been suggested that feeling anxiety about a potential earthquake may actually reduce the likelihood of earthquakes preparedness,[16,17] and that feelings of anxiety alone cannot explain participation in disaster preparedness activities.[18] It was also reported that those who are at risk of a catastrophic event whose occurrence is highly likely, but whose timing is unknown, may deal with that threat by ignoring or denying the seriousness of the situation.[19]

In addition, individuals tend to hold an overly optimistic view and to ignore the potential for an event with a low probability of occurring.[20,21] Therefore, the results of this survey showed that having perceived the risks of each item is associated with furniture anchoring, whereas heightening feelings of anxiety, fear,

TABLE 3

Association of Furniture Anchoring With Earthquake-Related Items

Earthquake-Related Items	Furniture-Anchoring Incidence n	%	*P*
Risk awareness about a future earthquake			
Having viewed earthquake intensity maps or damage predictions			
Yes	263	48.5	<.001
No	353	31.7	
Knowing estimated earthquake intensity in residential neighborhood			
Yes	334	44.4	<.001
No	286	31.3	
Knowing potential damage to their residential neighborhood			
Yes	275	43.9	<.001
No	344	33.0	
Risk perception about a future earthquake			
Expressing concern			
Yes	589	38.6	<.001
No	31	21.7	
Feelings of anxiety			
Yes	568	38.8	<.001
No	51	24.8	
Feelings of fear when an earthquake occurs			
Yes	612	37.7	.03
No	8	20.0	
Feelings of urgency			
Yes	512	40.9	<.001
No	107	26.2	
Time frame in which an earthquake is most likely to occur			
Within 9 y	308	43.7	<.001
After 10 y	289	31.9	
Predicted human damage to self and family			
Death, serious injury, light injury	572	37.3	.43
No damage	40	33.6	
Predicted material damage to dwelling			
Complete destruction, partial destruction, some damage	572	36.9	.47
No damage	44	40.7	
Knowledge of earthquake			
Knowledge of meaning of earthquake intensity, earthquake magnitude, seismic fault activity			
Yes	567	37.8	.02
No	35	27.3	
Knowledge of meaning of earthquake prediction information			
Yes	479	38.3	.06
No	131	33.0	
Knowledge of meaning of emergency earthquake warnings			
Yes	573	38.0	.01
No	38	27.1	
Government disaster preparedness information provided to residents			
Credibility of the information			
Credible	574	38.4	.002
Not credible	49	26.6	
Accuracy of the information			
Accurate	575	38.4	.002
Not accurate	48	26.8	
Understanding the information			
Yes	578	38.1	.01
No	41	26.6	
Receiving ample information			
Yes	379	42.2	<.001
No	242	31.2	
Voluntary disaster preparedness activities within the past 5 y			
Participated in local disaster preparedness activities			
Yes	347	41.6	<.001
No	269	32.7	
Participated in disaster preparedness activities at place of work and schools			
Yes	282	39.7	.005
No	225	32.4	

and urgency may not translate into greater implementation of furniture anchoring. These observations suggested the important role of education in disaster preparedness; providing the general population with accurate information about earthquake risk and potential damage, in addition to the necessity and methods of furniture anchoring, may be more effective than merely increasing perceptions of earthquake risk.

Government Disaster Preparedness Information Provided to Residents

The results of this study suggest that the beliefs of residents in the accuracy and reliability of disaster prevention information given by government agencies as well as the understanding and receiving of ample information are related to anchoring furniture. Risk communication by experts to the general public during normal periods can be a driving force for stimulating voluntary disaster preparedness activities and can encourage residents to learn about the need for official disaster preparedness administration.[22] At present, government institutions carry out education and training, as well as provide information on risk and countermeasures for future earthquakes, and thus the credibility of such risk communication among the general public is vital. Peter et al report in their empirical study that various forms of trust in organizations were significantly associ-

