

# Impact on the Physical Health-Status of Victims of the Noto Peninsula Earthquake — Focusing on Blood Pressure and Body-Mass Index (BMI) —

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## Abstract

**Purpose:** The aim of this study was to clarify the impact of the Noto Peninsula Earthquake on the physical health-status of Wajima City residents utilizing blood pressure and body-mass index (BMI) values obtained through basic health screening.

**Method:** Subjects were 5693 Wajima City residents who experienced the Noto Peninsula Earthquake and who underwent basic health screening in FY 2006 and 2007. Subjects were classified by gender, age, level of property damage and blood pressure. Level of property damage was classified into total destruction / near total destruction (hereinafter referred to as “total destruction”), half destruction, and less than half destruction. Blood pressure was classified into the presence of high blood pressure (defined as undergoing treatment by oral administration of medication) and the absence of high blood pressure. The blood pressure and BMI items from the basic health screening check were used to evaluate the health effects.

**Results:** With regard to systolic blood pressure (systolic BP), female subjects aged 75 years or older without high blood pressure who experienced either total destruction or property damage of less than half destruction showed a significant increase, and male subjects aged 75 years or older who experienced total destruction showed a significant decrease. With regard to the BMI of subjects with high blood pressure, male subjects less than 65 years of age who experienced total destruction, male subjects between 65 and 74 years of age who experienced half destruction, male subjects aged 75 years or older who experienced total destruction or less than half destruction, female subjects between 65 and 74 years of age who experienced either total destruction or half destruction, and female subjects aged 75 years or older who experienced less than half destruction showed a significant decrease after the earthquake. According to the results of examination by multiple logistic, no factors exerted an influence on the systolic BP; however, with regard to diastolic blood pressure (diastolic BP), age and total destruction to damage less than half destruction showed a significant increase. With regard to factors influencing BMI, increasing age in both female and male subjects correlated with a significant decrease in BMI. In addition, male subjects experiencing total destruction showed a significant decrease in BMI against those who experienced less than half destruction.

**Conclusion:** There was no significant correlation between systolic BP before and after the earthquake; however, for diastolic BP, age and total destruction to less than half destruction in female subjects correlated with a significant increase. With regard to BMI, as age increases, BMI tends to decrease, and specifically in male subjects, BMI showed a correlation with level of damage.

## Key words

Noto Peninsula Earthquake, Basic Health Screening, Blood Pressure, BMI, Elderly Individual

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## Introduction

Natural disasters have a large impact on the lives and physical conditions of individuals from the moment they strike. The Noto Peninsula Earthquake occurred on March 25, 2007. The epicenter of this earthquake was the coast of the Noto Peninsula. With a magnitude of 6.9 and an upper 6 intensity, this quake caused damage to houses in Monzen-machi, which was integrated into Wajima City in February, 2006. Wajima is an aging city with a population of 34,511, an aging rate of 34.2%, and a rate of elderly households of 18.8% as of April 1, 2006<sup>1)</sup>. The repair and rebuilding of houses has proceeded; however, residents are still forced to live in temporary housing one year after the earthquake. Such change causes stress to individuals and exerts a great influence on their health.

The impact of the earthquake on the physical health-status of the residents of Monzen has been reported from a physiological point of view. According to a study on the physical health-status of the individuals before and after the Great Hanshin-Awaji Earthquake, residents in the areas that had received significant damage to housing showed an increase in Triglycerides (TG) after the earthquake. The reason for this was thought to be acute emotional and physical stress. In addition, regardless of the level of damage to housing, an increase in blood glucose levels was seen in individuals surveyed within a year after the earthquake. Residents in temporary housing showed significantly low HDL cholesterol and significantly high TG compared with residents in general housing<sup>2)</sup>. In addition, the greater the housing damage and human injury involved, the higher the hemoglobin A1c concentration<sup>3)</sup>. An increase in blood pressure and subsequent heart disease resulting from the increase after the earthquake were also reported in a group of elderly individuals with high blood pressure living close to the epicenter<sup>4-6)</sup>.

Noto is an aging region. In senescence, while the individual's recognition and reaction to what is encountered in life differs depending on the experiences the individual has accumulated

throughout life, and whether or not the individual has the mental maturity with which to flexibly and adequately use such accumulated wisdom and experience, the elderly individual's physiological function has deteriorated<sup>7)</sup>; therefore, it is especially important for the elderly to have physical support in this period of life. The stress of environmental changes caused by disasters such as earthquakes in this period has an influence on the health of the elderly. In addition, the individual's physical deterioration interferes with activities aimed at the recovery of the region, which has a negative impact on the individual's quality of life as it approaches its close. Because few studies exist that examine the impact of earthquake on the physical health-status of the elderly in under populated areas, it is important to consider the physical support required for such individuals during and following natural disasters.

In this study, we compare the health conditions of the Noto Peninsula Earthquake victims living in Wajima City before and after the earthquake using the results of their basic health screening to clarify the impact of the earthquake on their physical health-status, and we discuss the medical and nursing care required by these individuals after the earthquake. Taking account of the regional characteristic that residents have higher blood pressure than subjects in existing studies and in the general population<sup>8,9)</sup>, we focus on blood pressure and BMI as easily comprehensible indices of impact on physical health-status.

