

Copayment Exemption Policy and Healthcare Utilization after the Great East Japan Earthquake

Yusuke Matsuyama,^{1,2,3,4} Toru Tsuboya,¹ Shun-ichiro Bessho,⁵ Jun Aida¹ and Ken Osaka¹

¹Department of International and Community Oral Health, Tohoku University Graduate School of Dentistry, Sendai, Miyagi, Japan

²Tokyo Medical and Dental University, Graduate School of Medical and Dental Sciences, Global Health Promotion, Tokyo, Japan

³Japan Society for the Promotion of Science, Tokyo, Japan

⁴Department of Quality and Safety of Oral Healthcare, Radboudumc, Nijmegen, Gelderland, the Netherlands

⁵Faculty of Economics, The University of Tokyo, Tokyo, Japan

Healthcare utilization after natural disasters remains understudied. In general, people in Japan pay 10%-30% of total amount of costs, according to their health insurance plan. A policy exempting survivors from copayments was introduced after the Great East Japan Earthquake in March 2011, which had a magnitude of 9.0 on the Richter scale and followed by devastating tsunamis. Among the disaster-affected areas, Miyagi prefecture experienced the largest number of deaths and the greatest extent of damage. However, the exemption was suspended in Miyagi prefecture from April, 2013, because of the huge governmental financial burden due to the immensity of damage from the disaster. Subsequently, in April 2014, the exemption was re-introduced, with smaller coverage. We, therefore, evaluated the influence of this policy change on monthly healthcare utilization in Miyagi prefecture between April 2008 and June 2015. We also evaluated the association between the proportion of people exempted from copayment in each municipality and the difference in healthcare utilization before and after the suspension using multivariable linear regression. Healthcare utilization in Miyagi increased immediately after the institution of the exemption policy and it peaked after one year. In March 2013, just before the suspension, a rapid increment in healthcare utilization was observed, suggesting that the copayment may be a barrier for people in the disaster-affected area to access to healthcare. The exemption policy did help the survivors to use healthcare utilization in Miyagi. After devastating natural disasters, policymakers should guarantee that all survivors can utilize healthcare services on demand.

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Introduction

The Great East Japan Earthquake (GEJE), the fourth-largest earthquake recorded in human history, which had a magnitude of 9.0 on the Richter scale and followed by devastating tsunamis, struck on March 11, 2011 (UNISDR, United Nations Office for Disaster Risk Reduction 2011). It caused 19,846 deaths, the number of death being 10 times higher than those during Hurricane Katrina (Brunkard et al. 2008; Centre for Research on the Epidemiology of Disasters 2016).

Mental and physical health problems increase after disasters. Cardiovascular events rapidly increased after the GEJE (Nozaki et al. 2013). The damage of disasters is associated with post-traumatic stress disorder (PTSD) and

depressive symptoms (Kennedy et al. 2015; Hikichi et al. 2016; Tsuboya et al. 2016). Further, the adverse effects of the disaster lasted for more than 2.5 years (Tsuboya et al. 2016, 2017). Thus, after disasters, medical demands greatly increase; however, access to healthcare among survivors is often disrupted (Shehab et al. 2008; Runkle et al. 2013).

After the GEJE, the Japanese government implemented a policy that exempts survivors from healthcare copayment. In general, people in Japan pay 10%-30% of total amount of costs, according to their health insurance plan. This copayment can be a barrier to access to healthcare (Murata et al. 2010). Fig. 1 shows the eligibility criteria for the exemption. In this policy, Japanese national government at first covered the entire cost, while local governments did not pay at all. However, the national gov-

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Correspondence: Toru Tsuboya, Department of International and Community Oral Health, Tohoku University Graduate School of Dentistry, 4-1 Seiryō-machi, Aoba-ku, Sendai, Miyagi 980-8575, Japan.
e-mail: tsubo828@gmail.com