TABLE 4

Odds Ratios (ORs) of Basic Information Items for Furniture Anchoring

	Crude			Adjusted[a]		
Basic Information Item	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***
Sex						
Female/male	1.07	(0.88-1.30)	.52	1.12	(0.90-1.38)	.31
Age, y						
20-39	1			1		
40-49	1.16	(0.86-1.55)	.34	1.09	(0.80-1.48)	.60
50-59	0.97	(0.72-1.29)	.81	0.89	(0.65-1.22)	.48
60-69	1.26	(0.96-1.67)	.10	1.13	(0.83-1.54)	.45
Education						
Junior high school, high school	1			1		
Technical school, junior college	0.97	(0.75-1.26)	.81	0.97	(0.73-1.28)	.81
University, graduate school, or higher	1.21	(0.95-1.54)	.12	1.28	(0.98-1.66)	.07
Marital status						
Married/not married	1.72	(1.35-2.19)	<.001	1.39	(1.05-1.84)	.02
Household composition						
Living alone, other	1			1		
2-Person household of husband and household where ≥2 generations live together	2.24	(1.61-3.14)	<.001	2.19	(1.55-3.11)	<.001
Occupation						
Part-time employment	1			1		
Full-time employment	1.06	(0.79-1.43)	.69	1.13	(0.81-1.58)	.48
Full-time homemaker, student, unemployed	1.21	(0.88-1.65)	.24	1.11	(0.80-1.54)	.55
Self-employed people, freelance profession, agriculture and forestry, fishery	1.08	(0.75-1.54)	.70	1.02	(0.69-1.51)	.91
Economic status						
Higher income/lower income	1.37	(1.12-1.67)	<.001	1.24	(1.01-1.53)	0.04
Possession of residence						
Own/rent	1.56	(1.20-2.04)	<.001	1.38	(1.03-1.85)	0.03
Type of residence						
Apartment, apartment complex	1			1		
Single-family house (2 or more stories)	1.33	(1.02-1.73)	.03	0.89	(0.58-1.35)	.58
Single-family house (1 story)	1.12	(0.78-1.60)	.56	0.82	(0.51-1.31)	.40
Structure of residence						
Nonwooden structure/wooden structure	1.25	(1.01-1.56)	.04	1.40	(1.10-1.80)	.01
Respondent requires special assistance[b]						
Yes/no	1.01	(0.63-1.61)	.98	1.16	(0.71-1.90)	.54
Household member requires special assistance[c]						
Yes/no	0.95	(0.77-1.16)	.60	0.85	(0.69-1.06)	.14
Respondent's dwelling is in a high-risk area[d]						
Yes/no	0.94	(0.77-1.16)	.58	0.93	(0.76-1.16)	.53

[a] Multivariate adjustment of sex, age, educational attainment, family composition, subjects' economic status, possession of residence. These variables were included in the models for the adjusted ORs.

[b] Pregnant women, those requiring nursing care in everyday life, those requiring assistance in everyday life, and people with disabilities.

[c] Infants, pregnant women, elderly persons (≥75 y), those requiring nursing care in everyday life, those requiring assistance in everyday life, people with disabilities, and foreign nationals.

[d] High-risk areas refer to the communities of respondents that had a high collection of buildings, steep land including cliffs, close proximity to the ocean or rivers, or soft ground.

ated with perceptions of concern and care for residents, of openness and honesty of information, and of knowledge and expertise.[23] Therefore, to gain the trust of the general population, government institutions must provide information on furniture anchoring that is easy to understand, correctly communicates the risk and knowledge of earthquakes, takes into account the local region and population, and communicates in a straightforward and consistent manner. If the provided information is trustworthy, the local population is more likely to believe it.[24]

A past survey found that residents had been obtaining,[25] and wished to obtain,[26] disaster prevention information via multiple means. Given this finding, local governments may need to continuously convey information to residents through multiple sources including the Internet, newsletters, news media, and seminars. As points to consider when providing information to the public, the following facts have been pointed out. First, differences exist between the general public and specialists when perceiving an item's importance for disaster prevention.[27] Second, residents seek not only simple, but also detailed information.[28] Therefore, information on disaster prevention should fully take into account characteristics of a given area, individuals, residential, economic, and family situations. Moreover, such information on earthquake characteristics, damage estimates, the necessity of anchoring furniture, and the methods of anchoring furniture should be comprehensible to residents.