## Methods

### 1. Subject

Subjects were Wajima City residents who underwent basic health screening in both FY 2006 and 2007. The number of individuals who received basic health screening was 7542 in FY 2006 and 7394 in FY 2007, and the number who underwent health screenings in both years was 5693. There were 1949 male subjects were (34.2%) and 3744 female subjects (65.8%). The average age of male subjects was  $71.7 \pm 9.8$  (40–98), and that of female subjects was  $69.6 \pm 11.3$  (25–101). With regard to the classification of high blood pressure, we

Table 1. Subject outline

	Male		Female	
	n=1949	%	n=3744	%
<b>Age</b>				
Less than 65 years of age	412	21.1	1000	26.7
Between 65 and 74 years of age	708	36.3	1393	37.2
75 years or older	829	42.6	1351	36.1
<b>Disease</b>				
High blood pressure group (Undergoing treatment by oral administration)	967	49.6	1740	46.5
Non-high blood pressure group	982	50.4	2004	53.5
<b>Damage to property</b>				
Total destruction <sup>1)</sup>	106	5.4	231	6.2
Half destruction	149	7.7	310	8.3
Less than half destruction	1694	86.9	3203	85.5

Note 1: "Total destruction" includes "near total destruction."

classified subjects undergoing treatment by oral administration into a high blood pressure group, and other subjects into a non-high blood pressure group. Male and female high blood pressure groups were 49.6% and 46.5%, respectively. In addition, subjects were classified by the degree of property damage caused by the earthquake. Subjects who experienced total destruction were 5.4% of males and 6.2% of females, and subjects who experienced half destruction were 7.7% of males and 8.3% of females (Table 1).

## 2. Data collection and analysis

1) We extracted subjects who underwent health screenings in both FY 2006 and 2007. The majority of subjects underwent health screening in September and October.

2) We analyzed basic attributes (gender, age) and health conditions of the subjects according to the level of damage to their housing. We used a paired t-test for the health screenings in FY 2006 and 2007, and one-way analysis of variance and multiple comparison to compare FY 2007 to FY 2006. In addition, subjects were classified into a high-blood pressure group and a non-high-blood pressure group for analysis and examination of the ratios of results in FY 2007 and FY 2006 by age and level of damage. We used a multiple logistic

model according to gender by using blood pressure and BMI as objective variables, and age and level of damage as explanatory variables. With regard to the level of damage, we processed the two variables of total destruction and half destruction toward damage of less than half destruction. For statistical analysis, we used HLBAU-6.24 for windows and considered  $p < 0.05$  as indicating the presence of significant differences.

## 3. Ethical considerations

Approval for this project was obtained from the Ethics Committee of the Kanazawa University School of Medicine (Approval No. 144). The plan was explained to the department in charge of surveys at the Wajima Municipal Office to obtain approval for the survey. Data was collected and managed by the administrator of individual information. Researchers handled the information by coded numbers.

## Results

Systolic and diastolic BPs and BMI before and after the earthquake are shown in the tables according to gender, age and level of property damage. Subjects were classified into three categories by age, and they were also classified into three categories by level of damage for each age category. The average ages among three groups according to level of damage failed to reveal the presence of any significant differences.

### 1. Results of systolic BP (Tables 2 and 3)

Analysis revealed no significant differences in systolic BP between male and female subjects in the high-blood pressure groups before and after the earthquake. In the male non-high-blood pressure group, subjects between 65 and 74 years of age showed a significant increase and subjects aged 75 years or older who experienced total destruction showed a significant decrease in systolic BP after the earthquake. In the female non-high blood pressure group, those aged 75 years or older who experienced total destruction or less than half destruction showed a significant increase after the earthquake. In comparisons before and after the earthquake, the male high-blood pressure group did not show any significant differences; however,

Table 2. Systolic BP by age and level of damage at the time of health screenings before and after the earthquake (Male)

High blood pressure group				FY 2006		FY 2007		FY 2007 / 2006			
Level of damage		n	M	SD	M	SD	p <sup>1)</sup>	M	SD	Comparison of two groups	p <sup>2)</sup>
Less than 65 years of age											
1. Total destruction <sup>3)</sup>	58.7 ± 4.36	10	154.0	16.7	147.1	16.5	0.22	0.96	0.11	1-2	0.38
2. Half destruction	56.5 ± 5.07	8	139.1	7.45	139.4	9.07	0.95	1.00	0.08	1-3	0.16
3. Less than half destruction	58.2 ± 4.85	130	142.0	15.1	142.6	15.3	0.62	1.01	0.11	2-3	0.89
Total	58.2 ± 4.85	148	142.7	15.1	142.7	15.1	0.94	1.01	0.10		
Between 65 and 74 years of age											
1. Total destruction	70.0 ± 3.23	14	141.9	16.4	141.8	13.0	0.98	1.01	0.10	1-2	0.58
2. Half destruction	70.4 ± 2.43	25	140.8	14.0	144.1	17.8	0.38	1.03	0.13	1-3	0.79
3. Less than half destruction	70.2 ± 2.72	334	142.6	16.8	141.3	16.6	0.17	1.00	0.12	2-3	0.22
Total	70.2 ± 2.73	373	142.5	16.6	141.5	16.5	0.30	1.00	0.12		
75 years of age or older											
1. Total destruction	79.9 ± 3.53	29	141.7	15.0	139.9	15.1	0.56	0.99	0.12	1-2	0.50
2. Half destruction	80.2 ± 4.67	45	137.3	15.6	138.6	18.4	0.64	1.02	0.14	1-3	0.89
3. Less than half destruction	80.4 ± 4.55	372	142.3	18.8	140.4	18.9	0.08	1.00	0.15	2-3	0.39
Total	80.3 ± 4.51	446	141.7	18.3	140.1	18.6	0.11	1.00	0.14		
Total		967	142.2	17.2	141.1	17.3	0.07	1.00	0.13		
Non-High blood pressure group											
Less than 65 years of age											
1. Total destruction <sup>3)</sup>	55.8 ± 7.25	15	142.9	27.9	137.9	16.8	0.31	0.98	0.11	1-2	0.38
2. Half destruction	56.7 ± 6.68	15	127.1	12.7	128.3	12.3	0.74	1.02	0.11	1-3	0.36
3. Less than half destruction	56.4 ± 6.22	234	130.1	16.4	130.2	15.4	0.96	1.01	0.12	2-3	0.76
Total	56.4 ± 6.31	264	130.7	17.2	130.5	15.4	0.85	1.01	0.12		
Between 65 and 74 years of age											
1. Total destruction	69.4 ± 2.39	15	133.1	9.65	134.7	13.0	0.63	1.02	0.10	1-2	0.65
2. Half destruction	69.9 ± 2.42	26	134.4	22.7	137.6	21.6	0.32	1.03	0.12	1-3	0.92
3. Less than half destruction	69.9 ± 2.84	294	132.9	18.1	134.6	18.5	0.07	1.02	0.12	2-3	0.55
Total	69.8 ± 2.79	335	133.1	18.2	134.8	18.5	0.04*	1.02	0.12		
75 years of age or older											
1. Total destruction	79.3 ± 3.52	23	138.6	18.3	127.0	24.4	0.005**	0.92	0.12	1-2	0.00083**
2. Half destruction	80.8 ± 4.11	30	132.2	14.7	137.4	18.9	0.15	1.05	0.14	1-3	0.00322**
3. Less than half destruction	80.3 ± 4.20	330	132.7	20.0	132.0	19.6	0.48	1.01	0.14	2-3	0.12
Total	80.3 ± 4.16	383	133.0	19.6	132.1	19.9	0.34	1.00	0.14		
Total		982	132.4	18.5	132.6	18.4	0.69	1.01	0.13		

