

RIETI–JER Workshop

Economics of Aging in Japan and other Societies

Presentation



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The Well-Being of Elderly Survivors after Natural Disasters: Measuring the Impact of the Great East Japan Earthquake

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Great East Japan Earthquake Survivors

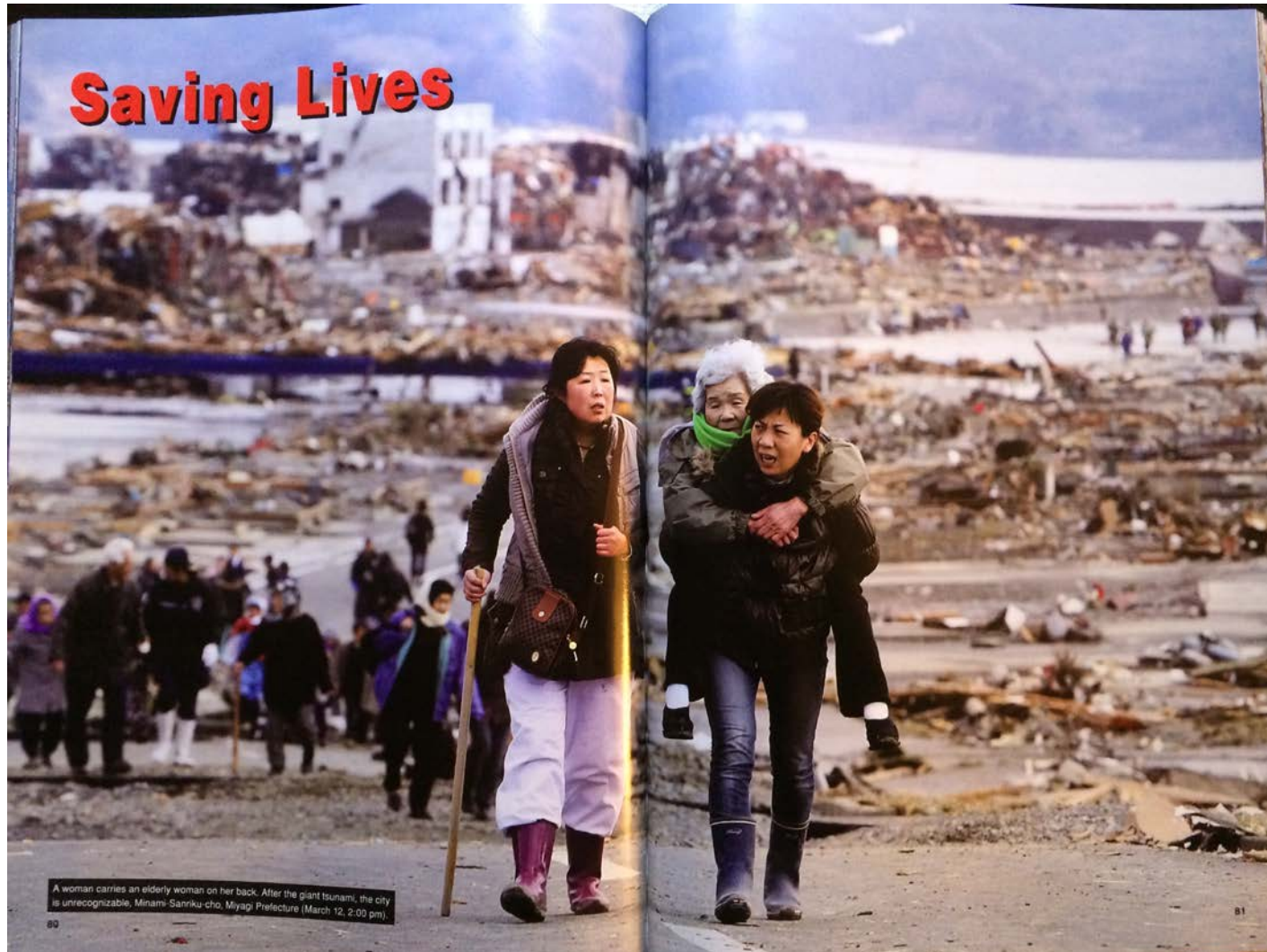


Photo source: “The Great East Japan Earthquake and Tsunami - A photojournalistic account of the first 10 days of the disaster”, Kahoku Shimpo Publishing Co.

Great East Japan Earthquake Survivors

Japan is a land of earthquakes with a rapidly aging society.

