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Original

Relationship between the suicide standardized mortality ratio
and local community indices before and after
the Great East Japan Earthquake in Iwate prefecture

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Abstract

The purpose of this research is to establish the relationship between the standardized mortality ratio, SMR, and the community index before and after the Great East Japan Earthquake that occurred on March 11, 2011. The 6 years from 2008 to 2013 are divided into two periods before and after the disaster, and the suicide SMR is calculated for the nine medical health areas and the correlation coefficient is calculated between it and the index related to the daily life, economic status, medical care and disaster damage. Furthermore, multiple linear regression

analysis is performed using the suicide SMR as the dependent variable, and the local community index as the explanatory variable. As a result, suicide in Iwate prefecture was found to be related to the low number of physicians before the disaster, the total number of temporary houses, and the small disaster recovery budget. While it is understood that these social factors the risk factors for the suicide, it is also suggested that there is a need to continue support for disaster stricken areas and measures for mental health.

Key words : SMR (standardized mortality ratio), suicide rate, disaster,
Great East Earthquake in Japan, regional accumulation of suicide

I. Introduction

The Great East Japan Earthquake of magnitude 9.0 occurred on March 11, 2011 with the hypocenter off the Sanriku coast in Miyagi prefecture (38.1 degrees north, 142.9 degrees east, depth 24km). Giant tidal waves followed the earthquake and caused

tremendous damage to the Pacific coast of the Tohoku region. In Iwate prefecture (hereinafter referred to as "the Prefecture,") human casualties included 5,127 dead and 1,129 missing, and the damage to housing included 26,165 houses completely or partially destroyed (as of September 1, 2015)¹⁾.

In a large scale disaster, many local residents experience trauma, deprivation and stress due to the post-disaster environment.

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Table 1. Suicide SMR by Iwate Prefecture Health Care Area

Health Care Area	Total			Before earthquake disaster
	Before earthquake disaster	After earthquake disaster	p	
Morioka	125.6 (113.7-137.6)	123.2 (110.73-135.7)	0.827	125.2 (110.9-139.6)
Central Iwate	154.4 (135.5-173.3)	136.2 (117.3-155.1)	0.050	151.9 (129.5-174.2)
Tanko	134.5 (112.0-157.0)	116.3 (94.0-138.7)	0.050	138.4 (111.3-165.5)
Ryoban	151.4 (127.2-175.5)	111.7 (89.5-133.9)	0.050	149.8 (121.3-178.3)
Kesen	117.5 (88.0-147.0)	102.8 (72.4-133.1)	0.275	119.9 (84.0-155.7)
Kamaishi	147.9 (110.8-185.0)	100.9 (66.5-135.3)	0.050	144.6 (100.35-188.9)
Miyako	142.7 (114.5-171.0)	109.0 (82.1-135.88)	0.513	137.6 (104.4-170.8)
Kuji	157.6 (120.9-194.2)	122.2 (87.6-156.7)	0.127	135.1 (94.3-176.0)
Ninohe	181.5 (142.3-220.8)	197.2 (153.1-241.2)	0.827	177.4 (130.9-223.9)

indicates 95% confidence interval

Before earthquake disaster: 2008 - 2010, After earthquake disaster: 2011 - 2013

Analytic method: Mann-Whitney test is used for before and after earthquake disaster comparison.

Therefore, it is widely known that the rate of depression and PTSD increases and mental health deteriorates after a large-scale disaster. When a survey was conducted 6 to 11 months after the Great East Japan Earthquake on the mental health of residents in 3 municipalities of the Prefecture, it was also found that 42.6% of the respondents had moderate to severe mental health problems, and the problems were related to economic difficulty, lack of social network, and so on²⁾.

In regard to the change in the suicide rate after the earthquake disaster, it is reported that when comparing before and after a large earthquake in the U.S., the rate of suicide increased by 69.2% one year after the earthquake disaster³⁾. Also, in the 1999 Taiwan earthquake, when comparing a regional level 2 years before and 2 years after the earthquake disaster, it is reported that the standardized (suicide) mortality ratio increased for males between 45 and 64 years old⁴⁾. On the other hand, in Japan, it is reported that the suicide rate significantly decreased 1 year after the Hanshin Awaji Earthquake disaster⁵⁾, and the

suicide rate of males decreased (that of females increased)⁶⁾ in the Niigata Chuetsu Earthquake of 2004. These reports indicate that the suicide rate does not necessarily increase uniformly in regions damaged by a large-scale disaster, and that when investigating the change in the suicide rate before and after a disaster various social factors need to be considered in addition to the stress and mental health condition of the local residents.

