Original article

Media coverage and stress in evacuees from Fukushima of the Great East Japan Earthquake

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Abstract

The Great East Japan Earthquake (GEJE), on March 11, 2011, forced many residents of Fukushima to evacuate to other prefectures. It is known as a triple disaster of earthquake, tsunami and nuclear accidents. People were exposed to repeated terrifying images of the disaster, such as footage of the tsunami and explosions at the nuclear plants, on television and every other type of media. The purpose of this study was to confirm evacuees' utilization rates of media coverage and verify the influences of that coverage on the change of their subjective stress for three years (stress3Y) from just after GEJE. Analyses were performed using anonymous self-administered questionnaires with 859 evacuees. First, comparisons among the types of media coverage consumed and age groups by gender were conducted to verify any unevenness or linear trends. Multiple regression analysis was then performed with the objective variable of stress3Y, and 24 explanatory variables: gender, age group, family structures, types of news source, and visual analogue scale (VAS) for measuring influences of media coverage. Few differences were found between the genders. The news source with the highest utilization was television, and over 70% of evacuees consumed multiple news sources. Regarding age differences, an upward age trend in newspaper utilization rate was observed, and downward trends were observed regarding mobile phone and internet usage. Stress3Ys were significantly influenced both positively (merits) and negatively (demerits) by television coverage. Information obtained via television particularly contributed to the reduction of stress, but oft-repeated scenes of disaster, such as coverage of the tsunami on television, seemed to cause evacuees and even non-evacuees to experience trauma. These results indicate that, in order to prevent disaster trauma, excessive repeated coverage of actual disaster scenes on television should be reconsidered in order to avoid exacerbating disaster-related stress and post-traumatic stress.

Media organizations should restrict the airing of vivid disaster scenes in the same way that they do for graphic murder and war scenes.

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Introduction

Over 123,000 evacuees of the Great East Japan Earthquake (GEJE) remain in a state of evacuation as of February 28, 2017 [1]. The number of evacuees from Fukushima Prefecture in particular is quite large; this was a disaster of historical proportions which affected many people's lives.

Koiso et al. [2] already discussed the change in respondents' subjective stress between just after GEJE and three year later (stress3Y) (Table 1), as well as the causes of that stress. In addition, Koiso et al. [3] qualitatively analyzed the relationship between media coverage and evacuee stress. According to Koiso et al., the strong criticism expressed by evacuees regarding slow and inadequate responses and reconstruction efforts by the national and local government were similar to those seen after the Chernobyl nuclear disaster. Also, similar to the Chernobyl case, when different opinions among scholars about the effects of nuclear radiation on human health caused rumors to spread throughout the media, and stress increased among the residents. Since the stress caused by media coverage adds to the stress they are already experiencing from evacuation, the overall stress of these evacuees must be reduced.

However, media coverage about the GEJE following the unprecedented nuclear accident, including daily coverage on television, radio, newspaper, and the Internet, has not been discussed as an independent factor influencing stress3Y. Kiso et al. [3] qualitatively analyzed the stress caused by media coverage using KH Coder (free software for text mining) [3]; however, the purpose of this study is to confirm evacuees' utilization rates of media coverage and verify the influence of that coverage on stress3Y using quantitative methodology.

Materials and Methods

1. Data collection and participants

Through organizations supporting evacuees of

Table 1. Questionaires regarding news sources administered to evacuatees from Fukushima Prefecture after the Great East Japan Earthquake.

Q1. Age of respondent: 2: 20-29 years old; 3: 30-39; 4: 40-49; 5: 50-59; 6: 60-69; 7: 70-79; 8: 80+
Q2. Gender: 1: male; 2: female
Q3. How many people are there in your family?
Q4. Who lives together with you?
1: spouse; 2: parent(s); 3: sibling(s); 4: child(ren) (How many? _____); 5: grandparent(s);
6: cousin(s); 7: friend(s); 8: other(s)
Q5. Where did you obtain public information around one month after the earthquake disaster?
(multiple +++answers possible)
1: radio, every day; 2: radio, occasionally; 3: television, every day; 4: television, occasionally;
5: mobile phone; 6: the Internet; 7: a newspapers; 8: one or more of sources 1-7; 9: others
Q6. What did you think about the photos and video footage of the disaster that you saw on television or +++other media sources?
These four questions included a visual analogue scale (VAS)* ranging from "disagree" to "strongly agree".
q6-1. Was the necessary information obtained? (single response)
q6-2. Because the photos and footage were shown repeatedly, did you feel stress? (single response)
q6-3. Because photos and footage were shown repeatedly, did you feel sad? (single response)
q6-4. Did you feel that important information was not obtained? (single response)
Q7. Please write freely if you have any requests for the media regarding the content or frequency of their +++news coverage, or their editorial stance.

