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STUDY ON FEATURES OF RUMORS GENERATED AT THE TIME OF DISASTER: CHARATERIZATION OF ACTUAL RUMORS

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Abstract

False or unfounded rumors generated during natural disasters have caused many problems by preventing proper information sharing, impeding emergency rescue and support activities in affected areas, and making people anxious. This study aimed to help establish appropriate countermeasures for such rumors by collecting actual rumors generated during past natural disasters and analyzing them to identify dominant patterns by which rumors circulate both during disasters and in other situations where false or unfounded rumors are easily spread.

To this end, we used books, published papers, websites, and other sources to collect 453 rumors that were generated during past natural disasters. We created 166 variables regarding rumor content and situations in which the rumors were generated and spread, and then analyzed these variables.

We classified the collected rumors' contents into six types: 1) the source and cause of the disaster, 2) recurrence of the disaster, 3) damage caused by the disaster (primary damage), 4) damage caused by the disaster (secondary damage), 5) response to the disaster, and 6) life in the affected areas. Then, to identify rumors that tended to spread easily in various situations, we performed cross-tabulation between these contents and disaster types (earthquake, heavy rain, eruption), the time when the disaster occurred (before and after World War II), and rumor sources (individuals, mass media, public agencies). We found that the types of rumors that readily circulated differed according to the characteristics of the disaster (e.g., the likelihood that the disaster would reoccur, the extent of damage, and the time period necessary for recovery and reconstruction). For example, in the case of earthquakes, rumors about earthquake recurrence, such as "it will hit us again," tend to spread easily due to the commonality of aftershocks (Fig. 1).

Analysis on the information sources revealed that insufficient information about the disaster may lead to situations where the general public creates rumors about disaster responses and daily life in affected areas due to anxiety and frustration about the lack of information. Meanwhile, unclear or vague information transmitted by mass media or public agencies tends to result in exaggerated information or creation of false rumors, leading to unfounded rumors about disaster recurrence (Table 1).

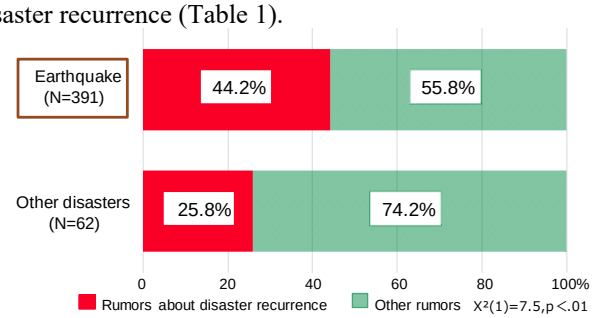

Fig. 1 – Proportions of rumors about disaster recurrence by disaster type

Table 1 – Occurrence of rumors categorized by source

Source	Rumors that are easily created	Rumors that are not easily created
General public	4. damage caused by the disaster (secondary damage)* 5. response to the disaster* 6. daily life in the affected area*	1. source and cause of the disaster** 3. damage caused by the disaster (primary damage)**
Mass media	1. source and cause of the disaster** 2. recurrence of the disaster** 3. damage caused by the disaster (primary damage)**	4.damage caused by the disaster (secondary damage)** 5. response to the disaster** 6. daily life in the affected area**
Public agencies	2. recurrence of the disaster**	3. damage caused by the disaster (primary damage)** 5. response to the disaster** 6. daily life in the affected area**

* : p<.05、** : p<.01

As a countermeasure against these rumors, disaster management education must emphasize that "rumors easily spread during disasters." Each of us should be aware of the possibility of problematic rumors. Furthermore, before earthquakes occur, educational entities should teach students about the potential for false rumors in a systematic manner, while after an earthquake occurs, mass media should continuously provide alerts about the possibility of false rumors to suppress their occurrence and spread

Keywords: actual rumors that spread during past natural disasters, disaster management education

1. Background and objective of this study

False or unfounded rumors generated during natural disasters have caused many problems by preventing proper information sharing, impeding emergency rescue and support activities in affected areas, and making people anxious. Almost without exception, rumors arise following in large-scale disasters [1]. In Japan, immediately after the 1923 Great Kanto Earthquake, rumors such as "Korean people set things on fire" and "Korean people poisoned a well" spread [2]. About one week after the 1995 Great Hanshin-Awaji Earthquake, rumors such as "a big earthquake is going to hit us again" and "a big earthquake with a seismic intensity of 6 will occur" spread in the affected area and the surrounding areas [3]. In the 2011 Great East Japan Earthquake, a rumor warned citizens that "groups of foreign thieves are robbing and raping one person after another" [4].

