17th World Conference on Earthquake Engineering, 17WCEE
Sendai, Japan - September 27th to October 2nd, 2021

What do people working in coastal tourism areas perceive about supporting tourists' tsunami evacuation?

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Abstract

Along the coastlines of Japan, many tourism areas are at risk of tsunami. When a subduction-zone earthquake occurred, and tsunami is imminent, all people in the estimated inundation areas must immediately evacuate to any safety zone by the tsunami arrival time. In the emergency situation, the tourism industry staff play a vital role in visitors' evacuation. This study examines tourism industry staff's risk perceptions and perceived behavioral control of supporting tourists' emergency evacuation. We analyzed relationships among the perceptions of the Nankai trough Earthquake (NTE) and tsunami, risk perceptions of situations after the earthquake, and perceived behavioral control of supporting tourists. The NTE will presumably occur in the near future, and strike large areas in Japan. This study contributes to understanding tourism staff's recognition of the emergency responses. The research site is Shirarahama in Shirahama Town, Wakayama, Japan. Shirarahama is a famous tourist area with beaches, sightseeing spots, and hot springs. In contrast, the region is at high risk for the NTE and tsunami. To understand emergency response perceptions of tourism industry staff, a questionnaire survey was conducted from October 23, 2019 to November 22, 2019 in Shirarahama area. The target was the staff members, including managers, regular employees, non-regular employees, and part-time workers, working in the estimated inundation area. The number of distributed questionnaires was 346, and the number of valid responses was 195 (56.4%). Results indicated that perceptions of the NTE and tsunami did not strongly affect perceptions of situations following the NTE and perceived behavioral control. However, lead time before the arrival of tsunami is essential to adequately support tourists' evacuation. Tourism industry staff should have accurate images of conditions after the earthquake and the recognition of available time. In the results of one-way analysis of variance, for perceptions of situations after the NTE, talking with other workers was statistically significant for eight items. These items are related not to the physical damage but to staff and tourists' behavior. In multiple regression analyses, information communication with tourists was the essential factor for perceived behavioral control. Issues of informing emergency situations and appropriate responses include informational contents and the provision channel that depend on each office condition, staff role(s), and post-earthquake condition. In addition to having correct knowledge of the earthquake and tsunami, the staff should be able to adequately consider situations after the earthquake. Based on the recognition, examining tourists' supports and the evacuation of themselves is necessary in planning these procedures.

Keywords: tsunami; evacuation behavior; tourism area; questionnaire; Shirahama Town; Nankai Trough Earthquake

1. Introduction

Along the coastlines of Japan, many tourism areas are at risk of tsunami. In tourism areas, many tourists are unfamiliar with the location, local emergency plan, and resources to protect them from natural hazards [1, 2]. Additionally, tourists often gather in relatively small spaces. When a subduction-zone earthquake occurred, and tsunami is imminent in the estimated inundation areas, even in the condition, all people, including residents, visitors, and tourist staff, must immediately evacuate to any safety zone by the tsunami arrival time.

Following the Sumatra earthquake of December 26, 2004, many people, including tourists and tourist industry staff, were killed by tsunamis [3, 4]. In Japan, the Nankai Trough Earthquake (NTE), a type of subduction-earthquake, is forecasted to occur in the near future [5]. After the NTE occurred, seismic motions and tsunamis can cause severe damage over large areas. Since, all tourism-related facilities in coastal areas

must establish systems that enable the entire population to evacuate promptly by tsunami arrival time. In these emergency situations, people working in coastal areas play a vital role in visitors' evacuation to safe zones.

Surveys for tourists' perceptions of tsunami risk indicated lack of local knowledge and regional natural hazard risks, and issues of the information communication [6, 7, 8, 9, 10]. The semi-structured interview survey for tourists' survivors from the Indian Ocean tsunami showed that there were problems of the tsunami awareness, warning systems, and personal preparation, and tourism workers had not sufficient knowledge of tsunami and evacuation [11].

