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Article

Recurring Natural Disasters and PTSD among Survivors

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Little research on the mental health of the survivors of recurring natural disasters has been conducted in Japan. The exception is Omori's survey on the mental health of the Tsubota district's residents after the eruption of Miyake Island in Tokyo (2010). The eruption on Miyake Island in July 2000 was a rare case of volcanic activity, and it continues emitting volcanic gas over a wide area of the island, even 11 years after the initial eruption. The gas level exceeds safety and environmental standards on many parts of the island.

This research on the mental health of survivors in the Tsubota area of Miyake village was conducted in 2009 using IES-R-J, nine years after the recurring disasters began. The results indicate that 25.6% of the sample was recognized as having PTSD. This research was designed to investigate possible factors that hinder recovery from PTSD.

Key words: Oyama eruption, Miyake Island, Post-Traumatic Stress Disorder, recurring natural disaster

PURPOSE

In Japan, active research on the mental health of natural disaster survivors started in the early 1990's. Such research includes a study of those affected by the eruption of Unzen in Nagasaki Prefecture in 1991 (Ohta et al., 1995), a study of survivors of the 1993 Southwest Hokkaido earth quake (Fujimori & Fujimori, 1996; Fujimori, 1998), and a study of the survivors of the 1995 Great Hanshin-Awaji earthquake in Kobe (Tanaka & Takagi, 1997). These academic milestones greatly influenced subsequent studies on natural disasters.

In order to measure the mental health of survivors, these influential studies on natural disasters utilized the General Health Questionnaire (GHQ). GHQ is a 60-item screening instrument that detects psychiatric disorders and associated symptoms that was developed by Goldberg in 1972. Afterwards, Goldberg & Hillier developed shorter 30- and 28-item versions in 1979. Based on these originals, Japanese scholars Nakagawa & Daibou (1985) established standardized Japanese versions of GHQ with 60, 30, 28, 20, and 12 items in 1985. GHQ is especially helpful for understanding mental health problems in disaster survivors, and the pioneering studies mentioned above adopted this questionnaire. The results that are acquired by using standardized Japanese versions of GHQ enable researchers in Japan to compare mental health problems of disaster survivors across different natural disasters. However, the studies referenced above only examine the mental health effects in cases where the natural disaster occurred as a singular instance and not as recurring natural phenomena within a particular area.

Unlike typical cases of volcanic eruption, the eruption of Oyama volcano on Miyake Island in July 2000 triggered an emission of toxic volcanic gases that continues to this day, nearly 11 years since the eruption. In many parts of Miyake Island, the concentration of the volcanic gas exceeds the standardized safety level.

Barton (1969) defined a disaster as a form of collective stress, and a state in which normally ex-

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pected living conditions are unavailable to many members of the social system. He explained that normally expected living conditions are unavailable when 1) safe and convenient living conditions are disrupted, 2) populations are under attack by an outside force, 3) there is insufficient food and water; and 4) there is a scarcity of necessary information. On Miyake Island, a prolonged disruption of safe and convenient living conditions has been caused by the continuous emission of volcanic gases.

Studies and reports on recurring disasters and the mental health of survivors are rare. Examples include research on the eruptions of volcanoes on Sakura Island in Kagoshima prefecture (Watanabe & Tanagihashi, 1984) and on Miyake Island in the Tokyo metropolitan district. However, the study of the Sakura Island eruption did not utilize the Japanese version of GHQ, and therefore is not comparable with similar studies of natural disasters. In contrast, Omori (2010) studied survivors of Oyama's eruption on Miyake Island using the Japanese adaptation of GHQ as a standardized measuring scale. Using GHQ28 to study survivors' mental health seven years after Oyama's eruption, Omori concluded that 63.6% of the survivors were identified as being at high risk for poor mental health conditions. His results also establish clear connections between recurring natural disasters and chronic mental heath conditions..

