Does Volunteering Reduce Mortality? Evidence from a Natural Experiment in Japan

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[Preliminary Version]

Abstract

Volunteering is a widespread economic activity across the world. Although volunteering is likely to contribute to the society, research on social returns to volunteering is scarce. In this paper, we explore the causal effect of volunteering which mainly targets the elderly on mortality at city level. A potential threat for identification is endogeneity of volunteering. Specifically, unobserved heterogeneity such as the quality of local health care service may affect both mortality and the level of volunteering. Furthermore, there may be more volunteers in cities with a large number of vulnerable people. In order to identify the causal effect of volunteering, we use exogenous variation in volunteering caused by the Great Hanshin-Awaji Earthquake which occurred in the Midwestern part of Japan in 1995. Using the instrumental variable estimator, we find that one percent increase in the number of volunteers reduces the number of deaths due to natural causes by about 0.13 percent.

Keywords: volunteering, mortality, natural experiment

JEL Classification: I10, J14

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1 Introduction

Volunteering is a popular activity across the world, e.g., more than a quarter of citizens in Japan and the United States and more than 40 percent of citizens in the United Kingdom participated in volunteer work.[1] Although volunteer work is likely to benefit society, research on its effect on social benefits is scarce. Among various possible social benefits, this study explores the effect of volunteering which mainly targets the elderly on mortality at city level.[2] Longevity and healthy life is important not only for individuals but also for the governments which expend a large amount of money for health care services. Given the recent trend of ageing society, the health care expenditure is likely to rise further and hence clarifying a contribution of volunteering to longevity and better health is important for overall maintenance of the society.

A major challenge to identify the causal effect of volunteering on mortality is endogeneity of volunteering. It may be the case that there are more volunteers in cities with a large number of people with high risk of mortality such as the elderly. It is thus hard to conclude from which direction causality runs. Moreover, unobserved heterogeneity across cities that affect both morality and the level of volunteering may bias estimates of the effect of volunteering. For example, there may be more volunteers in cities with low quality health care service, while at the same time low quality health care service is likely to lead to high mortality.

To identify the causal effect of volunteering on mortality, we require a source of an exogenous variation in volunteering. In this paper, we use an exogenous variation caused by the Great Hanshin-Awaji earthquake occurred in the Midwestern part of Japan in 1995. The level of volunteering considerably increased in some cities greatly hit by the quake, while other cities with no damage did not experience such a sharp increase in volunteering. Based on comparison of mortality due to natural causes between those cities with and without damage, our results indicate that one percent increase in the number of volunteers reduces the number of deaths due to natural causes by about 0.13 percent. A series of robustness checks are conducted to ensure that the result is not driven by direct effects of the quake.

As far as the author is aware of, this is the first paper to examine the effect of volunteering on mortality with (we argue) a credible identification strategy. Previous research on the effect of volunteering is done by social scientists in various discipline such as gerontology, sociology, psychology and economics. Their

[1] Japanese, UK and US data are from the Survey on Time Use and Leisure Activities, Citizenship Survey and Current Population Survey, respectively. Figures are proportions of people who engaged in volunteer work at least once in the past 12 months.

[2] 83 percent of volunteering focused in this paper target the elderly at home, while the rest of volunteer work targets the disabled and people in hospitals and care homes.

primary focus is on its effect on well-being and mental health of those who provide volunteer work, such as happiness, life satisfaction, self reported health and depression (Morrow-Howell et al., 2003; Musick and Wilson, 2003; Piliavin and Siegl, 2007; Thoits and Hewitt, 2001; Van Willigen, 2000; Young and Glasgow, 1998). There are, however, several papers which investigate the effect of volunteering on morality of old adults who participate in volunteering.[3] Using the Cox proportional hazards model, the papers compute hazard ratios for mortality that indicate the relative risk of mortality compared to a reference group conditional on control variables. The results of previous literature are somewhat conflicting: Musick et al. (1999) find that old Americans who joined one volunteer group and who spent less than 40 hours for volunteering is associated with a lower risk of mortality relative to non-volunteers, while such relationship is not observed among those who joined more than one group or who spent more than 40 hours for volunteer work. In contrast, based on observations for residents of Marin county in California, Oman et al. (1999) find that volunteering for two or more groups and the number of volunteer hours are associated with lower risk of mortality relative to no volunteering. Harris and Thoresen (2005) also find lower mortality risk among those who frequently volunteers relative to non-volunteers: old Americans who frequently volunteer have about 20 percent reduction in mortality risk relative to non-volunteers, while such relationship is not observed among those who sometime or rarely volunteer.[4] Finally, there is one paper which explores the effect on mortality using data that is different from the United States. Shmotkin et al. (2003), based on evidence from Jews living in Israel, find that participating in volunteer work is associated with 33 percent lower risk of mortality compared to no volunteering. An issue with these studies is that it is not clear if volunteering is reducing the risk of death or people with low risk of mortality is participating in volunteering from the outset.