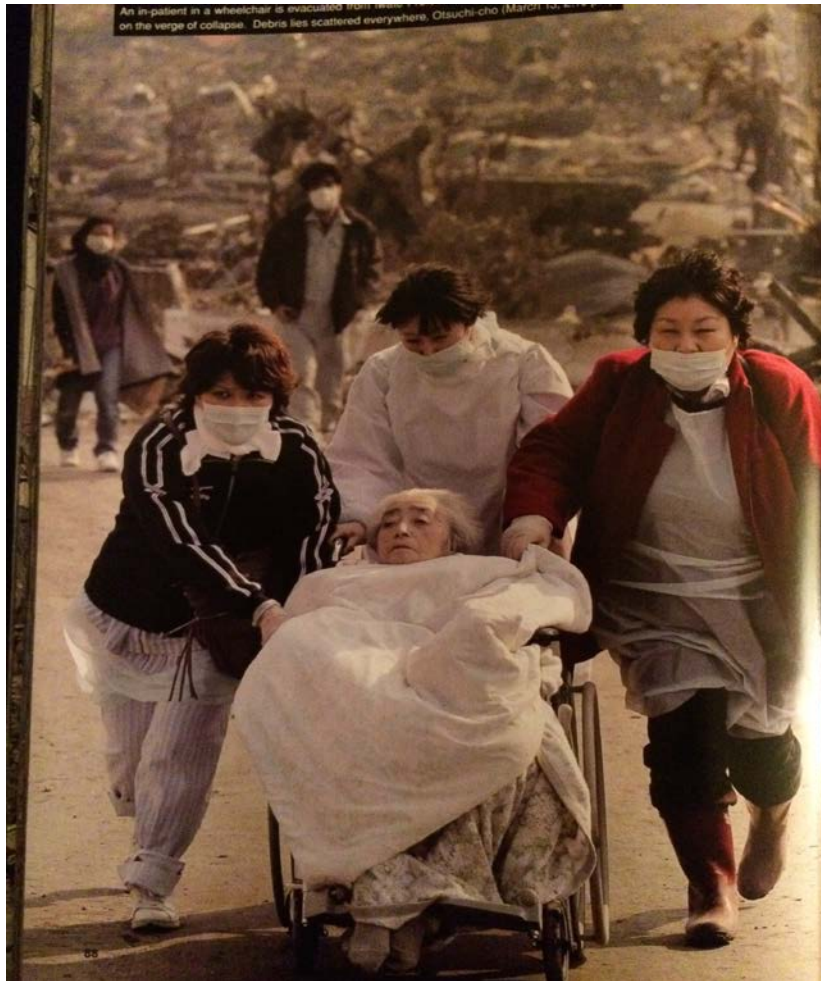
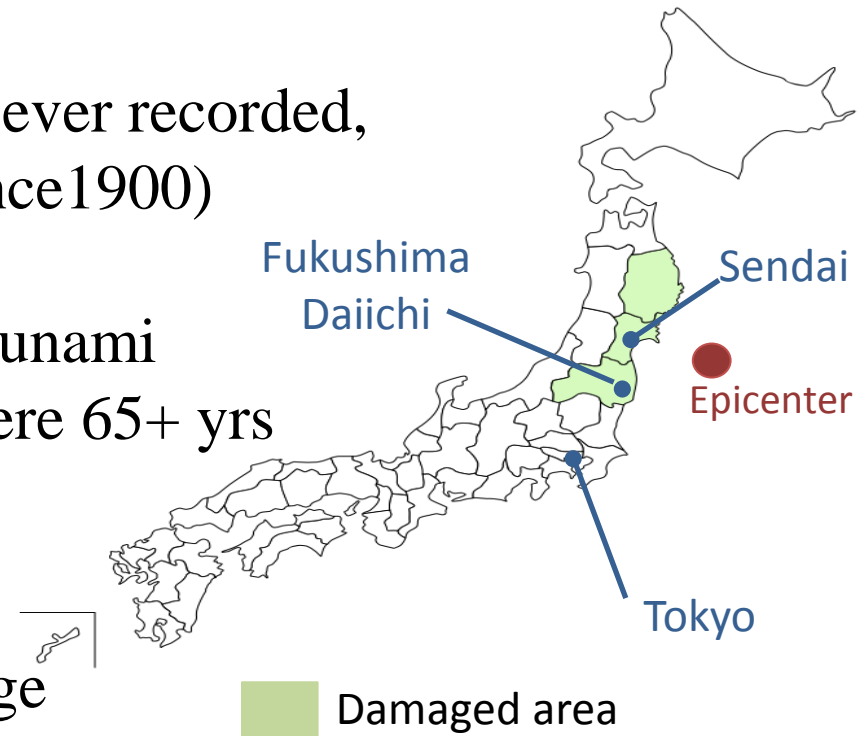


Photo source: "The Great East Japan Earthquake and Tsunami", Kahoku Shimpo Publishing Co.

