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Analysis of the Characteristics of Evacuation Information Acquirers from Online Media based on Typhoon Victim Data

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Abstract

In recent years, many natural disasters have occurred in Japan. As a means for providing information in the event of such a disaster, online media has emerged as a valuable resource. In this study, we analyze the online-media usage tendencies of victims evacuating from Typhoon No. 19 through questionnaire data. The results of cluster analysis and comparative analysis of evacuees' attributes demonstrate that acquiring evacuation information from online media is an information-seeking action similar to obtaining information from one's friends, acquaintances, and neighbors. Such behavior is a self-exploratory information gathering behavior. Therefore, as regards the direction of online media utilization in future of natural disasters, it should be an effective means for to collecting local disaster information from users; then this information can be utilized for disaster countermeasures.

Keywords: online media, natural disaster, evacuees, evacuation, information-seeking

1. Background

1.1. Utilization of Online Media During Natural Disasters

In recent years, many natural disasters have occurred in Japan, including devastating typhoons and earthquakes. Local governments and television have been the main information source for such disasters, but now additional information sources have emerged online (Austin & Jin, 2017; Imran et al., 2015; Meier, 2015; Palen & Hughes, 2018). For example, the Japan Meteorological Agency (2020) provides disaster prevention information on its websites and apps. The NHK also provides disaster information not only through broadcasts but also through its app (NHK, 2020). In addition, the AI Disaster Prevention Council is developing a disaster prevention AI chatbot for SNS

users to share information (Council on Artificial Intelligence for Disaster Resilience, 2020). This spread of new disaster information sources has the potential to support evacuation behavior. Therefore, it is necessary to consider ways to disseminate these new disaster information sources because, in past natural disasters, online media have been used to compensate for the shortcomings of mobile and landline phones, which has proven effective. The next section provides examples of online media used as countermeasures in natural disaster.

1.2. Use of Online Media in the Event of a Disaster

During recent natural disasters in Japan, online media users have voluntarily used online media to confirm the safety of loved ones and obtain disaster information, evacuation information, relief supplies information, and the like. This section considers the advantages of online media based on past natural disasters.

The first case is the Great East Japan Earthquake. The Great East Japan Earthquake occurred on March 11, 2011. The epicenter was 130 km east-southeast of the Oshika Peninsula in Miyagi Prefecture. The maximum seismic intensity of this earthquake was 7 (measured in Kurihara City, Miyagi Prefecture), and the maximum acceleration was 2,933 gal (Kurihara City, Miyagi Prefecture). The death toll was 15,895 and the number of missing persons was 2,533.¹ The number of Earthquake-related deaths was 3,701 (Cabinet Office, 2020a).²

During the earthquake, many communication methods, such as mobile phones, SMS, and landline phones, were out of service. However, the Internet was available. Victims used social media, such as Twitter, to confirm the safety of their relatives and to acquire disaster information and evacuation information (Doan, 2012; Peary et al., 2012; Wilensky, 2014).

The next example is the Kumamoto Earthquake, which caused a foreshock on April 14, 2016, followed by a main shock on April 16. Epicenter was the Kumamoto region in Kumamoto Prefecture. The maximum seismic intensity of the foreshock was 7 (measured in Mashiki Town, Kumamoto Prefecture) and 7 for the main shock (Mashiki Town, Kumamoto Prefecture, Nishihara Village). Maximum acceleration was 1,580 gal (Foreshock: Mashiki Town, Kumamoto Prefecture). The death toll was 50 people and the number of Earthquake-related deaths was 212 people (Cabinet Office, 2020b).³

During this earthquake, landlines and mobile phones were also out of service. Utilizing the lessons of the Great East Japan Earthquake, the use of the Internet expanded further at the Kumamoto earthquake. The use of social networking sites (SNSs) was not limited to citizens; local governments actively disseminated information about disasters

and evacuation lives through SNSs (Ministry of Internal Affairs and Communications, 2017; Yamada et al., 2018).

These cases demonstrate that the use of online media during natural disasters is increasing. Case studies of both victims and local governments show that information mediators are exchanging necessary information by means of both the sending and receiving functions through online media.