*:Visual Analogue Scale (VAS) is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. It is often used in epidemiologic and clinical research to measure the intensity or frequency of various symptoms.

GEJE as well as local governments, an anonymous self-administered questionnaire was sent to the families that had evacuated from Fukushima Prefecture to any of seven prefectures in the Kanto area. The questionnaires were sent to the evacuees on April 2014, and responses were collected by October 2014.

The complete questionnaire can be viewed via Google Drive [4]. Table 1 shows the seven questionnaire items related to media coverage. Item Q6 is composed of four questions incorporating the visual analogue scale (VAS) [5], which allows respondents to indicate their response on a scale ranging from 1 (disagree) to 10 (strongly agree).

Item Q7 was not analyzed in this study because it was a free-response item that has already been analyzed and published in a separate qualitative study [3].

Data analyses

1) Software

Microsoft Excel 2013 SP2 with Excel Statistics 2015 (add-in software), EZR (statistics R), and IBM Statistics version 21 were used for the data analyses.

2) Categories of post-disaster family structure

Single mother evacuees in this study were defined as females who evacuated from Fukushima due to the disaster with children younger than 20 and who had lived away from home since the disaster on March 11, 2011. They also either met the definition of a single mother under the Act on Welfare of Mothers with Dependents and Widows [6, 7] or at the time of the questionnaire, had lived alone with their children and apart from their spouse or other family members (such as grandparents) for five or more days per week in the area to which they had evacuated.

The family structures of respondents were classified into the following eight types: (1) single mother family (the respondent and her child(ren) younger than 20), (2) the respondent, her spouse, and her child(ren), (3) the respondent, her spouse, her child(ren), and one or more of their parents, (4) the respondent and her spouse, (5) the respondent, her spouse, and one or more of their parents, (6) the respondent and one or more of her parents, (7) the respondent alone, and (8) the respondent and one or more other family members (e.g., siblings, relatives). All variables were dummy variables indicating either absence (0) or presence (1).

2. Analytical methods

Analyses were conducted according to the following four steps:

1) The number of respondents in each type of family structure was calculated.

2) Statistics such as mean, SD, and distribution of the difference in subjective stress between just after GEJE and three years later (stress3Y) were calculated.

3) Utilization rates of media sources such as radio, television, and Internet were compared by gender with Fisher's exact test (2×2 table: FET2×2) using statistics R, and unevenness and linear trends by age group and by gender were measured with Fisher's exact test (2×7 table: FET2×7) and the Cochran-Armitage trend test (CATT2×7) using statistics R.

4) Stepwise multiple regression analysis (st-MRA) was performed using SPSS to build a multiple regression model with Pin < 0.15 and Pout > =0.15 [8]. The objective variable was stress3Y, and the 24 explanatory variables were gender, age groups (7), family structure (8), type of news source (10), and influence of media coverage measured by visual analogue scale (VAS) (4). The means, SDs, and coefficients of variance (CVs) were also calculated.

3. Ethical approval

This study was conducted in full accordance with ethical principles, including the World Medical Association Declaration of Helsinki, and it was approved by the Ethics Committee of Niigata University of Health and Welfare (Approval No:17489-140513) on May 22, 2014 .

The questionnaire included a page entitled, "Ethical considerations," which described the purpose of the study, the anonymous nature of the survey, participation based on free choice, and the absence of disadvantage of non-participation. Answering the questionnaire was deemed as consent to participate.

Results

1. Subjects

Of the data from 902 total respondents, those from 859 respondents were extracted after excluding incomplete individual items such as gender and age.