Great East Japan Earthquake

- Began March 11, 2011 at 2:46 pm local time
- Occurred about 130 kilometers (81 miles) off the Pacific coast of Tohoku, a region in northeastern Japan
- Magnitude 9.0
- Fifth most powerful earthquake ever recorded, most powerful ever in Japan (since 1900)
- 15,889 Deaths
 - Most died by drowning in tsunami
 - More than 55% who died were 65+ yrs
- Material damage estimated at 25 trillion yen (\$300 billion), worst recorded earthquake damage



Tsunami in Sendai City



Motivation: Aging and Natural Disasters

- Elderly are more vulnerable to disasters
- Earthquake is a large and unexpected exogenous shock
- We have to know how elderly survivors' lives and well-being have changed after huge disaster
 - Subjective well-being (SWB)
 - Physical and mental health
 - Labor status
 - Consumption
- Using subjective well-being (SWB) measure, estimate the impact of earthquake on subgroups of people

Existing Research on SWB, Shocks & Aging

SWB and Shocks

- Mental illness among people in Indonesia affected by 2004 Indian Ocean Tsunami. (Frankenberg et al,2008)
- 9/11 terrorist attack in US decreased SWB of people in Britain during following two months. (Metcalfe et al, 2011)
- Happiness adaption
 - People adapt to income change. (Di Tella et al., 2010)
 - Shocks like unemployment or being disabled experience reduced SWB, and do not fully recover to previous higher level.(Easterlin, 2005; Clark & Oswald, 1994; Oswald & Powdthavee, 2008)

SWB and Aging

- U curve relationship between aging and SWB (Wunder et al., 2013)

Existing Research on Natural Disasters

- Elderly disproportionately die due to natural disasters, physical strength playing a role (Duha-Sapir et al., 2006 ; Frankenberg, 2011)
- In developing countries, poor people suffer more from natural disasters due to lack of credit and formal insurance markets (Skoufias, 2003)
- A lack of access to capital inhibits recovery of microenterprise profits from 2004 Tsunami in Sri Lanka. (De mel et al., 2011)
- In Japan, Great Hanshin Earthquake survivors borrow to address large housing damage, and those who were free from a binding borrowing constraint maintained their consumption levels by borrowing. (Sawada & Shimizutani, 2008; 2011)

Existing Research on Great East Japan Earthquake

- SWB increased after the earthquake (Ishino et al., 2011)
 Though sample from damaged areas was small
- Males who experienced larger intensity of the earthquake became more risk tolerant (Hanaoka, et al, 2014).
- No similar research focusing on elderly (though directly damaged areas have large elderly populations)
- No comprehensive finding about survivors' life after the disaster.

JSTAR dataset covers the elderly:

- residing in **more severely** and **not directly** damaged areas
- **before** and **after** the earthquake of Japan focuses

This is the first paper using JSTAR to explore elderly survivors' life and SWB.

Summary of Main Results

Six months after the earthquake -

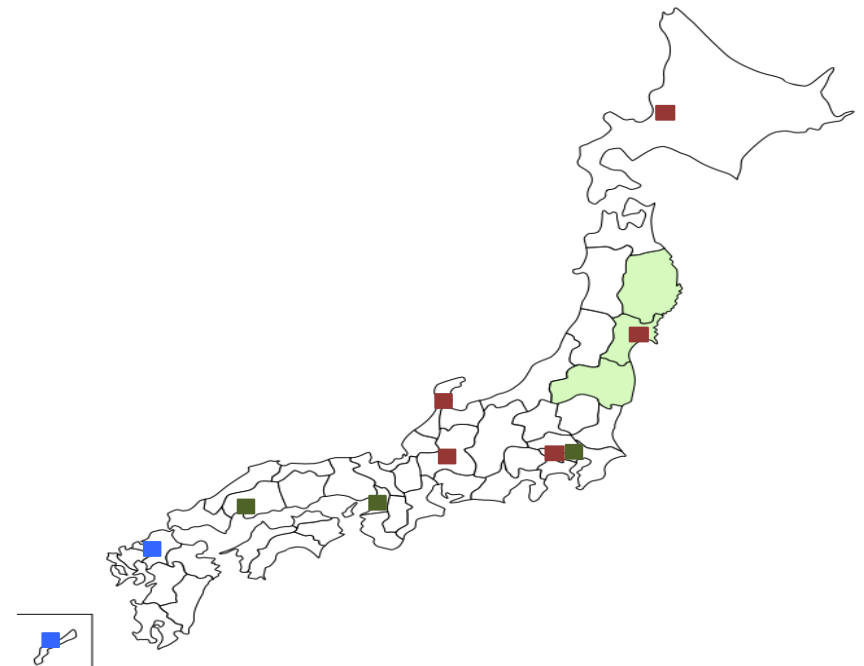
- Female survivors, especially in 60s, still had decreased SWB
- Little impact on health (though sleeping problems reported)
- Monthly total expenditure decreased
- Hours of work and wage changed