The suicide rate of the Prefecture had been trending at a higher level than the national average before the earthquake disaster and was 26.6 per 100,000 in 2014, ranking the Prefecture highest in the country (National average: 20.0⁷⁾). There are areas in the Prefecture where the comprehensive anti-suicide programs such as awareness-raising activities, local network of suicide prevention and medical institutions and gatekeeper training programs, and so on, led to a decrease in suicide rate⁸⁾, but the suicide rate for the whole Prefecture is still high.

In previous studies that targeted the time period before the earthquake disaster,

Males		Females		
After earthquake disaster	p	Before earthquake disaster	After earthquake disaster	p
130.5 (114.9-146.1)	0.827	131.4 (108.7-154.0)	111.4 (90.2-132.6)	0.827
138.9 (115.8-162.0)	0.050	160.7 (125.1-196.4)	130.4 (97.4-163.4)	0.127
116.8 (89.8-143.8)	0.050	123.6 (83.8-163.4)	113.9 (74.4-153.3)	0.275
120.2 (92.5-148.0)	0.127	152.8 (108.1-197.4)	91.2 (55.4-126.9)	0.275
86.0 (52.3-119.7)	0.050	114.8 (61.8-167.8)	138.7 (76.3-201.1)	0.827
113.1 (68.8-157.5)	0.050	159.5 (89.6-229.4)	76.0 (23.3-128.7)	0.050
124.2 (89.4-158.9)	0.827	156.0 (102.0-210.1)	76.1 (36.2-115.9)	0.513
163.5 (114.6-212.3)	0.827	215.2 (136.9-293.6)	39.6 (4.9-74.4)	0.050
196.4 (143.0-249.7)	0.827	192.2 (118.3-266.1)	199.5 (121.3-277.7)	0.827

it was reported that suicide is related to various factors such as medical resources, the economic condition of the area, the population distribution of the area, and so on (Takaya et al. ⁹⁾, Nohara¹⁰⁾). However, the relationship between social factors and the suicide rate before and after the Great East Japan Earthquake is not yet fully understood.

The purpose of this study is to clarify the factors related to the suicide SMR before and after the earthquake disaster by calculating the standardized mortality ratio (SMR) by health care areas of the Prefecture and by statistically investigating the relationship between the regional social indices that include the earthquake related factors and the suicide SMR by each health care area.

II. Materials and methods

The investigation covered 6 years from 2008 to 2013, before and after the earthquake, and the suicide SMR was calculated for the nine health care areas (Fig. 1: Morioka, central Iwate, Tanko, Ryoban, Kesen, Kamaishi, Miyako, Kuji, Ninohe) by extracting the



Fig. 1. Iwate Prefecture Health Care Areas

following data: 1) the age group populations by health care area of the Prefecture and the number of suicide deaths (Iwate Prefecture Health and Welfare Annual Report); 2) the number of suicide deaths by the age group populations (Ministry of Health, Labour and Welfare demographic statistics); 3) the age group populations of Japan (Statistics Bureau, Ministry of Internal Affairs and Communications). The investigation period

Table 2. Social Indices

1) Indices related to lives
Overall population
Population of 15 years old and older
Aging population
Population density
Number of births
Number of deaths
Number of stillbirths
Marriages
Divorces
2) Economic indices
Municipal tax, settled amount
Municipal tax, received amount
General tax stipulated in local tax law
Municipal inhabitant tax
Property tax
Light vehicle tax
Municipal cigarette tax
Mine products tax
Special land-holding tax
Special-purpose tax
National health insurance tax
Municipal account Total revenue
Municipal account Total expenditure
Assembly expense
General affairs expense
Welfare expense
Sanitation expense
Labor expense
Agriculture, forestry and fishery expense
Commerce and industry expense
Civil engineering expense
Firefighting expense
Education expense
Public loan expense
Disaster recovery expense
Economic strength index
Social insurance benefit amount
Number of social insurance medical treatments
Distributive income
3) Indices related to the earthquake disaster
Accumulated number of deaths from the Great East Japan Earthquake
Accumulated number of missing persons from the Great East Japan Earthquake
Accumulated number of injured persons from the Great East Japan Earthquake
Accumulated number of completely destroyed houses from the Great East Japan Earthquake
Accumulated number of partially destroyed houses from the Great East Japan Earthquake
Accumulated number of partially damaged houses from the Great East Japan Earthquake
Accumulated number of house inundated above the floor level due to the Great East Japan Earthquake
Accumulated number of housed inundated below the floor level due to the Great East Japan Earthquake
Total number of temporary houses
4) Indices related to medical care
Number of hospitals
Number of psychiatric hospital beds
Number of physicians
Total number of hospital beds
Number of general hospital beds

was divided into two periods, 3 years before the earthquake (2008 to 2010) and 3 years after the earthquake (2011 to 2013), and the SMR and the 95% confidence interval were calculated (overall and by males and females) for each of the nine health care areas for both periods (Table 1).

