Old Age, Disability, and the Tohoku-Oki Earthquake

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Since the Evacuation/Sheltering Guideline was first published in March 2005, Japan has been a leader in systematically promoting evacuation and shelter assistance initiatives for people with special needs (PSND) in times of disasters. Despite the nationwide, community-based initiatives prescribed by the Guideline, this paper first addresses the issue of evacuation by examining mortality data of the total population, the elderly, and people with disabilities (PWD). The elderly and PWD mortality rates were not even across the three disaster-hit prefectures. Their institutionalization rate was suggested as one of the causative factors; more elderly and PWD died in Miyagi because more of them resided in their own homes, due to the prefecture's socially inclusive normalization policy. A case study of Miyagi's Hachiman community responses to its 17 registered PSND illustrated the ways to overcome the issue of mainstreaming preparedness components in the everyday practice of social inclusion for the elderly and PWD. [DOI: 10.1193/1.4000126]

INTRODUCTION

People with disabilities (PWD) in disasters have long been a neglected issue in disaster studies and practice. Despite some early sensitizing works (e.g., Friedsam 1960, Tierney et al. 1988), the legislative changes that ensure equality of public services and goods to PWD such as the Americans with Disabilities Act (1990) in the United States, and the corresponding publication of guidelines for emergency managers (e.g., American Red Cross 1997, Kailes 2002, FEMA/American Red Cross 2004), the issue has been largely invisible to the minds of researchers or practitioners and PWD have been excluded from planning, decision-making or management of mitigation-preparedness-response-recovery cycles up until recently (Twigg et al. 2011). However, since the early 2000s, especially after 2004's Indian Ocean earthquake and tsunami and 2005's Hurricanes Katrina and Rita, there have been a growing number of coherent, yet limited, findings on PWD in disasters in English literature: PWD tend to be disproportionately more vulnerable to disasters; disaster preparedness, response, and recovery operations pay little attention to the needs and capacities of PWD; and the plan-do-check-action process of disaster management has not yet made significant advances toward more social inclusion of PWD (White et al. 2007, Kailes 2008, Kett and Twigg 2007, Clive et al. 2010, Twigg et al. 2011, Wisner, in press).

The issues of frail elderly in disasters have gained significant attention in Japan since 2004 when a series of natural disasters hit the Japanese archipelago, including the July Niigata-Fukushima flood, the 23 October typhoon, and the October Niigata Chuetsu earthquake,

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wherein notably more than 60% of the victims were over the age of 65. As a response to these tragedies, Japan's Cabinet Office established a committee on "Communicating Disaster Information and Evacuation/Sheltering Assistance for the Elderly and Other Population during Heavy Meteorological and Other Disasters." The committee published the first edition of the "Evacuation/Sheltering Assistance Guideline for People with Special Needs in Times of Disaster" in March 2005. After the guideline's publication, the term *saigaiji-youengosha* or "people with special needs in times of disaster" (PSND) was popularized in place of *saigai-jakusha* or "disaster-vulnerable people." The guideline defines PSND as follows:

> Those who require assistance for a series of evacuation actions in order to obtain necessary information promptly and accurately and thus to protect oneself in times of disaster. Examples of PSND include the elderly, PWD, foreigner, infants and pregnant women. PSND also have difficulties to adjust to new environments that are caused by evacuation, sheltering and changes in housing. They are, however, able to function daily, whereby living independently given the proper resources and services when necessary.

The guideline then suggests the following more practical examples that have been employed by some municipalities that have started their own PSND counter-disaster measures initiatives:

1. Those who are at his/her own residence and are assessed as long-term care (LTC)[1] level 3 or more (i.e., require moderate level of home care) who cannot stand up or walk without assistance from the other.
2. People with disabilities who are assessed as physical impairment level 1 or 2 and/or intellectual disability level A.
3. Single household elderly, elderly couples and other forms of non-single elderly household.

Following another series of heavy rainfall, flood and landslide disasters in the subsequent year of 2005, another Cabinet Office committee conducted field research on the 2005 meteorological disaster sites and revised the evacuation and sheltering assistance guideline in March 2006. The 2006 guideline emphasized: (1) establishing a special team in each municipal government that was in charge of coordinating assistance to the target population; (2) encouraging the information sharing of the special needs population within the local government and, if possible, with local community organizations, such as neighborhood associations and community emergency and response team; and (3) planning individualized evacuation/sheltering procedures for each PSND.

In the following fiscal year of 2006, the committee on PSND continued working on more detailed procedures and workflows in order to collect and share information on PSND, and to make individualized evacuation and sheltering assistance plans. In March 2007, the committee published the "Report on Preparedness Procedures for PSND," which emphasized the establishment of a system to assist PSND by facilitating cooperation between the

[1] The Long-Term Care (LTC) Insurance program in Japan was introduced in 2000. Individuals 65 years old and above are generally eligible for LTC services. However, individuals 40–64 years old may apply for "long-term care certification" from the municipality to be eligible for LTC services. Services range from home care visits from home helpers and use of special nursing homes for the elderly (Ministry of Health, Labor and Welfare 2002). LTC Level 3 or more means that a person requires a moderate level of care because s/he cannot stand up or walk by oneself, requiring full supports for toileting, bathing, and changing clothes.

local/municipal government disaster management department and its health and welfare department. The role of the disaster management department is to provide local hazard information, while the health and welfare department provides information on potential vulnerabilities within the target population. The 2007 report encouraged the use of maps where potentially vulnerable individuals, such as the frail elderly and people with disabilities (PWD) were projected onto multiple hazard layers, such as flood, landslide, and seismicity. The map can help identify who are at more risk because of their functional needs as well as of their geographic locations (Enders and Brandt 2007, Tatsuki and Comafay 2012).

It should be noted that when the Cabinet Office first established the 2004 committee on "Communicating Disaster Information and Evacuation/Sheltering Assistance for the Elderly and Other Population during Heavy Meteorological and Other Disasters," the term *saigai-jakusha* or "disaster-vulnerable people" was in use by the Office staffs and some committee members. In Japanese context, the term implies that the vulnerability is defined by their impairments and therefore is treated as a trait of those individuals. Disability literature (e.g., Oliver 1990, Twigg et al. 2011) calls this a "medical model" of disability. The term also implies that the society should respond to them in a compassionate manner like good Samaritans. This orientation is called a "charity model" of disability. In other words, it was apparent that mixtures of medical and charity models of disability were dominant when the committee started its work in the fall of 2004. After the committee started its activities, the facts from recent disasters such as the 2004 Niigata-Fukushima Flood disaster were briefed to the committee members: It was not simply the age or the frailty of the victims that mattered in death and life situations and the most vulnerable were those elderly in single or two-person (most typically elderly couple) households in a high-risk flood prone area whose everyday life was supported solely by formal community care (i.e., LTC) services such as home help, meals on wheels, day care, daily nurse visits and alike and, at the same time, whose informal social support network is weak. During normalcy, these people can rely solely on formal service providers for survival in everyday life at their own home. During disaster, however, those formal service providers are not able to come and help. In addition, if one's informal support from kith and kin is weak, s/he becomes very vulnerable to the threats of the hazards (Hayashi and Tatsuki 2004, Hayashi and Tamura, 2005). Based on the new evidence, the committee members started talking about an alternative model of disaster vulnerability which viewed it as a relational concept and considered it as a product of hazards, person needs as well as their capabilities, and environmental responsiveness to their functional needs. In order to stress this conceptual shift, the term *saigaiji-youengosha* or "people with special needs in times of disaster (PSND)" was coined for the publication of the 2005 guideline.

In order to define the degree and nature of special needs for each PSND, the person-in-environment (PIE) model of vulnerability was proposed (Tatsuki 2012, Tatsuki and Comafay 2010, 2012), which defined disaster Vulnerability (V) as a function of Hazards (H), Person (P), and Environment (E) factors, or $V = f(H, f(P, E))$. The P factor includes a demographic variable, long-term care (LTC) level, physical/intellectual/mental disability, and physical immobility variables. For example, those who are over the age of 85 ("oldest-old"), LTC Level 3 or more, with physical impairments and immobility may score high on P factor vulnerability. E factor includes built-environment fragility, as well as levels of social capital in the neighborhood. Those who reside in housing that was built before the new seismic

standard was introduced in 1981 and where his or her neighbors are not inclined to help each other may be highly vulnerable on E factor. Person and Environment interaction, or the $P \times E$ factor, includes household size and social isolation variables. If an oldest-old person answers that s/he lives by him- or herself, that the person whom s/he relies on in case of emergency resides outside of the city boundary, and that it would more than one hour for that help to arrive, s/he is vulnerable on this factor. The overall disaster vulnerability is estimated by a summation of all factor scores. Note that even though one is vulnerable on the P factor because of the old age and a high (i.e., more than Level 3) LTC level, one's overall disaster vulnerability may not necessarily be high if s/he enjoys daily close contacts with a large number of family members who live together in the same household, and therefore the $P \times E$ factor counterbalances the P factor vulnerability.

The alternative thinking that led officials to coin the new term PSND in the 2005 guideline seemed to align itself closely with a "social model" of disability (Oliver 1990), which defines disability as the social construction after having impairments. Because it is a social construction, disaster-countermeasure planning and implementations for PSND also need to be social. They require both society and individuals to work collaboratively in order to meet PSND's basic life functional needs, such as those for communication, medical care, maintaining functional independence, supervision, and transportation (Kailes and Enders 2007) during a disaster. Unlike its UK or U.S. counterpart models, however, an emancipatory and universalist orientation toward social inclusion (Oliver 1990, Barnes 2001) was less emphasized. For example, the 2005 guideline and the following revisions have kept emphasizing the use of "specially designated" shelters for PSND, and issues of universal access and social inclusion in designated shelters were so far not discussed at all.

The Japanese approach to issues of PSND may not have been universally oriented toward social inclusion. Nevertheless, almost all municipalities in Japan have undertaken disaster countermeasures planning and implementation initiatives for PSND since the publication of the 2005 guideline, the 2006 revised guideline and the 2007 report. According to the survey conducted by FDMA, as of 1 April 2011, 1,262 out of 1,644 municipalities (76.8%) completed formulating PSND assistance master plans and an additional 349 municipalities (21.2%) were expected to finish within 1 year. Similarly, 864 (52.6%) municipalities reported that they have finished creating and have been updating the PSND registry. A total of 684 (41.5%) municipalities said that they were currently in the process of making the registries. Municipalities have also been working hard on assigning local residents/helpers as registered evacuation supporters (RES). A total of 361 (22.0%) reported that they have completed the RES assignment, 998 (60.7%) are in the process, and 285 (17.3%) have not yet initiated the process (Fire and Disaster Management Agency 2011).