2. Change of subjective stress between just after GEJE and three years later

The change of respondents' stress between just after GEJE and three years later is shown in Table 2. Average stress3Y changed from 7.80 to 6.12, a decrease of 1.68. A paired t-test showed this difference to be highly significant ($p < 0.001$). The distribution of stress3Y is shown in Figure 1. Over one-third (34.81%) of the participants (stress3Y >= 0) showed no decrease in stress.

3. Trend analyses of utilization rate of each news source

1) Gender differences in utilization rate:

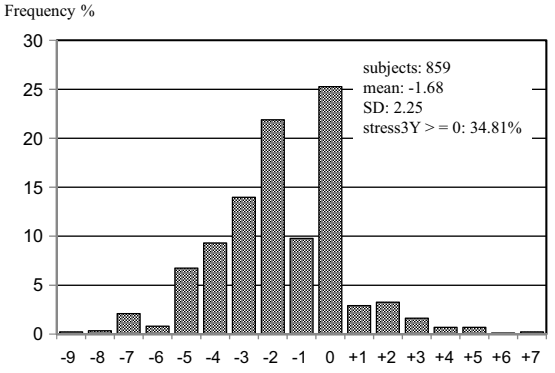


Figure 1. Change in subjective stress between just after the Great East Japan Earthquake and three years later.

Figure 2 shows that almost none of the differences between genders were significant, with the exception of the everyday utilization of radio of 60-69 year-olds ($p < 0.05$, male > female) and that of reading the newspaper of 50-59 year-olds ($p < 0.05$, male > female) by FET(2×2)s.

2) Age differences in utilization rate:

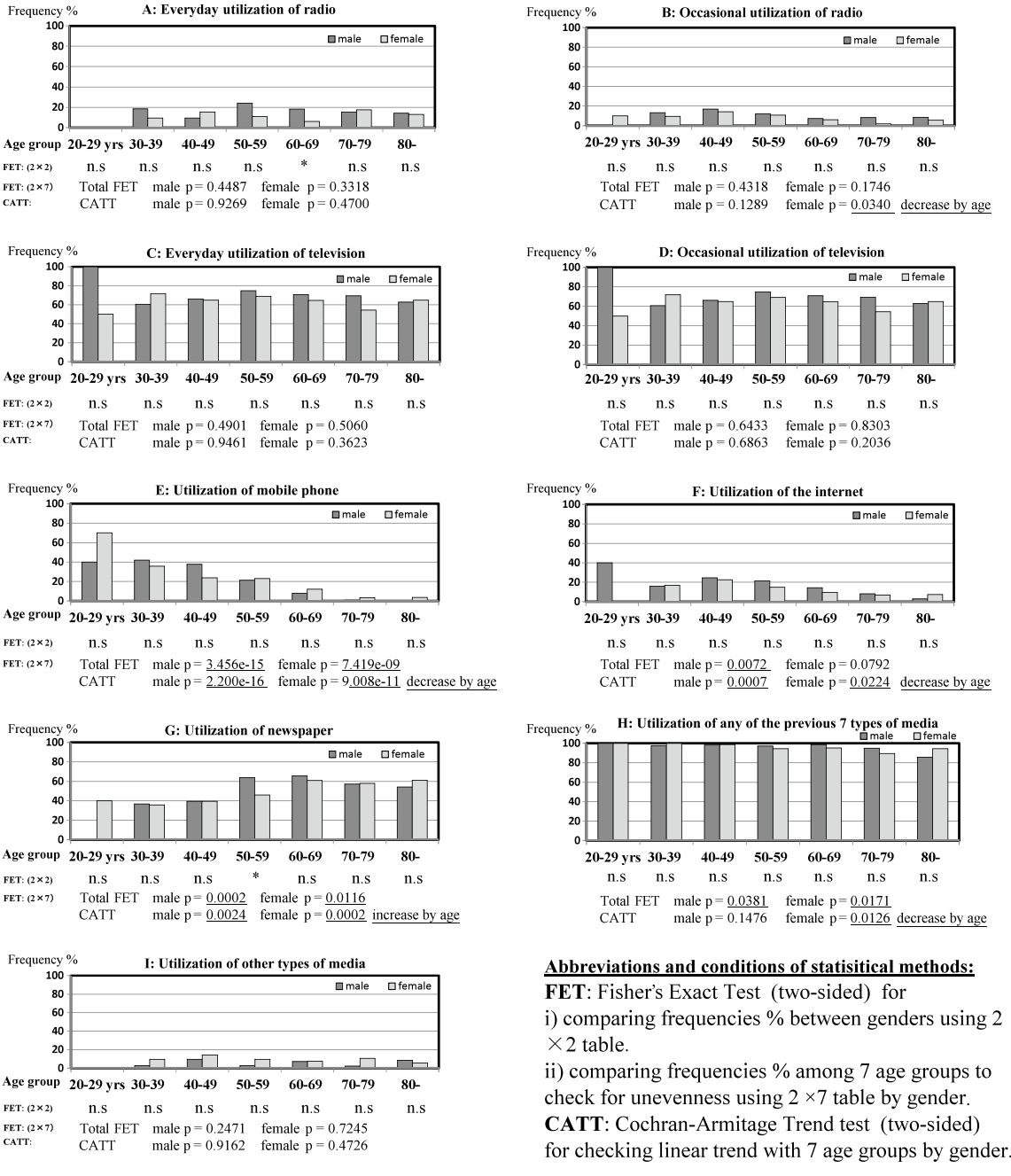
a) Unevenness by FET(2×7): Figure 2 shows that differences were significant ($p < 0.001$-0.05) for mobile phone, internet, newspaper, and any type of news source in males, whereas differences were significant ($p < 0.001$-0.05) for mobile phone, newspaper, and any type of news source in females.