Next, in the investigated periods, the following were examined from the Iwate prefecture statistics yearbook as the regional social indices (Table 2).

Furthermore, in order to clarify the relationship between the suicide SMR for before the disaster period (2008 to 2010) and after the disaster period (2011 to 2013), and the regional social indices 1) through 4), Pearson correlation coefficients were calculated for the suicide SMR and regional social indices (overall and grouped by males and females). In addition, in order to clarify the related factors for the suicide SMR, the regional social indices 1) ~ 4) were set as explanatory variables, the suicide SMR as the dependent variable, and multiple linear regression analysis (stepwise method) was performed separately for before the disaster (2008 to 2010) and after the disaster (2011 to 2013).

IBM SPSS Statistics for Windows J ver.22 was used for all the analyses and the significance level for the statistical analysis was set to less than 5%. Because the statistical data obtained in the course of calculating the suicide SMR in this study are limited to region (health care area), age and gender, and do not include information that can be used to identify an individual, we believe there is no ethical concern.

III. Results

1. Relationship between the suicide SMR and the regional social indices (Table 3)

There was a negative correlation only between the suicide SMR and the number of physicians, both overall and for males and females, before the earthquake disaster.

On the other hand, after the earthquake and Tsunami disaster, there was a significant negative correlation overall with the combined municipality's revenue total amount; combined municipality's expenditure total amount and welfare expense; agriculture, forestry and fishery expense; disaster recovery expense; accumulated number of deaths, accumulated number of completely destroyed houses, accumulated number of partially destroyed houses, and total number of temporary houses. For males, it was confirmed that there was a significant and relatively strong negative correlation with the combined municipality's revenue total amount; combined municipality's expenditure total amount and welfare expense; civil engineering expense; agriculture, forestry and fishery expense; disaster recovery expense; accumulated number of deaths; municipal mine products tax; accumulated number of missing persons; accumulated number of completely destroyed houses; accumulated number of partially destroyed houses; and total number of temporary houses. There was no item with which a correlation was confirmed for females.

2. Multiple linear regression analysis results for suicide SMR and regional social indices (Table 4)

As a result of the multiple linear regression analysis (stepwise method), the suicide SMR and the number of physicians were found to

Table 3. Iwate Prefecture Suicide SMR for Each Period and Social Indices by Regions

	Total	
	Before earthquake disaster	
	Correlation Coefficient	p value
Overall population	-0.167	0.405
Population of 15 years old and older	-0.168	0.401
Aging population	-0.165	0.410
Population density (Unit: person, household)	-0.206	0.302
Number of births (Unit: person, case)	-0.098	0.626
Number of deaths (Unit: person, case)	-0.107	0.596
Number of stillbirths (Unit: person, case)	-0.181	0.366
Marriages (Unit: person, case)	-0.092	0.650
Divorces (Unit: person, case)	-0.171	0.394
Municipal tax, settled amount (unit: 1000 yen)	-0.155	0.441
Municipal tax, received amount (unit: 1000 yen)	-0.153	0.447
General tax (unit: 1000 yen)	-0.148	0.462
General tax stipulated in local tax law (unit: 1000 yen)	-0.148	0.462
Municipal inhabitant tax (unit: 1000 yen)	-0.160	0.424
Property tax (unit: 1000 yen)	-0.135	0.501
Light vehicle tax (unit: 1000 yen)	-0.117	0.563
Municipal cigarette tax (unit: 1000 yen)	-0.153	0.446
Mine products tax (unit: 1000 yen)	0.043	0.830
Special land-holding tax (unit: 1000 yen)	0.183	0.361
Special-purpose tax (unit: 1000 yen)	-0.241	0.226
National health insurance tax (unit: 1000 yen)	-0.161	0.422
Municipal account Total revenue (unit: 1000 yen)	-0.163	0.417
Municipal account Total expenditure (unit: 1000 yen)	-0.159	0.428
Assembly expense (unit: 1000 yen)	-0.169	0.398
General affairs expense (unit: 1000 yen)	-0.147	0.465
Welfare expense (unit: 1000 yen)	-0.206	0.302
Sanitation expense (unit: 1000 yen)	-0.165	0.412
Labor expense (unit: 1000 yen)	-0.267	0.179
Agriculture, forestry and fishery expense (unit: 1000 yen)	-0.047	0.815
Commerce and industry expense (unit: 1000 yen)	0.044	0.829
Civil engineering expense (unit: 1000 yen)	-0.161	0.423
Firefighting expense (unit: 1000 yen)	-0.183	0.361
Education expense (unit: 1000 yen)	-0.157	0.435
Public loan expense (unit: 1000 yen)	-0.129	0.523
Disaster recovery expense (unit: 1000 yen)	0.180	0.370
Economic strength index	-0.182	0.362
Social insurance benefit amount (unit: 1000 yen)	-0.207	0.301
Number of social insurance medical treatments	-0.164	0.415
Distributive income	-0.172	0.390
Accumulated number of deaths from the Great East Japan Earthquake (unit: person)		
Accumulated number of missing persons from the Great East Japan Earthquake (unit: person)		
Accumulated number of injured persons from the Great East Japan Earthquake (unit: person)		
Accumulated number of completely destroyed houses from the Great East Japan Earthquake (unit: house)		
Accumulated number of partially destroyed houses from the Great East Japan Earthquake (unit: house)		
Accumulated number of partially damaged houses from the Great East Japan Earthquake (unit: house)		
Accumulated number of house inundated above the floor level due to the Great East Japan Earthquake (unit: house)		
Accumulated number of housed inundated below the floor level due to the Great East Japan Earthquake (unit: house)		
Total number of temporary houses (unit: house)		
Number of hospitals	-0.215	0.281
Number of psychiatric hospital beds	-0.264	0.183
Number of physicians	-0.438	0.022
Total number of hospital beds	-0.152	0.450
Number of general hospital beds	-0.207	0.301