Previous studies have also found that the tourism industry did not have enough emergency response measures for natural disasters [12, 13, 14, 15,16 17]. However, employees desired to learn response measures and tsunami evacuation drill [14]. Tourists also have demanded the preparation of tsunami evacuation measures [18]. In terms of the perception for crisis management, there was the gap between tourists and tourism industry managers [19].

The tourism industry and its institutions have a responsibility to tourists and society to reduce disaster risk [20]. For the intention of planning crisis management, social norms, attitudes, and past crisis experience were identified as factors [21]. In contrast, surveys of tourism staff perceptions have not been sufficiently accumulated. This study examines tourism industry staff's risk perceptions and perceived behavioral control of supporting tourists' emergency evacuation. To depict the staff perceptions and these factors, a questionnaire survey was carried out in a tourist area.

We analyzed relationships among perceptions of the NTE and tsunami, risk perceptions of situations after the earthquake, and perceived behavioral control of supporting tourists. Perceived behavioral control is a critical component that affects behavior intention in the theory of planned behavior [22, 23]. This study contributes to understanding tourism workers' recognition of the emergency responses.

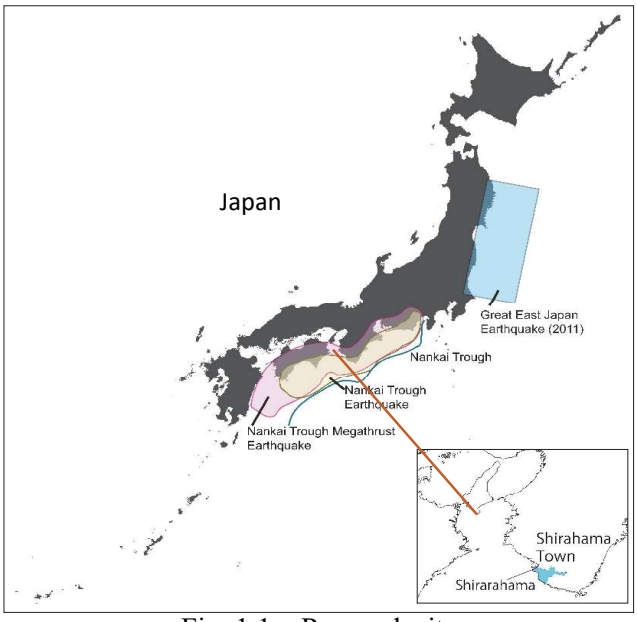

Fig. 1.1 – Research site

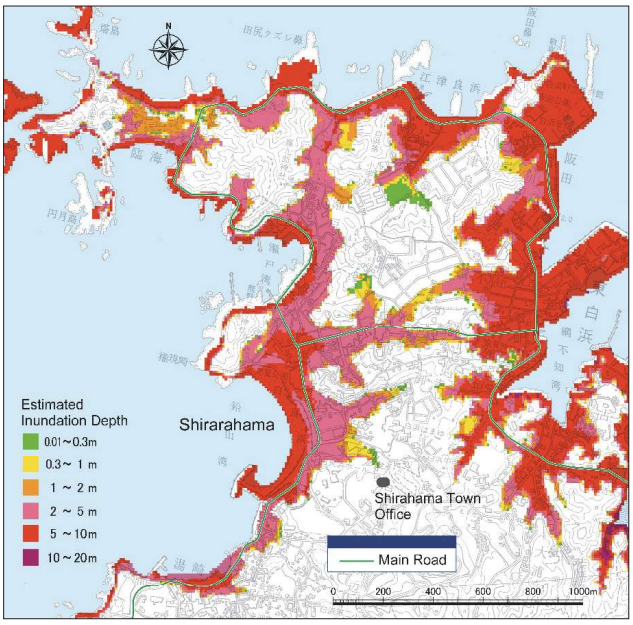

Fig. 1.2 – Tsunami hazard map in the research site
The map was arranged by the author based on the tsunami hazard map of Shirahama Town [25]. The tsunami inundation area has been estimated for the Nanakai Trough Megathrust Earthquake [26].