1.3. Summary of Typhoon No. 19 Damage

This study focuses on the Japanese evacuees who took action by utilizing online media during the Typhoon No. 19 (referred to hereafter as Typhoon 19) in 2019. Therefore, this section provides an outline of the events of Typhoon 19, which is the subject of our analysis.

Typhoon 19 hit Honshu on the Japanese mainland from October 12–13, 2019. In particular, severe damage occurred in the Kanto and Hokushinetsu Tohoku areas, with 262 rivers overflowing in 16 prefectures and 125 dikes failing in 7 prefectures. In the end, 99 people died, 3 went missing, 40 were seriously injured, and 341 were suffered minor injuries. The physical damage consisted of 3,280 buildings that were complete destroyed, 29,638 buildings that were partially destroyed, 35,067 buildings for with minor damage, 7,837 buildings with above-ground flooding, and 23,092 buildings with flooding below ground level (Cabinet Office, 2019).⁴

2. Literature Review

This section reviews previous studies of the utilization of online media in natural disasters, focusing, first, on research into the use of online media to evacuate victims and confirm their safety. Based on the use of social media at the time of the Great East Japan Earthquake, Yanagita (2012) pointed out such advantages of using social media at the time of disaster as simplicity, pushability, real-time property, personality, and spreadability. In order to widen the usage of media, Yanagida (2012) recommends that people become familiar with online media and improve their ability to collect information in that manner.

Shibatani (2011) found that, at the time of the Great East Japan Earthquake, the percentage of evacuees who used social media to confirm their safety was lower than the number of people who made telephone calls (5% versus 15%), but the achievement rate (the percentage of people who received confirmatory information) was extremely high for online media sources, such as Twitter at 86%. Yoshida and Shigyou (2012) conducted an interview survey of people who had used social media during the Great East Japan

Earthquake; they mentioned that, during the disaster, people could not take optimum action because of rumors and hoaxes spread via SNSs.

Second, some research investigated the use of online media by local governments and the issues emerged in this arena. Fujishiro et al. (2018) analyzed social media information about the Kumamoto earthquake; they pointed out that even if public institutions were able to triage information in normal situations, it would be dysfunctional during a large-scale disaster. Ishikawa et al. (2013) conducted an interview survey of the response of local governments during the 2011 Kii Peninsula flood when local governments assumed the use of social media as a complement to telephones and disaster prevention radios. Additionally, this study reports on the consideration of disaster prevention administration (Ishikawa et al., 2013).

However, these studies did not analyze the attributes and behavioral characteristics of evacuees based on information from online media. Elucidating the attributes and behavioral characteristics of evacuees will make it possible to consider measures for providing information to evacuees via online media.

3. Research Concept

This study analyzes the characteristics of online information behavior during a disaster. Specifically, this study visualizes similarities and dissimilarities between online media and other information sources at the time of disaster. In addition, this study compares and analyzes the attributes and evacuation tendencies of evacuees who use online media information and those who do not.

Table 1: Overview of survey

Survey period	October 15–16, 2019
Survey method	Smartphone research utilizing LINE Research Platform
Target subjects	Participants in LINE Research from 12 prefectures: Iwate, Miyagi, Fukushima, Ibaraki, Tochigi, Gunma, Saitama, Chiba, Niigata, Yamanashi, Nagano, and Shizuoka
The number of subjects	75,575 subjects (extracted from 1,243,622 survey participants)

This study conducted a web questionnaire survey to clarify the evacuation status of Typhoon 19. This survey was conducted via the LINE Research Platform web questionnaire system on October 15 and 16, 2019, two days after the typhoon hit Japan.

The subjects of the study were 75,575 people extracted from research monitors of 1,243,622 people living in the 12 prefectures affected by Typhoon 19 (Table 1).

As for the direction of analysis, first, the kinds of information sources and online media that were used by evacuees of Typhoon 19 will be visualized. Furthermore, cluster analysis will be performed on the relationship between evacuation information sources. Through these analyses, it may be possible to understand what kinds of information sources were used for evacuation decision making and to clarify how online media relates to other information sources.