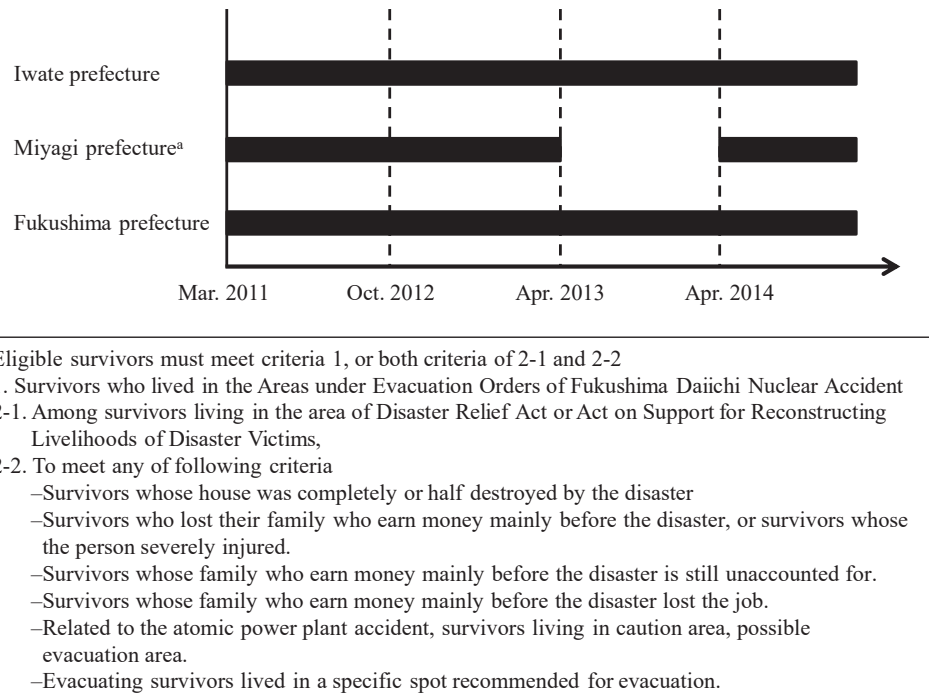


Fig. 1. Period and eligibility criteria of copayment exemption policy after the Great East Japan Earthquake.

^aEligible people were restricted to those who were exempted from residential tax based on their household income in Miyagi prefecture after April 2014.

ernment required local governments to cover 20% of the cost from October, 2012. In Miyagi prefecture, which experienced the largest number of deaths and the greatest extent of damage from the disaster, the local government halted the exemption from April, 2013, due to the financial burden, while the exemption was maintained in Iwate and Fukushima prefectures, located adjacent to Miyagi. The cessation in Miyagi was opposed by local politicians, physicians, and citizens' organizations. As a result, the exemption was reinstated from April, 2014, with a condition of covering those with low income. All-cause mortality did not increase at the time of suspension (Fig. 2).

To the best of our knowledge, no studies have examined the association between copayment exemption and healthcare utilization after disasters. Evaluating such a policy could prove important because, unfortunately, we will continue to experience devastating disasters all over the world. We regarded the policy change after the GEJE as a natural experiment (Craig et al. 2012) and evaluated the effects of exemption policy on healthcare utilization in Miyagi. This study described healthcare utilization in Miyagi before and after the disaster and evaluated the effects of the exemption policy on healthcare utilization.

Methods

Health insurance system in Japan

In Japan, UHC, universal healthcare coverage was achieved in 1961. The details of the system have been described elsewhere (Ikegami et al. 2011). Briefly, there are three health insurance plans; employment-based health insurance plans for < 75-year-old employ-

ees, NHI, National Health Insurance plan for < 75-year-old non-employees, and the LME, Late-stage medical care system for the elderly for ≥ 75 years old. Copayment costs for < 70 years old are 30%, they are 20% for 70-74 years old, and 10% for ≥ 75 years old; this excludes those with an annual household income of ≥ 1.45 million JPY (1 USD \approx 100 JPY), who pay 30%. In this study, we examined the data on people covered by NHI or LME because the exemption periods of employment-based health insurance plans were too varied to gather, as the employers uniquely extended their own exemptions.

Study design

Two ecological studies were conducted using different data sets: a descriptive analysis of prefecture-level healthcare utilization in Miyagi before and after the GEJE and an analysis to examine the association between the proportion of the people exempted from copayment in each municipality in Miyagi and their change in healthcare utilization during the suspension. We chose Miyagi prefecture, because it experienced the most severe damage from the disaster, and as a result, the highest proportion of survivors were eligible for exemption there: 27.7% of households were exempted in Miyagi in 2011, while 7.0% were exempted in Iwate and 15.2% in Fukushima (Okada 2012).

Ethical approval for this study was obtained from the Ethics Review Board of Tohoku University, Graduate School of Dentistry. All analyses were performed using Stata 14.0 software package (Stata Corp LP, College Station, TX).

Descriptive analysis of healthcare utilization in Miyagi before and after the GEJE

Dataset: Monthly data on healthcare utilization in NHI and

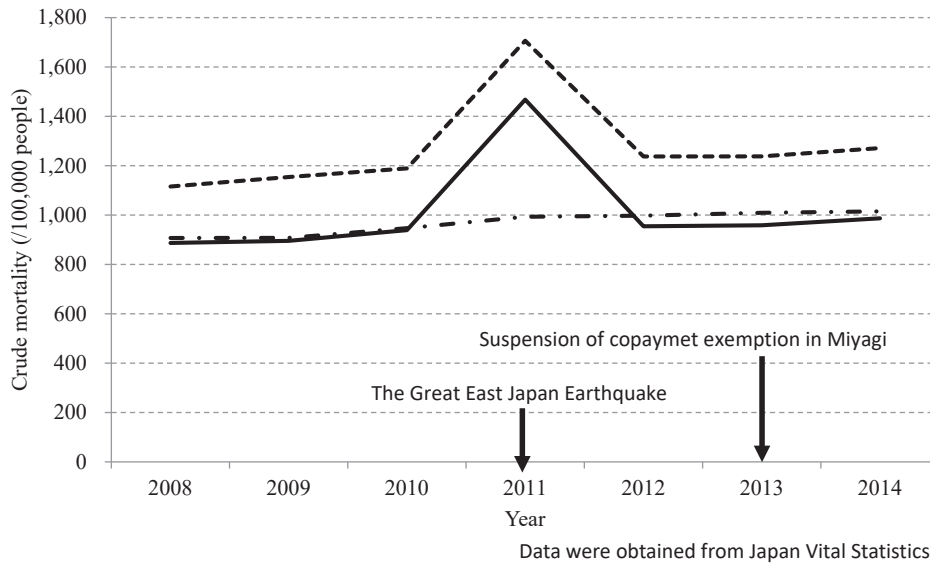


Fig. 2. All-cause mortality before and after the Great East Japan Earthquake.