b) Linear trend by Cochran-Armitage trend test:

Table 2. Change in subjective stress between just after GEJE and three years later.

	degree of subjective stress (maximum: 10)		
	Stage1: just after GEJE	Stage 2: three years after GEJE	Difference (Stage2 - Stage1)
participants	859	859	859
mean	7.80	6.12	-1.68
standard deviation	2.21	2.17	2.25
minimum	1	1	-9
first quartile	6	5	-3
second quartile (median)	8	6	-2
third quartile	10	8	0
maximum	10	10	7

GEJE (Great East Japan Earthquake)
Paired t-test between Stage 1 and Stage 2 t = 21.86 (p = 1.50718E-84)



Abbreviations and conditions of statisitical methods:

FET: Fisher's Exact Test (two-sided) for
i) comparing frequencies % between genders using 2 ×2 table.
ii) comparing frequencies % among 7 age groups to check for unevenness using 2 ×7 table by gender.
CATT: Cochran-Armitage Trend test (two-sided) for checking linear trend with 7 age groups by gender.

Note: Basic statistics of sum of all news sources: mean = 2.07, SD = 0.95, minimum = 0, maximum = 6, > = 2 or 3 = 70.3%, 27.6% respctively

Figure 2. Utilization rate comparison and measurement of unevenness and linear trend of each news source.

Figure 2 shows that linear trends were significant ($p < 0.001$-0.01) for mobile phone (decrease by age), Internet (decrease by age), newspaper (increase by age), and any type of news source (decrease by age) in males, whereas differences were significant ($p < 0.001$-0.05) for mobile phone (decrease by age), Internet (decrease by age), newspaper (increase by age), and any type of news source (decrease by age) in females.

c) Basic statistics of all news sources (1-8) were as follows: mean = 2.07, SD = 0.95; 70.3% of participants utilized two or more sources, and 27.6% utilized three or more sources.

4. Explanatory variables related to media coverage influencing stress3Y by st-MRA

Table 3 shows the basic statistics of the objective and 24 explanatory (independent) variables of the st-MRA. Frequency percentage for categorical items (nominal scales) and mean and SD for qualitative items (ratio scales) are shown in Table 3. The CVs of the VAS scale items show that, of items Q21 through Q24, the item with the highest variance was Q21, "Was necessary information obtained?"

Table 4 shows the results of the st-MRA. Nine variables were extracted from the 24 explanatory variables under the variable exclusion criteria at

Table 3. Variables for multiple regression analysis.