\*p&lt;0.05 \*\*p&lt;0.01 SD: Standard deviation

Note 1) Corresponding t-test for the health screenings in FY 2006 and 2007

Note 2) One-way analysis of variance and multiple comparison by the ratio of FY 2007 to FY 2006

Note 3) "Total destruction" includes "near total destruction."

Table 3. Systolic BP by age and level of damage at the time of health screenings before and after the earthquake (Female)

High blood pressure group				FY 2006		FY 2007		FY 2007 / 2006			
Level of damage		n	M	SD	M	SD	p <sup>1)</sup>	M	SD	Comparison of two groups	p <sup>2)</sup>
Less than 65 years of age											
1. Total destruction <sup>3)</sup>	58.2 ± 5.15	13	148.1	15.1	141.1	15.8	0.06	0.96	0.08	1-2	0.011*
2. Half destruction	59.1 ± 4.50	11	136.9	17.3	144.6	18.4	0.19	1.07	0.14	1-3	0.08
3. Less than half destruction	58.6 ± 5.00	216	140.6	14.2	140.9	15.1	0.71	1.01	0.10	2-3	0.07
Total	58.6 ± 4.98	240	140.8	14.5	141.1	15.2	0.75	1.01	0.11		
Between 65 and 74 years of age											
1. Total destruction	71.1 ± 3.05	36	142.6	15.1	144.2	15.3	0.64	1.02	0.14	1-2	0.45
2. Half destruction	70.5 ± 2.82	45	143.3	16.9	141.9	15.4	0.62	1.00	0.13	1-3	0.42
3. Less than half destruction	70.3 ± 2.80	551	141.7	16.4	141.2	17.1	0.47	1.00	0.13	2-3	0.83
Total	70.3 ± 2.83	632	141.9	16.4	141.4	16.9	0.50	1.00	0.13		
75 years of age or older											
1. Total destruction	80.2 ± 4.26	69	143.9	18.6	142.6	21.4	0.63	1.00	0.15	1-2	0.98
2. Half destruction	80.3 ± 4.83	73	141.4	16.5	140.2	15.1	0.54	1.00	0.12	1-3	0.58
3. Less than half destruction	80.3 ± 4.27	726	142.6	18.1	142.5	17.8	0.82	1.01	0.14	2-3	0.59
Total	80.3 ± 4.32	868	142.6	18.0	142.3	17.9	0.61	1.01	0.14		
Total		1740	142.1	17.0	141.8	17.2	0.49	1.01	0.13		
Non-High blood pressure group											
Less than 65 years of age											
1. Total destruction <sup>3)</sup>	55.5 ± 8.00	48	126.1	18.6	127.9	17.2	0.48	1.02	0.13	1-2	0.96
2. Half destruction	55.1 ± 9.09	45	128.2	18.4	129.7	20.0	0.51	1.02	0.13	1-3	0.63
3. Less than half destruction	53.4 ± 9.44	667	125.3	17.4	126.0	19.8	0.17	1.01	0.11	2-3	0.68
Total	53.6 ± 9.36	760	125.5	17.5	126.3	17.2	0.10	1.01	0.11		
Between 65 and 74 years of age											
1. Total destruction	70.2 ± 2.76	37	130.3	17.8	133.6	15.3	0.18	1.03	0.11	1-2	0.42
2. Half destruction	70.2 ± 2.85	80	134.7	18.4	135.3	15.8	0.73	1.01	0.12	1-3	0.15
3. Less than half destruction	69.6 ± 2.93	644	133.9	18.1	133.5	17.8	0.52	1.00	0.13	2-3	0.48
Total	69.7 ± 2.92	761	133.8	18.1	133.7	17.5	0.83	1.01	0.13		
75 years of age or older											
1. Total destruction	80.9 ± 4.24	28	130.9	17.6	138.2	14.4	0.02*	1.07	0.12	1-2	0.14
2. Half destruction	79.7 ± 3.78	56	133.6	12.3	135.8	15.1	0.27	1.02	0.11	1-3	0.10
3. Less than half destruction	79.7 ± 4.16	399	135.4	18.1	137.3	17.7	0.03*	1.02	0.14	2-3	0.86
Total	79.8 ± 4.13	483	134.9	17.5	137.2	17.2	0.005**	1.03	0.13		
Total		2004	130.9	18.2	131.7	17.9	0.02*	1.01	0.12		

\*p&lt;0.05 \*\*p&lt;0.01 SD: Standard deviation

Note 1) Corresponding t-test for the health screenings in FY 2006 and 2007

Note 2) One-way analysis of variance and multiple comparison by the ratio of FY 2007 to FY 2006

Note 3) "Total destruction" includes "near total destruction."