Such rumors during and after disasters have caused many problems. During the 1923 Great Kanto Earthquake, they triggered chaotic situations, including murder [2]. Chaos due to rumors, even when it is less serious than murder, can hinder rescue activities and make the general public more anxious; this is largely because in emergency situations, supplies and communication are significantly restricted [5]. Accordingly, it is important to take countermeasures against the creation and spread of rumors during disasters.

This study aimed to help establish appropriate countermeasures against rumors by collecting actual rumors generated during past natural disasters and analyzing them to identify dominant patterns by which rumors circulate, both during disasters and in other situations where false or unfounded rumors are easily spread. Specifically, we collected cases of rumors that were created and/or spread across different disaster types and eras, and then classified them to obtain an overall picture of rumors during periods of disaster. We then identified what types of rumors were easily created and spread in each different disaster, as well as the sources of these rumors. Finally, we discuss the countermeasures to be taken against rumors that arise during disasters.

2. Method

This study targeted past cases of rumors created during disasters in Japan. In regard to the definition of the term "rumor," Miyabe et al. (2013) stated, "many studies have been conducted on rumors from diverse perspectives. Such studies have targeted false or unfounded rumors, hearsay, and gossip, and the definitions of such terms differ among studies" [6]. This study employs the definition of "rumor" provided by the Japan Society for Disaster Information Studies (2016): "a rumor is temporary, spreads to a wide range of people, and affects society in a negative manner" [7]. We considered unfounded rumors, hearsay, and gossip, which were distinguished in previous studies, collectively as rumors.

We selected this study's target disasters from among past disasters in Japan that are listed on the Japan Meteorological Agency (JMA) websites: Past Earthquakes and Tsunami Disasters [8]; Major Earthquakes that Occurred around Japan and Caused Damages in Japan (from 1996) [9]; Past Volcano eruptions [10]; and Meteorological, Earthquake, and Volcano Phenomena that are Named by JMA [11]. From these websites, we identified 18 disasters (13 earthquakes, 3 eruptions, and 2 heavy rain disasters) for which the spread of rumors has been recorded in a book, published paper, or website. We then extracted 453 rumors (Table 2) from books, published papers, news articles on the Internet, blogs, etc., describing rumors that occurred during the disasters [1]–[5], [12]–[36].

Table 2 – Target disasters and numbers of rumors

No.	Year	Name	Number of cases
1	1891 (Meiji 24)	Nobi earthquake	4
2	1914 (Taisho 3)	Eruption of Sakurajima	3
3	1923 (Taisho 12)	Great Kanto earthquake	37
4	1944 (Showa 19)	Tonankai earthquake	5
5	1978 (Showa 53)	Izu–Oshima–Kinkai earthquake	11
6	1982 (Showa 57)	Earthquake near Urakawa	18
7	1982 (Showa 57)	Nagasaki floods of July 1982	20
8	1983 (Showa 58)	Central Sea of Japan earthquake	25
9	1984 (Showa 59)	Western Nagano earthquake	13
10	1986 (Showa 61)	Izu Oshima eruption	17
11	1991 (Heisei 3)	Mount Unzen eruption	18
12	1993 (Heisei 5)	Earthquake off the coast of Kushiro	9
13	1993 (Heisei 5)	Earthquake off the Southwest Coast of Hokkaido	38
14	1995 (Heisei 7)	Southern Hyogo Prefecture earthquake (Great Hanshin-Awaji earthquake)	45
15	2001 (Heisei 13)	Geiyo earthquake	1
16	2011 (Heisei 23)	Earthquake off the Pacific Coast of Tohoku (Great East Japan Earthquake)	157
17	2014 (Heisei 26)	August 2014 Hiroshima heavy rain (Hiroshima landslides)	4
18	2016 (Heisei 28)	Kumamoto earthquake	28

3. Results

3.1 Classification of rumor types

We categorized the 453 rumors into six major categories based on the time elapsed from the occurrence of the disaster, and into 20 subcategories based on content, as shown in Fig. 2.