Survey Data

JSTAR (Japanese Study of Aging and Retirement)

- 1st wave: 2007 in 5 cities (■)
- 2nd wave: 2009 in 7 cities including new 2 cities (■)
- 3rd wave: 2011 in 10 cities including new 3 cities (■)

		1 st Wave (2007)	2 nd Wave (2009)	3 rd Wave (2011)
1. Sendai	■	908	603	475
2. Kanazawa	■	1011	707	549
3. Takikawa	■	570	455	384
4. Shirakawa	■	806	697	637
5. Adachi	■	869	590	430
6. Naha	■		922	587
7. Tosu	■		645	510
8. Hiroshima	■			1099
9. Chofu	■			566
10. Tondabayashi	■			517
Total		4164	4619	5754



JSTAR Sample Cities



- Earthquake occurred in March 2011, JSTAR 3rd wave survey conducted six months after the earthquake.
- **Sendai city** – closest to epicenter – included in every wave.

Selection Bias? -> No

Dependent variable: Drop dummy = 1 if the respondent answer in wave 2 but do not answer in wave 3

VARIABLES	OLS	OLS	probit	probit
Sendai dummy	-0.00 (0.012)		-0.02 (0.065)	
City = Sendai		0.00 (0.015)		0.00 (0.081)
City = Kanazawa		-0.04** (0.015)		-0.23** (0.092)
City = Takigawa		-0.09*** (0.014)		-0.68*** (0.098)
City = Shirakawa		0.04*** (0.015)		0.20** (0.080)
City = Adachi		0.09*** (0.014)		0.38*** (0.073)
City = Naha		-0.00 (0.014)		-0.03 (0.079)
Married dummy	-0.02 (0.012)	-0.01 (0.012)	-0.10 (0.067)	-0.06 (0.069)
Age	-0.02* (0.012)	-0.02* (0.012)	-0.07 (0.065)	-0.07 (0.066)
Age squared	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.001)
Junior high school	0.01 (0.036)	0.05 (0.036)	0.04 (0.207)	0.30 (0.216)
High school	-0.00 (0.036)	0.02 (0.036)	-0.00 (0.207)	0.14 (0.215)
University	-0.01 (0.037)	-0.00 (0.036)	-0.07 (0.211)	0.01 (0.218)
IADL	0.01** (0.007)	0.01 (0.006)	0.07** (0.034)	0.05 (0.034)
Log household income	0.00 (0.005)	0.01 (0.005)	0.02 (0.029)	0.04 (0.030)
Pension dummy	-0.00 (0.014)	-0.00 (0.014)	-0.02 (0.074)	-0.03 (0.075)
Constant	0.98** (0.409)	0.92** (0.407)	1.65 (2.136)	1.18 (2.207)
Observations	5,977	5,977	5,977	5,977
R-squared	0.011	0.038		

How to Measure SWB?

- Well-being broadly defined (from CDC)
 - Physical well-being
 - Economic well-being
 - Psychological well-being
 - Life satisfaction etc.
- Measured with self-reports
- Proxy of utility
- Subjective and objective measure
- Life satisfaction: “How are you satisfied with your life”
 - 1: Satisfied (= 4 points), 2. Relatively satisfied (= 3 points),
 3. Somewhat unsatisfied (= 2 points), 4. Unsatisfied (= 1 points)
- Impact should be considered in policy-making

Estimation Strategy: Difference-In-Difference

- Unexpected shocks caused by a natural disaster
- JSTAR surveys before (2nd wave) and after (3rd wave) the earthquake
- Treatment group: Sendai City
- Control group: Other six cities
- Use Difference-in-difference approach
 - For this to identify the earthquake effect, we need to assume that direct damage of earthquake was limited to three prefectures.
 - Consistent with the fact that almost all death and buildings destroyed due to the earthquake occurred in that area.