— Iwate prefecture.
 — Miyagi prefecture.
 - . - Japan.

LME in Miyagi between April, 2008, and July, 2015, were obtained from the Survey on the Trend of Medical Care Expenditures (Ministry of Health Labour and Welfare 2016). The data were transformed into healthcare utilization per capita using yearly data on the number of people in each health insurance plan (Statistics Bureau Ministry of Internal Affairs and Communications 2016a,b) to consider changes in population size before and after the disaster.

Dependent variables: In all, 18 measures on healthcare utilization were evaluated. The original NHI and LME databases showed three categories: medical services for outpatients, medical services for inpatients, and dental services for outpatients. Three measures on healthcare utilization were derived for each of the following categories: health expenditure per capita (1,000 JPY/person/month), number of health insurance claims per capita (/1,000 people/month), and healthcare cost per health insurance claim (1,000 JPY/one health insurance claim). These categories amount to a total of 18 (= 3*3*2) dependent variables.

Statistical analyses: The 18 dependent variables were plotted according over time (with one month as one unit) to describe healthcare utilization in Miyagi.

Analyses to evaluate the effect of the exemption policy on healthcare utilization

Dataset: Only NHI data were used for these analyses because of data availability. Municipality-level healthcare utilization in all 35 municipalities in Miyagi in 2012 (when copayment was exempted) and 2013 (when the copayment exemption was suspended) were obtained from the annual report of the NHI (Statistics Bureau Ministry of Internal Affairs and Communications 2013). We linked the data to the proportion of those exempted from their copayment by municipalities in 2012. We further merged the following data: number of clinics, hospitals, and dental clinics per capita in 2012 (Ministry of Health Labour and Welfare 2012a), number of doctors and dentists per capita in 2012 (Ministry of Health Labour and Welfare 2012b), and average healthcare insurance premium in 2012

by municipality (Statistics Bureau Ministry of Internal Affairs and Communications 2013).

Dependent variables: The dependent variables were changes in healthcare utilization between 2012 and 2013, i.e., subtracting healthcare utilization in 2012 from utilization in 2013. Evaluation was conducted on 45 measures of healthcare utilization. Like our descriptive analysis, the original NHI database showed three categories: medical services for outpatients, medical services for inpatients, and dental services for outpatients. Three measures for healthcare utilization were derived for each of the following categories: health expenditure per capita (1,000 JPY/person/year), number of health insurance claims per capita (/1,000 people/year), and healthcare cost per health insurance claim (1,000 JPY/one health insurance claim). Further, the NHI database had categories for all NHI-plan age groups (0-74 years old: copayment before the disaster = 20-30%) and subgroups depending on insured people’s age and copayment rate: younger people (0-64 years old: copayment before the disaster = 30%), younger-older people (65-69 years old: copayment before the disaster = 30%), older-older people with higher incomes (70-74 years old with ≥ 1.45 million JPY annual household income: copayment before the disaster = 30%), and older-older people with lower incomes (70-74 years old with < 1.45 million JPY annual household income: copayment rate before the disaster = 20%). These categories amount to a total of 45 (= 3*3*5) dependent variables of healthcare utilization.

Statistical analyses: Multivariable linear regression models were used to adjust for the average healthcare insurance premium, the number of clinics, hospitals, and dental clinics per capita, and number of doctors and dentists per capita. The mathematical model is below:

$$\Delta Y_i = \gamma_0 + \gamma_1 X_i + \gamma_2 Z_i + v_i \quad (\text{Equation 1})$$

ΔY_i : difference in healthcare utilization in municipality i (2013-2012)

X_i : proportion of people who were exempted from copayment

in municipality i

Z_i : covariates in municipality i

γ_1 : coefficient which denotes association between copayment exemption and change in healthcare utilization

v_i : error term

Bonferroni's multiple comparison methods were used to consider multiple comparisons: i.e., statistical significance was set at $P = 0.0011$ ($= 0.05/45$). The 99% CI was also estimated, as we examined 45 dependent variables.

Results

Descriptive analysis

Figs. 3 and 4 show healthcare utilization among people enrolled in NHI and LME before and after the GEJE. In March, 2011, healthcare utilization in Miyagi decreased according to all measures (Figs. 3 and 4). After the introduction of the exemption policy, healthcare utilization increased according to several measures; for the NHI, healthcare expenditures and the number of health insurance claims for medical and dental outpatients increased, and in LME, the number of health insurance claims for dental outpatients increased (Figs. 3 and 4). These increments peaked one year after the GEJE. In March, 2013, just before the suspension of the exemption policy, healthcare expenditures and the number of health insurance claims for medical and dental outpatients and healthcare costs per health insurance claim for dental outpatients increased in NHI (Fig. 3) but no boost was observed in LME (Fig. 4). In April, 2014, when the exemption was reinstated, healthcare utilization did not increase significantly (Figs. 3 and 4).