Until recent years, the issue of people with special needs in times of disasters have been one of the most neglected themes in disaster research in English and Japanese. Japan was one of a few countries where nationwide initiatives on PSND have been planned among almost all municipalities and have been implemented among about one-fifth of them. The objective of this paper is to examine how these disaster countermeasures, as prescribed by the Evacuation/Sheltering Assistance Guideline for PSND (2005, 2006), worked or did not work in one of the better-prepared nations during the 2011 Tohoku-oki earthquake disaster, in order to

learn lessons from the local practices and to suggest the next actions to be taken toward better management of issues associated with PSND. In order to answer the research questions, different sources of data on the prefectural, municipal, community, organizational, and individual levels were used. Death tolls by prefecture (Iwate, Miyagi, and Fukushima) and by age group were obtained from the National Policy Agency. Municipal death rates of all residents, as well as those of PWD, were obtained from the Japan Broadcast Corporation (NHK) production team who conducted a series of three repeated telephone interview- and simple facsimile-based questionnaire surveys on the death tolls for all residents and those of PWD, directed to all 31 municipalities that recorded more than ten casualties from to the 11 March 2011 disaster. The NHK surveys were conducted in September 2011, January 2012, and September 2012. The survey repetition was necessary because municipalities kept updating PWD death tolls. Community-level results on the death and life situations of all 17 registered PSND in Hachiman, Ishinomaki City, was also obtained from the NHK team that conducted snowballing-style qualitative interviews to surviving PSND, their RESs, and key stakeholders in the community.

CASUALTY GAPS BETWEEN THE TOTAL POPULATION AND PSND[2]

ELDERLY CASUALTIES

Despite the abovementioned national and local government initiatives and corresponding community efforts on PSND disaster countermeasures in recent years, serious problems confronted municipalities, communities, PSND, and their families at the onset of the 11 March 2011 Tohoku-oki earthquake and tsunami disaster. Table 1 shows the death toll that was officially tallied and announced by the National Police Agency on 6 March 2012, the total population as of the 2010 census date of 1 October (The Statistics Bureau and the Director-General for Policy Planning of Japan 2011), and the number of deaths per 100,000 by gender, age, and prefecture. Figure 1 shows the proportion of Iwate, Miyagi, and Fukushima casualties by age group (gray bars) for each gender. For comparative purposes, population pyramids of the three prefectures (transparent bars) were overlaid onto the casualties-by-age-group bar charts. Figure 1 indicates that proportionally a far greater number of both male and female elderly (those who were over 60) died. Those who were over the age of 60 accounted for 64% of all male and 68% of all female casualties. Furthermore, gaps between gray (proportion of a given age-group casualty out of the total casualties) and transparent (proportion of a given age group out of the total population, which indicates the expected proportion of its age group) bars widened as age class increased. Compared with the expected proportion as estimated by the total population age distribution, 1.5 times more men of their 60s and 1.3 times more women of the same age group died. For men and women in their 70s, the ratios were 2.5 for men and 2 for women. For those who were over 80 years old, proportionately 3.4 times more men and 2.6 times more women died than the expected proportion. Future study needs to explore causes of the high elderly death toll despite the recent nationwide

[2] The following mortality data for the total population, the elderly, and PWD do not distinguish those who were institutionalized at the time (e.g., in hospitals and nursing homes) from those who were living at home. The reported mortalities were therefore treated as the best proxies of PSND mortality.

Table 1. Death toll, total population, and number of deaths per 100,000 by gender and age group

		Death toll			Total population			Number of deaths per 100,000		
Prefecture	Age	Male	Female	Total	Male	Female	Total	Male	Female	Total
Iwate	0–9	30	54	84	54,287	51,930	106,217	55	104	79
	10–19	41	41	82	65,306	61,918	127,224	63	66	64
	20–29	75	59	134	59,637	58,980	118,617	126	100	113
	30–39	134	108	242	80,390	77,575	157,965	167	139	153
	40–49	165	180	345	79,900	80,170	160,070	207	225	216
	50–59	297	308	605	95,059	95,486	190,545	312	323	318
	60–69	426	466	892	90,142	98,326	188,468	473	474	473
	70–79	550	606	1,156	70,130	93,844	163,974	784	646	705
	80+	400	616	1,016	36,961	75,041	112,002	1,082	821	907
Miyagi	0–9	170	165	335	101,846	97,068	198,914	167	170	168
	10–19	137	147	284	117,822	111,475	229,297	116	132	124
	20–29	177	155	332	135,185	134,457	269,642	131	115	123
	30–39	275	253	528	162,597	161,165	323,762	169	157	163
	40–49	321	348	669	145,852	146,619	292,471	220	237	229
	50–59	509	573	1,082	158,825	162,591	321,416	320	352	337
	60–69	900	854	1,754	151,083	157,214	308,297	596	543	569
	70–79	1,070	1,116	2,186	102,335	130,242	232,577	1,046	857	940
	80+	733	1,248	1,981	52,571	101,686	154,257	1,394	1,227	1,284
Fukushima	0–9	29	18	47	89,226	85,146	174,372	33	21	27
	10–19	24	29	53	104,283	98,804	203,087	23	29	26
	20–29	25	24	49	98,828	94,349	193,177	25	25	25
	30–39	44	33	77	127,461	122,496	249,957	35	27	31
	40–49	51	50	101	122,131	121,730	243,861	42	41	41
	50–59	103	92	195	148,080	145,806	293,886	70	63	66
	60–69	167	129	296	136,356	137,326	273,682	122	94	108
	70–79	172	233	405	96,086	125,140	221,226	179	186	183
	80+	156	222	378	54,725	109,005	163,730	285	204	231
Total		7,181	8,127	15,308	2,737,104	2,935,589	5,672,693	8,241	7,379	7,704

Note: The above table does not include 414 (Age unknown) or 64 (Age and Gender unknown).

Source: The National Police Agency, 6 March 2012; The Statistics Bureau and the Director-General for Policy Planning of Japan, 2011, 2010 Population Census.

initiatives for preparing disaster countermeasures for people with special needs, as was outlined in the previous section.

Figure 2 compares a ratio of the observed death proportion (gray bar) to the expected proportion (white bar) for a given age group by gender and prefecture in Figure 1. If the ratio is under 1, the observed death toll is proportionately lower than the population composition

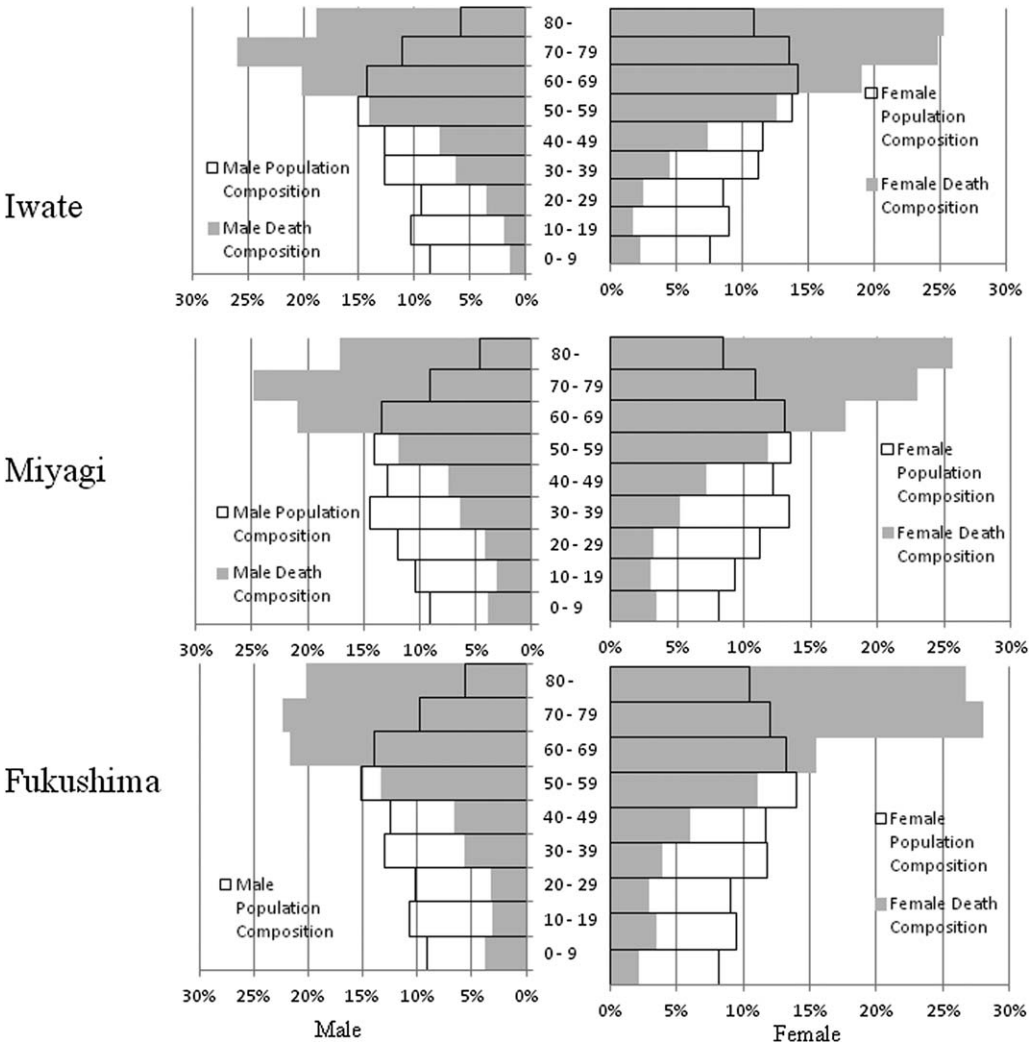

Figure 1. Population pyramid and the Tohoku-oki earthquake and tsunami mortality rate by prefecture by gender and age group as of 6 March 2012 (Source: The National Police Agency 2012, The Statistics Bureau and the Director-General for Policy Planning of Japan 2011).

for that age group. If the ratio is over 1, more deaths are observed for that particular age group compared with population age composition. The ratios among the three prefectures were similar (below 1) for men and women who were under 60 years of age. Over the age of 60, the ratios became bigger than 1, suggesting proportionately more of these age groups died in the three prefectures. Despite the nationwide counter-disaster measure initiatives in recent years, the results indicate that more extensive and intensive efforts are needed to counteract the vulnerability of elderly people to disasters, which have been reported in

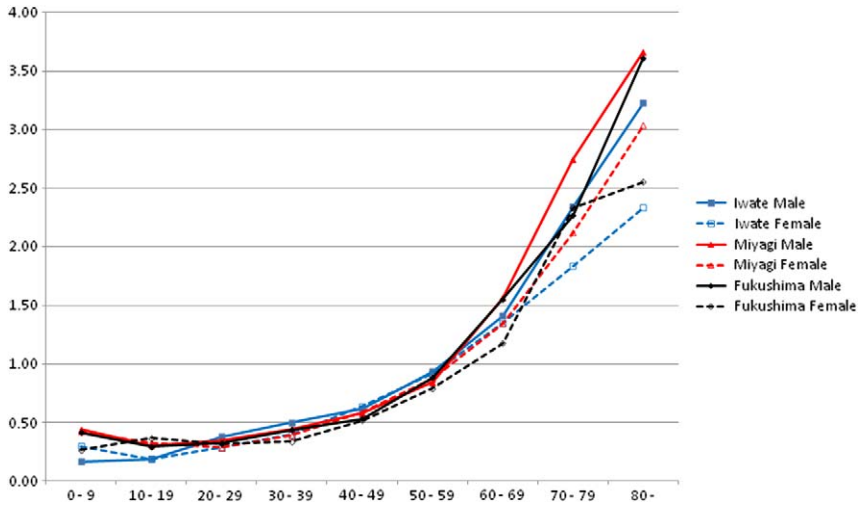

Figure 2. Ratio of observed to expected death toll by age, gender, and prefecture (Source: The National Police Agency 2012, The Statistics Bureau and the Director-General for Policy Planning of Japan 2011).

the field (e.g., Friedsam 1960, Blaikie et al. 1994, Tanida 1996, Wisner, in press, Sharkey 2007). Furthermore, gender and prefectural differences emerged for those who are over 60 years of age. For these age groups, proportionately more male than female elderly died. In addition, male and female elderly died proportionately more in Miyagi and Fukushima compared with Iwate Prefecture. Future investigations are needed in order to explain elderly death rate differences in gender and prefecture and to examine whether these differences are somewhat related to the differences in gender and prefecture specific initiatives.