2. Method

2.1 Summary of the Nankai Trough Earthquake

The Nankai Trough, located in the southern area of the Japanese archipelago, has repeatedly ruptured, which caused the NTE. The rupture areas under Nankai Trough are formed between the Philippine Sea plate and the Eurasian plate (Fig. 1.1). Over the past centuries, the NTE has caused extensive damage and casualties in large areas. The next NTE will presumably occur by 2050, and, if the earthquake occurred, affect a vast area in Japan [5, 24].

2.2 Research site

The research site is Shirarahama area in Shirahama, Wakayama, Japan. Shirarahama is a famous tourist area with beaches, sightseeing spots, and hot springs (Fig. 1-2). In contrast, the Nankai Trough Megathrust Earthquake (NTME) assessment, which assumes the largest rupture type in the NTE [25], has estimated JMA seismic intensity scale of 6+, and the tsunami height of 10 meters or over, tsunami arrival time to Shirahama Town of approximately 15 minutes after the earthquake; this estimated tsunami arrival time is shorter than those in the devastated areas of the Great East Japan Earthquake. Therefore, when the NTE occurred, the earthquake ground motions continue for minutes around Shirarahama area, and after that, all people in the estimated inundation area should evacuate promptly to any safety zone.

2.3 Data collection

To understand the emergency response perceptions of tourism industry staff, the survey was conducted in Shirarahama area. The target was the staff members, including managers, regular employees, non-regular employees, and part-time workers, working in the estimated inundation area in Shirarahama (Fig. 1.2). The questionnaire was distributed through Shirahama Town Office, Shirahama tourism association, Shirahama hot spring and ryokan group, and Shirahama society of commerce and industry, and returned by postal mail from October 23, 2019 to November 22, 2019. The number of distributed questionnaires was 346, and the number of valid responses was 195 (56.4%). Respondents' characteristics are shown in Table 1. The

Table 1 – Characteristics of respondents

	Variable	Frequency (%)
Gender	Women	78 (40.2%)
	Men	114 (58.8%)
	Others	2 (1.0%)
Age	30 years or under	22 (11.4%)
	31–40 years	34 (17.6%)
	41–50 years	40 (20.7%)
	51–60 years	51 (26.4%)
	61 years or over	46 (23.8%)
Position	Manager	57 (31.7%)
	Regular employee	102 (56.7%)
	Non-regular employee and Part-time job	21 (11.7%)
Period of continuous employment	One year or under	25 (13.1%)
	1–3 years	31 (16.2%)
	3–10 years	54 (28.3%)
	10 years or over	81 (42.4%)
Working place	Accommodation, including hotel, guesthouse, inn	68 (35.4%)
	Tourist related facility, including restaurant, hot-spring facility, souvenir shop	124 (64.6%)
Number of employees	1–10	74 (38.3%)
	11–50	75 (38.9%)
	51 or over	44 (22.8%)
Number of stories	1–2	85 (44.3%)
	3–4	50 (26.0%)
	5 or over	57 (29.7%)
Experience of emergency response training and meeting	a) Emergency response drill for tsunami evacuation	Yes 68 (36.0%)
		No 121 (64.0%)
	b) Emergency response drill estimating the situation after an earthquake	Yes 29 (15.3%)
		No 160 (84.7%)
	c) Seminar for earthquake emergency response	Yes 32 (17.6%)
		No 150 (82.4%)
	d) Talking with other workers for emergency response in preparing for tsunami	Yes 72 (39.6%)
		No 110 (60.4%)
	e) Explanation of your office's emergency response manual	Yes 52 (28.6%)
		No 130 (71.4%)

questionnaire included items of perceptions of the NTE and tsunami, perceptions of emergency situations, and perceived behavior control following the NTE and tsunami warning.