The second direction of analysis concerns the attributes of the evacuees who used online media. These attributes were subjected to a comparative analysis of such factors as age, gender, and marital status. Through this analysis, it is possible to clarify the tendencies of evacuees who use online media. Furthermore, the information-seeking behavior of online media users was analyzed. By analyzing the number of uses of each information source, assessment of information-seeking trends is clearer.

Finally, based on the results of these analyses, this paper examines the policy measures necessary to expand the use of online media during evacuation. There are two directions for this study: one for users of online media and one for non-users. This paper proposes that measures to optimize online media users' evacuation behavior and methods of evacuation information provision by making the most of their utilization. For non-users, measures are suggested for assisting them in using online media and taking evacuation action in the event of a disaster.

4. Survey Results

4.1. Evacuation Behavior based on Online Information

In the survey, there 3,915 participants who evacuated, that is, 5.25% of the 75,575 participants in the study. Based on data from these 3,915 participating evacuees, the study investigated the information sources for the evacuation measures used. The usage ratios for each information source are as follows: "Smartphone emergency Call" (55.16%), "TV/radio" (36.53%), "Disaster prevention radio" (32.34%), "Police/fire" (17.3%), "Website" (15.93%), "Family" (15.8%), "SNSs like Twitter" (12.6%), "Friends/acquaintances" (11.4%), "Other" (10.8%), "Neighbors" (9.7%), and "LINE information" (3.6%) (Figure 1).

Based on valid responses, evacuees were categorized into evacuees who used online media or evacuees who used other information sources. Evacuees who used online media ("SNSs like Twitter," "Website," or "LINE information") constituted 25.3% (or 977), of the participants. On the other hand, 74.8%, or 2,890, of the evacuees

used other information sources.

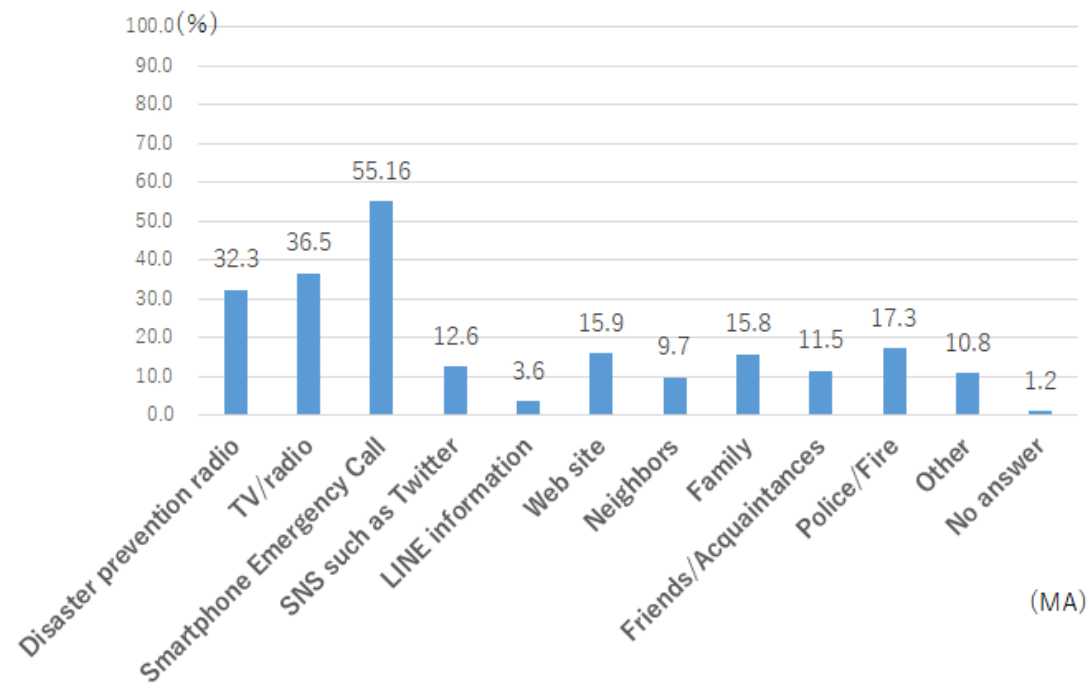


Figure 1: Information sources used for evacuation decisions

4.2. Visualization of Similarities in Evacuation Behavior via Cluster Analysis

To visualize the similarities in evacuation behavior for each information source, a cluster analysis was performed using the Ward method and the results were plotted in the form of a dendrogram.