*p<0.05, **p<0.01

(Pearson Correlation Coefficient)

After earthquake disaster		Males				Females			
		Before earthquake disaster		After earthquake disaster		Before earthquake disaster		After earthquake disaster	
Correlation Coefficient	p value	Correlation Coefficient	p value	Correlation Coefficient	p value	Correlation Coefficient	p value	Correlation Coefficient	p value
-0.005	0.979	-0.126	0.530	-0.042	0.835	-0.213	0.287	0.037	0.853
-0.006	0.978	-0.126	0.531	-0.043	0.831	-0.215	0.283	0.038	0.850
-0.010	0.959	-0.107	0.595	-0.059	0.769	-0.231	0.245	0.049	0.806
0.023	0.908	-0.190	0.344	-0.001	0.997	-0.204	0.308	0.037	0.856
0.001	0.997	-0.027	0.893	-0.029	0.887	-0.142	0.480	0.032	0.874
-0.035	0.861	0.067	0.740	-0.117	0.561	-0.143	0.477	0.069	0.731
0.231	0.246	-0.111	0.581	0.139	0.491	-0.226	0.256	0.306	0.121
-0.010	0.961	-0.023	0.911	-0.041	0.841	-0.132	0.511	0.028	0.892
0.007	0.972	-0.134	0.506	-0.022	0.915	-0.213	0.286	0.032	0.876
0.010	0.961	-0.122	0.544	-0.026	0.897	-0.197	0.326	0.041	0.838
0.008	0.969	-0.122	0.545	-0.029	0.886	-0.195	0.329	0.042	0.835
0.008	0.967	-0.116	0.563	-0.030	0.883	-0.193	0.334	0.043	0.831
0.008	0.967	-0.116	0.563	-0.030	0.883	-0.193	0.334	0.043	0.831
-0.016	0.938	-0.144	0.474	-0.048	0.811	-0.203	0.311	0.028	0.888
0.034	0.866	-0.092	0.648	-0.008	0.969	-0.183	0.361	0.057	0.779
0.029	0.885	-0.051	0.802	-0.020	0.920	-0.184	0.357	0.062	0.758
-0.011	0.956	-0.104	0.604	-0.055	0.784	-0.195	0.329	0.046	0.820
-0.307	0.119	0.092	0.649	-0.423	0.028	-0.051	0.802	-0.037	0.854
-0.094	0.641	0.164	0.413	-0.102	0.612	0.075	0.712	-0.058	0.774
-0.003	0.987	-0.228	0.253	-0.015	0.942	-0.221	0.268	0.015	0.941
0.013	0.950	-0.156	0.437	-0.012	0.953	-0.197	0.325	0.031	0.879
-0.446	0.020	-0.083	0.679	-0.517	0.006	-0.206	0.302	-0.090	0.654
-0.428	0.026	-0.088	0.664	-0.496	0.009	-0.204	0.308	-0.088	0.664
0.089	0.658	-0.172	0.391	0.047	0.817	-0.156	0.436	0.096	0.633
-0.300	0.129	-0.079	0.695	-0.280	0.158	-0.194	0.333	-0.160	0.425
-0.382	0.049	-0.097	0.629	-0.523	0.005	-0.237	0.235	0.028	0.888
-0.031	0.878	-0.101	0.615	-0.061	0.763	-0.225	0.258	0.018	0.929
-0.237	0.234	0.089	0.658	-0.281	0.155	-0.262	0.187	-0.059	0.771
-0.387	0.046	-0.057	0.779	-0.444	0.020	-0.137	0.494	-0.052	0.798
-0.092	0.648	0.117	0.562	-0.100	0.620	-0.044	0.826	-0.017	0.933
-0.377	0.053	-0.082	0.685	-0.488	0.010	-0.176	0.381	0.001	0.998
-0.084	0.679	-0.151	0.451	-0.073	0.716	-0.231	0.245	-0.053	0.793
0.059	0.769	-0.100	0.620	0.012	0.952	-0.202	0.313	0.070	0.730
0.021	0.917	-0.097	0.632	-0.017	0.934	-0.187	0.351	0.048	0.811
-0.461	0.016	0.031	0.879	-0.443	0.021	0.043	0.833	-0.168	0.403
0.101	0.615	-0.189	0.345	0.072	0.720	-0.169	0.400	0.086	0.671
0.102	0.686	-0.157	0.434	0.005	0.984	-0.240	0.227	0.189	0.452
0.333	0.177	-0.127	0.526	0.312	0.207	-0.206	0.304	0.095	0.706