Finally, there is one paper which exploits a difference in timing to deal with the endogeneity of volunteering. Luoh and Herzog (2002) find that Americans aged 75 or above who spent 100 hours or more for volunteering is one third as likely to die as those who volunteered less than 100 hours. Their analytical strategy is to regress mortality status in period t on volunteering participation status in period t-1 to identify the causal effect of volunteering on mortality, controlling for health status prior to participation in volunteer work (health status in period t-2) in their logit model. A potential issue with their approach is that estimates of the effect of volunteering are biased if time invariant unobserved heterogeneity which affects

[3] Cut-off values to define “old adults” vary across papers and range from 55 to 75.

[4] Volunteering is measured by subjective frequency of participation in volunteer work: respondents were asked how often they participated in volunteering in the past 12 months and chose from “never”, “rarely”, “sometimes” or “frequently”.

health status of an individual is also correlated to volunteering participation status of the individual.[5]

The reminder of the paper proceeds as follows: Section 2 explains the earthquake and its effect on volunteering. In section 3, we show the econometric specification and discuss identification strategy. Section 4 presents data sources, Section 5 discusses the empirical findings and Section 6 concludes the paper.

2 The Earthquake and Volunteering

2.1 The Great Hanshin-Awaji Earthquake

The Great Hanshin-Awaji Earthquake occurred on 17th January 1995 with its epicentre at the southern part of Hyogo prefecture. The dotted square in Panel A of Figure 1 indicates the location of Hyogo prefecture, while the cross in Panel B of Figure 1 indicates the epicentre. The quake recorded magnitude of 7.3 and the highest seismic intensity of 7 on Japanese intensity scale at the southern part of Hyogo.[6] The quake caused the second largest loss in post-war Japan: 6,433 people were killed, 43,792 people were injured, and more than 300 thousand people evacuated. More than 398 thousand houses, factories, shops were destroyed or burnt down and infrastructures such as water, electricity, gas supply and phone lines were seriously disrupted.

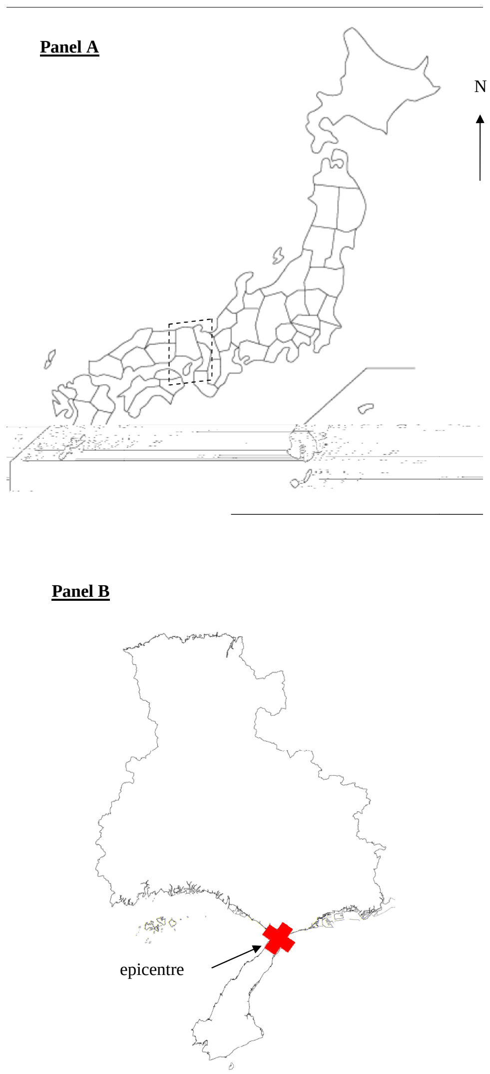
2.2 The Effect of the Earthquake on Volunteering

Shortly after the quake, a large number of volunteers from different parts of Japan gathered in the disaster area to provide emergency support such as transporting relief, managing asylums, providing meals and nursing. The total number of 1,377 thousand people volunteered over a year after the quake and about 70 percent of them participated in volunteering for the fist time (Hyogo Prefecture, 1996). Their activities attracted attention of the media and volunteering became a popular activity among the public. In fact, 1995 is called "*Volunteer Gannen*" meaning "the starting year of volunteerism" and the number of volunteers grew 4.6 times bigger in 2009 compared to 1980 (National Social Council of Welfare, 2009).