This paper investigates the mental health problems of survivors of recurring natural disasters further, with both GHQ and by measuring Post Traumatic Stress Disorder (PTSD). The researchers believe that measuring PTSD offers a broader perspective on mental health problems than GHQ alone. The concept of PTSD was first introduced in the Diagnostic and Statistical Manual of Mental Disorders Third Edition (DSM-III, 1980). Since then, the concept has been widely accepted by the Psychological Association, the Society of Clinical Psychology, and the Psychiatric Association in Japan. In 2002, Weiss and Marmar's 1997 version of the Impact of Event Scale-Revised (IES-R), a self-reporting questionnaire that measures symptoms relating to PTSD, was adapted and adjusted by Asukai et al. (2002) to create a Japanese version, IES-R-J.

The original IES was developed in 1979 by Horowitz et al. IES consists of two response states: avoidance and intrusion. Weiss and Marmar added hyper-arousal as a third response state in their 22-item revised version in 1997 (IES-R). The additional response state was introduced in order for IES-R to better address the PTSD diagnostic criteria of DSM-IV (1994). Weiss and Marmar's 22-item version is comprised of an intrusion section (seven items), an avoidance section (eight items), and a hyper-arousal section (seven items). Their revised IES evaluates participant symptoms that are experienced in a week using five response levels instead of a frequency-adapted Likert scale.

In this study, the Japanese version of IES-R was used to measure degrees of PTSD among the survivors of the Oyama eruption on Miyake Island. Simultaneously, the research sought to identify factors leading to recovery from PTSD among the survivors. This research on the effects of recurring natural disasters on their survivors is the first of its kind in Japan, and the authors hope that it offers new perspectives on assisting such survivors.

METHODS

1) Study period: This study was performed from September 2 to October 2, 2009, nine years after the eruption of Oyama on Miyake Island in 2000, which has caused continuous emission of toxic volcanic gas into the environment.

2) Study Sample: There are five districts in Miyake village of Tokyo: Kamitsuki, Izu, Igaya, Ako, and Tsubota. In those five districts, some areas are designated as high-concentration areas of poisonous volcanic gas (high concentration areas). Residents of Tsubota district over the age of 20 were chosen for the survey because that district is a high concentration area.

3) Survey methods: Questionnaires regarding the recovery process and stress among residents returning to Miyake Island were distributed and collected by the researcher and volunteers, targeting residents over 20 years old who were listed on the basic population registry. The delivery of the survey started after being permitted by the town

hall of Miyake village on September 2, 2009.

4) Questionnaires: Based on a supplementary survey, the following four topics were examined: 1) the demographic characteristics of individual survey participants, 2) the degree of damage caused by the disaster; 3) stressful events, and 4) mental health conditions. After a number of interviews with the residents of Miyake Island about their living conditions after their return to the island, the author determined these topics to be closely related to the recovery of mental health of the survivors. The demographic characteristics of the individuals surveyed included sex, age, occupation, family structure, length of residency, and whether the person lives in a high concentration area.

The degree of damage caused by the disaster takes into account whether any family members are living separately because of the eruption, whether there was any damage to their houses, their current living conditions, their return to work or change in occupation, and differences between their incomes before the eruption and after returning to the island. In order to find out how daily stressors relate to their mental health, participants were asked if they have concerns about their own health, the natural environment, the reconstruction of their living quarters, the return to their occupation, relationships in their community, resettlement and rebuilding in the area, the influence of the volcanic gas on health, the mandatory use of gas masks, and whether they have any objections to alarm systems for volcanic gas. In order to measure the survivors' mental health status, the Japanese-Language Version of the Impact of Event Scale-Revisited (IES-R-J) was used. IES-R was revised by Weiss & Marmar in 1997 to include hyper-arousal symptoms as a supplement to analyzing the original three symptoms. In Japan, Asukai and his team from the Tokyo Institute of Psychiatry created a Japanese version of IERS-R (IES-R-J) with permission from Weiss and Marmar. Because IES-R-J is a self-reporting measure, it tends to generate false positives, but it is nonetheless recognized and utilized for its simplicity and for participant compliance with its 22-item a screening measure.

RESULTS

1) Survey responses: The survey response rate was 75.3% (215 of 284).