According to the structure of the dendrogram, “SNSs like Twitter,” “Website,” and “LINE information,” which are classified as online media, have a structure similar to “Neighbors” and “Friends/Acquaintances.” This means that the Euclidean distance is close and similarity is high. The behavior of acquiring information from these information sources is considered active and exploratory.

Furthermore, since Euclidean distance of these information sources is far from “Disaster prevention radio,” “Smartphone emergency call,” “TV/radio,” etc., which are passive information sources, this shows that online media involve information acquisition behavior that is different from the information sources used so far (Figure 2).

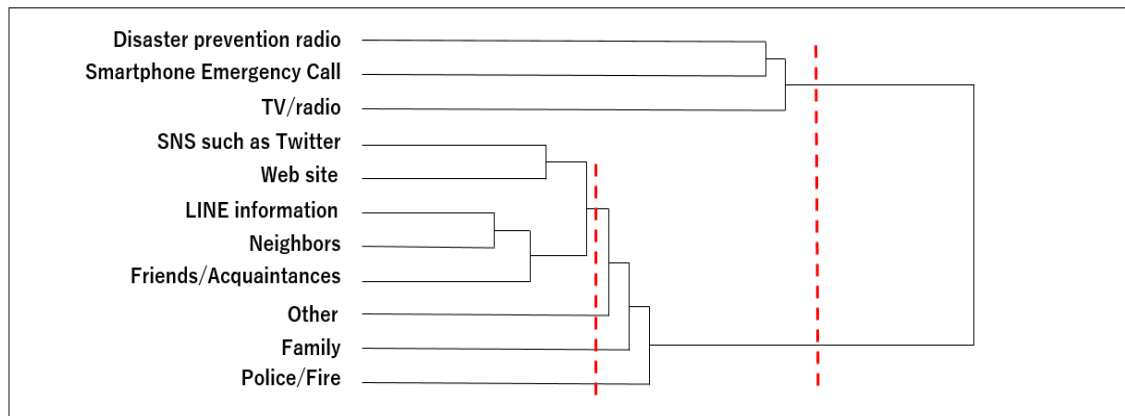


Figure 2: Dendrogram illustrating each evacuation behavior

4.3. Attributes and Trends of Evacuees based on Online Media Information

Next, the study clarifies the differences in attributes and behavioral characteristics between the 977 evacuees who used online information and the 2,890 evacuees who did not.

1) Age Factors

To clarify the relationship between age and the use of online media, the average ages of the evacuees who used online media and the those who did not were compared. This resulted in an average age of 34.45 for the former, younger than average age of the latter with a difference of 4.89 years. T-test results also showed a significant difference ($t(3,865) = 10.56, p < .01$) (Table 2).

Table 2: Comparison of age factor

	Mean	Median	SD	<i>P</i> value
Evacuees who did not use online media (n = 2,890)	39.34	40	12.49	< .01
Evacuees who used online media (n = 977)	34.45	34	12.54	

2) Marriage Factors

Next, the relationship between marital status and the use of online media, was clarified. This yielded a ratio of unmarried evacuees whose use of online media was significantly higher than that of married evacuees ($\chi^2(2) = 71.772, p < .01$), and the difference was 14.86 points (Table 3).

Table 3: Comparison of marriage factors

	Unmarried	Married	Divorced	<i>P</i> value
Evacuees who did not use online media (n = 2,890)	30.48%	59.48%	10.03%	< .01
Evacuees who used online media (n = 977)	45.34%	47.19%	7.47%	

3) Gender Factors

Gender was compared in order to clarify whether this could account for differences in reliance on information from online media sources. The results show that the ratio of male users was 4.71 points higher than that of non-users. An χ^2 test also showed a significant difference ($\chi^2(2) = 11.245, p < .01$) (Table4).