[5]Furthermore, it is hard to interpret their estimates of the effect of volunteering on mortality since they group those who did not volunteer and who volunteered less than 100 hours into the same category, i.e., the reference group also contains those who participated in volunteering. In addition, the previous literature use different cut-off values for measures of volunteering, e.g., 40 hours in Musick et al. (1999) while 100 hours in Luoh and Herzog (2002). It is hence not clear how robust their results are to different cut-off values.

[6]The seismic intensity 7 is assigned to a quake strong enough to alter a land form or cause a landslide.

Figure 1: The Epicentre



Note: Panel A shows the location of Hyogo prefecture in Japan, which is surrounded by the dotted square. Panel B indicates the epicentre in Hyogo prefecture.

In this paper, we focus on volunteers known to the Hyogo Council of Social Welfare (HCSW). These volunteers are based in Hyogo prefecture and engage in activities which mainly target the elderly.[7] Roughly 70 percent of volunteers are those not in labour force such as housewives and 60 percent of them are aged below 60. The main activities of these volunteers are to deliver meals, visit house/hospitals/care homes for a chat, organise community gathering and provide assistance to daily tasks such as going out. In cities greatly hit by the quake, the level of volunteering jumped up after the quake and kept increasing, whereas in other cities the level of volunteering evolved smoothly. Panel A of Figure 2 plots the evolution of the average number of volunteers in treatment and control cities.[8] As outlined earlier, a large number of volunteers engaged in volunteering to provide emergency support in the aftermath of the quake. In order to see how the level of volunteering evolved after getting rid of a temporary rise in volunteering related to emergency support, Panel B of Figure 2 plots the evolution of the average number of volunteers except 1995 and 1996. The graph clarifies that the level of volunteering increased in treated cities relative to control cities. In this paper, this variation in volunteering is used to identify the effect of volunteering on mortality due to natural causes. Unless otherwise mentioned, mortality refers to mortality due to natural causes hereafter.

3 Identification Strategy

This study explores the causal effect of volunteering on mortality by regressing mortality on a measure of volunteering, controlling for various socio-economic indicators. The following model is set up:

$$Mortality_{it} = \beta_0 + \beta_1 Volunteer_{it} + \beta_2 CityFE_i + \beta_3 YearFE_t + X_{it}^{0}\gamma + \varepsilon_{it} \qquad (1)$$

where $Mortality_{it}$ represents the number of deaths due to natural causes in city i in year t and $Volunteer_{it}$ is the level of volunteering. $CityFE_i$ and $YearFE_t$ are the city and year fixed effects, respectively. X_{it} and γ are K 1 vectors, where K is the number of socio-economic indicators, and ε_{it} is the disturbance term.

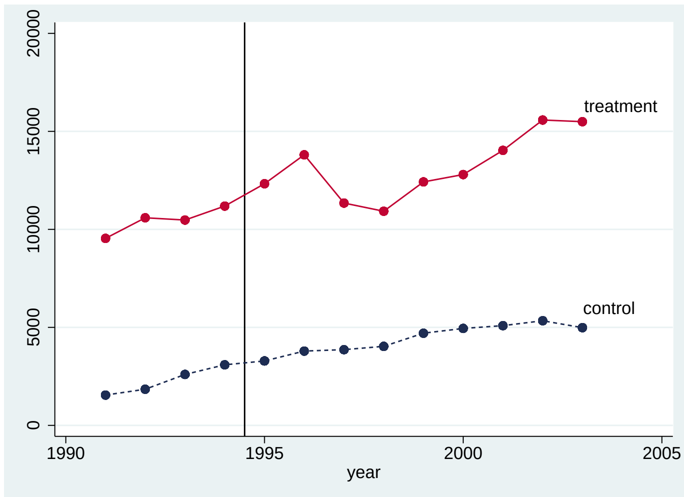
The main coefficient of interest is β_1 which measures the effect of volunteering on mortality. An econometric issue in the estimation of model (1) is endogeneity of the level of volunteering. For example, unobserved heterogeneity such as

[7] As of 2000, approximately 83%, 8% and 5%, respectively, of the volunteer activities known to the HCSW target the elderly, the disabled and people in hospitals and care homes, respectively.