2) Characteristics of survivors responding to the survey: As listed in Table 1, the survey participants were composed of 99 males (46.0%) and 116 females (54.0%). Their ages were between 20 and 88, and the average participant was 64.4 (SD =13.8). Occupations of the participants: Half of the participants were either unemployed or were farmers (27.4% unemployed and 23.7% engaged in farming). Additionally, participants were employed as civil servants (6.0%), in the construction industry (5.6%), or as service workers in hotels (5.1%), shops (4.7%), and restaurants (4.2%).

3) Degree of damage caused by the disaster, and stressful events: The participants reported

Table 1. Participant demographics

Item	Category	*N*	%
Gender (*N*=215)	Male	99	46.0
	Female	116	54.0
Age (*N*=215)	20 to 29	5	2.3
	30 to 39	9	4.2
	40 to 49	16	7.4
	50 to 59	40	18.6
	60 to 69	57	26.5
	over 70	88	40.9
Occupation (*N*=215)	Agriculture and forestry	51	23.7
	Fisheries	7	3.3
	Restaurants and stores	19	8.9
	Construction	12	5.6
	Accommodation	11	5.1
	Government official	13	6.0
	Employed	11	5.1
	Unemployed	59	27.4
	Other	30	14.0
Time living in the Islands (*N*=215)	Less than 10 years	4	1.9
	10 to 20 years	35	16.3
	More than 20 years	176	81.9
Family structure (*N*=215)	Living alone	36	16.7
	Living with family	179	83.3
Living in high concentration area (*N*=215)	Yes	43	20.0
	No	172	80.0

Table 2. Degree of damage inflicted on participants by disaster

Item	Category	*N*	%
Damage to house (*N*=215)	Yes	175	81.4
	No	40	18.6
Housing status after the return (*N*=215)	No damage to house and returned home	30	14.0
	House rebuilt	10	4.7
	House repaired	134	62.3
	Moved to public housing	25	11.6
	Other	16	7.4
Changes in job situations after eruption (*N*=215)	Same	131	60.9
	Different	61	28.4
	Unemployed after eruption	23	10.7
Current job status (*N*=134)	Very well	6	4.5
	Well	61	45.5
	Not well	54	40.3
	Bad	13	9.7
Changes in income after eruption (*N*=215)	Increased	6	2.8
	Same	60	27.9
	Decreased	149	69.3

Table 3. Reported stress due to damage from oyama

Item	Category	*N*	%
I am concerned about health (*N*=215)	Strongly agree	91	42.3
	Agree	72	33.5
	Neutral	43	20.0
	Disagree	9	4.2
I am concerned about nature and the environment (*N*=215)	Strongly agree	114	53.0
	Agree	64	29.8
	Neutral	29	13.5
	Disagree	8	3.7
I am concerned about recovery of house (*N*=214)	Strongly agree	67	31.3
	Agree	78	36.4
	Neutral	47	22.0
	Disagree	22	10.3
I am concerned about recovery of occupation (*N*=215)	Strongly agree	71	33.0
	Agree	77	35.8
	Neutral	45	20.9
	Disagree	22	10.2
I am concerned about human relations (*N*=214)	Strongly agree	41	19.2
	Agree	59	27.6
	Neutral	86	40.2
	Disagree	28	13.1
I am concerned about future life (*N*=214)	Strongly agree	73	34.1
	Agree	93	43.5
	Neutral	34	15.9
	Disagree	14	6.5
I am concerned about health issues involving volcanic gas (*N*=214)	Strongly agree	73	33.6
	Agree	71	33.2
	Neutral	57	26.6
	Disagree	14	6.5
I am concerned about wearing gas masks and alarm systems for volcanic gas (*N*=214)	Strongly agree	60	28.0
	Agree	73	34.1
	Neutral	62	29.0
	Disagree	19	8.9

stress as a result of damage caused by the disaster, as seen in Table 2. Participants reported the following to be stressful (Table 3): their own health (75.8%), nature and the environment (82.8%), recovery of their home (67.7%), recovery of their occupation (68.8%), relationships (46.8%), resettlement (77.6%), volcanic gases (66.8%), and wearing gas masks and alarm systems for volcanic gas (62.1%).