Table 4. Diastolic BP by age and level of damage at the time of health screenings before and after the earthquake (Male)

High blood pressure group				FY 2006		FY 2007		FY 2007 / 2006			
Level of damage		n	M	SD	M	SD	p <sup>1)</sup>	M	SD	Comparison of two groups	p <sup>2)</sup>
Less than 65 years of age											
1. Total destruction <sup>3)</sup>	58.7 ± 4.36	10	87.5	10.7	85.8	10.9	0.45	0.98	0.08	1-2	0.65
2. Half destruction	56.5 ± 5.07	8	87.8	9.24	87.3	4.43	0.90	1.01	0.12	1-3	0.63
3. Less than half destruction	58.2 ± 4.85	130	86.6	9.39	86.1	9.40	0.51	1.00	0.11	2-3	0.87
Total	58.2 ± 4.85	148	86.7	9.41	86.1	9.27	0.41	1.00	0.11		
Between 65 and 74 years of age											
1. Total destruction	70.0 ± 3.23	14	78.8	9.71	79.5	15.9	0.82	1.01	0.14	1-2	0.83
2. Half destruction	70.4 ± 2.43	25	82.9	11.5	81.6	8.11	0.62	1.00	0.14	1-3	0.75
3. Less than half destruction	70.2 ± 2.72	334	80.1	10.3	79.1	9.77	0.06	1.00	0.13	2-3	0.92
Total	70.2 ± 2.73	373	80.3	10.3	79.2	9.94	0.06	1.00	0.13		
75 years of age or older											
1. Total destruction	79.9 ± 3.53	29	77.1	7.14	76.3	9.01	0.62	0.99	0.12	1-2	0.43
2. Half destruction	80.2 ± 4.67	45	75.8	10.4	76.3	8.57	0.80	1.02	0.16	1-3	0.57
3. Less than half destruction	80.4 ± 4.55	372	76.3	10.9	76.2	10.6	0.83	1.01	0.15	2-3	0.62
Total	80.3 ± 4.51	446	76.3	10.6	76.2	10.3	0.83	1.01	0.15		
Total		967	79.4	10.9	78.9	10.5	0.12	1.00	0.14		
Non-High blood pressure group											
Less than 65 years of age											
1. Total destruction <sup>3)</sup>	55.8 ± 7.25	15	86.8	8.63	86.3	8.50	0.83	1.00	0.11	1-2	0.35
2. Half destruction	56.7 ± 6.68	15	81.5	7.65	84.3	9.19	0.30	1.04	0.12	1-3	0.92
3. Less than half destruction	56.4 ± 6.22	234	80.2	10.2	79.9	9.57	0.57	1.00	0.12	2-3	0.23
Total	56.4 ± 6.31	264	80.7	10.0	80.5	9.62	0.76	1.01	0.12		
Between 65 and 74 years of age											
1. Total destruction	69.4 ± 2.39	15	80.3	7.12	78.5	7.65	0.44	0.98	0.11	1-2	0.29
2. Half destruction	69.9 ± 2.42	26	79.2	12.2	80.8	13.2	0.46	1.03	0.14	1-3	0.29
3. Less than half destruction	69.9 ± 2.84	294	77.5	10.9	78.4	10.4	0.13	1.02	0.14	2-3	0.76
Total	69.8 ± 2.79	335	77.8	10.9	78.6	10.5	0.14	1.02	0.14		
75 years of age or older											
1. Total destruction	79.3 ± 3.52	23	73.0	11.3	69.0	9.36	0.10	0.96	0.15	1-2	0.15
2. Half destruction	80.8 ± 4.11	30	73.1	9.95	73.9	11.8	0.64	1.02	0.13	1-3	0.09
3. Less than half destruction	80.3 ± 4.20	330	74.0	10.6	74.1	11.0	0.80	1.01	0.14	2-3	0.84
Total	80.3 ± 4.16	383	73.9	10.5	73.8	11.0	0.92	1.01	0.14		
Total		982	77.0	10.9	77.2	10.8	0.54	1.01	0.13		

\*p<0.05 \*\*p<0.01 SD: Standard deviation Note 1) Corresponding t-test for the health screenings in FY 2006 and 2007  
 Note 2) One-way analysis of variance and multiple comparison by the ratio of FY 2007 to FY 2006  
 Note 3) "Total destruction" includes "near total destruction."

Table 5. Diastolic BP by age and level of damage at the time of health screenings before and after the earthquake (Female)