-0.245	0.526	-0.131	0.515	-0.121	0.756	-0.212	0.288	-0.209	0.590
-0.423	0.028			-0.521	0.005			-0.055	0.786
-0.372	0.056			-0.396	0.041			-0.131	0.515
-0.358	0.145			-0.304	0.220			-0.260	0.297
-0.406	0.036			-0.452	0.018			-0.094	0.640
-0.436	0.029			-0.403	0.046			-0.175	0.403
-0.250	0.228			-0.373	0.066			0.012	0.956
-0.211	0.322			-0.205	0.336			-0.168	0.432
-0.156	0.467			-0.102	0.635			-0.166	0.437
-0.416	0.031			-0.447	0.019			-0.115	0.568
-0.039	0.848	-0.181	0.366	-0.055	0.785	-0.255	0.199	-0.004	0.985
-0.052	0.838	-0.238	0.232	-0.089	0.727	-0.272	0.169	0.078	0.758
-0.244	0.315	-0.441	0.021	-0.145	0.555	-0.387	0.046	-0.020	0.934
-0.010	0.962	-0.121	0.548	-0.041	0.841	-0.187	0.350	0.048	0.817
-0.058	0.819	-0.178	0.375	-0.133	0.598	-0.237	0.233	0.142	0.574

Table 4. Iwate Prefecture Suicide SMR for Each Period and Social Indices by Regions

Independent variable	Total					
	Before earthquake disaster			After earthquake disaster		
	B	Standard deviation	Standardized coefficient	B	Standard deviation	Standardized coefficient
Number of physicians	-0.046	0.019	-0.438 *	—	—	—
Total number of temporary houses (unit: house)	—	—	—	—	—	—
Disaster recovery expense (unit: 1000 yen)	—	—	—	—	—	—

*:p<0.05, **:p<0.01

Note) The coefficients that were not significant in any of the overall, males, females category were deleted.

have a significant correlation ($p<0.05$) overall (-0.438), and for males (-0.441) and females (-0.387), with a negative standardized coefficient (β) before the earthquake disaster. After the earthquake disaster, the suicide SMR and the total number of temporary houses for males (0.879) had a positive standardized coefficient (β) and was found to be a significant correlation factor ($p<0.01$). The disaster recovery expense (-0.461) was found to be a significant correlation factor ($p<0.05$) with a negative standardized coefficient (β).

IV. Discussion

1. The suicide SMR and the regional social indices before the earthquake disaster

There was a negative relationship between both males and females and the number of physicians in the 3 years before the earthquake disaster. The effect of health problems is a major factor in suicides in Japan, and it is possible that the difficulty of receiving treatment for mental health disorders due to the shortage of physicians could be related to the suicide SMR.

Psychiatrists and psychotherapists are not the only people who are involved in mental health measures. From previous reports, it

has become clear that the awareness-raising education for general practitioners is effective for the prevention of suicides¹¹), and it is thought that measures such as medical care for depression provided by family doctors were effective for the prevention of suicide to a certain level.