4) Mental health of participant survivors: A principal component analysis was performed based on the data gathered by IES-R-J. According to the results (Table 4), across all items, the first component scored above 0.6, and the other components scored below 0.4. The correlation coefficients among sub-items intrusion, avoidance, and hyper-arousal exhibited significantly high correlations: intrusion and avoidance (0.844 ($p<.001$)), intrusion and hyper-arousal (0.867 ($p<.001$)), and avoidance and hyper-arousal (0.875 ($p<.001$)). Cronbach's α for the above data measured 0.963, demonstrating the reliability of the data from the IES-R-J. This analysis also indicates that there is only one component, rather than an even distribution across all three components.

In order to judge whether the participants have PTSD, a standardized scaling system for Japanese people was deemed necessary. According to Kato and Iwai (2000), the cutoff point to confirm PTSD is at a scale score of 24/25 on IES-R-J. In this study, the cutoff point of a score greater than or equal to 25 on IES-R-J is taken as indicating a possible PTSD (Fig. 1). Using this scoring system,

Table 4. Results of principal component analysis

Category	First principal component	Second principal component	Third principal component
Any reminder brought back feelings about it	**0.711**	0.280	−0.209
I had trouble staying asleep	**0.756**	0.231	−0.306
Other things kept making me think about it	**0.811**	0.312	−0.068
I felt irritable and angry	**0.674**	0.233	0.015
I avoided letting myself get upset when I thought about it or was reminded of it	**0.795**	0.283	−0.128
I thought about it when I didn't mean to	**0.836**	0.040	−0.181
I felt as if it hadn't happened or wasn't real	**0.643**	−0.211	0.194
I stayed away from reminders about it	**0.735**	−0.112	−0.129
Pictures about it popped into my mind	**0.766**	−0.066	−0.305
I was jumpy and easily startled	**0.810**	−0.085	−0.244
I tried not to think about it	**0.752**	−0.362	−0.166
I was aware that I still had a lot of feelings about it, but I didn't deal with them	**0.773**	−0.310	−0.012
My feelings about it were kind of numb.	**0.703**	−0.315	0.053
I found myself acting or feeling like I was back at that time	**0.729**	0.101	0.381
I had trouble falling a sleep	**0.702**	0.156	0.030
I had waves of strong feelings about it	**0.828**	0.123	0.047
I tried to remove it from my memory	**0.761**	−0.228	0.105
I had trouble concentrating	**0.748**	−0.077	0.247
Reminders of it caused me to have physical reactions such as sweating, trouble breathing, nausea, or a pounding heart	**0.684**	−0.154	0.103
I had dreams about it	**0.657**	0.360	0.388
I felt watchful and on-guard	**0.810**	−0.141	−0.056
I tried not to talk about it	**0.782**	−0.021	0.376
Eigenvalue	**12.390**	1.064	0.954
Proportion of variance (%)	**56.320**	4.838	4.338
Cumulative proportion (%)	**56.320**	61.159	65.497