High blood pressure group				FY 2006		FY 2007		FY 2007 / 2006			
Level of damage		n	M	SD	M	SD	p <sup>1)</sup>	M	SD	Comparison of two groups	p <sup>2)</sup>
Less than 65 years of age											
1. Total destruction <sup>3)</sup>	58.2 ± 5.15	13	88.9	12.2	83.8	12.4	0.08	0.95	0.12	1-2	0.06
2. Half destruction	59.1 ± 4.50	11	84.9	10.9	86.9	8.77	0.59	1.04	0.15	1-3	0.08
3. Less than half destruction	58.6 ± 5.00	216	84.2	9.24	83.9	8.46	0.67	1.00	0.11	2-3	0.34
Total	58.6 ± 4.98	240	84.5	9.51	84.0	8.70	0.48	1.00	0.11		
Between 65 and 74 years of age											
1. Total destruction	71.1 ± 3.05	36	79.6	10.1	79.7	8.10	0.97	1.01	0.14	1-2	0.68
2. Half destruction	70.5 ± 2.82	45	80.3	10.8	81.8	10.2	0.17	1.03	0.09	1-3	0.52
3. Less than half destruction	70.3 ± 2.80	551	79.3	9.64	78.8	9.67	0.19	1.00	0.12	2-3	0.20
Total	70.3 ± 2.83	632	79.4	9.74	79.1	9.64	0.37	1.00	0.12		
75 years of age or older											
1. Total destruction	80.2 ± 4.26	69	76.7	10.7	76.0	10.6	0.63	0.99	0.12	1-2	0.34
2. Half destruction	80.3 ± 4.83	73	74.2	9.81	75.4	10.6	0.34	1.02	0.16	1-3	0.41
3. Less than half destruction	80.3 ± 4.27	726	75.0	10.8	75.6	11.2	0.19	1.01	0.15	2-3	0.64
Total	80.3 ± 4.32	868	75.1	10.7	75.6	11.1	0.18	1.01	0.15		
Total		1740	78.0	10.7	78.0	10.2	0.76	1.01	0.14		
Non-High blood pressure group											
Less than 65 years of age											
1. Total destruction <sup>3)</sup>	55.5 ± 8.00	48	77.4	10.3	78.6	11.5	0.35	1.02	0.11	1-2	0.58
2. Half destruction	55.1 ± 9.09	45	78.7	9.75	78.8	10.7	0.95	1.01	0.10	1-3	0.56
3. Less than half destruction	53.4 ± 9.44	667	75.8	10.9	75.9	10.6	0.94	1.01	0.12	2-3	0.84
Total	53.6 ± 9.36	760	76.1	10.8	76.2	10.7	0.76	1.01	0.12		
Between 65 and 74 years of age											
1. Total destruction	70.2 ± 2.76	37	77.7	11.6	77.8	13.0	0.90	1.02	0.12	1-2	0.55
2. Half destruction	70.2 ± 2.85	80	78.1	10.0	77.3	17.8	0.47	1.00	0.12	1-3	0.53
3. Less than half destruction	69.6 ± 2.93	644	76.8	9.96	76.5	16.6	0.33	1.00	0.13	2-3	0.93
Total	69.7 ± 2.92	761	77.0	10.1	76.6	16.5	0.28	1.00	0.13		
75 years of age or older											
1. Total destruction	80.9 ± 4.24	28	71.7	10.5	75.2	9.24	0.06	1.06	0.13	1-2	0.19
2. Half destruction	79.7 ± 3.78	56	76.7	9.74	77.2	10.1	0.68	1.01	0.13	1-3	0.13
3. Less than half destruction	79.7 ± 4.16	399	74.9	10.3	75.2	10.3	0.69	1.02	0.16	2-3	0.98
Total	79.8 ± 4.13	483	75.0	10.3	75.4	10.2	0.36	1.02	0.16		
Total		2004	76.2	10.4	76.2	10.3	0.98	1.01	0.13		

\*p<0.05 \*\*p<0.01 SD: Standard deviation Note 1) Corresponding t-test for the health screenings in FY 2006 and 2007  
 Note 2) One-way analysis of variance and multiple comparison by the ratio of FY 2007 to FY 2006  
 Note 3) "Total destruction" includes "near total destruction."

Table 6. BMI by age and level of damage at the time of health screenings before and after the earthquake (Male)

High blood pressure group		FY 2006		FY 2007		FY 2007 / 2006		Comparison of two groups		
Level of damage		n	M	SD	M	SD	p <sup>1)</sup>	M	SD	p <sup>2)</sup>
Less than 65 years of age										
1. Total destruction <sup>3)</sup>	58.7 ± 4.36	10	26.0	3.54	24.9	3.83	0.011*	0.96	0.04	1-2 0.00005**
2. Half destruction	56.5 ± 5.07	8	25.0	2.98	25.8	4.45	0.23	1.03	0.06	1-3 0.00065**
3. Less than half destruction	58.2 ± 4.85	130	24.8	3.28	24.7	3.30	0.28	1.00	0.04	2-3 0.02
Total	58.2 ± 4.85	148	24.9	3.27	24.8	3.38	0.21	1.00	0.04	
Between 65 and 74 years of age										
1. Total destruction	70.0 ± 3.23	14	24.0	2.93	23.8	2.91	0.26	0.99	0.02	1-2 0.76
2. Half destruction	70.4 ± 2.43	25	24.5	3.79	24.2	3.98	0.04*	0.99	0.03	1-3 0.98
3. Less than half destruction	70.2 ± 2.72	334	24.2	2.85	24.2	2.84	0.32	0.99	0.09	2-3 0.64
Total	70.2 ± 2.73	373	24.2	2.92	24.2	2.92	0.10	0.99	0.08	
75 years of age or older										
1. Total destruction	79.9 ± 3.53	29	24.2	3.36	23.7	3.42	0.027*	0.98	0.04	1-2 0.53
2. Half destruction	80.2 ± 4.67	45	23.6	3.40	23.4	3.39	0.20	0.99	0.04	1-3 0.46
3. Less than half destruction	80.4 ± 4.55	372	23.4	3.08	23.2	3.11	0.004**	0.99	0.07	2-3 0.96
Total	80.3 ± 4.51	446	23.4	3.13	23.3	3.16	0.0003**	0.99	0.06	
Total		967	24.0	3.12	23.8	3.15	0.00006**	0.99	0.07	
Non-High blood pressure group										
Less than 65 years of age										
1. Total destruction <sup>3)</sup>	55.8 ± 7.25	15	24.9	4.62	24.2	4.74	0.001**	0.97	0.03	1-2 0.09
2. Half destruction	56.7 ± 6.68	15	24.1	2.52	23.9	2.47	0.63	0.99	0.05	1-3 0.001**
3. Less than half destruction	56.4 ± 6.22	234	23.5	2.80	23.6	2.94	0.14	1.00	0.04	2-3 0.36
Total	56.4 ± 6.31	264	23.6	2.92	23.6	3.03	0.65	1.00	0.04	
Between 65 and 74 years of age										
1. Total destruction	69.4 ± 2.39	15	23.8	2.69	23.3	2.80	0.06	0.98	0.04	1-2 0.04
2. Half destruction	69.9 ± 2.42	26	22.9	2.70	23.0	2.61	0.78	1.00	0.05	1-3 0.08
3. Less than half destruction	69.9 ± 2.84	294	23.3	2.91	23.2	2.91	0.11	1.00	0.04	2-3 0.37
Total	69.8 ± 2.79	335	23.3	2.88	23.2	2.88	0.07	1.00	0.04	
75 years of age or older										
1. Total destruction	79.3 ± 3.52	23	22.5	3.41	22.4	3.80	0.75	1.00	0.05	1-2 0.82
2. Half destruction	80.8 ± 4.11	30	22.7	3.13	22.7	2.99	0.98	1.00	0.05	1-3 0.53
3. Less than half destruction	80.3 ± 4.20	330	21.9	3.01	21.7	2.91	0.00009**	0.98	0.10	2-3 0.30
Total	80.3 ± 4.16	383	22.0	3.05	21.8	2.98	0.0002**	0.99	0.10	
Total		982	22.9	3.03	22.8	3.06	0.001**	0.99	0.07	