The effect of the exemption policy on healthcare utilization

Table 1 shows the means and SDs of healthcare utilization and its related factors. Between 2012 and 2013, healthcare expenditure increased for medical services for both outpatients (+900 JPY/person/year) and inpatients (+1,900 JPY/person/year), whereas it decreased for dental outpatients (-1,900 JPY/person/year). The number of health insurance claims decreased in all categories: -74.3/1,000 person/year for medical outpatients, -0.7/1,000 person/year for inpatients, and -84.4/1,000 person/year for dental outpatients. Healthcare cost per one health insurance claim increased in medical outpatients (+300 JPY/person/year) and inpatients (+9,400 JPY/person/year), whereas we again found a downturn in dental outpatients (-500 JPY/person/year). In 2012, 21.5% of people in all 35 municipalities in Miyagi were exempted from copayment.

Table 2 shows coefficients from Pearson's correlation between the proportion of people exempted from copayment and change in health service utilization in municipalities. These proportions were associated with utilization for medical and dental outpatients but were not associated with utilization for inpatients. The proportions exempted were associated with healthcare expenditures and the number of healthcare insurance claims, whereas it was not associated

with healthcare cost per health insurance claim except for dental outpatients.

Table 3 shows an association between the proportion of people exempted from copayment and changes in healthcare utilization during the suspension, adjusted for all covariates (i.e., γ_1 in Equation 1). Proportion of exempted population were found to be significantly associated with the following dependent variables after Bonferroni's multiple comparisons were applied: 1) healthcare expenditures for medical outpatients among the entire population and among younger people, 2) number of health insurance claims for medical outpatients among the entire population, younger people, and younger-older people, 3) healthcare expenditures for dental services among the entire population and all subgroups, and 4) number of health insurance claim for dental services, except for among older-older people with higher incomes. The relative decline at the time of suspension was greater for dental services.

Discussion

To the best of our knowledge, this is the first study evaluating the influence of copayment exemption policy on health service utilization in disaster-affected areas. The findings from this study may contribute to future policy decisions by Japanese governments in response to natural disasters. The key results of this study are as follows: healthcare utilization in Miyagi increased immediately after the institution of the exemption policy and it peaked after one year and then gradually decreased. A crest in healthcare utilization was also observed in March, 2013, just before the suspension. These boosts were more obvious among people in National Health Insurance than among people in the Late-stage medical care system for the elderly; people with higher copayments before the disaster seemed to be more susceptible to the exemption policy.

The exemption policy, in fact, reduced financial barriers and increased healthcare utilization. It might be argued that the boost in health service utilization was brought about by the disaster itself and not by the exemption policy because the earthquake and the following tsunami had devastating effects on people's health in the affected areas. It is reported that the survivors of the 2008 Wenchuan earthquake had worse periodontal condition after the disaster (Liu et al. 2010); 17% of older people living in damaged area by the GEJE lost their dentures (Sato et al. 2015). These factors might explain a part of the boost in healthcare utilization. However, they would not be the primary reason, because the boost was more obvious for people in NHI plans (< 75 years old) than for those in LME plans (≥ 75 years old); the increment of healthcare utilization was smaller for older people, who are in general more vulnerable to disasters than younger people. Instead, the proportion of copayment would explain the boost because the absolute difference in copayment before and after the exemption was more substantial for people in NHI plans than for those in LME plans, they might be encouraged to