PWD CASUALTIES

With regard to casualties among PWD, two mass-media corporations, *Mainichi Shimbun* newspaper and Japan Broadcasting Corporation (NHK), independently conducted telephone- and facsimile-based surveys of the disaster-hit municipalities[3] in Iwate, Miyagi, and Fukushima Prefectures. While *Mainichi* data has not been updated since it was published in late

[3] *Mainichi Shimbun* reported the results from 33 municipalities in three disaster-hit Tohoku prefectures on 24 December 2011, while NHK focused on those 31 municipalities where more than ten resident casualties were recorded. A part of NHK survey results was broadcast through ETV on 6 March 2012. Although the NHK survey was more detailed because it examined separate casualties among different disability categories, those numbers were not reported in the TV program. The original NHK survey data was provided to the author, who served as a commentator for the 6 March program. The major difference between the *Mainichi* and NHK surveys appeared in Ishinomaki City, where *Mainichi* PWD casualties (599) were much higher than those in the NHK survey (397 casualties). A personal communication to Mr. Kotaro Teranishi, the producer of the 6 March show, explained that the Ishinomaki City administration confounded direct and indirect death among PWD until February 2012. NHK thus used the direct casualties (397).

December 2011, NHK has updated the municipality PWD death toll[4] in January 2012 and September 2012 since the first survey that was conducted in September 2011. The NHK data was also cross-validated with the official PWD death toll by the Miyagi Prefecture administration at the end of August 2012. Cross-validation indicated that the NHK data was far more up-to-date and accurate than those of *Mainich Shimbun*. It was therefore decided that the NHK death toll would be used in order to estimate PWD casualties for the tsunami-hit municipalities in the other two prefectures, Iwate and Fukushima, which have not released the official numbers on PWD death.

Table 2 shows the mortality rates of the total population, those of PWD (all categories), and those for such specific disability categories as intellectual, physical (including visual, auditory, and orthopedic impairments), and mental disabilities. Figure 3 displays a very clear correlation between the total death tolls and those of PWD among the 31 tsunami-hit municipalities described in Table 2. The figure further indicates that the harsher the death toll among the total population (i.e., over 1.4% of total population mortality), the wider the gap grew between the total population death toll and that of PWD. In other words, proportionately more PWD were killed in those municipalities with harsher death tolls. Figure 4 compared municipality mortality rate distributions of the total population with those of PWD by prefecture. The comparisons suggest that high discrepancy between the total population and PWD casualties was found especially in Miyagi prefecture.

Figure 5 estimates magnitudes of the casualty gap between the total and PWD population for each of the three prefecture municipalities by means of fitting a simple no-intercept (i.e., no constant term) regression line:

$$PWD\ mortality = Casualty\ gap\ coefficient \times Total\ population\ mortality \quad (1)$$

Please note that an intercept, or a constant term, is set to zero and is thus omitted; if there is no casualty in the total population, the predicted PWD mortality is also zero. The above regression coefficient then indicates the degree of the total-population-to-PWD casualty gap. The larger the coefficient, the bigger the gap exists between the total and PWD mortalities. The regression (casualty gap) coefficient for Miyagi municipalities was 1.92 ($t = 15.1,\ p < .001$) and this regression model's coefficient of determination or R^2 was .946. In other words, one can interpret with very high accuracy ($R^2 = .946$) that the PWD mortality rate was nearly twice (1.92 times) as many as that of the total population in Miyagi prefecture. In contrast, a simple no-intercept regression analysis of Iwate municipalities turned out to be even more accurate ($R^2 = .995$) and it showed that only slightly higher (1.19 times, $t = 36.419,\ p < .001$) proportion of PWD died. Likewise, the casualty gap coefficient for Fukushima was even smaller than that of Iwate (1.16, $t = 3.776,\ p < .01$) and the model's R^2 was .641, indicating that the relationship between the two mortality variables was weaker due to a bigger error variance in Fukushima. Nevertheless, simple no-intercept regression analyses revealed that casualty-gaps were clearly observed in all three prefectures and that the gap was much bigger in Miyagi than in Iwate or Fukushima

[4] In the NHK PWD death toll surveys, PWD was defined as a person who was issued an official disability certificate from the residing municipality.

Table 2. Comparison of mortality rates among people with developmental, physical, and mental disabilities in Tohoku-oki earthquake (NHK 2012a, 2012b, 2012c, 2012d)

			Total population			PWD			PWD (Intellectual)			PWD (Physical)		
	Prefecture	Municipality	Population	Dead	Mortality	Population	Dead	Mortality	Population	Dead	Mortality	Population	Dead	Mortality
1	Iwate	Miyako City	59,442	517	0.9%	3,371	36	1.1%	479	2	0.4%	2,465	28	1.1%
2		Ofunato City	40,738	417	1.0%	2,268	47	2.1%	359	2	0.6%	1,742	42	2.4%
3		Rikuzen Takata City	23,302	1,760	7.6%	1,368	123	9.0%	221	5	2.3%	1,019	107	10.5%
4		Kamaishi City	39,578	958	2.4%	2,569	64	2.5%	346	2	0.6%	2,052	59	2.9%
5		Otsuchi Town	15,277	1,229	8.0%	1,012	95	9.4%	81	9	11.1%	807	87	10.8%
6		Yamada Town	18,625	775	4.2%	1,114	59	5.3%	172	0	0.0%	859	58	6.8%
7		Tanohata Villege	3,843	39	1.0%	203	3	1.5%	41	1	2.4%	142	2	1.4%
8		Noda Villege	4,632	27	0.6%	273	2	0.7%	41	0	0.0%	199	2	1.0%
		Iwate Total	205,437	5,722	3.2%	12,178	429	3.9%	1,740	21	1.2%	9,285	385	4.1%
9	Miyagi	Sendai City*	318,133	734	0.2%	13,432	53	0.4%	6,388	2	0.0%	30245	48	0.2%
10		Ishinomaki City	160,704	3,569	2.2%	7,893	397	5.0%	1,100	28	2.5%	6364	351	5.5%
11		Shiogama City	56,490	46	0.1%	2,997	0	0.0%	355	0	0.0%	2459	0	0.0%
12		Kesennuma City	73,494	1,234	1.7%	3,508	135	3.8%	544	3	0.6%	2872	131	4.6%
13		Natori City	73,140	911	1.2%	3,749	76	2.0%	375	4	1.1%	3069	68	2.2%
14		Tagajo City	62,979	125	0.2%	2,318	17	0.7%	337	1	0.3%	1790	16	0.9%
15		Iwanuma City	44,198	150	0.3%	1,770	14	0.8%	265	3	1.1%	1356	10	0.7%
16		Higashi Matsushima City	42,908	1,024	2.4%	1,920	114	5.9%	294	8	2.7%	1440	102	7.1%
17		Watari Town	34,846	306	0.9%	1,384	23	1.7%	230	0	0.0%	1004	22	2.2%
18		Yamamoto Town	16,711	616	3.7%	933	54	5.8%	129	3	2.3%	693	45	6.5%
19		Matsushima Town	15,089	16	0.1%	709	2	0.3%	90	0	0.0%	574	2	0.3%
20		Shichigahama Town	20,419	93	0.5%	882	8	0.9%	121	0	0.0%	723	8	1.1%
21		Onagawa Town	10,051	820	8.2%	605	81	13.4%	55	4	7.3%	456	66	14.5%
22		Minami Sanriku Town	17,431	793	4.5%	995	125	12.6%	150	3	2.0%	764	113	14.8%
		Miyagi Total	946,593	10,437	2.4%	43,095	1,099	3.8%	10,433	59	0.6%	53,809	982	1.8%
23	Fukushima	Iwaki City	342,198	430	0.1%	21,004	35	0.2%	2,195	3	0.1%	17,384	30	0.2%
24		Souma City	37,796	469	1.2%	1,903	23	1.2%	245	3	1.2%	1,480	17	1.1%
25		Minami Souma City	70,895	951	1.3%	4,398	16	0.4%	519	0	0.0%	3,581	16	0.4%
26		Naraha Town	7,701	69	0.9%	512	11	2.1%	65	0	0.0%	426	10	2.3%
27		Tomioka Town	15,996	134	0.8%	861	3	0.3%	122	0	0.0%	560	3	0.5%
28		Okuma Town	11,511	49	0.4%	565	0	0.0%	67	0	0.0%	468	0	0.0%
29		Futaba Town	6,932	94	1.4%	377	2	0.5%	18	0	0.0%	343	2	0.6%
30		Namie Town	20,908	358	1.7%	1,155	23	2.0%	146	1	0.7%	925	21	2.3%
31		Shinchi Town	8,218	116	1.4%	455	17	3.7%	51	2	3.9%	382	14	3.7%
		Fukushima Total	522,155	2,670	1.0%	31,230	130	1.2%	3,428	9	0.3%	25,549	113	0.4%
		Total	1,674,185	18,829	1.1%	86,503	1,658	1.9%	15,601	89	0.6%	88,643	1,480	1.7%