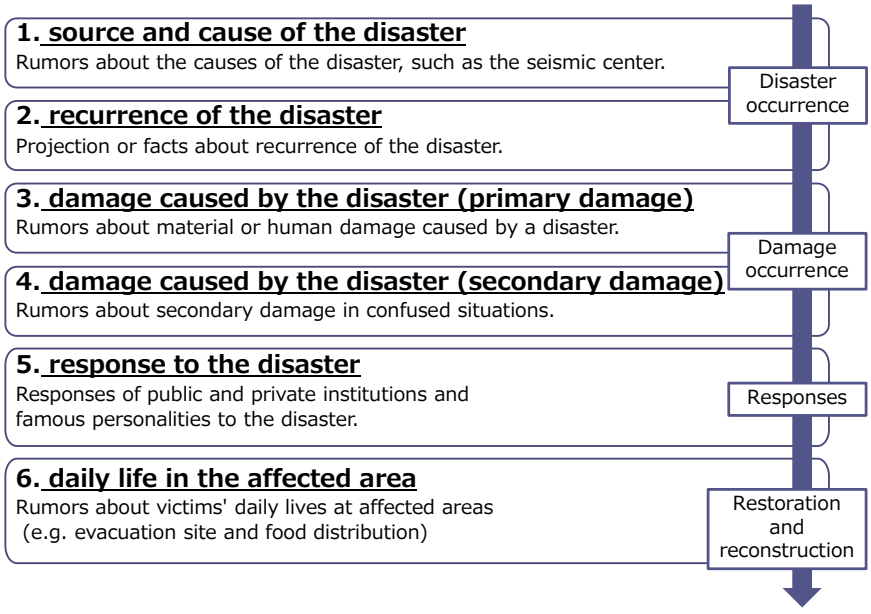

Fig. 2 – Rumors classified by time elapsed from the occurrence of the disaster

Rumors of the first major category, "the source and cause of the disaster," speculate about the possible causes of the disaster. This category includes two subcategories: 1) "unfounded speculation about the cause of the disaster," e.g., "the epicenter must be located in XX" and 2) "unrealistic speculation about the cause of the disaster," e.g., "this is an attack against Japan by a hostile country using seismic weapons" or "this was caused by a weapon developed by YY (name of an emerging religious group)."

The second major category is "recurrence of the disaster," consisting of three subcategories: 1) "affirmation of recurrence of the disaster," e.g., "an earthquake with seismic intensity X will occur Y months later," "a steam explosion will occur at YY (name of a place)"; 2) "denial of recurrence of the disaster," e.g., "the disaster will not recur," "the likelihood of an earthquake will decrease if a big aftershock occurs a month later"; and 3) "false information about recurrence of the disaster," e.g., "YY volcano erupted again ."

The third major category, "damage caused by the disaster (primary damage)," includes false rumors about damage directly caused by the disaster and consists of the following two subcategories: 1) "material damage," e.g., "XXX (name of a place) has been fully destroyed" or “the dam has collapsed”; and 2) "human damage," e.g., "people died due to a collapsed dam" or "someone who is in YYY [name of an area], call an ambulance!" (Note: If the information is genuine, the source of the information should call an ambulance themselves).

The fourth major category is "damage caused by the disaster (secondary damage)," which includes rumors about indirect (secondary) damage caused by the disaster. It consists of five subcategories: 1) "crime,” e.g., "a group of thieves is stealing supplies in the affected area" or "rape is occurring frequently"; 2) "escape," e.g., "the walls of the prison collapsed and the inmates have escaped"; 3) "generation of toxic substances," e.g., "black rain containing toxic substances will fall due to the explosion of the petrochemical complex"; 4) "epidemic diseases," e.g., "tetanus has occurred" or "dysentery has occurred"; and 5) "disaster-related death," e.g., "people are dying due to hunger" or "some people committed suicide in their despair over the situation."