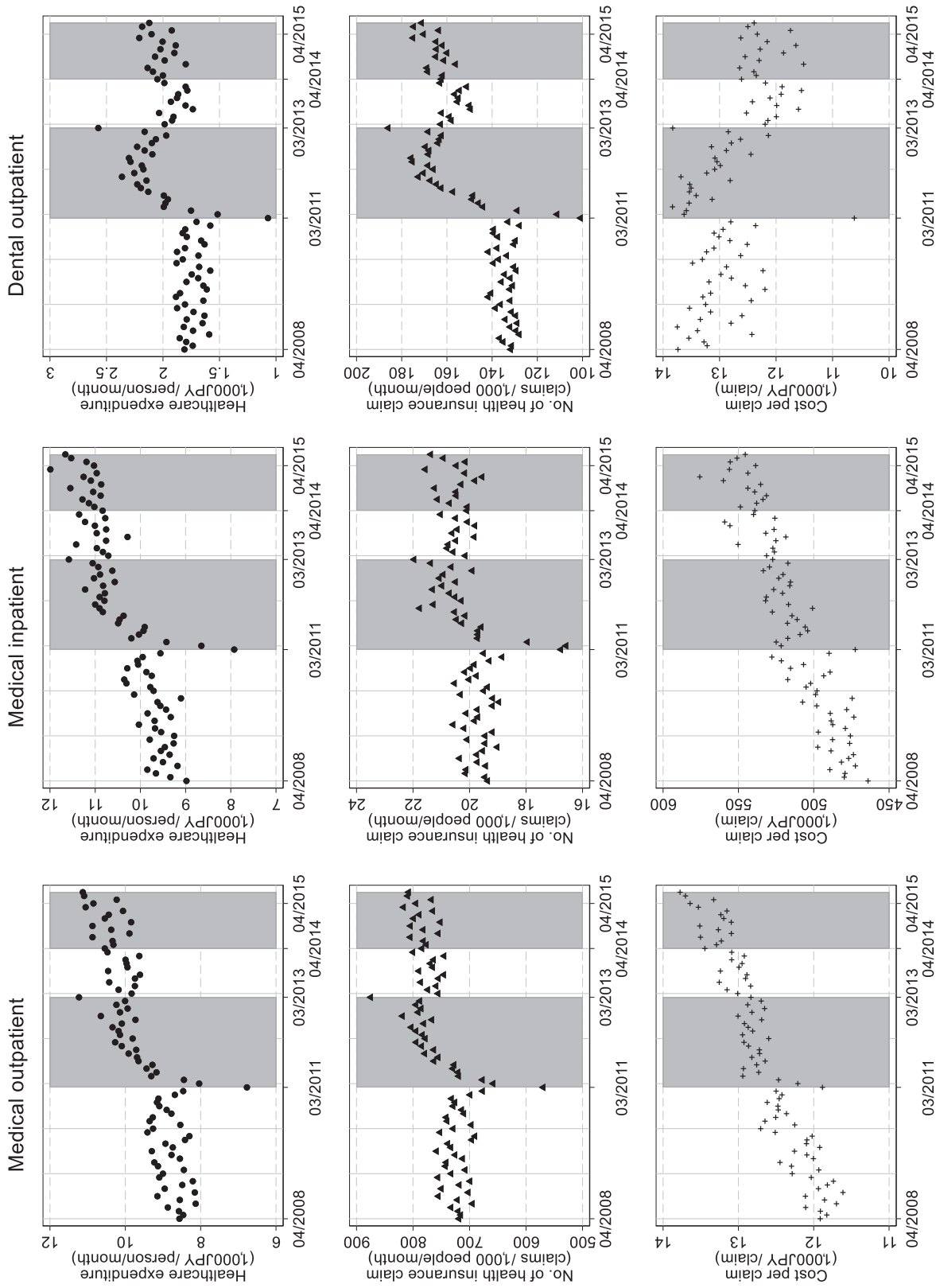


Fig. 3. Healthcare utilization in Miyagi before and after the disaster, National Health Insurance plans.

- Copayment exemption.
- Healthcare expenditure.
- ▲ No. of health insurance claim.
- + Cost per one health insurance claim.