The question assumed that respondents were in their offices and a certain situation following the NTE. The question for perceptions of situations after the NTE was "To what extent do you think these situations occur," using a seven-point Likert scale (1="the probability of occurrence is very low," 7="the probability of occurrence is very high"). The question for perceived behavior control was "To what extent do you think you can perform these things," on a seven-point Likert scale (1="will not be able to do at all," 7="will be able to do very well"). We treated these ordinal scales as interval scales, such as "the probability of occurrence is very low" is 1.0 point, and "the probability of occurrence is very high" is 7.0 point, and also "will not be able to do at all" and "will be able to do very well" are 1.0 and 7.0 points, respectively.

2.4 Data analysis

First, we described perceptions of the NTE and tsunami, including the seismic intensity scale, ground motion duration, tsunami height, tsunami arrival time, and inundation depth of their offices.

Second, one-way analysis of variance (ANOVA) for perceptions of situations after the NTE was applied to analyze differences in respondents' attributes and perceptions of the NTE and tsunami. Characteristics in Table 1 were used in these analyses.

Third, we used multiple regression analysis to find factors for perceived behavior control. In the analyses, items of perceptions of situations after the NTE, perceptions of the NTE and tsunami, and attributes were used as dependent variables.

3. Results

3.1 Perceptions of the Nankai Trough Earthquake and tsunami

Measured results of perceptions for the NTE and tsunami are shown in Figs. 2.1–2.5. For the NTE's seismic intensity scale, many respondents selected 6+ or over (Fig. 2.1). In the question of strong motion duration, the result showed that perceptions of the time length varied in respondents (Fig. 2.2).

For the question of the tsunami following the NTME, tsunami height, which is the height in the Shirarahama coastal area, was asked. In the result, approximately 40% of respondents chose 8m or less (Fig. 2.3). In the question of tsunami arrival time, although many respondents anticipated 15 min or under, about 10% of respondents selected 20 min or over (Fig. 2.4). For the question of the inundation depth at each workplace, approximately 60% of respondents chose 5 meters or over (Fig. 2.5).