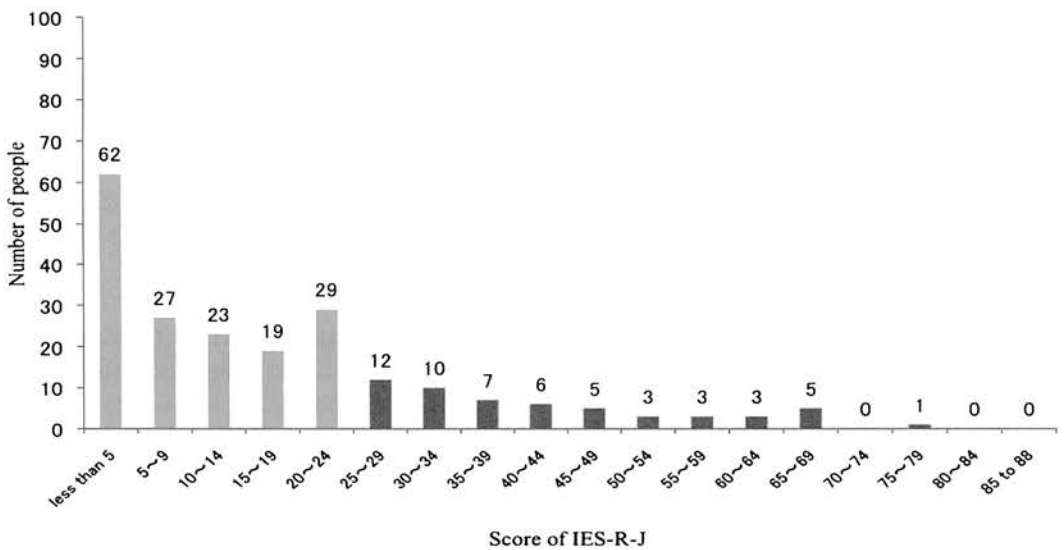

Fig. 1. Score distribution on IES-R.

25.6% of the participants were determined to be at high risk for PTSD (Fig. 2). This result exceeds the 1% to 14% of lifetime prevalence of PTSD determined in a prior study (DSM-IV 1994).

A χ^2 test was performed in order to study the characteristic factors that differentiate the PTSD group from the non-PTSD group. A comparison of the results reveals disparities by gender, with women having a higher risk for PTSD than men (32.8% vs. 17.2%) ($\chi^2=9.72$, $df=1$, $p<.01$). By age, a significant difference was seen between older (over 65 years old, 38.2%) and younger (less than 65 years old, 12.4%) adults, with individuals over 65 years old at higher risk of having PTSD than individuals under 65 years old ($\chi^2=20.516$, $df=1$, $p<.001$). Other factors with significant ratio differences in the risk of having PTSD are listed in Table 5.

This research sought to clarify the factors that hinder the mental health recovery of elderly survivors exposed to recurring disasters such as the eruption of Oyama on Miyake Island in 2000. The Multivariate Logistic Analysis devised by Takagi & Yanai (1995) was performed based on factors with significant differences in the risk of having PTSD. The Multivariate Logistic Analysis method analyzes how relative risk factors (independent variables) contribute to a certain event (dependent variable). In this study, PTSD (or lack of PTSD), with a cutoff point of 25 or above on the IES-R-J, is the dependent variable, and the following risk factors for PTSD were tested as independent variables: 1) gender, 2) age (above or below 65 years), 3) occupation, 4) change in income after returning to the island, 5) concerns with health, 6) concerns with the natural environment, 7) concerns with recovering one's home, 8) con-

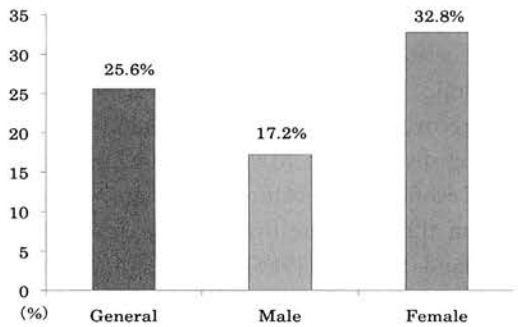

Fig. 2. Gender distribution of PTSD group.

Table 5. Comparison of PTSD risk by group

Item	%	χ^2	df	p
Job is NOT going well	31.8	6.66	1	<.05
Job is going well	13.2			
Income decreased	31.5	9.06	1	<.01
Income increased or same	12.1			
Have concerns about health	30.1	7.11	1	<.01
NO concerns about health	11.5			
Have concerns about nature and environment	29.2	7.17	1	<.01
NO concerns about nature and environment	8.0			
Have concerns about recovery of housing	32.4	12.29	1	<.001
NO concerns about recovery of housing	10.1			
Have concerns about recovery of job	30.4	5.81	1	<.05
NO concerns about recovery of job	14.9			
Have concerns about human relationships	34.0	7.65	1	<.01
NO concerns about human relationships	17.5			
Have concerns about health issues involving volcanic gas	31.3	7.36	1	<.01
NO concerns about health involving volcanic gas	14.1			
Have concerns about gas masks and gas alarms	31.3	6.20	1	<.05
NO concerns about gas masks and gas alarms	16.0			