\*p<0.05 \*\*p<0.01 SD: Standard deviation Note 1) Corresponding t-test for the health screenings in FY 2006 and 2007  
 Note 2) One-way analysis of variance and multiple comparison by the ratio of FY 2007 to FY 2006  
 Note 3) "Total destruction" includes "near total destruction."

Table 7. BMI by age and level of damage at the time of health screenings before and after the earthquake (Female)

High blood pressure group		FY 2006		FY 2007		FY 2007 / 2006		Comparison of two groups		
Level of damage		n	M	SD	M	SD	p <sup>1)</sup>	M	SD	p <sup>2)</sup>
Less than 65 years of age										
1. Total destruction <sup>3)</sup>	58.2 ± 5.15	13	25.2	3.73	25.1	4.19	0.62	0.99	0.03	1-2 0.97
2. Half destruction	59.1 ± 4.50	11	26.3	3.21	26.1	3.43	0.50	0.99	0.03	1-3 0.32
3. Less than half destruction	58.6 ± 5.00	216	25.0	3.65	25.0	3.67	0.38	1.00	0.03	2-3 0.33
Total	58.6 ± 4.98	240	25.0	3.63	25.1	3.68	0.60	1.00	0.03	
Between 65 and 74 years of age										
1. Total destruction	71.1 ± 3.05	36	25.5	2.92	25.1	3.07	0.03*	0.98	0.05	1-2 0.93
2. Half destruction	70.5 ± 2.82	45	24.8	2.98	24.3	2.40	0.06	0.99	0.06	1-3 0.29
3. Less than half destruction	70.3 ± 2.80	549	24.5	3.36	24.4	3.41	0.71	1.00	0.08	2-3 0.30
Total	70.3 ± 2.83	630	24.5	3.31	24.5	3.33	0.10	1.00	0.07	
75 years of age or older										
1. Total destruction	80.2 ± 4.26	69	23.4	3.14	23.2	3.28	0.10	0.99	0.05	1-2 0.82
2. Half destruction	80.3 ± 4.83	72	23.8	3.71	23.8	3.71	0.98	0.99	0.13	1-3 0.85
3. Less than half destruction	80.3 ± 4.27	720	23.6	3.44	23.5	3.42	0.035*	0.99	0.11	2-3 0.91
Total	80.3 ± 4.32	861	23.6	3.44	23.5	3.43	0.017**	0.99	0.10	
Total		1740	24.1	3.47	24.1	3.48	0.007**	0.99	0.09	
Non-High blood pressure group										
Less than 65 years of age										
1. Total destruction <sup>3)</sup>	55.5 ± 8.00	48	22.8	3.35	22.7	3.44	0.30	0.99	0.04	1-2 0.49
2. Half destruction	55.1 ± 9.09	45	23.4	3.93	23.4	3.52	0.63	1.00	0.05	1-3 0.33
3. Less than half destruction	53.4 ± 9.44	667	22.5	3.26	22.5	3.28	0.67	1.00	0.04	2-3 0.99
Total	53.6 ± 9.36	760	22.6	3.32	22.5	3.31	0.42	1.00	0.04	
Between 65 and 74 years of age										
1. Total destruction	70.2 ± 2.76	37	23.0	3.44	22.5	3.67	0.03*	0.98	0.05	1-2 0.23
2. Half destruction	70.2 ± 2.85	80	23.5	3.26	23.2	3.34	0.02*	0.99	0.04	1-3 0.005*
3. Less than half destruction	69.6 ± 2.93	644	23.3	3.11	23.3	3.09	0.50	1.00	0.04	2-3 0.04
Total	69.7 ± 2.92	761	23.3	3.15	23.2	3.14	0.05	1.00	0.04	
75 years of age or older										
1. Total destruction	80.9 ± 4.24	28	22.3	3.96	22.2	3.65	0.58	1.00	0.05	1-2 0.82
2. Half destruction	79.7 ± 3.78	56	22.9	3.36	22.7	3.27	0.22	0.99	0.05	1-3 0.45
3. Less than half destruction	79.7 ± 4.16	394	22.6	3.14	22.5	3.19	0.016*	0.98	0.12	2-3 0.50
Total	79.8 ± 4.13	478	22.6	3.22	22.5	3.23	0.006**	0.99	0.11	
Total		2004	22.9	3.25	22.8	3.24	0.001**	1.00	0.07	

\*p<0.05 \*\*p<0.01 SD: Standard deviation Note 1) Corresponding t-test for the health screenings in FY 2006 and 2007  
 Note 2) One-way analysis of variance and multiple comparison by the ratio of FY 2007 to FY 2006  
 Note 3) "Total destruction" includes "near total destruction."