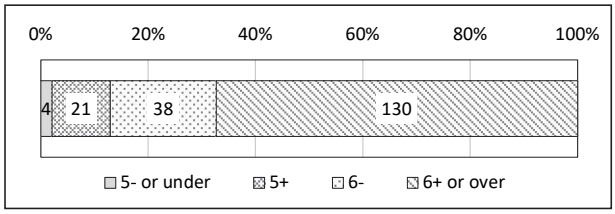

Fig. 2.1 – The perception of the seismic intensity scale

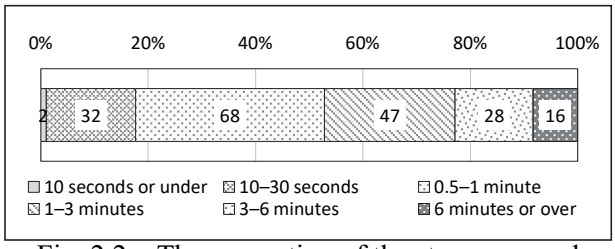

Fig. 2.2 – The perception of the strong ground motion duration

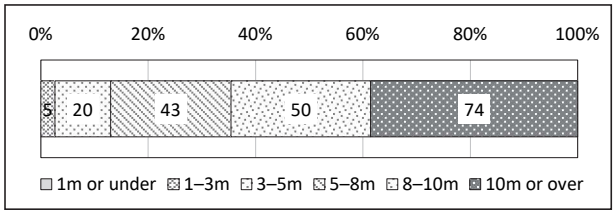

Fig. 2.3 – The perception of the tsunami height

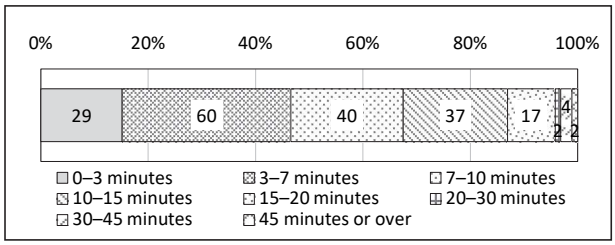

Fig. 2.4 – The perception of the tsunami arrival time

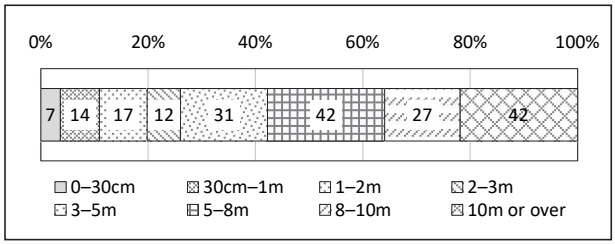

Fig. 2.5 – The perception of the inundation depth

3.2 Perceptions of situations after the earthquake

Table 2 presents results of perceptions for situations after the NTE. The highest mean item was "2) the equipment and materials in your office are scattered by the seismic motions." The item of "1) your office building is damaged by the seismic motions," related to physical damage, was also high mean one. In contrast, the mean of "8) there are many tourists who do not evacuate immediately even though the staff announced the evacuation," associated with tourists' evacuation behavior, was relatively low.

To identify differences for these items in attributes and perceptions of the NTE and tsunami, we applied one-way ANOVA and multiple comparisons using Tukey's method at $p<0.10$ level of significance. Since some categories of perceptions and characteristics were low numbers, category integration or exclusion was performed for them; the perception of the seismic intensity scale was divided into three categories: 5+ or under, 6-, and 6+ or over; the perception of the strong ground motion duration was divided into five categories: 0–0.5 min, 0.5–1 min, 1–3 min, 3–6 min, and 6min or over; the perception of tsunami height was divided into four categories: 5 m or under, 5–8 m, 8–10 m, and 10 m or over; the perception of tsunami arrival time was divided into six categories: 0–3 m, 3–7 m, 7–10 m, 10–15 m, 15–20 m, and 20 m or over; and women and men were used in gender categories. Table 3 displays all results of one-way ANOVA and multiple comparisons.

Focusing on differences in perceptions of the NTE and tsunami, no items were statistically significant, excluding strong ground motion duration for 4), and tsunami height for 12). In the analysis of 12), all workplace attributes were statistically significant. In terms of items related to the experience of the training and meetings, "d) talking with other workers" was statistically significant for eight items.

3.3 Factors of perceived behavioral control

Table 4 shows items and response results for perceived behavioral control after the earthquake. The item of the highest mean was "iv) to cooperate appropriately with other worker(s)." However, these means of perceived behavioral control were lower than those for perceptions of situations after the NTE.

To find factors of perceived behavioral control, multiple regression analyses, using the items in Table 4 as dependent variables, were performed with the stepwise procedure at $p < 0.10$ level of significance.

Table 2 – Perceptions of situations after the NTE

Questionnaire items	Mean	S.D.
1) Your office building is damaged by the seismic motions.	5.89	1.57
2) The equipment and materials in your office are scattered by the seismic motions.	6.39	1.16
3) Many people are injured and unable to walk due to seismic motions.	5.74	1.37
4) The information from staff member(s) does not sufficiently reach tourists.	5.37	1.55
5) The staff members themselves become confused and are unable to adequate responses.	5.58	1.38
6) Due to seismic motions, moving through the evacuation routes to the evacuation sites is difficult.	5.79	1.44
7) The evacuation routes are closed due to a large number of tourists.	5.64	1.46
8) There are many tourists who do not evacuate immediately even though the staff announced the evacuation.	4.76	1.83
9) Many tourists evacuate by their vehicles.	5.45	1.68
10) Appropriate information is not provided to foreign tourists who have difficulty understanding Japanese.	5.91	1.49
11) Adequate supports are not provided to people needing extra time to move by themselves, for instance, elderly people.	5.99	1.32
12) Due to many tourists outside your office, confusion occurs during the evacuation.	5.96	1.35

Table 3 – Results of one-way ANOVA and multiple comparisons for the perceptions of situations after the earthquake