In the period investigated in this study, the number of physicians in Iwate prefecture before the earthquake disaster in 2008 was 191.9 per 100,000 people (national average 224.5), ranking 37th¹²). Takaya et al. point out the scarcity of medical resource as a related factor for suicide⁹), and the results of this study for the period after the period investigated by Takaya et al. also support the past report regarding suicide in Iwate prefecture.

However, the factors related with the suicide SMR other than the number of physicians noted in the past, the number of hospitals, the number of general hospital beds and the number of psychiatric hospital beds did not show a correlation with the suicide SMR in this study. The scarcity of physicians, not the number of hospital beds, was pointed out as the related index, and although the details are not clear, this is thought to indicate

(Linear Regression Analysis)

Males						Females					
Before earthquake disaster			After earthquake disaster			Before earthquake disaster			After earthquake disaster		
B	Standard deviation	Standardized coefficient	B	Standard deviation	Standardized coefficient	B	Standard deviation	Standardized coefficient	B	Standard deviation	Standardized coefficient
-0.044	0.018	-0.441 *	–	–	–	-0.055	0.026	-0.387 *	–	–	–
–	–	–	0.291	0.032	0.879 **	–	–	–	–	–	–
–	–	–	-1.120E-05	2.357E-06	-0.461 *	–	–	–	–	–	–

that the role of the physician in the local area is significant from a medical resource perspective and its scarcity is a serious risk for suicide.

2. Correlation between the suicide SMR and the regional social indices after the earthquake disaster

1) Index related to the economy

There were significant and relatively strong negative correlations with the municipality's total revenue the municipality's total expenditure, both overall and for males after the earthquake disaster. The municipality's revenue and expenditure totals reflect various economic conditions such as the income situation of residents and government subsidies, funds invested in the local economy, and so on. For instance, the negative correlation between the suicide SMR and civil engineering expense for males, and the negative correlation with disaster recovery expenses both overall and for males were confirmed in this study. It is possible that the content and scale of these regional reconstruction projects and construction businesses are related to the economic problems of the region such as the available jobs and unemployment. Therefore, it is assumed that when the municipality's

revenue and expenditure totals decrease, the local economy stagnates and the economic vulnerability of the region is reflected in unemployment, bankruptcies and reduction of reconstruction projects.

There have been many reports so far that the weakness of the economic base is related to the increase in the suicide rate. In Akita prefecture, which has as high a suicide rate as that of the Prefecture, it has been found that social environmental factors are related to regional difference in the suicide rate and depression, and unemployed workers, business owners who have gone bankrupt, workers who are forced to work long hours, and others are found to be at high risk¹³⁾. Also in Aomori prefecture, which has a high suicide rate, it is pointed out that the suicide SMR is negatively correlated with one-person households, primary industry (fisheries) and migrant work (nearly the workforce) especially with males¹⁴⁾.

Also, welfare expenditure, a part of municipal expenditure, which had a negative correlation, is an index for welfare activity, and welfare activity plays an important role in preventing suicides. After the earthquake disaster, the functions of the town office and the public health center were interrupted

in many regions, and it is true that welfare activity for the public assistance recipients and handicapped people did not go smoothly. Local residents with problems did not have any place to go to get advice and were left alone, and their insecurity increased, leading to psychiatric disorders such as depression¹⁵⁾. Furthermore, it is presumed that welfare support for such psychiatric disorders was not sufficiently available, creating a double problem which is related to suicides.

Additionally, municipal expenditure on agriculture, forestry and fisheries also had a significant negative correlation with the suicide SMR, overall and for males. There was also a negative correlation with the mine products tax. In Iwate prefecture, 77% of the land is forest, and the Sanriku coast is a suitable fishing ground for the fishing industry. Therefore, the Prefecture is abundant in agriculture, forestry and fishery resources, and expenditure on agriculture, forestry and fisheries is directly related to the economic activity index. Agricultural production is valued at 243.3 billion yen (11th nationwide: 2013), forestry production is about 16.8 billion yen (6th: 2011), for fisheries the figure is about 28.9 billion yen (16th: 2012), all of which are relatively high compared to the national averages, and they are the core industries in Iwate prefecture¹⁶⁾. It is presumed that after the earthquake disaster, the agriculture, forestry and fishery businesses in the coastal and interior areas were impacted and economic activity stagnated, leading to an increase in individual risk due to stressful life events such as unemployment and bankruptcy. It has been pointed out previously that suicide is high in areas with a low percentage of

employment in tertiary industries (areas with a high percentage of employment in primary industry). Conversely, in areas where the primary industry is a base such as agriculture and forestry, fishery, livestock and others, suicide is presumed to be high. In order to support people engaged in primary industry and ultimately reduce the suicide rate, it is thought that an injection of public funds such as through agriculture, forestry and fishery expenditure is necessary.