			PWD (Physical impairment subcategories)									PWD (Mental)		
	Prefecture	Municipality	Population (Visual)	Dead	Mortality (Visual)	Population (Auditory)	Dead	Mortality (Auditory)	Population (Orthopedic)	Dead	Mortality (Orthopedic)	Population	Dead	Mortality (Mental)
1	Iwate	Miyako City	176	2	1.1%	215	4	1.9%	1354	10	0.7%	427	7	1.6%
2		Ofunato City	190	4	2.1%	156	3	1.9%	953	21	2.2%	167	3	1.8%
3		Rikuzen Takata City	87	11	12.6%	73	6	8.2%	525	54	10.3%	128	12	9.4%
4		Kamaishi City	183	4	2.2%	206	3	1.5%	1066	19	1.8%	188	3	1.6%
5		Otsuchi Town	Not recorded									144	0	0.0%
6		Yamada Town	88	4	4.5%	102	7	6.9%	679	31	4.6%	83	1	1.2%
7		Tanohata Villege	5	0	0.0%	12	0	0.0%	77	0	0.0%	20	0	0.0%
8		Noda Villege	19	0	0.0%	24	1	4.2%	102	1	1.0%	33	0	0.0%
		Iwate Total	112	4	3.6%	788	24	3.0%	4756	136	2.9%	1190	26	2.2%
9	Miyagi	Sendai City	Not recorded									6155	3	0.0%
10		Ishinomaki City	Not recorded									676	23	3.4%
11		Shiogama City	165	0	0.0%	156	0	0.0%	1288	0	0.0%	183	0	0.0%
12		Kesennuma City	205	7	3.4%	211	9	4.3%	1617	82	5.1%	223	3	1.3%
13		Natori City	229	5	2.2%	236	10	4.2%	2784	38	1.4%	305	4	1.3%
14		Tagajo City	123	1	0.8%	104	3	2.9%	915	2	0.2%	191	0	0.0%
15		Iwanuma City	86	1	1.2%	108	0	0.0%	742	7	0.9%	149	1	0.7%
16		Higashi Matsushima City	104	9	8.7%	104	5	4.8%	712	57	8.0%	186	5	2.7%
17		Watari Town	70	0	0.0%	90	0	0.0%	644	13	2.0%	150	1	0.7%
18		Yamamoto Town	43	4	9.3%	38	2	5.3%	375	23	6.1%	111	6	5.4%
19		Matsushima Town	36	0	0.0%	21	0		310	1	0.3%	45	0	0.0%
20		Shichigahama Town	40	1	2.5%	29	0	0.0%	403	3	0.7%	38	0	0.0%
21		Onagawa Town	23	1	4.3%	40	6	15.0%	206	36	17.5%	94	11	11.7%
22		Minami Sanriku Town	42	11	26.2%	74	11	14.9%	349	50	14.3%	81	7	8.6%
		Miyagi Total	1166	40	3.4%	1211	46	3.8%	10345	312	3.0%	1756	38	2.2%
23	Fukushima	Iwaki City	1350	6	0.4%	1201	0	0.0%	10010	14	0.1%	1425	2	0.1%
24		Souma City	97	0	0.0%	120	1	0.8%	841	5	0.6%	178	3	1.7%
25		Minami Souma City	276	0	0.0%	275	2	0.7%	2038	7	0.3%	298	0	0.0%
26		Naraha Town	32	1	3.1%	19	0	0.0%	249	6	2.4%	21	1	4.8%
27		Tomioka Town	26	0	0.0%	34	0	0.0%	305	1	0.3%	179	0	0.0%
28		Okuma Town	27	0	0.0%	56	0	0.0%	266	0	0.0%	30	0	0.0%
29		Futaba Town	26	2	7.7%	28	0	0.0%	192	0	0.0%	16	0	0.0%
30		Namie Town	63	0	0.0%	64	2	3.1%	493	12	2.4%	84	1	1.2%
31		Shinchi Town	30	1	3.3%	36	0	0.0%	225	11	4.9%	22	1	4.5%
		Fukushima Total	1927	10	0.5%	1833	5	0.3%	14619	56	0.4%	2253	8	0.4%
		Total	3,205	54	1.7%	3,832	75	2.0%	29,720	504	1.7%	5,199	72	1.4%

*Almost all casualties in Sendai City were recorded in the coastal-fronting Miyagino and Wakabayashi wards. Therefore, the total and PWD population subtotals from these two wards were used in obtaining Sendai's mortality rates.

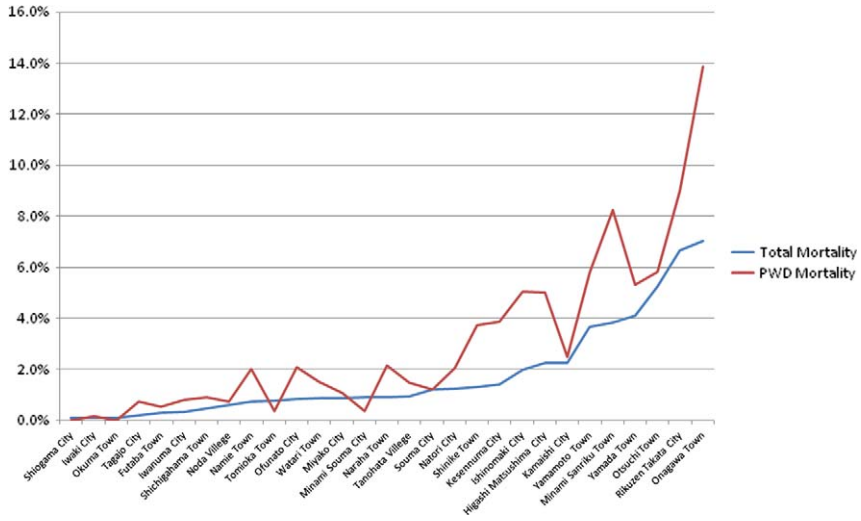

Figure 3. Comparison of total mortality and mortality among people with disabilities in Iwate, Miyagi, and Fukushima Prefectures (NHK 2012).

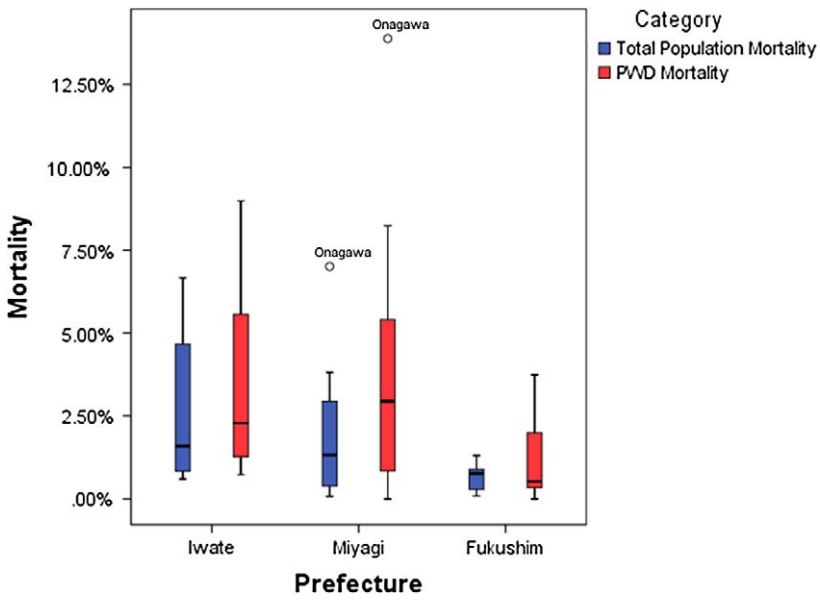

Figure 4. Comparison of total mortality and PWD mortality rate distributions in Iwate, Miyagi, and Fukushima Prefectures (NHK 2012).

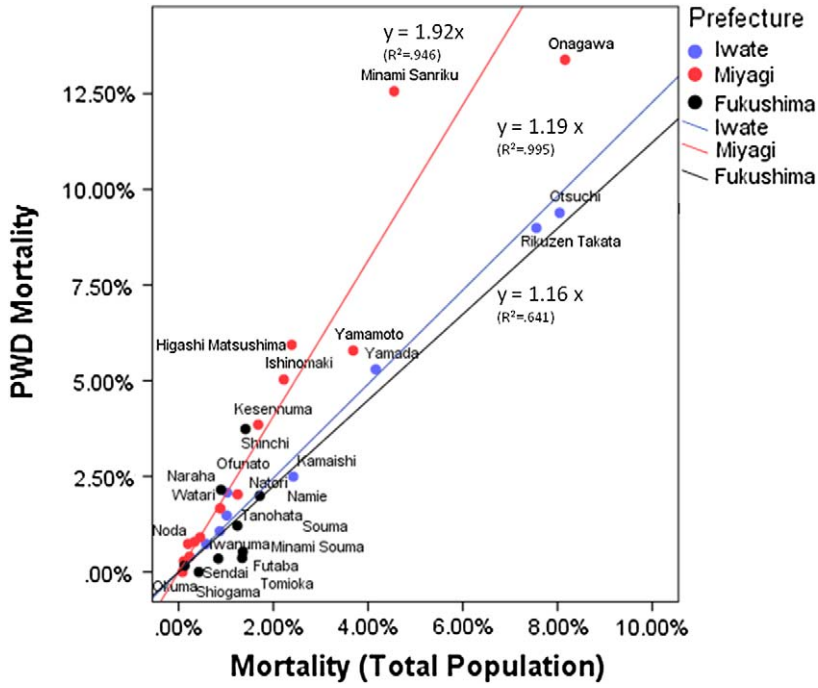

Figure 5. Regression of PWD mortality on total population mortality by in Iwate, Miyagi, and Fukushima Prefectures.

prefecture. Note that the similar results were also found from elderly mortality analyses as was shown in Figure 2. The cause of the gaps and the prefectural difference, especially between Miyagi on one hand and Iwate and Fukushima on the other, is examined in the next section.

Figures 6 to 10 show casualty gaps between the total population and PWD by different disability categories. Less and nearly equal casualties were observed among people with intellectual (casualty gap coefficient 0.76, $t = 8.29$, $p < .001$, see Figure 6) and mental disabilities (casualty gap coefficient 0.98, $t = 7.44$, $p < .001$, see Figure 7), respectively. In contrast, bigger gaps were found among people with physical impairments. The mortality rate of those with auditory impairments was 1.65 times ($t = 10.763$, $p < .001$, see Figure 8); visual impairments, 1.74 times ($t = 5.626$, $p < .001$, see Figure 9); and orthopedic impairments, 1.84 times ($t = 12.77$, $p < .001$, see Figure 10) that of the total population. Furthermore, significant prefectural differences were found in the mortality rates of those with orthopedic impairments and other physical impairments. For people with orthopedic impairments, their mortality rate in Miyagi was 2.3 times ($t = 14.484$, $p < .001$) more than the total population, while it was 1.25 times more in both Iwate ($t = 12.16$, $p < .001$) and Fukushima ($t = 2.87$, $p < .05$). Likewise, mortality gap coefficients for people with physical impairments (which include orthopedic, visual, and auditory impairments) were 2.15 ($t = 12.87$, $p < .001$), 1.4 ($t = 29.27$, $p < .001$), and 1.22 ($t = 4.06$, $p < .01$) for Miyagi,

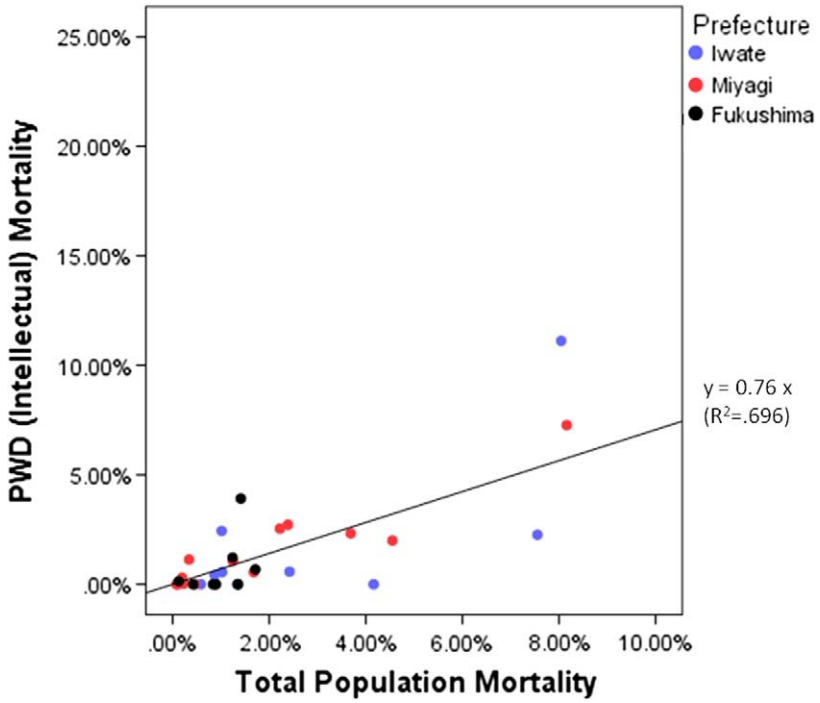

Figure 6. Regression of PWD (Intellectual) mortality on total mortality.