Questionnaire items	Seismic intensity scale	Strong ground motion duration	Tsunami height	Tsunami arrival time	Inundation depth	Gender	Age	Position	Period of continuous employment	Working place	Number of employees	Number of stories	a) Emergency response drill for tsunami	b) Emergency response drill after earthquake	c) Seminar of emergency response	d) Talking with other workers	e) Explanation of your office's manual
1) Your office building is damaged by the seismic motions.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.031 manager< non-regular employee	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.081 no< yes
2) The equipment and materials in your office are scattered by the seismic motions.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.050 no< yes	n.s.	n.s.
3) Many people are injured and unable to walk due to seismic motions.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.099 tourist facility<accommodation	p=0.072 1–10 < 51+	n.s.	n.s.	n.s.	n.s.	p=0.022 yes< no	n.s.
4) The information from staff member(s) does not sufficiently reach tourists.	n.s.	p=0.036 1–3,0.5–1, 0–0.5,3–6<6+	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.039 yes< no	p=0.042 no< yes
5) The staff members themselves become confused and are unable to adequate responses.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
6) Due to seismic motions, moving through the evacuation routes to the evacuation sites is difficult.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
7) The evacuation routes are closed due to a large number of tourists.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.035 11-50< 51+	n.s.	n.s.	n.s.	n.s.	p=0.006 yes< no	n.s.
8) There are many tourists who do not evacuate immediately even though the staff announced the evacuation.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.001 yes< no	n.s.
9) Many tourists evacuate by their vehicles.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.017 yes< no	n.s.	p=0.017 yes< no	p=0.048 yes< no	p=0.018 yes< no
10) Appropriate information is not provided to foreign tourists who have difficulty understanding Japanese.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.040, -30< 41–50, 51–60	n.s.	p=0.088 1–3y <0–1y	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.000 yes< no	n.s.
11) Adequate supports are not provided to people needing extra time to move by themselves, for instance, elderly people.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.077 yes< no	n.s.
12) Due to many tourists outside your office, confusion occurs during the evacuation.	n.s.	n.s.	p=0.019 8–10m <10m+	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	p=0.007 tourist facility<accommodation	p=0.021 1–10, 11–50 <51+	p=0.005 1–2F < 5F+	n.s.	n.s.	n.s.	p=0.000 yes< no	n.s.

Table 4 – The perceived control in the emergency situations

Questionnaire items	Mean	S.D.
i) To respond adequately after the Nankai Trough Earthquake	3.54	1.53
ii) To inform the situations to all tourists	3.73	1.52
iii) To have tourists recognize appropriate behavior	3.62	1.48
iv) To cooperate appropriately with other worker(s)	4.22	1.54
v) To guide the evacuation of all tourists	3.81	1.67
vi) To assist person(s) who have difficulty moving smoothly by themselves	3.66	1.52
vii) To support injured person(s) who cannot walk by themselves	3.58	1.46

Table 5 – Dummy variables and categories in multiple regression analysis

Variable	Category
The perceptions of the Nankai Trough Earthquake	
Seismic intensity scale	0: 6- or under, 1: 6+ or over
Strong ground motion duration	0: 3 minutes or under, 1: 3 minutes or over
Tsunami height	0: 8m or under, 1: 8m or over
Tsunami arrival time: 10–15 minutes	0: Other categories, 1: 10–15 minutes
Tsunami arrival time: 15+ minutes	0: Other categories, 1: 15 minutes or over
Inundation depth: 2–5m	0: Other categories, 1: 2–5m
Inundation depth: 5–10m	0: Other categories, 1: 5–10m
Inundation depth: 10m+	0: Other categories, 1: 10m or over
Personal attribute	
Gender: women	0: Other categories, 1: Women
Age: 31–50 years	0: Other categories, 1: 31–50
Age: 51+ years	0: Other categories, 1: 51 or over
Position: manager	0: Other categories, 1: manager
Position: regular employee	0: Other categories, 1: employee
Period of continuous employment	0: 3 years or under, 1: 3years or over
Attribute of the workplace	
Working place	0: Accommodation, 1: Tourist related facility
The number of employees: 11–50	0: Other categories, 1: 11–50
The number of employees: 51+	0: Other categories, 1: 51 or over
The number of stories: 3–4F	0: Other categories, 1: 3–4
The number of stories: 5F+	0: Other categories, 1: 5 or over
The experience of emergency response training and meeting	
a) Emergency response drill for tsunami evacuation	0: No, 1: Yes
b) Emergency response drill estimating the situation after earthquake	0: No, 1: Yes
c) Seminar of earthquake emergency response	0: No, 1: Yes
d) Talking with other workers for emergency response in preparing for tsunami	0: No, 1: Yes
e) Explanation of your office's emergency response manual	0: No, 1: Yes