Difference-In-Difference (Cont.)

The main estimating equation is:

$$Y_{int} = \alpha + \beta_1 After_{ijt} + \beta_2 Sendai_{it} + \beta_3 After_{ijt} * Sendai_{it} + \gamma X_{ijt} + u_{ij} + \epsilon_{ijt}$$

- Y : Outcome variables of individual i in city j at time t
(SWB, labor, consumption, health)
- $After = 1$ if year = 2011 (3rd wave), 0 otherwise
- $Sendai = 1$ if respondent lives in Sendai city, 0 otherwise
- X : time-varying individual characteristics
- u : unobservable individual characteristics

β_3 is causal impact of earthquake on outcome variables

Results: Impact on SWB (Total)

VARIABLES	(1) OLS	(2) OLS	(3) Fixed Effects	(4) Random Effects	(5) Ordered logit
After×Sendai	0.010 (0.053)	0.022 (0.056)	-0.026 (0.042)	-0.005 (0.039)	0.046 (0.145)
After	0.080*** (0.020)	0.035* (0.021)	0.123 (0.085)	0.028* (0.016)	0.071 (0.053)
Sendai	-0.005 (0.036)	-0.010 (0.037)		-0.008 (0.039)	0.011 (0.097)
Married		0.147*** (0.026)	-0.001 (0.145)	0.160*** (0.030)	0.377*** (0.066)
Age		0.091*** (0.028)	0.146* (0.077)	0.104*** (0.030)	0.218*** (0.071)
Age square		-0.001*** (0.000)	-0.001*** (0.001)	-0.001*** (0.000)	-0.001** (0.001)
Junior high school		0.057 (0.085)		0.088 (0.116)	0.104 (0.225)
High school		0.038 (0.085)		0.068 (0.116)	0.064 (0.225)
University		0.074 (0.086)		0.122 (0.117)	0.146 (0.228)
IADL		-0.175*** (0.016)	-0.057 (0.041)	-0.159*** (0.023)	-0.416*** (0.043)
Log household income		0.093*** (0.012)	0.004 (0.019)	0.064*** (0.013)	0.225*** (0.032)
Pension dummy		0.097*** (0.031)	0.012 (0.053)	0.072** (0.033)	0.217*** (0.080)
Constant	3.092*** (0.013)	-1.953** (0.916)	-0.699 (3.313)	-2.001** (1.014)	
Observations	7,441	6,266	6,266	6,266	6,266
R-squared	0.003	0.075	0.010		
Number of hhid			3,972	3,972	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Results: Impact on SWB (Gender and Age)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Male				Female			
	Total FE	50s FE	60s FE	70s FE	Total FE	50s FE	60s FE	70s FE
After×Sendai	-0.003 (0.063)	-0.209 (0.146)	-0.026 (0.087)	0.076 (0.087)	-0.049 (0.056)	-0.01 (0.131)	-0.114* (0.067)	0.14 -0.099
After	0.068 (0.124)	-0.054 (0.253)	0.271 (0.171)	-0.046 (0.194)	0.191 (0.117)	0.447* (0.265)	0.047 (0.158)	0.138 -0.185
Constant	-2.046 (4.689)	-6.252 (17.517)	1.857 (9.535)	-0.971 (15.482)	0.819 (4.680)	17.760 (17.160)	-9.926 (9.805)	-5.352 (15.681)
Observations	3,212	776	1,546	1,213	3,054	723	1,436	1,168
R-squared	0.014	0.048	0.011	0.022	0.015	0.056	0.027	0.010
Number of hhid	2,008	501	941	745	1,964	467	894	753

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables include age, age square, married dummy, IADL, log of household income, household pension dummy.

Results: Impact on Health

- Self –Reported Health: 1(Poor) – 5 (Excellent)
- IADL (Difficulty of instrumental activities of daily living): 0 (No) – 5 (Most)
- CESD20 (Depression measure of 20 questions): 0 – 57 (More depressed)

	(1) FE	(2) FE	(3) FE
	Self-Reported Health	IADL	CESD20
	Total	Total	Total
After×Sendai	0.02 (0.058)	-0.00 (0.028)	0.62 (0.433)
After	-0.19* (0.107)	0.09* (0.053)	0.63 (0.836)
Constant	-5.53 (3.969)	3.48* (1.975)	82.53*** (30.877)
Observations	8,071	7,540	6,068
R-squared	0.004	0.004	0.008
Number of hhid	4,576	4,388	3,905