When the economic strength of a municipality decreases, welfare activities are understandably weakened, and industrial rehabilitation is delayed. Lack of welfare support and economic difficulty will manifest themselves in residential areas. It is necessary to pay attention to the weakness of the municipal economy as a risk factor for deterioration of mental health.

2) Index related to earthquake disaster

In this study, after the earthquake disaster there were negative correlations between the suicide SMR and the indices that reflect human casualties such as the accumulated number of deaths (overall, males) and accumulated number of missing persons (males), damage to housing such as completely or partially destroyed houses (overall, males) and total temporary houses (overall, males). In other words, the suicide SMR was low in areas where the damage from the disaster was significant.

Following previous scale disasters, it has been pointed out that the destruction and loss of property are related to mental disorders¹⁷⁾, and the suicide rate increases after such disasters^{18,19)}. For instance, following the Hanshin Awaji Earthquake disaster, it was

reported that the experience of suffering human loss can induce depression more easily than other symptoms²⁰⁾. However, this time it should be pointed out that the reason factors such as the human casualties and damage to housing were related to a low suicide SMR value was that there was active support for residents suffering hardship, such as the families of the earthquake victims. It can be presumed that when the local community gives especially strong support to those at high risk of suicide, suicide can be prevented. Another possibility is that the Prefecture originally had a high suicide rate, and factors other than the disaster are strongly related to suicide.

3. Relationship between the suicide SMR and the regional social indices: results of multiple linear regression analysis

The number of physician was pointed out as a related factor for suicide SMR before the earthquake disaster, regardless of gender. The shortage of physicians was an item confirmed to be correlated to the suicide SMR. Whether it is a direct or an indirect factor is undetermined, but it is confirmed that it is a factor that affects the occurrence of suicide.

On the other hand, after the earthquake disaster, it was found that the total number of temporary houses (positive related factor) and disaster recovery expense (negative related factor) are related factors to the suicide SMR in males. Although the total number of temporary houses showed negative correlation, it could be a positive related factor when confounded with other indices. Therefore, as an index related to suicide after the earthquake disaster, it is thought that direct damage such as housing damage is a

risk (risk factor), and the provision of realistic support for the disaster damage as shown by the disaster recovery expenditure protects against this (prevention factor).

In a large scale disaster, the living condition of resident is changes frequently and the refuse period is extended. Therefore, the stress of disaster greatly affect the mind and body directly and indirectly. In the "Ottawa Charter" created by the World Health Organization in 1986, eight items - peace, residence, education, food, income, stable environment, sustainable resources, social justice and fairness - are selected as the prerequisite to one' s health²¹⁾. However, because an earthquake disaster severely impacts all of these areas, when the disaster victims are forced to live in temporary housing such living conditions becomes an important risk factor in themselves. Careful observation is necessary for early discovery of signs of mental health disorders. Also, recovery from a disaster requires sufficient disaster recovery expenditure, and it is thought that the leads to the securing of the prerequisites for health in the disaster-stricken areas.

Additionally, we would like to investigate the effect of selecting these indices only for males. Generally, because males are less likely to request assistance compared to females²²⁾, and participate less in the community compared to females, the risk of becoming isolated is higher for males than females. Also, males are likely to face various social problems such as unemployment or a slump in the family business due to disaster damage, and responsibility for economic independence. In order to avoid the situation of isolation that males are prone to fall into, it is thought

that creating an environment to assist mutual support among the workplace, families and community residents is necessary.

4. Mental care in the disaster stricken area

There are regional differences in the pace of recovery and reconstruction, in the mental recovery of the disaster victims. Also, following a few months after the disaster, when it is time to move from temporary housing to the public disaster-relief housing, it becomes necessary to leave the community built up at the temporary housing facility, and to build a new community. If one cannot fit into the new community, there is a risk of feeling isolated, which is a risk factor for suicide²³⁾. In addition, it is presumed that being forced to live in the temporary housing for a prolonged period would cause severe mental and physical pain and greatly affect mental health. There has been a report of the seriousness of the secondary stress accompanying the rebuilding of lives during the restoration period after the Great Hanshin Earthquake²⁴⁾.