The fifth major category, "disaster responses” by well-known personalities or organizations, consists of the following three subcategories: 1) "evacuation of disaster-responding personnel or well-known people," e.g., "XX (a public figure) has escaped from the affected area" or "all personnel of the Disaster Response Headquarter of YY City have escaped from the City"; 2) "statements of involved personnel," e.g., "XX (a politician) said YYYYY, revealing defects in their character or qualities as a leader"; and 3) "support and aid to the affected area," e.g., "electrical supply from the utility company will be restarted soon" or "an airdrop of supplies will be performed from a helicopter."

The sixth major category, "daily life in the affected area," includes rumors about victims' everyday life, as well as reconstruction and recovery from the disaster. It consists of five subcategories: 1) "safety prevention measures," e.g., "a raincoat must be worn because rain containing toxic substances will fall" or "we should be provided with iodine-containing gargle medicine because it is effective as a countermeasure against radioactive substances"; 2) "unrealistic phenomena," e.g., "sparks from the fire flew far ahead, so that semi-burned paper money fell onto houses in rural areas"; 3) "distribution of supplies and food," e.g., "if you go to XX (place), you can get anything you want" or "tomorrow, an evacuation site at XX elementary school will cook and serve 100 kg of meat"; 4) "use of facilities,” e.g., "an alternative route for the broken national road is now available" or "hospitals do not provide treatment"; and 5) "evacuations," e.g., "evacuees will be expelled from this school evacuation site once classes resume" or "eligibility for temporary housing will be lost if one leaves an evacuation site."

Figure 3 shows the proportions of rumors in each category. The category "recurrence of the disaster" has the highest tendency to occur (41.7%). This is likely due to the increased anxiety and interest in the disastrous phenomenon that suddenly occurred, as well as the lack of information about the causes of the disaster and their lives in the near future. This category is followed by "damage caused by the disaster (secondary damage)" (21.0%), "daily life in the affected area" (14.1%), and "disaster responses" (13.9%). Due to the inconvenience of life at an evacuation site, which is totally different from normal life, people are likely to conjecture about the behavior of others and responses by organizations. On the contrary, rumors

about "damage caused by the disaster (primary damage)" (11.7%) and "the source and cause of the disaster" (1.8%), which can be guessed in regard to disasters that have already occurred, were less frequent.