Iwate, and Fukushima, respectively. These findings[5] may suggest (1) that people with physical impairments faced the issues of immobility far more seriously than those with other disability categories or those without any disability; (2) that people with physical and more specifically, orthopedic, impairments in Miyagi were more vulnerable to the tsunami hazards than those in Iwate and Fukushima; and (3) that the high casualty gap of those with physical and more specifically, orthopedic, impairments seems to be responsible for prefectural (i.e., Miyagi versus Iwate or Fukushima) differences in overall PWD casualty gaps, as presented in Figure 5.

CAUSES OF ELDERLY AND PWD CASUALTIES

Table 3 compares proportions of institutionalized elderly and their casualty rates among Iwate, Miyagi, and Fukushima. The casualty rate for institutionalized elderly (5.2%) was strikingly high in Miyagi, as opposed to Iwate (2.1%) or Fukushima (0.4%). This seems to be due to the fact that nursing homes for the elderly tend to be situated in the scenic (and tsunami-prone) seaside areas in Miyagi, while in Iwate and Fukushima, nursing

[5] Coefficients of determination or R^2 values for regression lines in figures 6 to 10 ranged from .54 to .858. Small number of observations with outliers seem to cause lower R^2 values. The relationships between different PWD category mortalities and the total population mortality, therefore, need to be interpreted with some cautions.

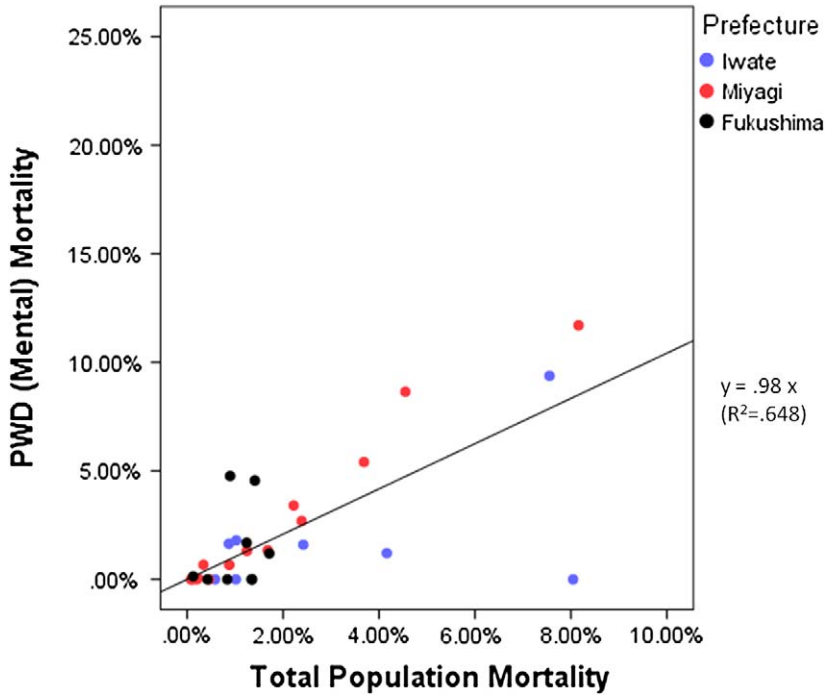

Figure 7. Regression of PWD (Mental) mortality on total mortality.

homes tend to be located in hillside and inland areas, respectively (Kahoku Shimpo 2011). Secondly, when location safety is controlled, the elderly in nursing homes who are taken care by the home workers on a 24-hour basis are generally better protected against tsunami hazards compared with the elderly living in their own homes. The rates of the institutionalized elderly are relatively higher in Iwate (2.6%) and Fukushima (2.5%) than in Miyagi (2.0%). This difference may further explain the lower elderly casualty rates in Iwate and Fukushima. Thirdly, higher institutionalization may also explain lower casualty rates among elderly women who have higher propensity to spend time alone in the nursing homes due to their longer longevity.

Differences in institutionalization rates may also explain inter-prefectural PWD casualty differences. Rates of institutionalized people with physical disabilities were strikingly different among Iwate (3.1%), Miyagi (0.7%), and Fukushima (1.3%). It is suspected that the lower rate of institutionalization may have caused higher casualties among people with physical disabilities in Miyagi (Table 4). Preceding studies of total population casualties have suggested such causative factors as tsunami height and arrival time (Suzuki and Hayashi 2011, Suzuki 2012); proportion of inundated area; distance to epicenter; types of coastline (rias or plain); proportions of aged 65 or older, as well as of those in fishery and agriculture (Ueda 2012); and a ratio of recorded maximum tsunami height to expected tsunami height (Matsumoto and Tatsuki 2012). In order to examine the relative magnitude of the PWD institutionalization rate to the other causative factors on PWD casualties, data was obtained from

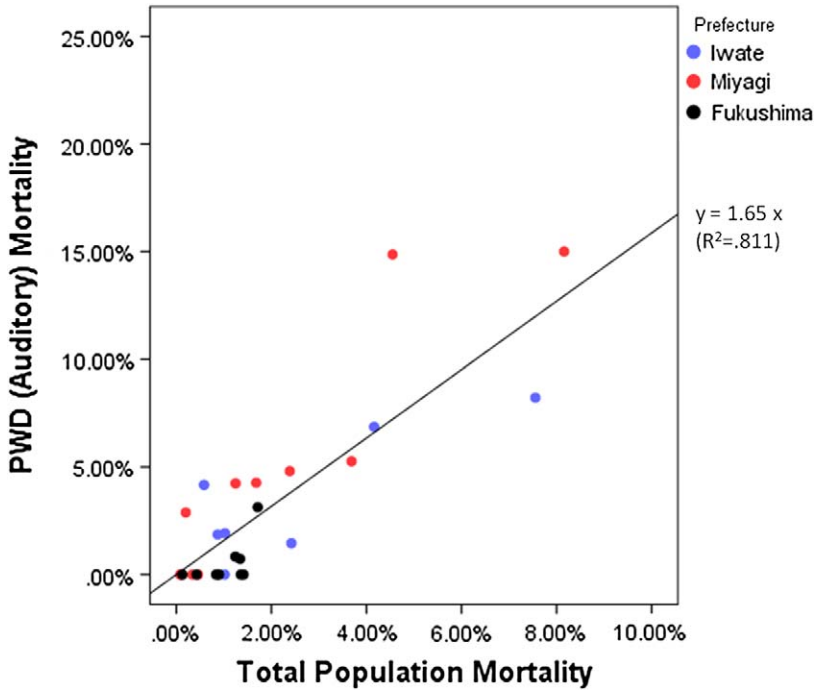

Figure 8. Regression of PWD (Auditory) mortality on total mortality.

preceding studies on municipality level casualties, and their correlations are presented in Table 5. Stepwise regression analyses of these variables on PWD casualties were then conducted and the final result was presented in Table 6. Among the final predictor variables, the proportion of institutionalized PWD turned out to be one of statistically significant causative variables ($t = -5.674$, $p < .001$) with its unstandardized coefficient size of about –1.0, suggesting that a 1% increase in PWD institutionalization means 1% lower PWD casualties. This interpretation was made possible because the no-intercept regression (i.e., $y = ax$) model was used, as explained in the previous section. In addition to the PWD institutionalization rate, the final regression model also suggests that the bigger the total population casualties (the casualty gap between the total population and PWD, however, is 1.1, implying the gap is not so large), the wider the inundated area, the more the aged and those who engaged in fishery and agriculture, and the sooner tsunami arrived, the more PWD died. These six predictor variables accounted for almost all PWD casualty variance ($R^2 = .968$) with high parsimony (i.e., no sign of multicolinearity because their tolerance statistics were all beyond .5).

THE LIFE AND DEATH SITUATIONS OF 17 PSND IN HACHIMAN COMMUNITY, ISHINOMAKI CITY

On 11 September 2012, or one and a half a years after the Tohoku-oki earthquake, the Japan Broadcasting Cooperation (NHK) ETV channel aired testimonial reports on the life

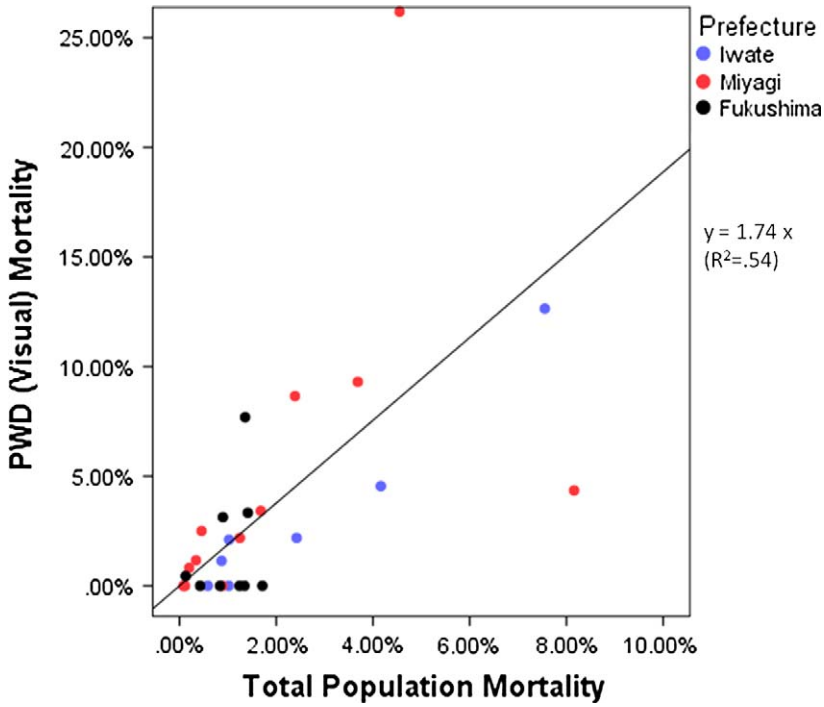

Figure 9. Regression of PWD (Visual) mortality on total mortality.