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Results: Impact on Mental Health (CESD)

VARIABLES	(1) Bothered by things	(2) Poor appetite	(3) Could not shake off blues	(4) Felt as good as others	(5) Trouble keeping mind on task	(6) Felt depressed	(7) Everything was an effort	(8) Felt hopeful	(9) Life was failure	(10) Felt fearful
After×Sendai	0.0393 (0.0482)	-0.000644 (0.0298)	-0.00643 (0.0347)	-0.0301 (0.101)	-0.0385 (0.0409)	0.0336 (0.0456)	0.0478 (0.0447)	0.0766 (0.0889)	0.0131 (0.0433)	0.0522 (0.0447)
After	0.0252 (0.0195)	0.0259* (0.0138)	0 (0.0153)	0.0105 (0.0395)	0.00621 (0.0173)	-0.00448 (0.0183)	0.0522*** (0.0181)	0.0702** (0.0315)	0.0227 (0.0170)	0.0125 (0.0151)
Constant	0.339*** (0.00825)	0.138*** (0.00574)	0.174*** (0.00640)	0.979*** (0.0169)	0.271*** (0.00728)	0.343*** (0.00777)	0.372*** (0.00769)	0.877*** (0.0136)	0.301*** (0.00726)	0.199*** (0.00661)
Observations	5,964	6,015	5,969	5,851	5,944	5,957	5,960	5,745	5,932	5,914
R-squared	0.002	0.002	0.000	0.000	0.000	0.000	0.007	0.004	0.001	0.002
Number of hhid	3,870	3,882	3,869	3,827	3,862	3,863	3,869	3,779	3,858	3,848

VARIABLES	(11) Sleep was restless	(12) Was happy	(13) Talked less than usual	(14) Felt lonely	(15) People were unfriendly	(16) Enjoyed life	(17) Crying	(18) Felt sad	(19) Felt people disliked me	(20) Could not get going
After×Sendai	0.176*** (0.0490)	-0.0941 (0.0697)	0.0208 (0.0466)	0.00865 (0.0467)	0.00640 (0.0291)	0.0380 (0.0682)	0.0734* (0.0411)	0.0858** (0.0428)	0.000641 (0.0319)	0.00176 (0.0499)
After	-0.104*** (0.0198)	0.0404 (0.0281)	0.00565 (0.0190)	0.00791 (0.0186)	0.00337 (0.0133)	0.0366 (0.0289)	0.0231 (0.0150)	0.0221 (0.0173)	0.0123 (0.0108)	0.0335* (0.0186)
Constant	0.523*** (0.00837)	1.217*** (0.0120)	0.316*** (0.00803)	0.360*** (0.00788)	0.139*** (0.00553)	1.297*** (0.0122)	0.197*** (0.00647)	0.280*** (0.00734)	0.127*** (0.00471)	0.398*** (0.00798)
Observations	5,966	5,807	5,929	5,929	5,943	5,823	5,942	5,927	5,957	5,969
R-squared	0.014	0.001	0.000	0.000	0.000	0.001	0.004	0.004	0.001	0.002
Number of hhid	3,870	3,800	3,855	3,856	3,857	3,805	3,857	3,855	3,860	3,866

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Result: Impact on Consumption

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Monthly expenditure		Food consumption		Dine-out consumption		Durable goods expenditure	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE
After×Sendai	-9,708.88*	-8,475.87**	3,658.61***	3,643.87***	280.93	1,363.97	30,642.99***	30,287.95**
	(5,328.715)	(4,200.559)	(1,368.430)	(1,227.284)	(1,256.452)	(950.479)	(9,741.809)	(13,347.496)
After	5,494.76**	2,371.86	-1,811.04***	-1,654.04	455.41	2,512.82	24,725.29***	11,981.08
	(2,160.752)	(8,941.132)	(540.961)	(2,094.370)	(538.176)	(2,119.266)	(3,653.633)	(21,988.366)
Sendai	27,678.21***		77.01		-909.45		-1,353.64	
	(3,644.106)		(929.731)		(858.194)		(6,582.229)	
Constant	-188,605.01**	-147,496.21	-101,185.29***	-38,500.71	17,983.58	194,584.86**	-229,784.66	-201,459.33
	(81,964.511)	(306,828.962)	(20,628.859)	(74,063.793)	(20,318.817)	(81,537.922)	(140,250.331)	(800,554.758)
Observations	5,016	5,016	5,657	5,657	3,408	3,408	7,217	7,217
R-squared	0.071	0.008	0.071	0.007	0.014	0.014	0.018	0.026
Number of hhid		3,312		3,598		2,448		4,326
Individual FE		YES		YES		YES		YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, *p<0.1

Note: Control variables include age, age square, married dummy, education dummy.