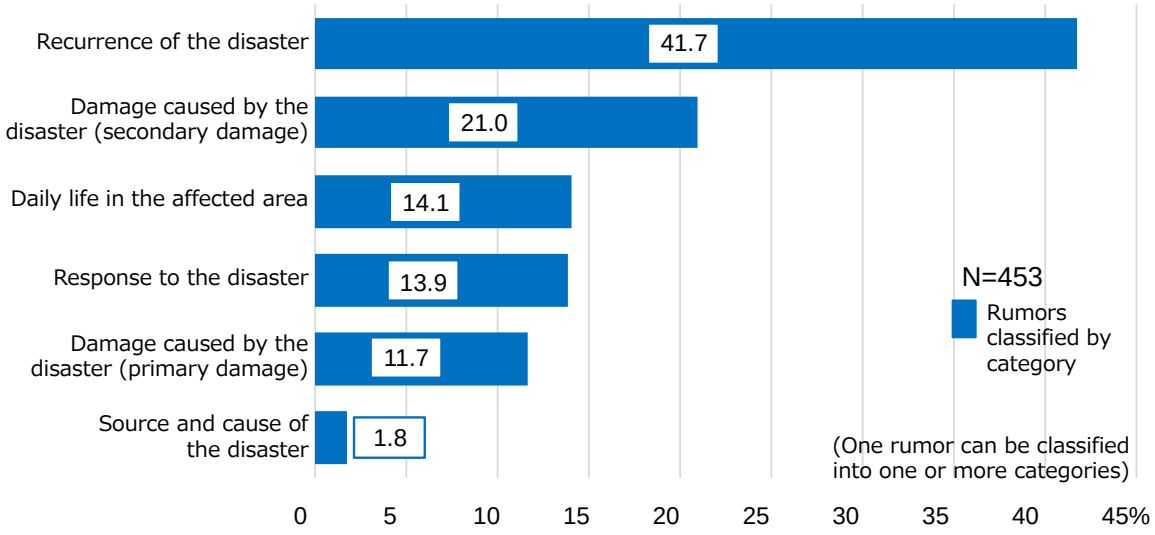

Fig. 3 – Proportion of the six categories of rumors

3.2 Rumors that occur more frequently for each disaster type

We performed a cross-tabulation (Chi-square test) of these six rumor categories and disaster types in order to identify patterns of occurrence of rumors by category type (earthquake, heavy rain, and volcanic eruption). Table 3 shows the occurrence of rumors, by disaster type, that were identified by this test.

Table 3 – Occurrence of rumors, categorized by disaster type

	Rumors that occur easily	**Rumors that do not occur easily**
Earthquake	2. recurrence of the disaster** 5. response to the disaster* 6. daily life in the affected area**	3. damage caused by the disaster (primary damage)**
Heavy rain	3. damage caused by the disaster (primary damage)** 4. damage caused by the disaster (secondary damage)*	2. recurrence of the disaster** 6. daily life in the affected area*
Volcanic eruption	3. damage caused by the disaster (primary damage)**	6. daily life in the affected area*

* : p＜.05、** : p＜.01

We found that rumors that occurred more easily during earthquake disasters (n=391) than other disaster types include "recurrence of the disaster," "response to the disaster," and "daily life in the affected area." On the other hand, in earthquake disasters, rumors about "damage caused by the disaster (primary damage)" did not occur easily relative to other disasters. In particular, as shown in Fig. 1, in earthquake disasters, rumors about "recurrence of the disaster" accounts for 44.2% of rumors, and are thus predominant

relative to other disaster types ($\chi^2(1)=7.5$, p<.01). In regard to the subcategories, "affirmation of recurrence of the disaster" (e.g., "a similar earthquake is going to hit us") has a high likelihood of occurring relative to other disaster types (43.2% for earthquake disasters vs. 24.2% for other disaster types; $\chi^2(1)=8.0$, p<.01). Earthquakes cause frequent aftershocks in addition to the main shock, which sometimes cause further significant damage. Under such conditions, people have increased anxiety about larger earthquakes in the future and the resultant damage. This may promote the occurrence and spread of rumors about "affirmation of recurrence of the disaster."

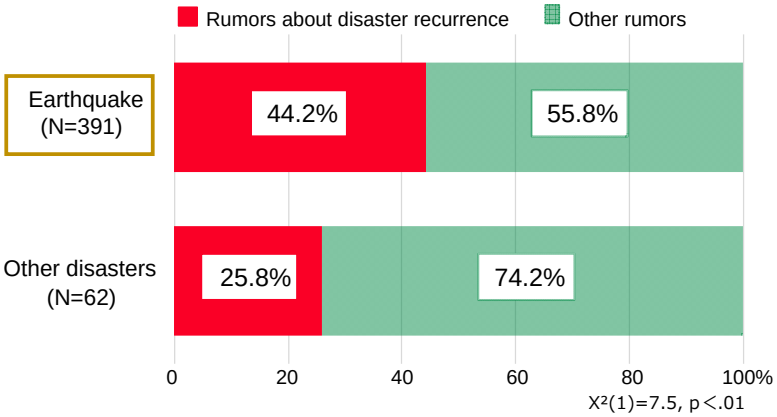

Fig. 1 – Proportion of rumors about "recurrence of the disaster" in earthquake disasters (re-post)