Table 8. Factors influencing blood pressure and BMI

Systolic BP					
Factor		Coefficient	p	Odds ratio	95% confidence interval
Male (n=1949)					
Age		0.0004	0.928	1.000	0.991 – 1.010
Level of damage experienced					
Total destruction <sup>1)</sup> / Less than half destruction		-0.349	0.0503	0.705	0.496 – 1.001
Half destruction / Less than half destruction		0.200	0.246	1.222	0.871 – 1.713
Female (n=3744)					
Age		0.002	0.466	1.002	0.996 – 1.008
Level of damage experienced					
Total destruction <sup>1)</sup> / Less than half destruction		0.136	0.247	1.146	0.910 – 1.442
Half destruction / Less than half destruction		0.043	0.715	1.045	0.826 – 1.321
Diastolic BP					
Factor		Coefficient	p	Odds ratio	95% confidence interval
Male (n=1949)					
Age		0.096	0.143	1.007	0.998 – 1.016
Level of damage experienced					
Total destruction <sup>1)</sup> / Less than half destruction		-0.161	0.359	0.852	0.604 – 1.200
Half destruction / Less than half destruction		0.021	0.905	1.021	0.728 – 1.431
Female (n=3744)					
Age		0.009	0.003**	1.009	1.003 – 1.015
Level of damage experienced					
Total destruction <sup>1)</sup> / Less than half destruction		0.250	0.037*	1.283	1.015 – 1.623
Half destruction / Less than half destruction		0.072	0.356	1.074	0.849 – 1.360
BMI					
Factor		Coefficient	p	Odds ratio	95% confidence interval
Male (n=1949)					
Age		-0.011	0.017*	0.989	0.980 – 0.998
Level of damage experienced					
Total destruction <sup>1)</sup> / Less than half destruction		-0.586	0.0017**	0.557	0.386 – 0.803
Half destruction / Less than half destruction		0.003	0.988	1.003	0.717 – 1.403
Female (n=3744)					
Age		-0.009	0.001**	0.991	0.985 – 0.996
Level of damage experienced					
Total destruction <sup>1)</sup> / Less than half destruction		-0.167	0.149	0.846	0.673 – 1.062
Half destruction / Less than half destruction		-0.123	0.301	0.884	0.700 – 1.117

\* p < 0.05, \*\*p < 0.01

Note 1: “Total destruction” includes “near total destruction.”

subjects in the female high-blood pressure group aged less than 65 years who had experienced total destruction showed significantly lower systolic BP than female subjects who had experienced less than half destruction. In the male non-high-blood pressure group aged 75 years or older, those who experienced total destruction showed significantly lower systolic BP than those who had experienced half destruction and less than half destruction. The female non-high-blood pressure group did not show any significant differences according to level of damage.

## 2. Results of diastolic BP (Table 4 and 5)

With regard to diastolic BP, there were no

significant differences between male and female subjects in the high-blood pressure group and those in the non-high-blood pressure group before and after the earthquake.

## 3. Results of BMI (Table 6 and 7)

With regard to BMI, in the high-blood pressure group of male subjects less than 65 years of age who had experienced total destruction, those between 65 and 74 years of age who had experienced half destruction, those aged 75 years or older who had experienced total destruction or less than half destruction showed a significant decrease in BMI after the earthquake. In the high-blood pressure group of female subjects between

65 and 74 years of age who had experienced total destruction, and those aged 75 years or more who had experienced less than half destruction showed a significant decrease in BMI.

In the non-blood pressure group, male subjects less than 65 years of age and those between 65 and 74 years of age who had experienced total destruction, and those aged 75 years or older who had experienced less than half destruction showed a significant decrease in BMI. Female subjects between 65 and 74 years of age who experienced total destruction or half destruction, and those aged 75 or older who experienced less than half destruction showed a significant decrease in BMI.

In comparisons before and after the earthquake, the high-blood pressure group of male subjects aged less than 65 years of age who had experienced total destruction showed significantly lower BMI values than those who had experienced half destruction or less than half destruction. In addition, in the non-high-blood pressure group of male subjects, those aged less than 65 years of age who had experienced total destruction showed significantly lower BMI values than those who experienced less than half destruction. In the non-high-blood pressure group of female subjects, those between 65 and 74 years of age who had experienced total destruction showed significantly lower BMI values than those who had experienced less than half destruction.

#### **4. Factors influencing blood pressure and BMI (Table 8)**

With regard to systolic BP, there were no factors indicating significant correlation among either the male or female subjects. With regard to diastolic BP, female subjects showed significant differences for age and total destruction against a level of damage of less than half destruction. With regard to BMI, increase in age in both male and female subjects correlated with a significant decrease in values. In addition, male subjects who had experienced total destruction showed a significant decrease in BMI values compared to those who had experienced less than half destruction.

## **Discussion**

Disasters precipitate physiological stress responses in human victims<sup>10</sup>. The destruction of housing and loss of family members experienced by victims of natural disasters such as earthquakes can be considered stress factors associated with the changes in environment, and physical deterioration caused by the stress response is believed to have an impact on recovery from natural disasters.

Wajima City, where we carried out the survey for this study, is an aging city. In senescence, physiological functions deteriorate<sup>7</sup>; therefore it is especially important to provide physical support during this period.