Variables	n = 859		
	mean	SD	frequency %
Outcome (dependent) variable Difference in subjective stress between just after the disaster and three years later	-1.68	2.25	
Explanatory (independent) variables 1-24			
1 Gender (1: male, 2: female)			1: 53.3 2: 46.7
2 Age groups in increments of 10 years	5.54	1.54	
< Eight categories of post-disaster family structure > (0: no, 1: yes)			
3 Single mother family (respondent and child(ren) under 20)			7.1
4 Respondent (mother) with spouse and child(ren)			21.9
5 Respondent (mother), spouse, child(ren), and grandparent(s)			2.7
6 Respondent (wife) and spouse			25.5
7 Respondent (wife), spouse, and parent(s)			4.5
8 Respondent and parent(s)			3.0
9 Respondent alone			20.5
10 Respondent and other family members (e. g. sibling(s), relatives)			14.8
< Categories of news sources and utilization frequency > (0: no, 1: yes)			
11 Radio, everyday			14.4
12 Radio, occasionally			9.1
13 Television, everyday			67.2
14 Television, occasionally			20.8
15 Mobile phone			16.4
16 Internet			14.0
17 Newspaper			53.6
18 One or more of the previous sources			96.0
19 Other sources			7.1
20 Sum of all the sources	2.07	0.95	
<Visual Analog Scale (VAS)> from "disagree" to "strongly agree"	mean	SD	coefficient of variance (CV)
21 Was the necessary information obtained?	4.94	2.44	0.49
22 Because the photos and footage were shown repeatedly, did you feel stress?	5.92	2.48	0.42
23 Because photos and footage were shown repeatedly, did you feel sad?	6.85	2.31	0.34
24 Did you feel that important information was not obtained?	6.90	2.35	0.34

Table 4. Results of the stepwise multiple regression analysis.

Explanatory variables	Unstandardized coefficients		Standardized coefficients	t-value	p-value	Collinearity statistics
	B	Std. Error	β			VIF
constant	-2.0320	0.4819		-4.2169	p < 0.0001	
1 Age group (10-year increments)	0.2853	0.0533	0.1949	5.3571	p < 0.0001	1.17
2 Gender (1: male, 2: female)	-0.6459	0.1584	-0.1431	-4.0784	p < 0.0001	1.09
3 Single mother family (respondent and child(ren) under 20)	0.7709	0.3207	0.0880	2.4034	0.0165	1.18
5 Respondent (mother), spouse, child(ren), and grandparent(s)	0.7226	0.4719	0.0518	1.5314	0.1261	1.01
8 Respondent and parent(s)	0.7665	0.4456	0.0583	1.7199	0.0858	1.02
13 Television, every day	-0.3433	0.1663	-0.0716	-2.0647	0.0393	1.06
20 Sum of all media sources	-0.1507	0.0825	-0.0636	-1.8257	0.0683	1.07
22 Respondent feels stress because photos/ footage were shown repeatedly	0.0674	0.0311	0.0741	2.1636	0.0308	1.04
24 Did you feel that important information was not obtained?	-0.0475	0.0320	-0.0515	-1.4866	0.1375	1.06

Note 1) Objective variable is stress3Y: differences of subjective stress between just after Great East Japan Earthquake (GEJE) and three year later.
Note 2) Explanatory are 24 variable in Table 3.
Note 3) Statistical method: stepwise multiple regression analysis (Pin = Pout = 0.15) by SPSS 21.0
Note 4) R = 0.2661 ($p < 0.001$ by F-test)
Note 5) VIF = Variable Inflation Factor (VIF < 10 is acceptable)
Note 6) Durbin-Watson ratio = 1.8801

Pin < 0.15 and Pout >= 0.15. Six out of the nine extracted variables were significant. Goodness of the model was obtained based on the results of the F test, VIF, and Durbin-Watson ratio [8] to determine the accuracy of the equation. The interpretation of the significant variables are as follows:

Q1 Age group: The upward-sloping linear trend was highly significant ($p < 0.001$), indicating that stress3Y increased with age.

Q2 Gender: The downward-sloping trend was highly significant ($p < 0.001$), meaning females' stress3Y was likely to decrease with age.