In heavy rain disasters (n=24), rumors in two major categories, "damage caused by the disaster (primary damage)" and "damage caused by the disaster (secondary damage)," occurred more easily than in other disaster types. On the other hand, rumors on "recurrence of the disaster" and "daily life in the affected area" did not occur as easily in heavy rain disasters compared to other disaster types. In particular, as shown in Fig. 4, in heavy rain disasters, the category "damage caused by the disaster (primary damage)" accounts for 58.3% of rumors, higher than in other disaster types ($\chi^2(1)=53.1$, p<.01). In regard to subcategories, rumors about "material damage" (37.5% for heavy rain disasters vs. 6.5% for other disasters; $\chi^2(1)=29.1$, p<.01) and "human damages" (25.0% for heavy rain disasters vs. 2.8% for other disasters; $\chi^2(1)=29.4$, p<.01) occurred more easily in heavy rain disasters than in other disasters. Heavy rain causes more localized damage than other disaster types, and the type of damage varies widely: floods due to river water, erosion of low altitude land due to inland water, or landslide. People want to know about material damage (what damage occurred in what areas) and human damage (where and how people were injured or killed), potentially resulting in the occurrence and spread of rumors about "damage caused by the disaster (primary damage)." In the subcategory "material damage," rumors about damage to infrastructure and facilities, like "the dam collapsed" or "the road is unavailable," were more likely to occur. Such information is important when people evacuate from a heavy rain disaster and seek post-disaster relief. This may contribute to the occurrence and spread of rumors about these issues.

In volcanic eruptions (n=38), rumors about "damage caused by the disaster (primary damage)" occurred more easily than in other disaster types (28.9% for volcanic eruption vs. 10.1% for other disasters; $\chi^2(1)=11.9$, p<.01). On the other hand, rumors about "daily life in the affected area" did not occur as easily during volcanic eruptions. In the major category "damage caused by the disaster (primary damage)," the subcategory "material damage" was significantly more likely to occur (28.9% for volcanic eruption vs. 6.3% for other disasters; $\chi^2(1)=23.9$, p<.01). Specifically, rumors about damage to particular areas or facilities occurred more easily. Volcanic eruptions sometimes require evacuation of residents in designated areas with higher risks, even before the volcano actually erupts. Anxiety caused by not knowing the current status of one's home and community may contribute to the occurrence and/or spread of rumors about damage to specific facilities or communities.

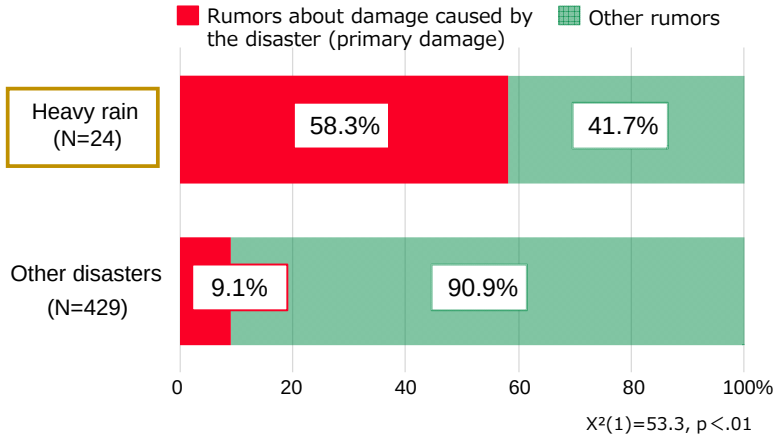

Fig. 4 – Proportion of rumors about "damage caused by the disaster (primary disasters)" in heavy rain disasters

3.3 Rumors that occur more frequently for each source

Next, we analyzed rumors that occurred by source (mass media, public agencies, or general public that is not a particular person or an organization). We performed a cross-tabulation (Chi-square test) of rumor sources and rumor categories. Table 1 shows the occurrence of rumors, by source, that were identified by the test.

Table 1 – Occurrence of rumors categorized by source (re-post)

Source	Rumors that are easily created	Rumors that are not easily created
General public	4. damage caused by the disaster (secondary damage)* 5. response to the disaster* 6. daily life in the affected area*	1. source and cause of the disaster** 3. damage caused by the disaster (primary damage)**
Mass media	1. source and cause of the disaster** 2. recurrence of the disaster** 3. damage caused by the disaster (primary damage)**	4.damage caused by the disaster (secondary damage)** 5. response to the disaster** 6. daily life in the affected area**
Public agencies	2. recurrence of the disaster**	3. damage caused by the disaster (primary damage)** 5. response to the disaster** 6. daily life in the affected area**