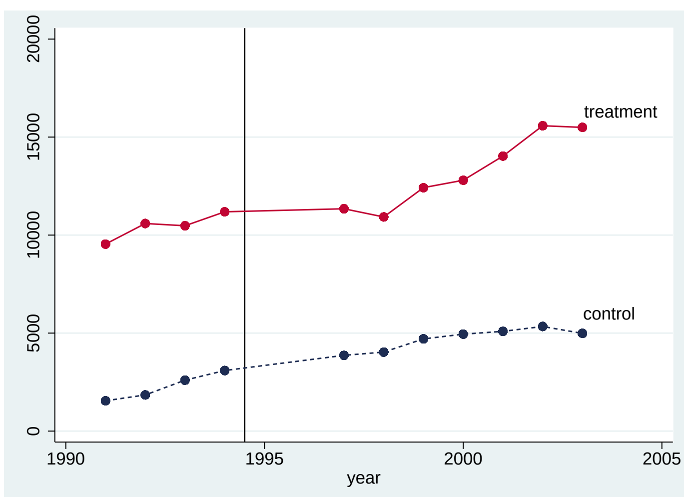
[8] A city is classified as treated if the city recorded a positive level of physical damage due to the quake.

Figure 2: Evolution of Volunteering over Time

Panel A



Panel B



Note: Solid line corresponds to the evolution of the average number of volunteers in treated cities, while dotted line corresponds to that in control cities. A city is classified as treated if the city recorded a positive level of physical damage due to the quake.

the quality of local health care service may affect both mortality and the level of volunteering. Furthermore, there may be more volunteer activities in cities with a large number of vulnerable people (reverse causality). If these concerns are valid, estimation of model (1) by OLS yields biased estimates. An unbiased estimate for β_1 can be obtained by using the Within Group (WG) estimator if the only source of endogeneity is unobserved heterogeneity. In addition, if reverse causality is also an issue, the Within Group Instrumental Variable (WG-IV) estimator should be used to obtain an unbiased estimate for β_1. The estimation using the WG-IV estimator requires an instrument which gives an exogenous variation in volunteering. In this paper, physical damage caused by the Great Hanshin Awaji Earthquake is used as an instrument for volunteering.

As described earlier, in cities greatly hit by the quake, the level of volunteering increased after the quake, while in other cities the level of volunteering smoothly evolved. Identification of the effect of volunteering requires an assumption that trends of the level of volunteering in treatment and control cities were the same prior to the quake. Panel A of Figure 2 supports this assumption.[9] Note that the fact that the level of volunteering is higher in treated cities than control cities does not invalidate the identification since the city fixed effect absorbs systematic differences in the average level of volunteering across cities.

Furthermore, it is important for the identification that treated and control cities have similar characteristics prior to the quake. Table 1 compares pre-treatment characteristics of treatment and control cities. Panel I of Table 1 indicates that age and sex compositions, a natural increase and decrease of population, divorce rate and widowed rate are not statistically different in treated and control cities. However, treated cities display higher in-migration and out-migration rates. The different migration behaviour biases estimates if migration decision is correlated to mortality and different between treatment and control cities. The difference in in-migration and out-migration rates are, however, statistically constant across pre- and post-quake period, implying that the differences in migration rates are absorbed by the city fixed effect. Panel II of Table 1 suggests that a level of educational attainment is higher in treated cities than control cities but the difference is not statistically significant. With regard to characteristics related to labour market and economy, percentage of unemployment and employment are very similar in treatment and control cities as shown in Panel III of Table 1. Per capita income and public elderly medical expenditure also seem to have no important differences.

In order to identify the causal effect of volunteering, we require another assumption that the instrument for volunteering has no direct effect on mortality. The nature of the instrument, however, raises several concerns about the validity

[9] Validity of the assumption is further investigated by regression.