and death situations of the 17 PSND in Hachiman community, Ishinomaki City, Miyagi Prefecture. Hachiman community is situated along the left bank of Kyu-Kitagami River that runs through the central part of Ishinomaki City. About 350 households, or 900 people, were residing in this community, and the 2011 March tsunami killed 38 residents. It should be noted that Ishinomaki City was renowned for its citywide, community-based evacuation planning initiatives for PSND. As early as 2004, the city was recognized as one of the ten model municipalities on PSND preparedness master planning. By the end of 2010, 401 out of 421 administrative districts in the city completed individualized evacuation planning for each PSND in the neighborhood (Ishinomaki City 2008). Among Ishinomaki communities, Hachiman has been one of the leading communities for emergency response neighborhood networking for PSND, which began in May 2004 (NHK 2006). This was a year before even the first edition of the evacuation/sheltering assistance guideline was published by the Cabinet Office in 2005. In July 2002, Ishinomaki City faced a serious flooding threat due to the strong rainfall precipitated by Typhoon 6, and the city administration issued the city's first evacuation public warning in its history. After the warning was lifted, the city learned that there were people who knew about the warning being issued, but who were not able to evacuate by themselves. With the help from the citywide 369 *minsei-iin*, or commissioned welfare volunteers, who were assigned to about every 160 households in the city, the city administration identified 1,780 PSND, and they were listed in the city PSND registry by the end of October 2002. The city's definition of PSND consisted of two categories: the frail elderly in

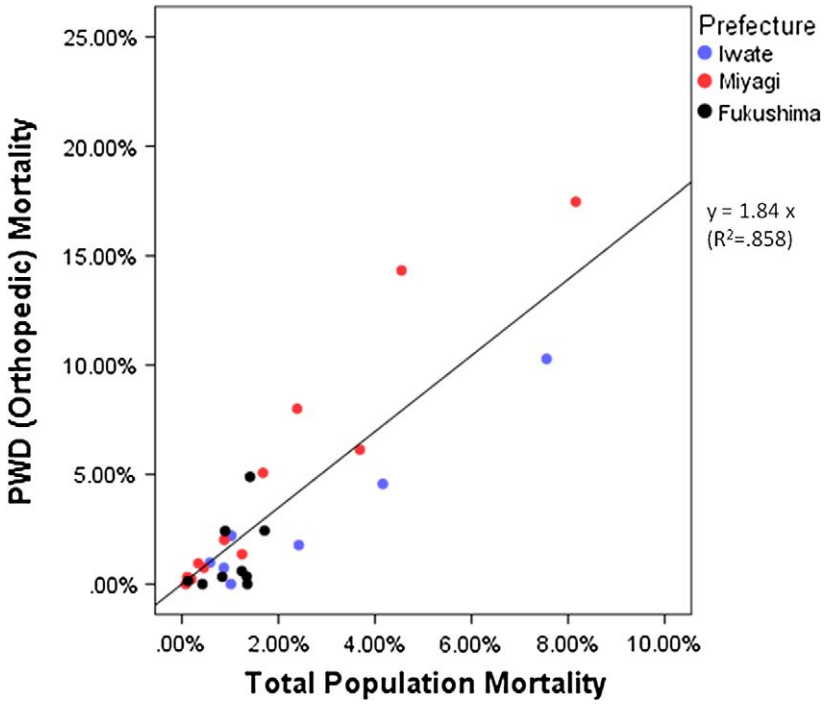

Figure 10. Regression of PWD (Orthopedic) mortality on total mortality.

single households or elderly dyad (couple, siblings, and parent-child) households; and the PWD. In response to the city's initiative for PSND support networking, local *minsei-iins*, resident association leaders, shop owners, housewives, and retired residents in Hachiman community, where the 1960 Chile tsunami disaster caused sizable damages, decided to organize their own emergency response neighborhood network in May of 2005. The network assigned and registered two local resident evacuation supporters (RES) for each of 17 PSND. The 9 PSND out of the 17 were registered in the city PSND registry, and the other 8 elderly people were assessed being less critical but still in need of neighbors' help due to the frailty. These eight PSND were listed in the community's own registry. The Hachiman community network activities were featured by NHK ETV crew on 17 January 2006. Because the crew had developed rapport with key local residents through the 2006 production, they were able to re-enter the community and to re-interview the key stakeholders about the network's responses to the 2011 March tsunami disaster. The interviews took place from June to August of 2012.

Table 7 summarizes the life and death situations of the 17 PSND. Two out of the registered 17, or 11.8%, PSND, died due to the tsunami in Hachiman community, wherein a total 38 out of about 900, or 4.2%, residents were killed directly by tsunami. This means that the PSND died about 2.8 times more, proportionately, in Hachiman community. This casualty gap ratio is comparable to the citywide ratio of 2.3, that is, 397 out of 7,893, or 5.0%, PWD

Table 3. Number of those who are over the age of 70, proportions of institutionalized elderly, and institutionalized elderly casualty rates among Iwate, Miyagi, and Fukushima

Prefecture	Over 70 years of age	Institutionalized elderly (%)	Institutionalized elderly casualty (%)
Iwate	275,976	7,173 (2.6%)	152 (2.1%)
Miyagi	386,834	7,548 (2.0%)	389 (5.2%)
Fukushima	384,956	9,779 (2.5%)	37 (0.4%)

Source: 2010 Population Census (http://www.e-stat.go.jp/SG1/ estat/List.do?bid=000001034991&cycode=0)
Fy 2009 Long Term Care Service Provider and Institution Survey (http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001070484)
Fy 2009 Social Service Institution Survey (http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068770)
Kahoku Shimpo, 13 December 2011.

compared with a total 3,569 out of 160,704, or 2.2%, residents who were killed in Ishinomaki City (Table 2). Fisher's exact test probability (an alternative to the Chi-square test where there is less than 5 frequency in any cell) of the 2-by-2 ("PWD vs. non-PWD" by "Hachiman vs. the rest of Ishinomaki") death toll frequencies was .188 (one-tailed), and thus there was no significant difference in PWD-to-non-PWD death counts between Hachiman and the rest of Ishinomaki.

It should be further mentioned that the Hachiman community mortality gap ratio of 2.3 is also very similar to Miyagi's mortality gap coefficient 2.15 (with standard error of .167) for people with physical impairments, which was obtained from the previous no-intercept regression analysis. This suggests that the life and death situations in Table 7 may illustrate reasonably representative pictures of how the disaster countermeasures for PSND functioned (or did not function) in Ishinomaki City or in Miyagi Prefecture during the Tohoku-oki earthquake and tsunami disaster, despite its small sample size and definitional fuzziness between PSND (for Hachiman community) and PWD (for Ishinomaki and Miyagi).

Among the 17 registered PSND in Table 7, 14 individuals (12 households) were at their own residence in the community, and the other 3 were either at short-term stay units in a nursing home, an in-patient unit in a hospital, or a day service center at the time of the event and were able to survive with the help from these institutions. Out of the 14 PSND who were at home, 7 individuals (cases 1, 2, 3, 12, 14, 15, and 16) in six households (cases 2 and 3 are in the same household) were assisted for emergency evacuation by their RES. Four RES dashed to the assigned PSND residence immediately after the earthquake and the other two RES (each of them was the PSND's own daughter) were with their mothers and drove them to the designated shelter (cases 15 and 16). In contrast, no RES showed up for rescue to six individuals (cases 4, 5, 6, 7, 8, and 13) in five households (cases 7 and 8 are in the same household) because the RES were at work, out of town, or helping themselves from tsunami attacks. These six individuals with no RES assistance were saved either through self-help (cases 4, 6, 7, and 8), a neighbor (case 13), or a home helper or acquaintance who happened to drive by the site (case 5). Finally, it is unknown if the RES came or not for two PSND because both of them were dead either from the tsunami (case 11) or at her

Table 4. Number of those who were issued disability certificates and those who were institutionalized at social welfare facilities for PWD in Iwate, Miyagi, and Fukusima

	Types of disability registry (FY 2009)			Types of social welfare facilities for PWD (FY 2009)		
Prefecture	Physical disability certificates	Intellectual disability certificates	Mental disability certificates	Institutionalized people with physical disability (%)	Institutionalized people with intellectual disability (%)	Institutionalized people with mental disability (%)
Iwate	46,039	10,141	5,505	1,427 (3.1%)	931 (9.2%)	53 (1.0%)
Miyagi	50,476	9,285	9,335	378 (0.7%)	1,647 (17.7%)	76 (0.8%)
Fukushima	63,985	14,636	6,620	822 (1.3%)	1,521 (10.4%)	69 (1.0%)

Note: Numbers are as of March 2010

Source: Fy 2009 Social Welfare Administration Reports (http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068770)
Fy 2009 Health Administration Reports (http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068836)
Fy 2009 Social Welfare Instition Reports (http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068770)

Table 5. Correlations of the variables that were reported to be related to total population and PWD casualty

		1	2	3	4	5	6	7	8	9
1	PWD casualty									
2	Total population casualty	.908**								
3	Distance to the epicenter	−.657**	−.656**							
4	Proportion of innundated area	.696**	.566**	−.425*						
5	Types of sea coast	−.535**	−.538**	.653**	−.364*					
6	Sum of the proportions of aged 65 or older and those in fishery and agriculture	.547**	.450*	−.292	.242	−.644**				
7	A ratio of recorded maximum tsunami height to expected tsunami height	.085	.068	.262	−.066	.500**	−.198			
8	Tsunami arrival time	−.598**	−.566**	.758**	−.407*	.875**	−.446*	.313		
9	Proportion of institutionalized PWD	.058	.273	−.274	−.087	−.646**	.429*	−.516**	−.431*	

*p<.05
**p<.01

Note: *Proportion of innundated area* and *Sum of the proportions of aged 65 or older* and *Those in fishery and agriculture* are from Ueda (2012). *Tsunami aririval time* is from Suzuki (2012). *A ratio of recorded maximum tsunami height to expected tsunami height* is from Matsumoto and Tatsuki (2012).