Knowledge

The practice of anchoring furniture is linked to earthquake knowledge, in particular knowing the epicenter, magnitude, seismic scales, and the meaning of emergency earthquake warnings. Knowledge of earthquakes affects risk perception, and having more knowledge directly influences conviction about the importance of voluntary disaster preparedness activities.[29] From this perspective, risk knowledge appears to be influenced by subjective risk perception, official warning information, and the belief in the importance of furniture anchoring, suggesting that the general population needs to have a clear understanding of various types of information. Types of knowledge include official warning information, know-how of surviving a disaster, and knowledge of the local area.[30] By combining these 3 types of information and communicating this information to residents, the general public can gain a more comprehensive and concrete understanding of risk and engage in furniture an-

TABLE 5

Odds Ratios (ORs) of Earthquake-Related Items for Furniture Anchoring

	Crude			Adjusted[a]		
Earthquake-Related Items	**OR**	**95% CI**	***P***	**OR[a]**	**95% CI[a]**	***P***
Risk awareness about a future earthquake						
Having viewed earthquake intensity maps or damage predictions (yes/no)	2.04	(1.65-2.51)	<.001	1.92	(1.54-2.39)	<.001
Knowing estimated earthquake intensity in residential neighborhood (yes/no)	1.75	(1.44-2.14)	<.001	1.73	(1.40-2.14)	<.001
Knowing potential damage to their residential neighborhood (yes/no)	1.59	(1.30-1.95)	<.001	1.54	(1.24-1.91)	<.001
Risk perception about a future earthquake						
Expressing concern (yes/no)	2.27	(1.50-3.42)	<.001	2.07	(1.36-3.15)	<.001
Feelings of anxiety (yes/no)	1.93	(1.38-2.69)	<.001	1.79	(1.27-2.51)	<.001
Feelings of fear when an earthquake occurs (yes/no)	2.42	(1.11-5.28)	.03	2.17	(0.98-4.81)	.06
Feelings of urgency (yes/no)	1.95	(1.52-2.50)	<.001	1.90	(1.47-2.45)	<.001
Time frame in which an earthquake is most likely to occur						
Within 9 y	1.65	(1.35-2.03)	<.001	1.65	(1.33-2.04)	<.001
After 10 y	1			1		
Predicted human damage to self and family						
Death, serious injury, light injury	1.18	(0.79-1.75)	.42	1.23	(0.82-1.85)	.32
No damage	1			1		
Predicted material damage to dwelling						
Complete destruction, partial destruction, some damage	0.85	(0.57-1.27)	.43	0.94	(0.63-1.42)	.78
No damage	1			1		
Knowledge of earthquake						
Knowledge of meaning of earthquake intensity, earthquake magnitude, seismic fault activity (yes/no)	1.62	(1.08-2.42)	.02	1.54	(1.01-2.35)	.04
Knowledge of meaning of earthquake prediction information (yes/no)	1.26	(0.99-1.60)	.06	1.26	(0.98-1.62)	.07
Knowledge of meaning of emergency earthquake warnings (yes/no)	1.65	(1.12-2.42)	.01	1.67	(1.12-2.48)	.01
Government disaster preparedness information provided to residents						
Credibility of the information (credible/not credible)	1.72	(1.22-2.43)	<.001	1.67	(1.17-2.39)	.01
Accuracy of the information (accurate/not accurate)	1.70	(1.20-2.40)	<.001	1.68	(1.17-2.42)	.01
Understanding the information (yes/no)	1.70	(1.17-2.46)	.01	1.59	(1.08-2.33)	.02
Receiving ample information (yes/no)	1.61	(1.31-1.96)	<.001	1.52	(1.23-1.88)	<.001
Voluntary disaster preparedness activities within the past 5 y						
Participated in local disaster preparedness activities (yes/no)	1.46	(1.20-1.79)	<.001	1.40	(1.12-1.75)	<.001
Participated in disaster preparedness activities at place of work and schools (yes/no)	1.37	(1.10-1.71)	<.001	1.28	(1.02-1.61)	.03

[a] Sex, age, educational attainment, household composition, subjects' economic status, and possession of residence were included in the models for the adjusted OR.

choring. A national survey found that residents want to obtain earthquake knowledge from multiple sources, including television and newspapers.[26] Therefore, the rate of furniture anchoring may be improved by disseminating knowledge and information through a number of channels including education, training, media, and governmental newsletters.