Table 1: City Characteristics

	Treatment		Control		
	Mean	Std. Err.	Mean	Std. Err.	p-value
I Demography					
% Pop under 15	18.24	6.58	19.07	6.38	0.94
% Pop over 65	11.18	4.26	14.30	3.78	0.63
Sex ratio	0.95	0.15	0.94	0.14	0.96
Birth per 1,000 pop	9.80	1.55	10.04	1.70	0.93
Death per 1,000 pop	6.72	1.15	8.22	1.05	0.39
In-migration per 1,000 pop	57.96	10.54	33.41	5.08	0.02
Out-migration per 1,000 pop	58.70	10.83	34.92	5.25	0.03
% Divorced	2.63	1.17	2.11	0.94	0.75
% Widowed	7.20	2.77	9.26	2.58	0.63
II Education					
% Compulsory	18.24	6.38	28.65	7.87	0.41
% High school	33.55	12.83	31.30	11.15	0.91
% University	19.18	7.44	11.56	4.78	0.38
III Economy					
% Unemployed	1.71	0.71	1.39	0.59	0.75
% Employed	47.20	17.48	47.72	15.67	0.98
Income per cap	1,613	264	1,204	202	0.24
Elderly medical exp per cap	682	119	558	95	0.45

Labels of variables indicate the following. % Pop under 15: % of those aged under 15 over the total population; % Pop over 65: % of those aged 65 or above over the total popultaion; Sex ratio: number of male relative to female; Birth per 1,000 pop: number of births per 1,000 poplation; Death per 1,000 pop: number of deaths per 1,000 poplation; In-migration per 1,000 pop: number of inward migrants over 1,000 poplation; Out-migration per 1,000 pop: number of outward migrants over 1,000 poplation; % Divorced: % of those divorced over people aged 15 or over; % Widowed: % of those widowed over people aged 15 or over; % Compulsory; % of people whose highest education is the compulsory education (i.e., junior high school) over the total population; % High school: % of people with high school diplomas; % University: % of people with university degrees; % Unemployed: % of the unemployed over the total population; % Employed: % of the employed over the total population; Income per cap: per capita taxable income (in 1,000 Japanese yen); and Elderly medical exp per cap: per capita public medical expenditure for the elderly (in 1,000 Japanese yen). Mean reffers to weighted means where population is used as weights. Standard errors are reported next to the means. p-value reffers to p-values of t-tests under the null of equality of means in treatment and control cities.

of the assumption. For example, condition of a chronic illness may have deteriorated due to an unfamiliar life in asylums or other quake related disruption in daily life, which may lead to an increase in mortality. To handle a potential temporary increase in mortality in the aftermath of the quake, we omit year 1995 from the sample. The quake occurred in January 1995 and the number of refugees recorded 316,678 at the peak in January 1995. The number of refugees, however, steadily decreased as (re)construction of houses and temporary housing kept on and 97 percent of refugees left asylum by August.[10] The quake also caused a serious damage to infrastructure: water, electricity, gas supply and phone lines were cut off in the disaster area right after the quake.[11] Recovery of the infrastructure was, however, extremely rapid. Electricity and phone lines were recovered by the end of January 1995 and water and gas supply was recovered by the end of April 1995. Moreover, medical facilities were also heavily damaged by the quake. As of 25th January 1995, 33 percent of hospitals and clinics in Hyogo prefecture were closed due to damage to buildings or disruption in infrastructure. Within a month, however, 70 percent of hospitals and clinics resumed and 93 percent resumed by the end of 1995. Omitting year 1995 from the sample, hence, addresses a possibility of an increase in mortality induced by a temporary disruption in a daily life, infrastructure and medical facilities.

Nevertheless, there may still be a concern that the quake has a long term consequences on mortality even after omitting year 1995 from the sample. For instance, the quake may have disproportionately killed infirm people such as the elderly, which leads to a lower mortality later on since relatively fitter people survived. Moreover, mental stress induced by, for example, facing deaths of a large number of people or loosing houses may have a persistent effect on mortality even after 1995. To address this concern, we further restrict the sample and drop a set of cities heavily damaged by the quake. Figure 3 shows cities in Hyogo according to their damage status. Shaded area in Figure 3 corresponds to the set of cities which recorded positive level of physical damage.[12] Among the set of cities with damage, the gray area corresponds to a subset of cities which recorded moderate damage, while the black area corresponds to a subset of cities highly damaged.[13] These are four cities close to the epicentre and account for a substantial amount of physical

[10] By the end of 1995, almost every refugee left asylums.

[11] Water, electricity and gas supply and phone lines were cut off in 1,270, 2,600, 845 and 100 thousand households, respectively, right after the quake.

[12] Damage is measured by the number of deaths, people injured and destroyed households. Here "death" corresponds to accidental deaths due to a direct effect of the quake such as being crushed or killed in a fire.