Table 6. Multiple regression analysis of PWD casualty rates

Predictors	Unstandardized coeffient		Standardized coefficients			Multi-colinearity tolerance
	B	SE	Beta	*t*-value	*p*	
Total population casualty	1.129	.097	.715	11.628	.000	.507
Proportion of innundated area	.041	.011	.272	3.693	.001	.577
Sum of the proportions of aged 65 or older and those in fishery and agriculture	.631	.113	.487	5.577	.000	.654
Tsunami arrival time	−.021	.007	−.197	−3.151	.004	.563
proportion of institutionalized PWD	−.983	.173	−.371	−5.674	.000	.671

Adjusted R^2 = .968

Note: No-intercept regression

Table 7. PFND listed in the city registry and in Yawata community's own registry

Case no.	Name	Gender	Disability/ medical/ physical conditions	Household members	Registerd evacuation supporters (RES)	Did the RES come?	Alive or dead	Evacuation process	Note
1	Mrs. SB	Female	Difficulty in walking (use handcart) Old	Single household	Mr. N Mrs. N	Yes (came after the first big wave) No (at work)	Alive	Was attacked by the tsunami wave inside the house and lost consciousness. Mr. N (RES) came to rescue her after the first wave calmed down. Mr. N put Mrs. SB on his back and climbed a nearby mountain road while they were chased by another tsunami wave. Mr. N handed her at the top of the mountain to other neighbors.	One RES (Mr.N) came partly because Mr. N was in good contact with Mrs. SB on a regular basis. After the earthquake Mr. N (RES) thought of his family first and then of Mrs.SB. Glad to be able to save her. Without daily communications with Mrs. SB, the rescue would not have occured. Mrs.SB currently lives in a home for the elderly because she lost the house.
2	Mrs. SN (Grandmother)	Female	Bedridden/ physically immobile	Son Son's wife	Mr. A (Next-door neighbor)	Yes (came immediately)	Alive	After the tremer, the whole family went outside looking for help. Mr. A (RES) came running to help Mrs.SN and Mr.ST. Local volunteer fire fighters also assisted them to evacuate to the nearby evacuation center (Minato Elementary School).	One RES came immideately after the tremor. Mrs. SN is bedridden and had no prior evacuation drill experiences. It was hard to be transported on a wheelchair because her body does not bend. Family members and one RES were not enough to evacuate her. The volunteer firefighters' extra help was very valuable. Mr. A is not planning to go back to Yawata community because he is not confident to help her again. Wife of Mr. A (RES) passed away.
3	Mr. ST (Father)*	Male	Left hemiplegia due to stroke		Mr. IR	No			

4	Mrs. C	Female	Leg paralysis Neck tumor	Husband Daughter	Mr. AR (Commisioned welfare volunteer) Mr. T	No (at work) No (at work)	Alive	Evacuated to the second floor of the own house. Rescued after a few days and transported to the Ishinomaki Red Cross hospital.	No RES came but Mrs. C and her family self-helped by evacuating to the second floor of the house. They survived because the tsunami did not reach the second floor level. Mrs. C is determined to go back to her community even though she knew that she will not be able to evacuate by herself. Her Husband died after hospital transportation.
5	Mr. O	Male	Visual	Single household	Mr. C Mr. I	No No	Alive	Because the long tremor reminded him of tsunami, Mr.O dashed outside and asked for help. However, there was no reply. When he was at loss at the road side, his home helper passed by in her car and she picked him up and took him to the nearby shelter.	No RES came. Mr. O self-helped by asking for help from her neighbors and eventually rescued by his home helper.
6	Mrs. W	Female	Old	Daughter	Mr. AK Mr. AT (Mr. AK's wife)	Unknown Unknown (killed by tsunami)	Alive	Unknown	It is unknown if RES came. Mrs. W Passed away after evacuation at her temporary housing unit.
7	Ms. OB	Female	Difficulty in walking/ epilepsy	Ms. OB's Mother Ms. OB's 2 Brothers	Mr. ST	No	Alive	Decided to evacuate after the big tremor followed by tsunami warning alert from official disaster radio. Grandfather advised the whole family to climb up the path to the top of the nearby mountain.	No RES came and the family self-helped. They were not sure where to escape. Learned that it makes sense for a whole family to decide where to go prior to the event.
8	Ms. OB's grandfather*	Male	Difficulty in walking/back pain		Mr. AJ	No (helping oneself was all Mr. AJ could do)	Alive		
9	Mr(s). AZ	?	Bedridden		?		?	Was at a nursing care home for a short stay on that day.	Unable to locate
10	Mr(s). A2	?	?		?		?	Was an in-patient at a hospital.	Unable to locate
11	Mr(s).TM*	?	Auditory	Single household	? ?	? ?	Dead	Caught by tsunami and washed away. Mr(s). TM was rescued at the nearby bridge. (S)he was transported to the Red Cross Hospital, but was not saved.	Dead Unknown if RES came or not.

(*continued*)

Table 7. (*continued*)

Case no.	Name	Gender	Disability/ medical/ physical conditions	Household Members	Registerd evacuation suporters (RES)	Did the RES come?	Alive or dead	Evacuation process	Note
12	Mrs. SM*	Female	Difficulty in walking/ diabetis	Single household	Mr. K Mrs. K (Mr.K's wife)	Yes (escorted to Mr. K's own house) No (killed by tsunami)	Dead	Mr.K(RES) came and escorted Mrs. SM to his house. Mr. F, the president of the neghborhood association, came to see her and urged her to evacuate with him and his wife. On their way to the shelter, Mrs. SM could not walk any longer and told Mrs. F to go without her. Moment after, Mrs. SM was swept away by tsunami. Tsunami also attacked Mrs. F but she barely escaped death.	One RES (Mr. K) came to escort to his house. Mrs. SM traveled with large luggage. That was another reason why she could not continue walking. A tall RC building was standing on the way to the shelter. Mrs. F feels that they could have looked for a shelter in that building.
13	Mrs. M*	Female	Difficulty in walking (uses cane)	Single Household	Mrs. TS Mrs. M's Daughter	No (killed by tsunami) No (living in Sendai)	Alive	When Mrs. M went outside after the earthquake, her neighbor assisted her to evacuate to the designated shelter.	No RES came because that person was killed by the tsunami. The neighbor assisted the evacuation to the shelter. Currently, Mrs. M lives with her daughter in Sendai.
14	Mrs. TY*	Female	Old (89 yrs old)	Single household	Mrs.I Mrs. TY's Daughter	Yes (escorted to the second floor of Mrs. M's house) No (living in Daimon)	Alive	Mrs. I (RES) came and helped her to go up stairs because that was what she wanted. Two days later, Mrs. I was spotted by her neighbor Mr. T who used a ladder to rescue her from the second floor window. Mr. T escorted her to the designated shelter.	One RES (Mrs. I) came to assist in-house evacuation. Mr. T (non-registered evacuation supporter), who went to school with Mrs. TY's son, has been looking for her for the past two days. Currently, she lives with her son's family in Hebita neighborhood (about 4 km away) in the same city.

15	Mrs. E*	Female	Old (88 yrs old)	Single household (family members living in proximity)	Mr. TM (Daughter's husband) Mr(s). IT	Yes (living together at the time of the EQ)	Alive	Mrs. E was recently dischared from a hospital and was spending a few days at her daughter's house. The daughter drove Mrs. E to the top of the nearby mountain.	One RES spouse (her own daughter) assisted evacuation because Mrs. E was temporarlily living with the daughter.
16	Mrs. M*	Female	Difficulty in walking/ artificial joint	Single household (family members living in proximity)	Mrs. H (daughter) Mr(s). M (neighbor)	Yes (happened to be together)	Alive	Mrs. H (RES) just dropped off Mrs. M from a regular visit to the hospital. Mrs. H picked her up again and drove to the designated shelter. Howerever, they were not sure how to get there and wasted some time. Then the tsunami came after them. Mrs. H's friend who was with them in the same car dashed out but Mrs. H could not abandon her mother. She took a small path to the top of the nearby mountain and escaped the tsunami attack.	One RES (daughter) assisted evacuation because she was with her.
17	Mrs. NM*	Female			Mr. NR	No (helping oneself was all Mr. NR could do)		Was at the day service center.	Unable to locate

*means the person is listed in Yawata community's own PFND list.

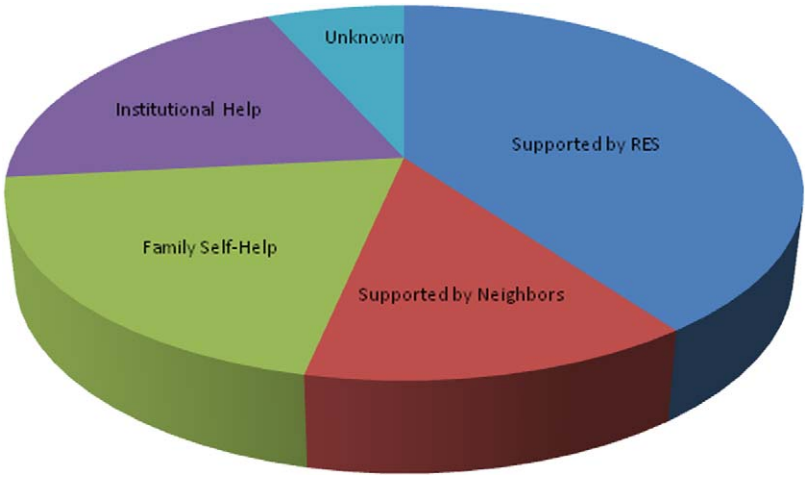

Figure 11. Hachiman community results of PSND evacuation support.

temporary housing unit (case 6). As Figure 11 illustrates, it is now clear that Hachiman community's emergency response network functioned to help half of the registered 14 PSND who were at their own homes and saved six lives, while self-help and informal mutual help from a neighbor or a friend saved about a third (six lives) of the most vulnerable elderly and people with disabilities in Hachiman community. This seems to encourage the community-based initiatives for PSND in other parts of the country. It should be mentioned that Miyagi's casualty gap between the total population and PWD was the biggest in the three disaster-hit prefectures despite community-based efforts like those in Hachiman community.

CONCLUSION

This paper addressed casualty gaps between the total population and PSND by examining prefectural- and municipal-level aggregated death toll data. It was made clear that those who were over the age of 60 and/or those with disabilities were disproportionately more vulnerable to the Tohoku-oki earthquake and tsunami. Among PWD, those with physical (orthopedic, visual, and auditory) impairments died proportionately more than the total population or people with the other categories of disabilities. The elderly and PWD casualty rates were not even across the three prefectures; more elderly and PWD died in Miyagi than in Iwate and Fukushima. The rate of institutionalization among the elderly and PWD was suggested as one of possible causative factors that may explain casualty gaps among prefectures and different PWD categories and between genders. In the case of the elderly casualties, more institutionalized elderly died in Miyagi than in Iwate or Fukushima because nursing homes in Miyagi tended to be located in scenic (and tsunami-prone) coastal areas. This suggests more efforts in mitigation (i.e., tighter land use control for institutional facilities based on hazard maps) and preparedness activities (e.g., more frequent disaster drills, staff training, etc.) for the institutions situated in tsunami hazard–prone areas. Given the location safety factor being controlled, however, those elderly who were in institutional facilities were better protected against tsunami hazards thanks to seismically compliant buildings and care workers available

on a 24-hour basis. The comparably higher institutionalization rates may explain lower casualty rates for the Iwate and Fukushima elderly, as well as for female elderly across the three prefectures (elderly women have a higher propensity to be institutionalized in nursing homes due to their greater longevity).