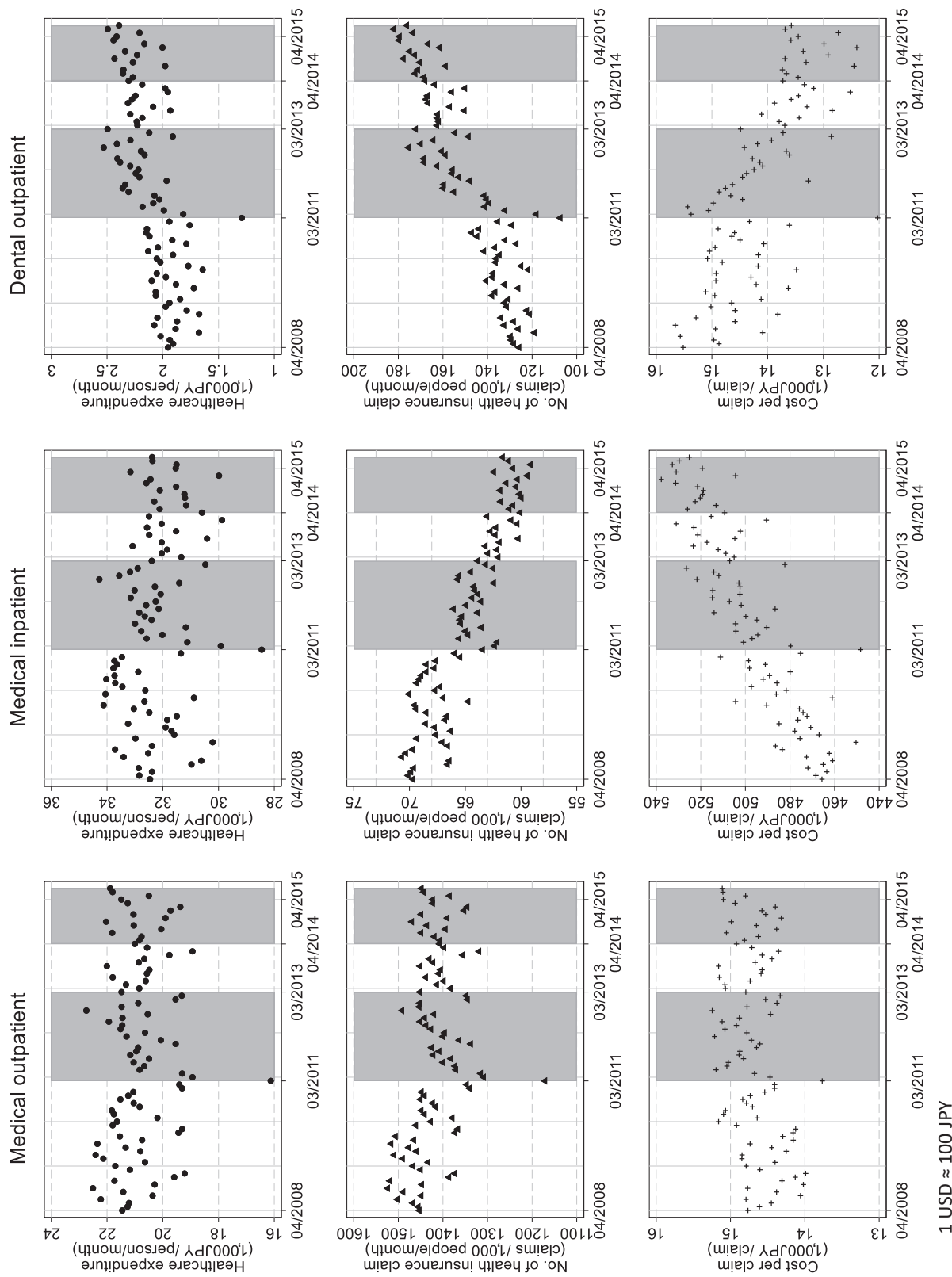


Fig. 4. Healthcare utilization in Miyagi before and after the disaster, Late-stage medical care system for the elderly plans.

- Copayment exemption.
- Healthcare expenditure.
- ▲ No. of health insurance claim.
- + Cost per one health insurance claim.

1 USD ≈ 100 JPY

Table 1. Descriptive statistics of healthcare utilization and related factors in each year in 35 municipalities in Miyagi prefecture; National Health Insurance (0-74-year-olds: copayment before the disaster = 20%-30%).

	2012		2013	
	Mean	SD	Mean	SD
Healthcare expenditures (1,000 JPY/person/year)				
Medical outpatients				
Entire population	112.2	11.3	113.1	9.6
Younger people ^a	81.2	8.7	80.4	7.3
Younger-older people ^b	151.3	25.1	153.2	25.1
Older-older people with higher incomes ^c	174.4	39.6	152.0	43.6
Older-older people with lower incomes ^d	190.1	25.3	186.9	23.0
Medical inpatients				
Entire population	118.7	16.0	120.6	16.0
Younger people ^a	88.0	15.2	90.4	11.8
Younger-older people ^b	150.7	23.8	153.8	25.7
Older-older people with higher incomes ^c	186.0	102.7	129.9	90.9
Older-older people with lower incomes ^d	196.5	27.4	189.0	25.9
Dental outpatients				
Entire population	22.8	3.2	20.9	2.2
Younger people ^a	19.1	2.9	16.9	1.6
Younger-older people ^b	27.7	4.5	24.9	3.7
Older-older people with higher incomes ^c	31.5	11.2	27.4	9.0
Older-older people with lower incomes ^d	33.5	4.4	30.3	4.8
Health insurance claims (/1,000 people/year)				
Medical outpatient				
Entire population	8,634.1	698.6	8,559.8	571.4
Younger people ^a	6,341.6	501.3	6,147.4	329.3
Younger-older people ^b	11,342.0	1,157.9	11,226.2	858.0
Older-older people with higher incomes ^c	14,268.0	2,792.0	11,915.8	2,386.6
Older-older people with lower incomes ^d	15,132.6	1,325.5	14,543.8	1,204.9
Medical inpatients				
Entire population	247.6	33.7	246.9	35.3
Younger people ^a	192.7	33.8	193.0	25.9
Younger-older people ^b	294.8	50.7	300.8	45.6
Older-older people with higher incomes ^c	363.2	222.5	273.8	150.5
Older-older people with lower incomes ^d	392.3	43.6	373.7	43.9
Dental outpatients				
Entire population	1,724.8	278.2	1,640.4	231.1
Younger people ^a	1,495.4	217.2	1,369.3	156.5
Younger-older people ^b	2,055.3	426.1	1,970.2	384.6
Older-older people with higher incomes ^c	2,662.5	885.7	2,241.4	626.3
Older-older people with lower incomes ^d	2,422.1	432.8	2,264.9	457.4
Cost per health insurance claim (1,000 JPY/claim)				
Medical outpatients				
Entire population	13.0	1.3	13.3	1.3
Younger people ^a	12.8	1.2	13.1	1.1
Younger-older people ^b	13.3	2.1	13.7	2.2
Older-older people with higher incomes ^c	12.3	1.9	12.8	2.4
Older-older people with lower incomes ^d	12.6	1.4	12.9	1.5
Medical inpatients				
Entire population	480.1	23.3	489.5	28.6
Younger people ^a	457.8	24.8	469.9	32.8
Younger-older people ^b	513.9	46.2	512.2	47.4
Older-older people with higher incomes ^c	541.8	165.6	460.9	210.1
Older-older people with lower incomes ^d	499.8	27.9	506.3	43.0
Dental outpatients				
Entire population	13.3	1.0	12.8	0.9
Younger people ^a	12.8	0.9	12.4	0.8
Younger-older people ^b	13.6	1.3	12.8	1.0
Older-older people with higher incomes ^c	11.9	1.6	12.3	2.4
Older-older people with lower incomes ^d	14.0	1.3	13.5	1.1
People exempted from copayment (%)	21.5	23.6	-	-
Number of clinics, hospitals, and dental clinics (/100,000 people)	61.1	27.7	-	-
Number of doctors and dentists (/100,000 people)	171.2	94.9	-	-
Healthcare insurance premiums (1,000 JPY/person/year)	75.1	13.9	-	-

Standard deviation, SD; 1 USD \approx 100 JPY.

^aPeople aged 0-64 years (copayment before the disaster = 30%).