[13] A city recorded above the 75th percentile value of deaths is classified as a highly damaged city. The median value is also tried as a robustness check.

damage due to the quake.[14]

Omitting these cities has several implications. Firstly, most individuals died due to the direct effect of the quake were living in these highly damaged cities. Therefore, if the quake killed vulnerable people disproportionately, it would have happened in these omitted cities. Secondly, if mental stress caused by, for example, facing to a large number of deaths or severe destruction of houses and communities had a long term effect on mortality, it would have affected mortality in omitted cities. Furthermore, approximately 98 percent of refugees stayed in these cities. If a life in asylums had a long term effect on mortality, again, it is likely to have happened in these cities. Finally, as mentioned earlier, medical facilities were also heavily damaged by the quake. Given that the most disruption in medical facilities was restored by the end of 1995, any effect of the disruption on mortality is likely to be accounted for by omitting year 1995 from the sample. Nevertheless, one may still be concerned that the disruption in medical facilities had long term consequences. For example, a condition of chronic disease deteriorated because one could not get adequate medical treatment during 1995. Omitting cities heavily damaged by the quake handles this concern since medical facilities which experienced heavy damage were concentrated in omitted cities.[15] Yet, we control for supply of medical treatment such as the number of hospitals, clinics and doctors in the regression as a robustness check.

4 Data and Variables

Our sample consists of observations for 88 cities in Hyogo prefecture from 1990 to 2003. Mortality data is obtained from Current Population Survey (*Jinko Dotai Chosa*) conducted every year by Ministry of Health, Labour and Welfare. The Survey is conducted since 1898 and collects data on birth, death, stillbirth, marriage and divorce. Given that age specific mortality is not available at city level, data on mortality sorted by causes of death is taken from the survey.

Volunteering data is available from Activity Report of the Hyogo Council of Social Welfare (*Kennai Syakyo Katsudo Genkyo Chosa*). The report provides various figures related to volunteering such as the number of volunteers and volunteering groups at city level in Hyogo prefecture. Furthermore, the report describes characteristics of volunteers and care receivers as well as problems and challenges

[14]The four cities account for 98, 85 and 88 percent of the total deaths, serious injury and full destruction of houses, respectively. Particularly Kobe city alone accounts for considerable amounts of damage: 71, 60 and 61 percents of the total deaths, serious injury and full destruction of houses, respectively.

[15]As of 27th February 1995, about 99 percent of hospitals and clinics closed were in omitted cities.

Figure 3: Damaged Areas

Note: Shaded area corresponds to the set of cities which recorded physical damage due to the quake. Among damaged cities, the black area is a subset of cities highly damaged by the quake, while the gray area is a subset of cities suffered from moderate damage.

which volunteer activities in Hyogo are facing. The report is a useful source of information about volunteering in Hyogo prefecture and can be obtained from 1990 onwards.

Data on quake damage is obtained from Fire Service White Paper 1996 (*Hesei 8 Nenban Syobo Hakusyo*) and the website of Hyogo Prefecture. They report level of physical damage due to the quake officially confirmed by the Fire and Disaster Management Agency of the Ministry of Internal Affairs and Communications. The quake damage is categorized into damage on humans and buildings and each category is further divided into sub-categories according to extent of damage.

Public medical expenditure for the elderly is available from National Health Insurance and Health Insurance for the Aged in Hyogo 1990 to 2003 (*Hyogo no Kokuho Rouken*). The document summarises public expenditure related to health at city level in Hyogo prefecture. Data of covariates other than the public medical expenditure is obtained from a survey report, System of Social and Demographic Statistics of Japan (*Syakai Jinko Tokei Taikei*). The survey covers every municipality in Japan and collects information on socio-economic and demographic conditions of municipalities. The survey has been conducted since 1976 and provides 1,500 social and demographic variables by municipality. As socio-economic indicators, we use measures of economic activity, demography and educational level at city level: taxable income per capita, unemployment rate, sex ratio, number of the elderly, number of divorce and high school participation rate. These are potential determinants of mortality suggested by Menchik (1993).