Results: Impact on Labor

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	FE	FE	FE	FE	FE	FE	FE	FE
	Hours of Work				Hourly Wage			
	Total	Male	Male 50s	Female	Total	Male	Male 60s	Female
After×Sendai	0.93 (1.149)	2.31* (1.378)	4.05** (2.031)	-1.54 (2.050)	191.76* (102.313)	146.18 (139.875)	302.68* (177.803)	248.10* (147.767)
After	-5.13*** (2.067)	-6.89*** (2.518)	-1.12 (3.477)	-2.52 (3.582)	-259.92 (188.951)	-174.01 (257.686)	-401.69 (350.823)	-362.61 (273.169)
Constant	-158.12** (75.325)	-169.63* (91.566)	159.44 (227.493)	-138.31 (130.783)	-6,906.24 (6,871.699)	-3,884.81 (9,336.281)	-9,901.67 (19,559.757)	-9,711.89 (10,000.667)
Observations	3,488	2,103	816	1,385	3,352	1,949	1,027	1,403
R-squared	0.019	0.038	0.027	0.006	0.007	0.009	0.028	0.020
Number of hhid	2,234	1,327	499	907	2,214	1,280	652	934

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Results: Impact on Labor

VARIABLES	(1) Full time job dummy		(3) Part time job dummy				(7) Unemployed dummy	
	Total		Total		Female 50s		Total	
	FE	Probit	FE	Probit	FE	Probit	FE	Probit
After×Sendai	0.00 (0.015)	-0.03 (0.104)	-0.02 (0.017)	-0.07 (0.105)	-0.14** (0.059)	-0.54* (0.281)	0.02 (0.011)	0.21 (0.189)
After	-0.01 (0.029)	0.14*** (0.039)	0.10*** (0.033)	0.08** (0.037)	0.24** (0.108)	0.07 (0.102)	-0.03 (0.020)	-0.26*** (0.065)
Constant	1.01 (1.062)	0.98 (1.601)	2.01* (1.199)	-10.21*** (1.489)	9.02 (6.783)	-4.15 (17.567)	0.40 (0.750)	-2.42 (2.419)
Observations	7,847	7,847	7,847	7,847	940	940	7,847	7,847
R-squared	0.004		0.005		0.034		0.008	
Number of hhid	4,524		4,524		549		4,524	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Subgroup Impact

In order to determine whether the earthquake has a different effect on outcomes depending on:

- Whether a respondent lives alone
- Whether a respondent works
- Whether HH has public pension for constant income
- Whether income/housing assets/financial assets is higher than median in city

Estimate following equation:

$$y_{ijt} = \alpha + \beta_1 \text{After}_{ijt} + \beta_2 \text{Sendai}_{ijt} + \beta_3 \text{After} * \text{Sendai}_{ijt} + \beta_4 Z_{ijt} \\ + \beta_5 \text{After} * Z_{ijt} + \beta_6 \text{Sendai} * Z_{ijt} + \beta_7 \text{After} * \text{Sendai} * Z_{ijt} \\ + \beta_8 X + u_j + v_t + \epsilon_{ijt}$$

Coefficient β_7 captures different subgroup (Z) impact

Results: SWB

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: SWB (Life Satisfaction)						
Z	Single	Work	Pension	High income	High housing asset	High financial asset
VARIABLES	FE: Total	FE: Total	FE: Total	FE: Total	FE: Total	FE: Total
After×Sendai	-0.025 (0.040)	-0.004 (0.051)	-0.044 (0.088)	0.050 (0.059)	-0.008 (0.074)	0.128* (0.067)
After×Sendai×Z	0.162 (0.137)	-0.008 (0.080)	0.052 (0.098)	-0.148 (0.094)	-0.044 (0.210)	-0.263*** (0.093)
After	0.157** (0.074)	0.128* (0.077)	0.144* (0.084)	0.123 (0.086)	0.147* (0.077)	0.176** (0.076)
Z	0.142* (0.079)	0.019 (0.045)	0.056 (0.051)	0.023 (0.036)	0.024 (0.032)	0.025 (0.030)
After×Z	0.023 (0.050)	0.060* (0.035)	0.007 (0.048)	0.003 (0.041)	0.006 (0.047)	-0.021 (0.038)
Sendai×Z	-0.549*** (0.176)	-0.012 (0.125)	-0.109 (0.111)	-0.005 (0.093)	0.032 (0.183)	0.055 (0.078)
Constant	-0.118 (2.847)	1.702 (2.989)	-0.736 (3.343)	-1.534 (3.266)	-0.304 (2.883)	-0.066 (2.829)
Observations	7,440	7,408	7,421	6,429	7,440	7,440
R-squared	0.014	0.012	0.012	0.012	0.012	0.015
Number of hhid	4,364	4,353	4,361	4,051	4,364	4,364