* : p＜.05、** : p＜.01

We found that rumors involving "damage caused by the disaster (secondary damage)," "response to the disaster," and "daily life in the affected area" were transmitted more easily by the general public (n=404) than other sources of rumors. On the other hand, rumors about "the source and cause of the disaster" and "damage caused by the disaster (primary damage)" were not transmitted as easily by the general public. In particular, as shown in Fig. 5, 22.8% of rumors that are transmitted by the general public relate to "damage caused by the disaster (secondary damage)," which is predominant relative to rumors transmitted by other sources. They are followed by "daily life in the affected area" (14.9% for general public vs. 0% for other sources; $\chi^2(1)=5.0$, $p<.05$), and "disaster responses" (14.4% for general public vs. 0% for other sources; $\chi^2(1)=4.8$, $p<.05$). After a disaster occurs, information about primary damages such as destroyed buildings

and deaths can be confirmed with our own eyes or obtained through television, radio, or newspapers. On the other hand, information about secondary damages cannot be obtained as accurately because the contents and extent of secondary damages vary significantly due to a range of factors. In addition, it is difficult to obtain information about support provided in affected areas on mass media because such information is specific to each local area. Such a lack of information may lead to the occurrence and spread of rumors about "damage caused by the disaster (secondary damage)" and "daily life in the affected area." In addition, people may release their stress and frustration about changes in their daily life by transmitting or spreading rumors on "disaster responses" to vent personal negative emotions about politicians and other public figures.

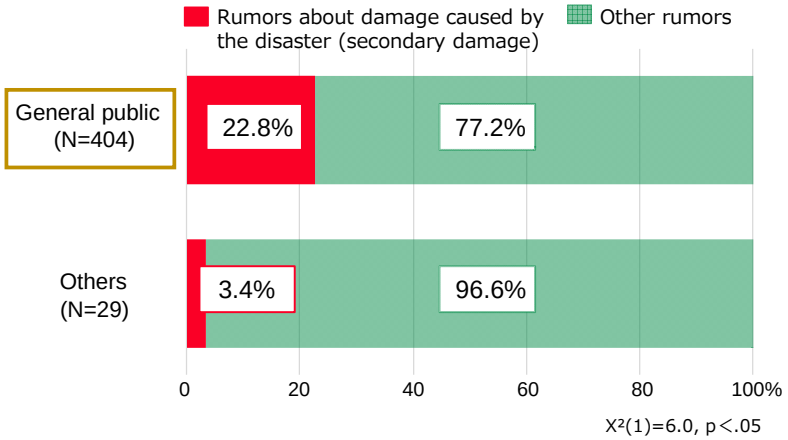

Fig. 5 – Proportion of rumors about "damage caused by the disaster (secondary disasters)" transmitted by the general public

Among rumors that were transmitted by mass media (n=79), the following categories tended to occur more easily: "cause and source of the disaster," "recurrence of the disaster," and "damage caused by the disaster (primary damage)." On the other hand, rumors regarding "damage caused by the disaster (secondary damage)," "response to the disaster," and "daily life in the affected area" did not occur as easily among rumors transmitted by mass media. Specifically, as shown in Fig. 6, 60.8% of rumors that are transmitted by mass media relate to "recurrence of the disaster," which is predominant relative to rumors transmitted by other sources. After a disaster occurs, information about it is reported on television and radio, and the information continues to be updated as soon as more information is known (e.g., in the case of an earthquake disaster, the seismic intensity, the location of epicenter, damages, etc.). This continuous updating contributes to the different amount of information available among individuals based on the time when people acquire information, creating a situation in which the overall picture of the disaster is vague for certain groups of people. This may lead to the generation and spread of rumors about "source and cause of the disaster." In addition, in case of earthquake disasters, news agencies often call attention to possible recurrence of the disaster, e.g., "please be prepared, as aftershocks may occur." This is intended to serve as a reminder that there is a possibility of recurrence of the disaster, but because the information is transmitted among people who are anxious about recurrence, the concept of “possibility of recurrence” can be gradually transformed into affirmative rumors such as “aftershocks will occur” and “more damage will be caused by large aftershocks,” which can spread.