Therefore, suicide prevention in disaster stricken areas should be carried out by understanding the changes in the region in detail, and confirming the state of recovery and needs, and maintaining awareness of the restoration process. Our university was commissioned by the prefecture and to establish "Iwate Prefecture Mental Care Center" in Morioka city and the four coastal regions (Kuji area, Miyako area, Kamaishi area and Ofunato area). Since February 2012 it has provided the disaster stricken areas with support and suicide prevention programs. The center conducts the following programs: 1) disaster victim support, 2) support of the

people engaged in support, 3) support of regional activity, 4) spreading and promotion of health education, 5) personnel training such as for gate keepers, 6) networking activity to establish links with the region, in parallel with 7) suicide prevention centered around the dissemination of the Kuji model.

Under the current situation in the Prefecture, faced with many issues such as the shortage of physicians and uneven distribution of physicians in regional areas²⁵⁾, we have established an earthquake disaster stress consultation room in seven locations in the coastal disaster areas, and are conducting psychiatrist calls and consultations. Also, we are implementing gate keeper training spearheaded by the Cabinet Office in the center, and suicide prevention measures are being put into practice to compensate for the shortage of physicians.

Since the Great East Japan Earthquake was the most disastrous earthquake on record, in regards to the process of going through the grieving phase, honeymoon phase, disillusionment phase and reconstruction phase following the disaster^{26,27)}, each of the phases are said to have been lengthened²⁸⁾. Except for some urban areas, the residents' environment has many problems related to the severity of the climate, and inconvenience due to limited means of transportation in a prefecture faced with an aging population and depopulation⁹⁾. It is expected that, in this situation, the effect of the disaster will impact the mental health of residents over a long period of time. When the families of the deceased in the Hanshin Awaji Earthquake disaster in 1995 were investigated 15 years later, half of them had a high risk of PTSD symptoms, grief reaction

and depression symptoms²⁹⁾. The effect of a disaster on mental health is presumed to extend over a long period of time, and it is thought that it is necessary to devise a plan for mental health over a long period of time.

Thus, providing realistic support for the disaster stricken area such as through disaster recovery expenditure is thought to improve the overall measures for the disaster stricken area, and contribute to the reduction of social risks. Additionally, it is thought that if it is possible to obtain the cooperation of those people close by and to ensure a system for consultations even in a stressful environment, this will lead to the prevention of suicide.

V. Conclusions

The relationship between the suicide SMR and the regional social indices was investigated for before and after the Great East Japan Earthquake. As a result, it was found that the factors closely related to the suicide SMR were the low number of physicians before the earthquake disaster, the large number of temporary houses, and the low amount of disaster recovery expenditure after the earthquake disaster. Although the effect of stress on mental health is great following a large scale disaster, it is presumed that suicide rates can be suppressed by implementing appropriate measures for disaster recovery. It is thought that the results of the investigation obtained in this study indicate that continued support over long period of time is necessary for the disaster victims, with the understanding that the regional social indices related to health and welfare, economics and health care are risk factors for suicide.

VI. Limitation

This study investigated the relationship between the suicide SMR and social indices from the comparison of data limited to the 3 years before and after the earthquake disaster. It is possible that the risk factors may change due to changes in the recovery situation in disaster stricken areas, and it will be necessary to also investigate in the future by expanding the investigated periods. Also, although we found no factors related to the regional social indices after the earthquake disaster for females, there may be related a social index that was not investigated in this study. An investigation should be conducted for other social indices that were difficult to collect in this study, along with the expansion of the investigation periods.

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岩手県における東日本大震災前後の 自殺標準化死亡比の変化と 社会生活指標との関連

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要旨

2011年3月11日に発生した東日本大震災により日本の岩手県の住民は甚大な被害を受けたが、震災前後での社会的要因と自殺発生との関連は十分に明らかになっていない。本研究では、自殺の標準化死亡比 (standardized mortality ratio : SMR) について、震災前後の変化及び社会指標との関連を明らかにする事を目的とした。方法としては2008年から2013年までの6年間を震災前後で2期に区分し、各期の岩手県内9保健医療圏の自殺 SMR を算出し、生活・経済・医療・

震災被害に関する指標との相関係数を求めた。そして、自殺 SMR を従属変数、地域社会指標を説明変数として震災前後で線形重回帰分析を行った。結果として岩手県の自殺の集積性は震災前は少ない医師数、震災後は多い合計仮設住宅戸数、少ない災害復旧費が関与することが明らかとなった。これらの社会要因を自殺の危険因子として把握しつつ継続的に被災地における支援やメンタルヘルス対策を継続していく必要性が示唆された。