5 Results

We begin by presenting the WG estimates of the first stage equation of model (1). Table 2 shows the estimates of regressions in which the logged number of volunteers is regressed on damage indicators and other controls between 1990 and 2003. In every specification, year 1995 is omitted from the sample to mitigate a concern that mortality is directly affected by the quake in the aftermath. The quake damage is measured by four damage indicators; percentage of (i) people seriously injured, (ii) people lightly injured, (iii) households whose houses are fully destroyed, and (iv) households whose houses are half destroyed. Columns (1) to (4) correspond to a specification that controls only for city and year fixed effects. Effects of the quake damage on volunteering are positive regardless of types of damage indicators. In addition to city and year fixed effects, we further control for socio-economic indicators: columns (5) to (8) correspond to a specification that accounts for logged income level, unemployment rate, sex ratio, logged number of the elderly, logged number of divorce and high school participation rate. The result indicates a bigger

effect of each damage indicator on volunteering and the p-values are now lower. For example, column (6) shows that one percentage point increase in percentage of people lightly injured raises the number of volunteers by approximately 20 percent on average, cateris paribus. Finally, in order to deal with a concern that the quake had a long term consequences on mortality even after 1995, in Table 3 we restrict the sample and omit observations for highly damaged cities. The results are robust to the restriction of the sample: the effects of damage on volunteering are even bigger and highly statistically significant. An interesting point to note is that an increase in the magnitude of the coefficients implies that the level of volunteering increased most not in the highest damaged cities but in the moderately damaged cities.

Table 4 summarises results of IV regressions in which the logged number of deaths due to natural causes is regressed on the logged number of volunteers and other covariates. Results displayed in Table 4 uses percentage of people lightly injured as an instrument for volunteering.[16] Odd number columns present WG estimates of β_1 in model (1), whereas even number columns show reduced form estimates of the effect of the quake damage on mortality. The results are considerably robust to different sets of covariates as well as different sample composition. Firstly, columns (1) and (2) correspond to a specification that controls only for city and year fixed effects. The effect of volunteering on mortality is negative and statistically significant and so does the reduced form estimate. However, the estimate in column (1) is biased if any difference across cities which varies over time is correlated to the level of volunteering. To account for time varying heterogeneity across cities which may affect mortality, socio-economic indicators are added to the specification in columns (3) and (4). The estimates are even bigger in absolute terms and highly statistically significant. Finally, we restrict the sample in columns (5) to (8) and omit observations for highly damaged cities in order to tackle a concern that the quake had a direct effect on mortality even in the long run. Results reconfirm the previous findings and estimates obtained from the restricted sample is not statistically different from those from the full sample. For example, the estimate in column (7) suggests that one percent increase in the number of volunteers reduces mortality by about 0.13 percent on average, ceteris paribus. Evaluating at the mean, the estimate implies that roughly three people save their lives in a given year when volunteers increase by 100 people.[17] Therefore, we conclude that volunteering not only yields individual returns such as an increase in well-being of volunteers themselves (e.g., Morrow-Howell et al., 2003), but also brings about

[16]Using other instruments do not modify findings significantly as is expected from the robust first stage results.

[17]The unconditional mean of the annual number of deaths due to natural causes is 466 in our data.

Table 2: Effect of the Quake Damage on Volunteering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Controls	CityFE+YearFE				Full Controls			
Damage Indicator	% seriously injured	% lightly injured	% half destroyed hh	% fully destroyed hh	% seriously injured	% lightly injured	% half destroyed hh	% fully destroyed hh
	0.501	0.170***	0.0203**	0.0137*	0.755*	0.201***	0.0252**	0.0195**
	(0.369)	(0.0390)	(0.00953)	(0.00764)	(0.453)	(0.0356)	(0.00976)	(0.00863)
# of Obs	1,007	1,007	1,007	1,007	1,007	1,007	1,007	1,007
R-squared	0.179	0.195	0.190	0.187	0.192	0.209	0.203	0.203
# of Cities	88	88	88	88	88	88	88	88

Notes: Standard errors are clustered by city. *** denotes p<0.01, ** denotes p<0.05 and * reffers to p<0.1. The dependent variable is the number of volunteers. Controls included into the analysis are income per capita, unemployment rate, sex ratio, the number of people aged 65 or over, the number of divorces, high school participation rate, city and year fixed effects. Every variable in level is logged. Four damage indicators correspond to percentage of (i) people seriously injured, (ii) people lightly injured, (iii) households whose houses are fully destroyed, and (iv) households whose houses are half destroyed. Year 1995 is omitted from the sample.