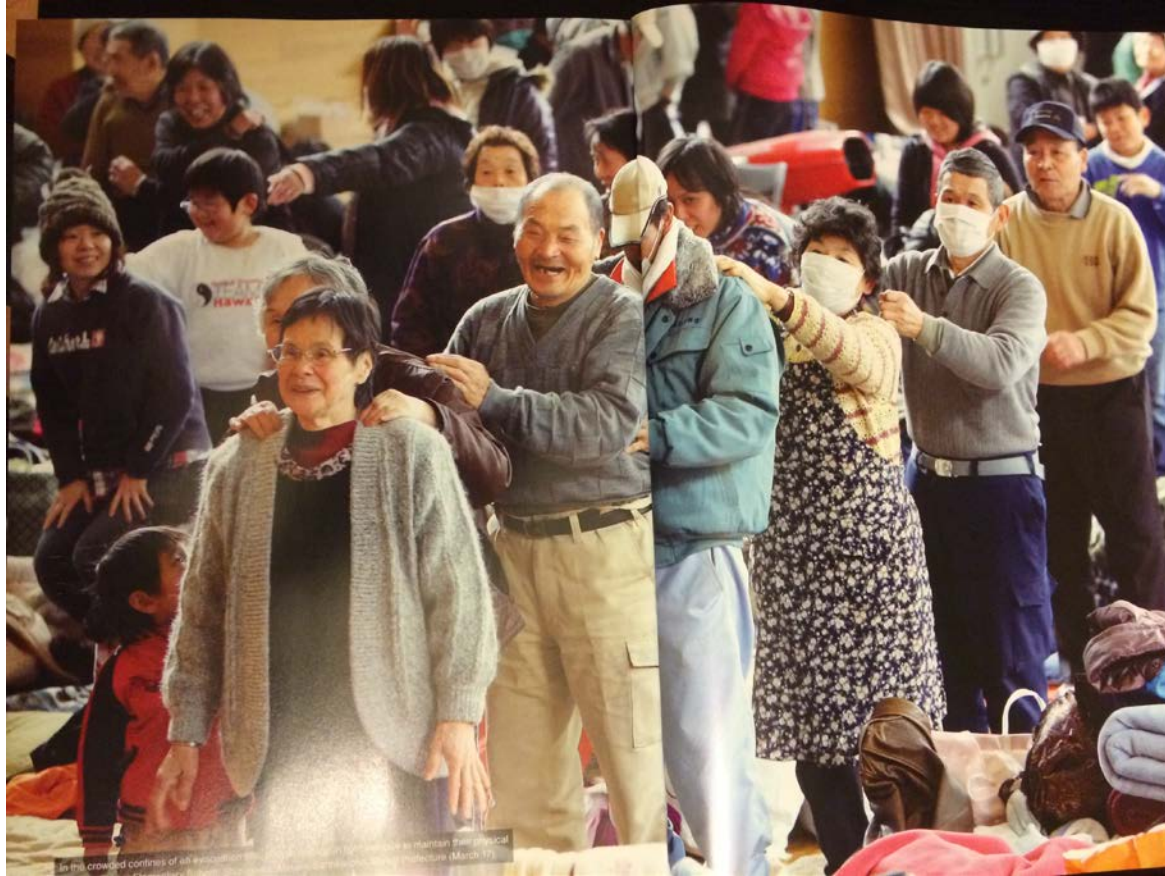
Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Conclusion

- Difference-in-difference approach
- Females ages 60s experienced negative impact on SWB
- Decrease in total monthly expenditure
- Increased hours of work and wage rate
- Why limited or no significant impact on SWB?
 - ⇒ Time (six months) and early economic recovery in Sendai may play a role.
 - However, still some mental problems
- Future research
 - Closer examination of levels of damage on individual basis, and analyze the effect of various kinds of help for survivors

Thank you very much for your attention!



People engaged in light exercise to maintain their physical well-being in an evacuation site.

Photo source: "The Great East Japan Earthquake and tsunami",
Kahoku Shimpo Publishing Co.