Family structure: Q3 Single mother family: The upward-sloping trend was significant ($p < 0.05$), meaning single mothers' stress3Y was higher than that of other family structures.

Regarding Q13 ("television, everyday"), the downward-sloping trend was significant ($p < 0.05$), indicating that the stress3Y of respondents watching television everyday was lower than that of those consuming other news sources. On the other hand, in Q22 ("respondents felt stress because pictures were played repeatedly"), the upward-sloping trend was significant ($p < 0.05$), meaning that the stress3Y of participants responding in this way was higher than those who felt no stress. These seemingly contradicting results are explained in the Discussion section below.

The correlation coefficient between Q13 ("television, everyday") and Q22 ("Because pictures were played repeatedly, did you feel stress?") was non-significant ($r = -0.0348$) (two-tailed $p = 0.3144$). This result indicates that the stress3Y of some respondents was positively influenced by information from television, while other respondents were negatively influenced due to scenes of GEJE play-

ing repeatedly.

Discussion

1. Media coverage as a secondary stressor

Lock et al. [9] conducted a literature review on secondary stressors caused by extreme events or disasters such as earthquakes and floods. According to the review, secondary stressors were classified into 10 types including economic, difficulties with compensation, health, and the media. It is for this reason that media coverage was taken up as a candidate stressor in this study.

2. Types of media coverage utilized by evacuees

There were few gender differences in the utilization rate of different types of media. Similarly, differences in the utilization rate of radio (except occasionally in female), television, and other types by age group were not significant. Utilization of newspaper, however, showed a significant upward trend by age group, whereas cell phone and Internet use showed a significant downward trend by age group.

According to a 2003 study by the Ministry of Land, Infrastructure and Transport [10], there are four requirements for information provided to people during and after a disaster: i) effectiveness (whether the necessary information could be obtained), ii) efficiency (how much effort was needed to obtain necessary information), iii) satisfaction (whether necessary information was obtained without stress), and iv) accessibility (whether disabled or elderly residents could obtain necessary information).

Regarding the CV of Q21 in Table 3, effectiveness varied widely compared to the other three VAS-type questionnaires. On the other hand, the means and SDs of Q22 and Q23 indicate that satisfaction was not easily obtained.

Figure 2 shows that almost all evacuees at any age and of both genders utilized at least one type of media device, therefore, at least elderly accessibility was obtained.

Savoia et al. [11], based on the results of a survey of adult residents of West Virginia, US, after a drinking water crisis, concluded that the consumption of local television news during a crisis was the most important factor for timely dissemination of information.

Many previous studies on so-called disaster myths, such as panic, psychological shock, looting, increases in the crime rate, and material convergence have confirmed that such myths have not been generally observed in actual disasters around the world, including in Japan [12, 13]. However, according to an online questionnaire survey on the five myths that was administered to 20-39 year-old participants of both genders, participants gave credits to these disaster myths to a certain extent. Furthermore, multiple regression analysis showed that the main news sources delivering disaster myths were media coverage rather than private sources of information [12].

Tanner et al. [14] focused on mobilizing information for residents facing 11 types of disaster in the US. While local television news is the most cited source for seeking news and information, many individuals also tried to access news from the Internet to obtain accurate information to help them act appropriately. This coincides with the high rate of respondents utilizing multiple media sources in this study, as shown in Figure 2 above.

3. Age differences of utilization rate

Figure 2 shows that age-related linear trends were significant ($p < 0.001$-0.01) for mobile phone, Internet, and either of 1-7 types of news sources, the usage of which decreased with age in both genders, whereas newspaper utilization increased with age in both genders.

A white paper by the Ministry of Internal Affairs and Communications (MIC) [15] investigated the information sources that Japanese people felt were important, as well as how their perceptions changed between 2005 and 2010.

Television was recognized as being important

among all the age groups (the maximum and minimum in 2010 were 98% of those in their 50s and 89% of those in their 20s, respectively), while perceptions of the Internet varied widely among age groups, registering as nearly as important as television among people in their 10s through 40s (the maximum and minimum in 2010 were 81% of those in their 20s and 33% of those in their 60s).