According to the results of data analysis, in systolic BP after the earthquake, the non-high-blood pressure group of male subjects aged 75 years or older who had experienced total destruction showed a significant decrease, and the non-high-blood pressure group of female subjects who had experienced total destruction or less than half destruction showed a significant increase. In the comparison of level of damage, male subjects aged 75 years or more who had experienced a larger level of damage showed a greater decrease in systolic BP, and female subjects aged less than 65 years who had experienced a larger level of damage showed a greater decrease in systolic BP. In addition, according to the results of multiple logistic models, the older the female subjects were, the more the diastolic BP increased, and the larger the level of damage experienced, the more the diastolic BP increased. There was no certain tendency for blood pressure increase and decrease by age and level of damage. Although an impact was revealed on subjects aged less than 65 years, it is thought that the larger the level of damage experienced was, the more the subjects tended to be influenced, and the older the subjects were, the more blood pressure tends to be influenced by the disaster. In addition, subjects in the high-blood pressure groups were undergoing treatment by oral administration; therefore, it is thought that the reported values may not accurately reflect the actual status. In the areas where 20% or more of



the housing suffered total or half destruction as a result of the Hanshin-Awaji Earthquake, diastolic BP showed a significant decrease for two months after the earthquake<sup>2)</sup>. Furthermore, it was reported that high-blood pressure groups showed a significant increase in systolic BP and diastolic BP, which recovered to baseline within four weeks of the earthquake<sup>6)</sup>. It was also reported that increases in blood pressure at the time of the earthquake returned to the normal state within a month of the earthquake<sup>11)</sup>. In this study, with regard to BP, there were few significant differences in the majority of the groups. However, some significant increases and decreases in blood pressure were observed six months after the earthquake. The stress-induced change of blood pressure is related to the autonomic nervous system. The autonomic nervous system comprises sympathetic and parasympathetic nerves. The sympathetic nerves function in extreme situations involving fear and exercise, while parasympathetic nerves work to maintain action and build energy<sup>12)</sup>. This may be the result of differences in impact on physical health-status arising from differences in the basic attributes of the subjects. In addition, we also think that the impact of the earthquake continues on non-high-blood pressure subjects who are aged 75 years or older. The greater the level of damage experienced, the more influence on changes in blood pressure. This in turn is thought to be influenced by reconstruction activities after the earthquake. These results show that it is necessary for healthcare professionals to provide long-term support for elderly victims because they usually require time for physical recovery. In addition, it is important to adopt the standpoint of preventing secondary problems in elderly non-high-blood pressure victims as well as victims who fall into the high-risk high-blood pressure group.

It is reported that BMI showed a tendency for decrease after the earthquake<sup>2)</sup> and that subjects were aware of their reduction in weight<sup>13)</sup>. The results of this study showed that the older both male and female subjects were, the more their BMI values decreased. Even at the six-month point after the earthquake, there was a significant

difference in the decrease of BMI values. In addition, male subjects showed a significant difference according to the level of damage experienced, and the greater the level of damage experienced, the greater the decrease in BMI. It was reported in General Health Questionnaire (GHQ) administered after the earthquake that fear and sleeplessness, the impact of disaster, continued for an extended period<sup>13,14)</sup>. The factors influencing this are considered to be a relative increase in exercise due to disaster recovery activities, a worsening of nutritional status, stress due to property damage, and a lack of sleep. Due to the significant decrease in BMI in subjects aged 75 years or older, a great deal of time is required for physical recovery in the elderly, an amount of time similar to the time required for blood pressure to return to normal; and also necessitating long-term medical care.

A limitation of this study was that it was not able to refer to the physical condition of the subjects in the acute stage due to the fact that the data obtained for this study was not collected immediately after the earthquake, and the impact on physical health-status is evaluated based on blood pressure and BMI alone. Furthermore, there is a possibility that the data for subjects who exhibited symptoms immediately after the earthquake were excluded from the data in the health screenings. It is also inappropriate to refer to the impact on psychological well-being based on these study results. On the other hand, this study was carried out on a large number of residents in an under-populated area with a high concentration of elderly people in order to clarify the relatively long-term impact of earthquake on physical health-status. Therefore, the results of this study can contribute to the discussion on providing specific measures for health management and guidance to disaster victims, and these data can serve as the basic material for supportive measures in areas with similar experiences in the future and may prove useful in the planning of disaster measures. Henceforth, we have the necessity to examination impact on the physical health-status with analysis of another physical data.

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## 能登半島地震被災住民における身体的健康影響 — 血圧およびBMIに焦点をあてて —

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### 要 旨

**目的：**本研究は、能登半島地震に被災した輪島市住民の基本健康診査の血圧およびBMIの成績を用いて身体的健康影響を明らかにすることである。

**方法：**対象者は、能登半島地震に被災した輪島市住民で、平成18年度、平成19年度の基本健康診査を継続して受診した5,693名である。対象者を、男女別、年齢別、罹災の程度別—全壊・大規模半壊（以下、全壊と略す）、半壊、それ以下の被害、高血圧疾患の内服治療中であるかないかに分類した。基本健康診査の項目のうち血圧、BMIを用いて健康影響を評価した。

**結果：**収縮期血圧では、非高血圧群の女性75歳以上の全壊とそれ以下の被害で有意な上昇、男性75歳以上の全壊で有意な低下があった。BMIでは、高血圧群の男性65歳未満の全壊、65–74歳の半壊、75歳以上の全壊、それ以下の被害、女性では、65–74歳の全壊、75歳以上のそれ以下の被害において、震災前後でのBMIに有意な減少があった。非高血圧群の男性65歳未満と65–74歳の全壊、75歳以上のそれ以下の被害、女性65–74歳の全壊、半壊、75歳以上のそれ以下の被害で有意な減少があった。多重ロジスティックを用いて検討した結果では、収縮期血圧に影響する要因はなかったが、拡張期血圧では、女性で年齢と罹災程度のそれ以下に対する全壊で有意な上昇を示した。BMIへ影響する要因として、男女とも年齢で有意な減少の関連を示した。また、男性では、罹災程度がそれ以下に対して、全壊で有意な減少があった。

**結論：**震災前後で収縮期血圧では、有意な関連はなかったが、拡張期血圧では、女性で年齢とそれ以下に対する全壊で有意に上昇していた。BMIでは、年齢が上昇するとBMIが減少する傾向にあり、特に男性では罹災程度と関連していた。