Table 3: Effect of the Quake Damage on Volunteering with Restricted Sample

	(1)	(2)	(3)	(4)
Damage Indicator	% seriously injured	% lightly injured	% half destroyed hh	% fully destroyed hh
	3.445**	0.225***	0.0397***	0.0268***
	(1.458)	(0.0377)	(0.00993)	(0.00841)
# of Obs	955	955	955	955
R-squared	0.207	0.213	0.213	0.212
# of Cities	84	84	84	84

Notes: Standard errors are clustered by city. *** denotes p<0.01, ** denotes p<0.05 and * reffers to p<0.1. The dependent variable is the number of volunteers. Controls included into the analysis are income per capita, unemployment rate, sex ratio, the number of people aged 65 or over, the number of divorces, high school participation rate, city and year fixed effects. Every variable in level is logged. Four damage indicators correspond to percentage of (i) people seriously injured, (ii) people lightly injured, (iii) households whose houses are fully destroyed, and (iv) households whose houses are half destroyed. Year 1995 as well as four highly damaged cities are omitted from the sample.

social benefits.

6 Conclusions

The paper explores the causal effect of volunteering that mainly targets the elderly on mortality. To identify the causal effect on mortality, we exploit an exogenous variation in volunteering caused by the earthquake which hit the Midwestern part of Japan in 1995. The level of volunteering greatly increased in cities damaged by the quake, while cities not damaged by the quake did not experience such increase. Based on comparison of mortality in cities hit by the quake and not hit by the quake, our results suggest that one percent increase in the number of volunteers reduces the number of deaths due to natural causes by approximately 0.13 percent on average. The results are robust even after omitting highly damaged cities from the sample to mitigate a concern that some direct effects of the quake is driving the results. Although the nature of the data does not allow us to pin down if the reduction in mortality occurs on the side of care givers or care receivers, the reduction is likely to be driven by a reduction in mortality of care receivers since those

Table 4: Second Stage and Reduced Form

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Restricted Sample			
Controls	cityFE+yearFE		Full Control		cityFE+yearFE		Full Control	
	Second	RF	Second	RF	Second	RF	Second	RF
	-0.150***	-0.0256***	-0.154***	-0.0310***	-0.143***	-0.0305***	-0.133***	-0.0298***
	(0.0340)	(0.00722)	(0.0386)	(0.00357)	(0.0328)	(0.00458)	(0.0305)	(0.00337)
# of Obs	1,007	1,007	1,007	1,007	955	955	955	955
# of Cities	88	88	88	88	84	84	84	84

Notes: Standard errors are clustered by city. *** denotes p<0.01, ** denotes p<0.05 and * reffers to p<0.1. The dependent variable is the number of deaths due to natural causes. Controls included into the analysis are the number of volunteers, income per capita, unemployment rate, sex ratio, the number of people aged 65 or over, the number of divorces, high school participation rate, city and year fixed effects. Every variable in level is logged. Percentage of people lightly injured is used as an instrument of volunteering. Year 1995 is omitted from the sample in every regression and additionally observations for four highly damaged cities are omitted in regressions in columns (5) to (8).

who provide volunteer work are relatively younger and fitter than care receivers.[18] Moreover, our estimates indicate a contemporaneous effect of volunteering on mortality and hence they capture a short run effect of volunteering. To the extent that volunteering also reduces mortality of those who provide volunteer work as suggested by previous literature (e.g., Luoh and Herzog, 2002), effects of volunteering on mortality may be even higher in the long run since volunteers are less likely to die due to natural causes shortly after they provide volunteer work.

We contribute to literature on the effect of volunteer work by revealing the causal effect of volunteering on mortality. Volunteer work is not only associated with individual benefits such as an increase in happiness of volunteers (c.f., Thoits and Hewitt, 2001) but also yields social benefits. Given that population ageing is proceeding in considerable speed in Japan and burdening public health care expenditure, contribution of volunteers to longevity and healthy life is important for maintenance of the society. The results also have an implication for other developed countries where the governments face tight budgets. For example, the UK government seeks to build a "Big Society" in which the government transmits more power to private sectors and neighbourhood groups, presuming that private companies, charities and voluntary groups could run public services (BBC, 2011). This study yields an implication for the "Big Society" policy by showing that volunteers can indeed contribute to longevity and better health. Moreover, most volunteers are those not in labour force such as housewives, outcomes of whose activities are hard to measure. The results, however, suggest that their activities yield sizable social benefits and hence policies which encourage volunteering would help mobilizing (human) resources available to the society to enhance well-being of individuals.

[18] As of 2000, volunteer activities known to the HCSW target the elderly, the disabled and people in hospitals and care homes. On the other hand, those who participate in volunteering are presumably fit enough to provide volunteer work and roughly 60% of volunteers are aged below 60. In Japan, those aged below 60 account only for roughly 10 percent of the total deaths due to natural causes.

References

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