Figure 2 shows that the utilization rates of television were nearly all lower than 70% and most of the Internet usage rates were lower than 20%. These data points do not reflect the respondents' perceptions of which information sources were more important, as in the MIC study, but rather their utilization rates. However, it is logical to assume that utilization rates indicate a perception of importance, and vice versa; therefore, the evacuees' accessibility to main media sources such as television and Internet seems to have been very low. In particular, Internet usage by evacuees seems to have been extremely limited.

4. Impact of television on stress3Y

After adjusting for confounding factors [8] such as gender, age, and family structure by MRA, the results of this study at first glance seem to indicate contradictory influences of television coverage on stress levels. Specifically, television seems to have acted simultaneously and independently as both a reducer and an inducer of stress3Y.

Previous reports by the authors [2,3] have touched on a transition in the stress experienced by evacuees displaced from Fukushima to other prefectures. Namely, stress levels among evacuees peaked in the early stage when the national and municipal governments as well as experts and media were all thrown into confusion after their initial experience of the unprecedented nuclear disaster. However, with their evacuation outside the prefecture, having for the time being avoided the risk of radiation damage, it was interpreted that their stress levels decreased significantly after subsequently receiving a certain degree of assistance and support from the private and public sectors and once homecoming became more likely as a valid awareness of the risks of low-level radiation gradually spread. The recognition of television as a factor in stress reduction was considered to be due to the fact that the characteristics of television were leveraged so that evacuees were provided with a large quantity of high-quality information within a short period of time.

Okuda [16] reviewed various media coverage by television and radio during two weeks after the GEJE, finding that the national public broadcaster, NHK, as well as almost all private media organizations, produced feature programs about the GEJE and broadcast them continually, even foregoing commercials. The unprecedented concentration of this coverage likely contributed to evacuees being able to easily obtain much-needed information. However, the overflow of unrelenting information about the disaster, particularly from television, should also be considered in light of its potential to exacerbate mental stress.

According to a review of the mental health impact of the September 11, 2001 terrorist attacks in New York, US [17], a number of studies concluded that psychological sequelae to the attacks were not restricted to those exposed to the event, but also spread to those who were aware of the event through the media. Because actual images of the destruction of the Twin Towers in New York were repeatedly broadcast via television day after day, the incident remained fresh in Americans' minds longer than would otherwise be expected.

Hosaka [18] called attention to a new type of mental health care that could address the unease and fear that even non-evacuees experience when they are forced to live and re-live a simulation of the actual disaster through the medium of television. Encountering virtual scenes of people dying meant that even non-evacuees have experienced circumstances that fulfill the conditions for developing trauma, because, as opposed to the still images people saw in the wake of the Hanshin-Awaji

Earthquake, more realistic video footage was typical of the news coverage after the GEJE.

The results of this study and previous studies on post-traumatic stress disorder (PTSD) due to disaster indicate that excessive repeated coverage of actual disaster scenes on television should be reconsidered in light of mental health considerations. Media organizations should engage in a certain amount of non-official restriction of coverage, similar to how they handle footage of graphic murder or war scenes, in order to reduce disaster trauma.

Conclusion

Utilization of different types of media by evacuees from Fukushima Prefecture after the GEJE were analyzed using quantitative methods, following the qualitative analysis conducted in a previous study. Few gender differences were found. The news source most highly utilized was television, and over 70% of evacuees consumed multiple news sources. It was observed that the use of newspapers increased with age and that of the Internet decreased with age.

Stress3Ys were significantly influenced, both positively and negatively, by television news coverage. Namely, television coverage contributed to the reduction of stress by providing much-needed information, but at the same time, the excessive repetition of graphic disaster scenes, such as the tsunami, on television seems to have contributed to the development of trauma in evacuees and possibly in non-evacuees as well. The findings of this study indicate that unwarranted repeated coverage of actual disaster scenes on television should be reconsidered in light of the prevention of disaster trauma, with broadcasters self-imposing non-official restrictions in a manner similar to their handling of the reporting of vivid murder or war scenes.

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Conflicts of interest

This research received no grant from any funding agency in the public, commercial, or not-for-profit sectors. The authors declare that they have no relevant conflicts of interest.

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