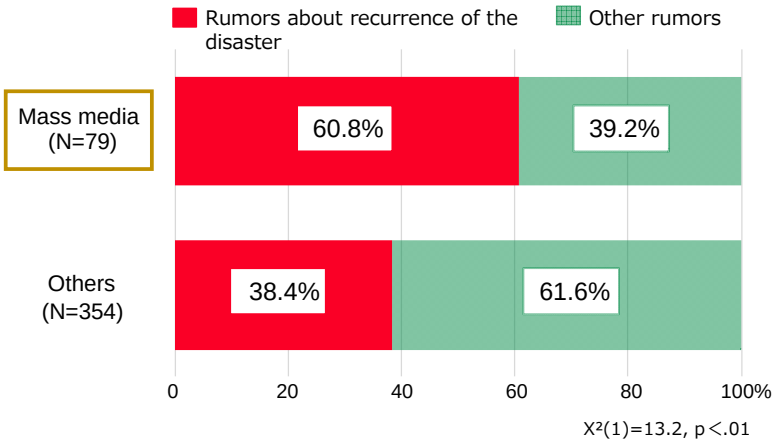

Fig. 6 – Proportion of rumors about "recurrence of the disaster" reported by the mass media

Among rumors that were transmitted by public agencies (n=45), rumors about "recurrence of the disaster" tended to occur more easily. On the other hand, rumors on "damage caused by the disaster (primary damage)," "response to the disaster," and "daily life in the affected area" did not occur as easily among rumors transmitted by public agencies. As with mass media, public agencies tended to generate rumors about "recurrence of the disaster" (88.9% for public agencies vs. 37.1% for other sources ; $\chi^2(1)=44.2$, $p<.01$). In addition, like news agencies, public agencies often call attention to possible recurrence after an earthquake disaster occurs, e.g., "please be prepared, aftershocks may occur." Public agencies are generally more reliable information sources, leading to the occurrence and spread of rumors about "recurrence of the disaster." In fact, in the 1978 Izu-Oshima-Kinkai earthquake, a caution about possible aftershocks released by Shizuoka Prefectural Office in the name of the Governor was transformed into an official evacuation advisory as it was transmitted among the citizens. As shown in this case, rumors can occur even when public agencies and news agencies transmit correct information [37]. Thus, correct information may be received incorrectly due to the receiver's mental state, leading to the occurrence of rumors.

4. Conclusion

In this study, we collected rumors that occurred in past disasters and classified them into six categories to analyze the patterns and causes of rumors, categorized by disaster type and rumor source.

As a countermeasure against these rumors, disaster management education must emphasize that "rumors spread easily during disasters." Each of us should be aware of the possibility of problematic rumors. Furthermore, before earthquakes occur, educational entities should systematically teach students about the potential for false rumors. After an earthquake, mass media should continuously provide alerts about the possibility of false rumors to suppress their occurrence and spread.

Specifically, the fact that "rumors are easily created in disaster times" should be communicated along with past actual cases. When receiving information during a disaster time, in order not to be misled by such rumors, a two-phase check must be performed: 1) question the contents of the information (keeping calm to determine whether there is anything strange about the information) and 2) confirm whether the information has also been published by multiple reliable sources such as TV, newspaper, and public websites. This two-phase check is based on the idea of intrinsic checks (check for the presence of any unrealistic information or inconsistency in the received information itself) and extrinsic check (judge the genuineness of the information using other evidence) [5][13].

When someone transmits information during a time of disaster, it is also important 1) to transmit any information only after confirming its genuineness (i.e., performing a two-phase check before passing on any information); 2) not to exaggerate or create information based on their speculation (i.e., not changing the

information based on an unfounded assumption, which also means that they will not be misled by false rumors); and 3) to transmit any information in a manner that is clear and easy to understand (to avoid misunderstanding by receiver, which also means that they will not transmit false rumors). It is necessary to suppress the occurrence of rumors as much as possible through pre-disaster education on appropriate disaster responses and distribution of flyers to alert the general public.

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