^bPeople aged 65-69 years (copayment before the disaster = 30%).

^cPeople aged 70-74 years with annual household incomes of \geq 1.45 million JPY (copayment before the disaster = 30%).

^dPeople aged 70-74 years with annual household incomes of $<$ 1.45 million JPY (copayment rate before the disaster = 20%).

Table 2. Correlations between proportions of people exempted from copayment and change in healthcare utilization in municipalities at the suspension; National Health Insurance (0-74-year-olds: copayment before the disaster = 20%-30%).

	Medical outpatient		Inpatient		Dental outpatient	
	ρ	P-value	ρ	P-value	ρ	P-value
Healthcare expenditures (1,000 JPY/person/year)						
Entire population	-0.61	< 0.001*	-0.27	0.11	-0.92	< 0.001*
Younger people ^a	-0.52	0.004	-0.23	0.22	-0.88	< 0.001*
Younger-older people ^b	-0.46	0.005	-0.12	0.48	-0.87	< 0.001*
Older-older people with higher incomes ^c	-0.60	0.001*	-0.15	0.44	-0.75	< 0.001*
Older-older people with lower incomes ^d	-0.46	0.011	-0.23	0.23	-0.66	< 0.001*
Health insurance claims (/1,000 people/year)						
Entire population	-0.826	< 0.001*	-0.35	0.04	-0.94	< 0.001*
Younger people ^a	-0.88	< 0.001*	-0.31	0.10	-0.92	< 0.001*
Younger-older people ^b	-0.816	< 0.001*	-0.21	0.24	-0.90	< 0.001*
Older-older people with higher incomes ^c	-0.787	< 0.001*	-0.19	0.33	-0.77	< 0.001*
Older-older people with lower incomes ^d	-0.034	0.863	-0.13	0.51	-0.80	< 0.001*
Cost per health insurance claim (1,000 JPY/claim)						
Entire population	0.1499	0.3902	0.04	0.83	-0.48	< 0.001*
Younger people ^a	0.1723	0.3714	-0.06	0.74	-0.41	0.03
Younger-older people ^b	0.1756	0.3131	0.08	0.67	-0.25	0.15
Older-older people with higher incomes ^c	0.0551	0.7763	0.02	0.92	-0.08	0.68
Older-older people with lower incomes ^d	-0.531	0.003	-0.23	0.23	-0.16	0.40

Pearson's correlation coefficient, ρ ; 1 USD \approx 100 JPY.

*Statistically significant after applying Bonferroni's multiple comparisons ($P < 0.0011$).

^aPeople aged 0-64 years (copayment before the disaster = 30%).

^bPeople aged 65-69 years (copayment before the disaster = 30%).

^cPeople aged 70-74 years with annual household incomes of \geq 1.45 million JPY (copayment before the disaster = 30%).

^dPeople aged 70-74 years with annual household incomes of $<$ 1.45 million JPY (copayment rate before the disaster = 20%).

visit dental clinics. We also found a similar tendency in 0-64- and 65-69-year-old people, whose copayment was 30%, that they were more susceptible to the policy suspension than 70-74-year-old people, whose copayment was 20%. This is consistent with the well-known RAND Health Insurance Experiment Study, which showed that participants who were assigned higher copayment rates were less likely to visit dental clinics (Manning et al. 1985).

Exceptionally, people aged 70-74 with higher incomes were not susceptible to suspension, although they paid 30% copayment before the GEJE. This might suggest that the 30% copayment rate was affordable for their economic situation, or it may be explained by that those with higher incomes are less likely to have health problems (Solar and Irwin 2010). This is consistent with a review showing that healthcare utilization is susceptible to copayment among

people with lower incomes (Kiil and Houlberg 2014).

The differences among medical outpatient, medical inpatient, and dental outpatient utilization could be explained by price elasticity. Dental services are more susceptible to price than medical services: the price elasticity of medical services for acute patients, non-acute patients, and dental patients are estimated at -0.16 , -0.20 , (Manning et al. 1987), and -0.41 (Ando and Takaku 2016); households in the highest income quintile spend 2.9 times more on dental treatment and care than those in lowest income quintile but no such difference was observed in their payments for medical care (Ozaki et al. 2000).

Importantly, we observed another peak just before the suspension of the exemption policy. It is less likely that people in the affected area suddenly began to suffer from severe diseases at this time. It is reasonable to consider that

Table 3. Healthcare utilization changes between 2012 (with the copayment exemption policy) and 2013 (without the copayment exemption policy); National Health Insurance (0-74-year-olds: copayment before the disaster = 20%-30%).