Independent variables were perception items of situations after the NTE (Table 2), perceptions of the NTE and tsunami, and attributes. The dummy variables are shown in Table 5.

In the analysis results (Table 6), "4) the information from staff member(s) does not sufficiently reach tourists," an item associated with information communication, was statistically significant and negative for all independent variables. The personal attribute of gender was a factor for v), vi), and vii). Since these items are related to behaviors that require some physical activity, the dummy variable of "gender: women" is considered a factor and negative in these analyses.

For item of "i) to respond adequately after the Nankai Trough Earthquake," perceptions of 5) and 8) were factors and negative as well as 4). These perceptions, related to appropriate response and information transition from staff, also became factors decreasing perceived behavioral control.

Table 6 – Results of multiple regression analysis for the perceived behavioral control

	R^2 (Adjusted R^2)	1) Your office building is damaged by the seismic motions.	2) The equipment and materials in your office are scattered by the seismic motions.	3) Many people are injured and unable to walk due to seismic motions.	4) The information from staff member(s) does not sufficiently reach tourists.	5) The staff members themselves become confused and are unable to adequate responses.	6) Due to seismic motions, moving through the evacuation routes to the evacuation sites is difficult.	7) The evacuation routes are closed due to a large number of tourists.	8) There are many tourists who do not evacuate immediately even though the staff announced the evacuation.	9) Many tourists evacuate by their vehicles.	10) Appropriate information is not provided to foreign tourists who have difficulty understanding Japanese.	11) Adequate supports are not provided to people needing extra time to move by themselves, for instance, elderly people.	12) Due to many tourists outside your office, confusion occurs during the evacuation.
i) To respond adequately after the Nankai Trough Earthquake	.219 (.185)		0.15 (0.059)		-.24 (0.010)	-.20 (0.025)			-.20 (0.011)				0.18 (0.024)
ii) To inform the situations to all tourists	.283 (.252)			0.18 (0.038)	-.47 (0.000)		-.15 (0.043)		-.22 (0.005)				0.18 (0.026)
iii) To have tourists recognize appropriate behavior	.249 (.227)				-.40 (0.000)				-.12 (0.084)				
iv) To cooperate appropriately with other worker(s)	.203 (.183)	0.16 (0.035)			-.35 (0.000)		-.15 (0.045)						
v) To guide the evacuation of all tourists	.225 (.207)				-.43 (0.000)								
vi) To assist person(s) who have difficulty moving smoothly by themselves	.179 (.164)				-.29 (0.000)							-.17 (0.033)	
vii) To support injured person(s) who cannot walk by themselves	.180 (.165)				-.27 (0.001)							-.14 (0.078)	

Table 6 (continued) – Results of multiple regression analysis for the perceived behavioral control

	seismic intensity scale	strong ground motion duration	tsunami height	tsunami arrival time: 10-15 m	tsunami arrival time: 15+ m	inundation depth: 2–5m	inundation depth: 5–10m	inundation depth: 10m+	gender: women	age: 31–50	age: 51+	position: manager	position: regular employee	period of continuous employment	working place	the proportion of employees: 11-50	the proportion of employees:51+	the number of stories 3–4f	the number of stories: 5f+	a) the drill for tsunami evacuation	b) the drill for earthquake	c) seminar of earthquake response	d) talking with other workers	e) explanation of emergency manual
i) To respond adequately after the Nankai Trough Earthquake																					0.15 (0.036)		0.13 (0.098)	
ii) To inform the situations to all tourists														0.11 (0.093)						0.12 (0.077)				
iii) To have tourists recognize appropriate behavior			0.15 (0.031)																0.15 (0.035)					0.14 (0.045)
iv) To cooperate appropriately with other worker(s)																							0.19 (0.009)	
v) To guide the evacuation of all tourists									-.13 (0.069)									-.14 (0.041)						0.13 (0.071)
vi) To assist person(s) who have difficulty moving smoothly by themselves									-.13 (0.060)															
vii) To support injured person(s) who cannot walk by themselves									-.23 (0.002)															