Table 6. Factors contributing to PTSD

Risk factor	Category	Partial regression	Relative	95% Confidence interval	
				(Lower limit)	(Upper limit)
Age	Group over 65 years old Group under 65 years old	1.10	2.99 ($p<.05$)	1.16	7.72
Income situations after the return to the island	Income decreased Income increased or same	1.02	3.18 ($p<.05$)	1.04	9.68
Concerns about nature and environment	Have concerns No concerns	1.84	6.29 ($p<.05$)	1.30	30.47

cerns with recovering one's occupation, 9) concerns with relationships, 10) concerns with volcanic gas affecting health, and 11) concerns with wearing gas masks and volcanic gas alarm systems.

Table 6 presents the results of the Multivariate Logistic Analysis, indicating that among the 11 independent variables (risk factors), concerns with natural environment (6.29 times), age (2.99 times), and change of income after the return to the island (3.18 times) exhibited significant differences.

DISCUSSION

In order to examine the problem of PTSD, this research examined the mental health of residents living with an ongoing or recurring natural disaster using the Japanese edition of IES-R. In Japan, through their research on the survivors of the Great Hanshin-Awagi Earthquake, Kato and Iwai (2000) determined the cutoff point of IES-R-J indicating PTSD to be 25. Based on this cut-off point, this research found 25.6% of participant survivors of the volcanic eruption on Miyake Island to have a high risk for PTSD. The frequency of participants with PTSD in this study was thus greater than that of a prior study (DSM-IV 1994), which found the lifelong prevalence of PTSD to be 1 to 14%. This study found that one out of four participating survivors of the recurring disaster exhibited a risk of having PTSD. This conclusion indicates the severity of the effect of volcanic gases on Miyake Island and suggests a need for revising the treatment guidelines for Miyake Island residents.

In this study, the risk ratio for PTSD varied by gender, with women having higher risk than men. In Olff's review of the literature on PTSD (2007), he stated that women consistently have a higher risk of PTSD than men. He correlated women's high risk to the types of traumas that they experienced: exposure to traumas in early age, recognition of threats or uncontrollability, dissociative reactions, insufficient social support resources, and alcohol abuse after a traumatic experience.

Olff's study and the Miyake cases share risk factors such as recognition of uncontrollability and insufficient social support resources. In this study of Miyake Island residents, factors such as uncontrollability and insufficient social support resources may correspond to the reported frustration with the uncertainty of returning to the lives they remember from before Oyama erupted and their loss of a support system in the community. These risk factors are very likely to be hindering their recovery from PTSD.

The Multivariate logistic analysis identified several other risk factors hindering the recovery from PTSD among the study population, including age (above or below 65 years) (2.99 times), the change of income after the return to the island (3.18 times), and having concerns about the natural environment (6.29 times).

With regard to age, participant survivors over 65 years have a higher risk of mental disorders than those under 65. They also face various social limitations due to their age when attempting to recover, such as employment, banking loans, and remarriage. Moreover, participant survivors over 65 are not getting enough social support, and the problem of insufficient social support resources is considered to hinder their recovery.

As for the change of income after their return to the island as a risk factor, it is clear that the economic stagnation of Miyake Island hinders their recovery from mental health conditions. Recurring disasters on Miyake Island limit the island's economic opportunities and growth, which in turn threatens the livelihood of residents on the island. Raphael (1986) states that financial assurance is necessary for recovery from the mental conditions caused by a disaster.

This research evaluated the situation of the residents of Miyake Island who chose to live in the island despite toxic volcanic gas. The results suggest that the residents' lives would be improved by learning to use safety precautions that would allow them to feel more of a sense of control in their lives and less negative perceptions of their environment. Additionally, it is important for the new community on Miyake Island to make government benefits, and social support services more accessible to disaster survivors.

This research is the first study to examine the

problem of PTSD among survivors of recurring natural disasters in Japan. The research also analyzed the risk factors that cause chronic mental conditions. The researchers hope that the knowledge derived from this study will build a foundation for future research in the field. It is also hoped that this field will be considered worthy of research and recognized as beneficial to society.

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