	Medical outpatient			Inpatient			Dental outpatient		
	Coef	99% CI	Relative change ^e	Coef	99% CI	Relative change ^e	Coef	99% CI	Relative change ^e
Healthcare expenditure (1,000 JPY/person/year)									
Entire population	-23.1	-36.6, -9.6	-20.6%	1.8	-30.1, 33.7	1.5%	-10.8	-14.5, -7.1	-47.4%
Younger people ^a	-21.0	-38.7, -3.3	-25.8%	11.9	-51.8, 75.6	13.5%	-8.7	-13.7, -3.7	-45.5%
Younger-older people ^b	-33.6	-67.5, 0.3	-22.2%	-13.3	-99.4, 72.8	-8.9%	-9.3	-14.0, -4.7	-33.7%
Older-older people with higher incomes ^c	-104.3	-278.3, 69.7	-59.8%	-186.3	-971.1, 598.4	-100.2%	-36.0	-69.6, -2.3	-114.2%
Older-older people with lower incomes ^d	-34.2	-72.4, 4.0	-18.0%	-30.0	-160.3, 100.3	-15.3%	-9.9	-19.3, -0.4	-29.4%
Health insurance claims (/1,000 people/year)									
Entire population	-1,568.6	-2,068.6, -1,068.6	-18.2%	-31.2	-105.4, 43.1	-12.6%	-610.0	-782.1, -437.8	-35.4%
Younger people ^a	-1,579.6	-2,223.2, -936.0	-24.9%	12.6	-62.5, 87.7	6.5%	-535.9	-764.5, -307.2	-35.8%
Younger-older people ^b	-2,742.3	-4,131.4, -1,353.3	-24.2%	-104.1	-291.3, 83.0	-35.3%	-760.6	-1,164.5, -356.7	-37.0%
Older-older people with higher incomes ^c	-10,311.9	-20,951.9, 328.1	-72.3%	-353.5	-1,691.0, 984.0	-97.3%	-2,005.6	-4,500.4, 489.3	-75.3%
Older-older people with lower incomes ^d	-993.5	-2,381.2, 394.2	-6.6%	-52.2	-265.8, 161.5	-13.3%	-549.9	-1,048.6, -51.2	-22.7%
Cost per health insurance claim (1,000 JPY/ claim)									
Entire population	-0.5	-1.8, 0.8	-3.9%	64.4	-27.5, 156.2	13.4%	-1.9	-4.0, 0.2	-14.3%
Younger people ^a	-0.5	-2.5, 1.5	-3.9%	22.3	-159.5, 204.1	4.9%	-1.5	-4.6, 1.6	-11.5%
Younger-older people ^b	0.0	-2.3, 2.3	-0.1%	116.4	-98.1, 331.0	22.7%	0.8	-2.1, 3.8	6.2%
Older-older people with higher incomes ^c	0.6	-7.6, 8.9	5.2%	155.9	-771.6, 1,083.4	28.8%	-6.3	-16.0, 3.5	-52.7%
Older-older people with lower incomes ^d	-1.7	-4.0, 0.6	-13.5%	0.7	-147.2, 148.6	0.1%	-1.1	-5.0, 2.7	-8.1%

Coefficient, Coef; confidence interval, CI; 1 USD ≈ 100 JPY.

Dependent variables were difference of healthcare utilization (2013-2012); minus sign means healthcare utilization decreased in 2013.

Coefficients and 99% CIs are on prevalence of exempted survivors (per 100% increment), adjusted for number of clinics, hospitals, and dental clinics, number of doctors and dentists, and healthcare insurance premium.

^aPeople 0-64 years old (copayment before the disaster = 30%).

^bPeople 65-69 years old (copayment before the disaster = 30%).

^cPeople 70-74 years old with annual household incomes of ≥ 1.45 million JPY (copayment before the disaster = 30%).

^dPeople 70-74 years old with annual household incomes of < 1.45 million JPY (copayment rate before the disaster = 20%).

^eRatio of the coefficient to the mean healthcare utilization in 2012.

people hurried to visit clinics because the exemption period was ending soon. This hypothesis is supported by our results that the boost just before the suspension was more evident in dental services than in hospital costs, and it was more evident for those in NHI plan who usually bare 30% of the total cost than in those in LME plan, who bare only 10% of the cost. This might suggest that some, particularly those in NHI plans, hesitate to visit health care facilities, because they cannot afford their copayment. Policymakers must account for underuse due to copayment; it would be reasonable to set lower copayment rates for healthcare or a lower upper limit for total copayments being paid by patients.

This is the first study reporting healthcare utilization after a natural disaster. We evaluated the influence of a copayment exemption policy on healthcare utilization in a

“natural experimental” situation. The findings of this study can contribute to current and future policy decisions in Japan following disasters. On the other hand, the study has some limitations. First, it is an ecological study and, thus, the individual-level association is unclear. Second, we were not able to divide the effects of the exemption policy from the increment of disease following the GEJE. It has been reported that health problems increase after disasters (Nozaki et al. 2013; Ochi et al. 2013). However, in the present study, the population most vulnerable to the disaster (≥ 75 years old) was less likely to increase their healthcare utilization. Further, dental services were more influenced by the exemption policy, though dental diseases would be less likely to be affected by disaster damage than other diseases. These results suggest that disaster damage alone cannot explain the change in healthcare utilization in this

study. Third, we could not evaluate the adverse effects of the suspension on survivors' health; however, at least prefecture-level all-cause mortality did not increase during the suspension (Fig. 2). Fourth, the generalizability of this study is limited to the Japanese healthcare system, even though its conclusions might be informative to other countries, as research on post-disaster healthcare utilization is scarce. Further study is needed in other countries with different healthcare systems.

We evaluated the copayment exemption policy following the Great Japan Earthquake with respect to healthcare utilization among survivors. After devastating natural disasters, policymakers should guarantee that survivors can utilize healthcare service on demand.

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Conflict of Interest

The authors declare no conflict of interest.

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