Standardized coefficient (p value)

4. Discussion

This study analyzed the tourism industry's staff perceptions of emergency responses after the NTE. For perceptions of the NTE and tsunami, many respondents selected one minute or shorter in the question of the ground motion duration (Fig. 2.2). However, the NTE assessment has estimated that strong ground motions continue a few minutes [27]. After the Great East Japan Earthquake, strong ground motions also continued for minutes in devastated areas. To examine adequate emergency response after the NTE, tourism industry facilities and their staff must have not only accurate knowledge of seismic intensity, but also the recognition of the nature of ground motions, for instance, the time length of strong ground motions.

On the other hand, results indicated that perceptions of the NTE and tsunami did not strongly affect perceptions of situations in the aftermath the NTE and perceived behavioral control (Tables 3, 6). However, lead time before the arrival of tsunami is essential to adequately support tourists' evacuation. Therefore, tourism industry staff should have accurate images of conditions after the earthquake and the recognition of available response time. On this basis, the tourism industry facilities should consider what staff can and cannot do and what procedures they must follow during the term from the earthquake to estimated tsunami arrival. For adequate responses, emergency response plan must be detailed and have the feasibility. In factors of perceived behavioral control, the seminar experience was not significant. For the examination of emergency response, results suggested that not only learning knowledge about the earthquake and tsunami but also drills and discussion for emergency response play an important role (Tables 3, 6).

Tsunami height is also an important scale to consider emergency responses. Although the NTME assessment has indicated tsunami height is over 10m at Shirarahama area, many respondents regarded it as lower than that. To improve the evacuation measures and the preparedness, tourism staff should also have correct knowledge of tsunami.

In the results of one-way ANOVA for perceptions of situations after the NTE, "b) talking with other workers" was statistically significant for eight items (Table 3); these are related not to the physical damage but to staff and tourists' behavior. For these items, staff members with experience of talking about emergency responses perceived lower than those without the experience. Discussing situations and emergency responses in staff members may decrease the recognition that visitors could be confused after the earthquake.

In multiple regression analyses, information communication, the item of 4), was the essential factor for perceived behavioral control. Issues of informing emergency situations and appropriate responses include informational contents and the provision channel that depend on each office condition, staff role(s), and post-earthquake situation. For perceptions of situations after the earthquake, the item of 12), related to tourists' confusion outside the office, was largely associated with workplace condition (Table 3). To enable to perform profound and adequate actions in emergency situations, each workplace must examine both response procedures and the contents of information for tourists following the earthquake. To enhance emergency responses, warning messages must include accuracy, clarity, certainty, sufficient information, clear guidance, and the specification of the location [28]. For efficient warning messages and appropriate responses, emergency drills and discussion are also crucial.

5. Conclusion

This study revealed relationships among perceptions of the NTE and tsunami, risk perceptions after the earthquake, and perceived behavioral control of the tourist industry staff. Results indicated that the time length between the NTE's occurrence and tsunami arrival time was not largely significant for risk perceptions of situations after the NTE and perceived behavioral control in the analyses. The main factor of perceived behavioral control in the emergency situation was the perception of information communication.

Improving emergency responses for the earthquake and tsunamis is essential in the high-risk areas. In addition to having correct knowledge of the earthquake and tsunami, the staff should be able to adequately

consider situations after the earthquake. Based on the recognition, examining tourists' supports and the evacuation of themselves by estimated tsunami arrival time is needed in planning procedures.

Acknowledgement

The author would like to thank the respondents of the tourist industry staff in Shirarahama who shared their precious time and experiences in the survey.

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