Stepwise regression analysis demonstrated that PWD casualty rates among 31 tsunami-hit municipalities were almost perfectly ($R^2 = .968$) explained by such causative factors as total population casualties, proportion of inundated area, proportions of aged 65 or older as well as of those in fishery and agriculture, tsunami arrival time, and PWD institutionalization rate. Among these five predictors, PWD institutionalization rate seems to explain casualty gaps among the three prefectures. Regression analysis indicated that 1% increase in PWD institutionalization meant 1% decrease in PWD casualty rate. Iwate and Fukushima were evidenced with higher proportions of PWD institutionalization than Miyagi. The higher propensity of PWD residing in institutional facilities in Iwate and Fukushima in comparison to Miyagi seems to be mainly due to the lack of socially inclusive services and resources, such as home help, visiting care, attendant and day services for PWD, as well as centers for independent living. It should be mentioned that this author does not support the view that the institutionalization of the elderly and/or PWD is the implied solution to prevent higher casualties among the elderly and PWD. The notion of emanicipatory and socially inclusive approaches to disability issues (Oliver 1990, Barnes 2001) is commonly shared in Japanese social service policy and administration since the introduction of the universal social service system (Titmus 1974) for the elderly (Public Nursing Care Insurance Law 1997) and for PWD (Services and Supports for Persons with Disabilities Act 2005). In fact, Miyagi was one of the leading prefectures that promoted the socially inclusive normalization policies for PWD under the leadership of the former Governor Shiro Asano who asserted all PWD colonies should be dismantled (Asano, 2003). The root causes of higher casualties among the elderly and PWD seem to lie in the fact that socially inclusive social services for the elderly and PWD are, at this point, designed for a time of normalcy and not for times of disasters. At the same time, Japanese disaster management policies for people with special needs or PSND have been non-universal in their orientations and have not been capable of collaborating with mainstream social service policies that have become socially inclusive and universal in their orientations.

The serious casualty gaps emerged not because there was a lack of effort made to reduce disaster vulnerability among PSND. Japan has been one of the leading countries in systematically promoting PSND evacuation and shelter assistance initiatives since March 2005. Ishinomaki's Hachiman community responses to 17 PSND were presented as the evidence that pre-planned local community initiatives saved nearly half of the most vulnerable residents in this community. Ishinomaki City has been one of the leading municipalities in PSND disaster countermeasure planning, by creating the citywide PSND registries, sharing PSND information with neighborhood associations, and assigning two registered evacuation supporters to each PSND in almost all neighborhood communities. Hachiman community practice seems to be the answer to overcoming the issues of mainstreaming preparedness components in the everyday practice of social inclusion of the elderly and PWD and to bridging disaster management and social, as well as community service provisions for this population.

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REFERENCES

American Red Cross, 1997. *Disaster Preparedness for People with Disabilities*, Washington, D.C.

Asano, S., 2003. Manifest for Dismantling Insitutional Facilities for PWD, available at http://www.asanoshiro.org/sinbun/03/030107-kousei.htm (last accessed on 19 February 2013).

Barnes, C., 2001. Emancipatory Disability Research: Project of Process?, Public Lecture at City Chambers, Glasgow, 24 October 2001, available at http://disability-studies.leeds.ac.uk/files/archiveuk/Barnes-glasgow-lecture.pdf (last accessed 30 September 2012).

Blaikie, P., Cannon, T., Davis, I., and Wisner, B., 1994. *At Risk*, Routledge, New York, 284 pp.

Clive, A., Davis, E. A., Hansen, R., and Mincin, J., 2010. Disability, in *Social Vulnerability to Disasters* (B. D. Phillips et al. eds), CRC Press, Boca Raton, FL, 187–216.

Enders, A., and Bradt, Z., 2007. Using Geographic Information System technology to improve emergency management and disaster response for people with disabilities, *Journal of Disability Policy Studies* **17**, 223–229.

FEMA/American Red Cross, 2004. *Preparing for Disaster for People with Disabilities and other Special Needs*, Federal Emergency Management Agency/American Red Cross, Washington, D.C.

Fire and Disaster Management Agency, 2011. *A Research Report on Municipalities Counter-Disaster Measures for People with Functional Needs in Times of Disaster*, available at http://www.fdma.go.jp/neuter/topics/houdou/2307/230708_1houdou/02_houdoushiryou.pdf (last accessed on 26 September 2011).

Friedsam, H. J., 1960. Older persons as disaster casualties, *Journal of Health and Human Behavior* **1**, 269–273.

Hayashi, H., and Tamura, K., 2005. Profiling causes of deaths at the Niigata flooding disaster on July 13, 2004, *Journal of Social Safety Science* **7**, 197–206 (in Japanese).

Hayashi, H., and Tatsuki, S., 2004. Causes of casualties in 7.13 Niigata flood, Presentation at the *Interim Briefing Session on 2004 July Niigata/Fukushima and Fukui Flood Disasters*, 19 November 2004, Niigata University.

Ishinomaki City, 2008. *An Example of Assisting People with Special Needs in Disaster: Ishinomaki City Initiative that Prioritized City-wide Expansion of PSND Counter-Disaster Measures*, available at http://www.bousai.go.jp/3oukyutaisaku/youengosya/h20/h20_pdf/03.pdf (last accessed on 19 October 2012).

Japan Broadcasting Cooperation (NHK), 2006. *Social Welfare Network: How to Protect People with Special Needs*, ETV, 17 January 2006, available at http://www.nhk.or.jp/heart-net/fnet/arch/tue/60117.html (last accessed on 15 October 2012).

Japan Broadcasting Cooperation (NHK), 2012a. *Social Welfare Network: One Year after the Eastern Japan Earthquake: Disasters Experience of People with Disabilities*, ETV, 6 March 2012, available at http://www.nhk.or.jp/heart-net/fnet/info/1203/120306.html (last accessed on 15 October 2012).

Japan Broadcasting Cooperation (NHK), 2012b. *Activities of Tasketto Center for Independent Living in Sendai*, Video program produced for public viewing at NHK Heart Forum, Iino Hall, Tokyo, 10 June 2012.

Japan Broadcasting Cooperation (NHK), 2012c. *How to Support People with Disabilities (1): Evacuation Assistance*, Heart-Net TV, 11 September 2012.

Japan Broadcasting Cooperation (NHK), 2012d. *How to Support People with Disabilities (2): Sheltering Assistance*, Heart-Net TV, 12 September 2012.

Kahoku Shimpo, 2011. Focus: 59 Elderly Institutions Hit by Tsunami and 578 People Died or Missing, 13 December 2011.

Kailes, J. I. 2002. *Emergency Evacuation Preparedness: Taking Responsibility for Your Safety, A Guide for People with Disabilities and other Activity Limitations*, Center for Disability and the Health Professions, Western University of Health Sciences, Pomona, CA.

Kailes, J. I., and Enders, A., 2007. Moving beyond "special needs": A function-based framework for emergency management and planning, *Journal of Disability Policy Studies* **17**, 230–237.

Kailes, J. I., 2008. *Southern California Wildfires After Action Report*, Center for Disability and the Health Professions, Western University of Health Sciences, Pomona, CA.

Matsumoto, A., and Tatsuki, S., 2012. Study of casualties of elderly and disability person in the Great East Japan Earthquake, *Journal of Social Safety Science* **18**, 241–250.

Ministry of Health, Labour, and Welfare, 2010. Fiscal Year 2009 Health Administration Reports, available at http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068836 (last accessed on 17 February 2013).

Ministry of Health, Labour, and Welfare, 2010. Fiscal Year 2009 Long Term Care Service Provider and Institution Survey, available at http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001070484 (last accessed on 17 February 2013).

Ministry of Health, Labour, and Welfare, 2010. Fiscal Year 2009 Social Service Institution Survey, available at http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068770 (last accessed on 17 February 2013).

Ministry of Health, Labour, and Welfare, 2010. Fiscal Year 2009 Social Welfare Administration Reports, available at http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068770 (last accessed on 17 February 2013).

Ministry of Health, Labour, and Welfare, 2010. Fiscal Year 2009 Social Welfare Institution Reports, available at http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068770 (last accessed on 17 February 2013).

Nishimura, A., Izumi, Y., Yamamoto, M., Ueno, Y., and Tatsuno, Y., 1995. Forensic consideration toward the reconstruction of a new disaster medical countermeasures in Japan: Based on postmortem examinations of Hanshin-Awaji earthquake victims, *Journal of Health and Welfare Statistics* **42**, 30–36.

Oliver, M., 1990. *The Politics of Disablement: A Sociological Approach*, Palgrave Macmillan, New York,190 pp.

Peek, L., and Stough, L. M., 2010. Children with disabilities in the context of disaster: A social vulnerability perspective, *Child Development* **81**, 1260–1270.

Sharkey, P., 2007. Survival and death in New Orleans: An empirical look at the human impact of Katrina, *Journal of Black Studies* **37**, 482–501.

Suzuki, S., 2012. *East Japan Earthquake Tsunami Arrival Time Simulation* (Computer Simulation Data), obtained from Research Center for Disaster Reduction Systems, Kyoto University.

Suzuki, S., and Hayashi, H., 2011. A preliminary critical causal analysis on the mortality caused by the 2011 East Japan earthquake tsunami, *Journal of Social Safety Science* **15**, 179–188.

Tanida, N., 1996. What Happened to Elderly People in the Great Hanshin Earthquake, British Medical Journal, Vol. **313**, pp.1133–1135.

Tatsuki, S., 2012. Challenges in counter-disaster measures for people with functional needs in times of disaster following the Great East Japan earthquake, *International Journal of Japanese Sociology* **21**, 12–20.

Tatsuki, S., and Comafay, N., 2010. Evacuation and sheltering assistance planning for special needs population: Kobe disadvantaged population mapping project, Paper presented at the *International Sociological Association World Congress of Sociology*, Gothenburg, Sweden, 15 July 2010.

Tatsuki, S., and Comafay, N., 2012. Counter disaster measures for people with functional needs in times of disaster in Japan: Achievements and challenges before and after the Great East Japan earthquake and tsunami disaster, *Journal of Disaster Management* **1**, 35–60.

The National Police Agency, 2012. The 2011 East Japan Earthquake Official Death Toll in Iwate, Miyagi, and Fukushima Prefectures (announced on 6 March 2012).

The Statistics Bureau and the Director-General for Policy Planning of Japan, 2011. 2010 Population Census, available at http://www.stat.go.jp/data/kokusei/2010/index.htm (last accessed on 31 March 2012).

Tierney, K. J., Petak, W. J., and Hahn, H., 1988. *Disabled Persons and Earthquake Hazards*, University of Colorado Institute of Behavioral Science, Boulder, CO.

Titmus, R. M., 1974. *Social Policy: An Introduction*, Routledge, New York, 160 pp.

Twigg, J., Kett, M., Bottomley, H., Tan, L., and Nasreddina, H., 2011. Disability and public shelter in emergencies, *Environmental Hazards* **10**, 248–261.

Ueda, R., 2012. Multiple regression analysis of human damage due to tsunami in the 2011 Great East Japan earthquake: Synthetic study on characteristics of tsunami and social factor, *Journal of Social Safety Science* **18**, 443–450.

White, G. W., Fox, M. H., Rooney, C., and Cahill, A., 2007. *Assessing the Impact of Hurricane Katina on Persons with Disabilities*, Center on Independent Living/National Institute on Disability and Rehabilitation Research, University of Kansas.

Wisner, B., in press. Disability and disaster: Victimhood and agency in earthquake risk reduction, in *Earthquakes* (C. Rodrigue, and E. Rovai, eds.), Routledge, London, draft available at www.radixonline.org/disability.html (last accessed 28 September 2012).

Wisner, B., Blaikie, P., Cannon, T., and Davis, I., 2003. *At Risk: Natural Hazards, People's Vulnerability and Disasters*, Second Edition, Routledge, New York, 496 pp.

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