Table 4: Gender composition comparison

	Male	Female	Other	<i>P</i> value
Evacuees who did not use online media (n = 2,890)	24.26%	75.33%	0.42%	< .01
Evacuees who used online media (n = 977)	28.97%	70.21%	0.82%	

4) Comparison of the Number of Information Sources Used

To clarify information usage tendency among the participants who used online information, the study compared the number of information sources of evacuees who used online media and those who did not. The results show that evacuees who used online media tended to use a variety of information sources to make evacuation decisions in contrast to the other evacuees. Evacuees who used online media used on average 3.5 more information sources, which is 1.69 points higher than evacuees who did not use online media. The results of a t-test also show a significant difference ($t(1,262) = 31.85, p < .01$) (Table 5).

Table 5: Comparison of the number of information sources

	Mean	Median	SD	<i>P</i> value
Evacuees who did not use online media (n = 2,890)	1.81	2	1.00	< .01
Evacuees who used online media (n = 977)	3.50	3	1.56	

5. Discussion

The survey results show that unlike the information behavior of passive acquisition information, such as “Disaster prevention radio,” “Smartphone emergency call,” and “TV/radio,” online media is an active and exploratory information acquisition behavior. These behavioral characteristics are similar to other information sources, including “Neighbors” and “Friends/acquaintances.” Based on the nature of the information provided, sources like “Disaster prevention radio,” “Smartphone emergency Call,” and “TV/radio” can be considered passive information acquisition sources. However, online media requires active acquisition because users must search for the necessary information. This is supported by the fact that online media clusters close to “Neighbors” and “Friends/acquaintances,” as shown in the cluster analysis.

Furthermore, the average age of evacuees who used online media was younger than the average age of evacuees who did not use it, the percentage of unmarried was also high. It is imagined that they are taking active information actions through everyday online media use. As a clue to support this, the analysis results showed that users tended to take evacuation behavior not only from online media but also from multiple information sources.

If so, it should be possible to take evacuation measures by sharing the information they have, using the communication and information utilization abilities of people who use online media. For example, in Kobe City, a demonstration experiment was conducted in 2018 in which SNS users reported local disaster information in response to AI chatbot inquiries, and based on that information disaster countermeasures and evacuation measures in Kobe City were considered (National Institute of Information and Communications Technology, 2019). It is conceivable that any user who can use online media for evacuation behavior will provide useful information.

6. Conclusion

This study analyzed the characteristics of evacuees who took evacuation action by utilizing online media during natural disasters. The results of analysis demonstrate that

online media is closely related to the behavior of acquiring information from neighbors or friends and acquaintances because all of these sources entail active acquisition. Furthermore, a variety of information sources were used; online media users did rely on one source or solely on online media. Another finding is that utilizing online media users' collection ability could be an effective countermeasure in a disaster.

However, there are some issues that could not be mentioned in this study. This analysis did not include regional trends in evacuee behavior. For example, if there is a difference in online media usage rates between large, mid-sized, and small cities, it may be necessary to take measures to educate those in areas where usage is not as advanced. Furthermore, it is necessary to consider complementary relationships and cooperative relationships with conventional information sources.

Furthermore, there is a difference in the information required by evacuees at different stages of a natural disaster. For example, immediately after a disaster occurs, the most pertinent information includes whether an evacuation is necessary, the location of evacuation sites, and information confirming or denying hoaxes. Thereafter, information about relief supplies, evacuation conditions, etc., is required at the emergency measures stage of a disaster. Finally, at the recovery stage, information is needed regarding the disaster recovery support system and for coping with the longer-term evacuation circumstances. In this final stage the kind of information needed is more personalized, and because online media can flexibly deal with the personalization of information, it is necessary to conduct research on optimized disaster information provision methods using online media.

This study focused on the information acquisition behavior of evacuees but did not analyze the subjects who did not evacuate. Analyzing the information behavior the people who have decided not to evacuate in the face of a natural disaster would also be an effective focus for research into the method, content, and timing of information provision during a natural disaster. These research topics can be investigated in the future.

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¹ As of March 8, 2019.

² As of September 30, 2018.

³ As of April 13, 2018.

⁴ As of February 12, 2020.