VOLUNTARY DISASTER PREPAREDNESS ACTIVITIES

Participation in voluntary disaster preparedness activities was found to be associated with furniture anchoring. According to Japanese law, voluntary disaster prevention organizations are described as organizations actively formed by residents for the purpose of mutual assistance and cooperation among neighbors and members of the community in response to disaster.[31] Voluntary disaster prevention organizations are usually situated as a single unit within neighborhood associations, with an average of 287 affiliated households.[32] Organizational activities during nondisaster periods include education such as the dissemination of disaster prevention knowledge, knowing of high-risk disaster areas, and providing disaster prevention training. Previous research has shown that community education is the most essential factor underlying behavior in response to earthquakes and for determining earthquake preparedness.[33] Surveys conducted in Fukui Prefecture, Japan, and the San Francisco Bay area of the United States duly found that residents who had received disaster prevention education were more likely to be prepared for earthquakes than those who had not.[34] The results of our study suggest that individuals who take part in voluntary disaster preparedness activities will appreciate the necessity of furniture anchoring, acquiring the necessary knowledge and skills, and increase the likelihood of actually engaging in furniture anchoring. Furthermore, such an association with furniture anchoring was also observed for activities at work and school in addition to voluntary ones. We think that an educational system is required for local participants owing to results of the present study, so that residents can engage in disaster preparedness training at any time, in any place, and as frequently as they like. For these purposes, organizations, work places, and schools should increase the frequency of education and training opportunities while providing services in which it is easy for residents to participate.

Housing and Marital Status

Nonwooden residences have been found to be associated with the practice of anchoring furniture. In Japan, a popular method of furniture anchoring is to secure poles between a piece of furniture and the ceiling. This method is different from installing a metal bracket and securing a piece of furniture directly to a wall, and provides an easy method for furniture anchoring that avoids damaging the piece of furniture or the dwelling interior. However, this method only works if there is a basic level of structural strength in the ceiling. Since ceilings of wooden structures may not have sufficient strength, such homes may not be able to engage in furniture anchoring using the pole method; the inability to use this method may lead to less furniture anchoring in wooden structures.

Furthermore, marital status has been found to be associated with the practice of anchoring furniture. As with our results, marital status has been found to be associated with greater engagement in furniture anchoring in previous studies looking at factors in earthquake preparedness.[18,35] This finding might be attributable to married couples being more aware of protecting their family and might lead to more furniture anchoring. These findings indicate that it may be necessary to develop more effective methods for motivating unmarried people to anchor their furniture, especially since the rate of unmarried people is currently increasing in Japan.[36]

In the present study, the rate of anchoring furniture is 37.1%. This rate is higher than the 26.2% reported by the 2010 Cabinet Office survey of Japanese citizens,[37] and lower than the 69.3% reported by a 2009 survey in Shizuoka Prefecture.[25] The rate in our survey may have been higher than that of the national survey because Shizuoka Prefecture, where our participants live, is considered to have a high likelihood of sustaining serious damage by the predicted Tokai Earthquake. Thus, people in Shizuoka may practice furniture anchoring more than those in the rest of Japan. On the other hand, the reason the rate in the present study was lower than that of the study of the Shizuoka Prefecture may be because of the 6.5 magnitude earthquake that occurred 3 months before the survey, resulting in 1 death and 311 injuries; the prefectural survey included areas that suffered large-scale damage.

Residents reported that they did not anchor furniture because of the hassles involved, monetary costs, and/or potential scratching of furniture and damage to rooms, and no sense of urgency. These comments may be due to the low awareness of earthquake risks and the necessity to anchor furniture. Furthermore, residents living in rental properties are concerned that anchoring furniture damages the property of owners. Therefore, improving the anchoring rate may necessitate community and workplace disaster prevention education to enhance the awareness of residents and property owners on the importance of anchoring furniture.

Limitations

Some limitations to this research were noted. First, the survey was conducted with participants who voluntarily completed the surveys and self-reported their status of furniture anchoring, without providing details such as what percentage of furniture was anchored and how the anchoring was accomplished. However, there should be limited bias in the results, as the status of furniture anchoring can be objectively observed and the answers can be easily recorded. Second, the survey was limited to 2 cities in Shizuoka Prefecture and thus may not have accurately represented the whole of Japan. Nonetheless, this research still had the advantages of providing a statistical analysis of furniture anchoring factors using a large number of survey participants chosen at random from public lists and capturing a wide range of age groups in the general population.

CONCLUSIONS

To reduce harm to people from a potentially massive earthquake, further improvements to the incidence of furniture anchoring is

important. It is necessary to improve levels of risk awareness and risk perception, levels of earthquake knowledge, and the credibility and amount of government disaster preparedness information provided to residents, as well as to increase participation in voluntary disaster preparedness activities that were found to be associated with furniture anchoring in this research. Toward this end, more mutual risk communication between government institutions and the local population is crucial through education and training in daily life.

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