POPULATION－BASED SURVEY ON INDIRECT HEALTH EFFECTS AFTER THE 1995 GREAT HANSHIN-AWAJI EARTHQUAKE

By

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ABSTRACT

A population-based survey was conducted to estimate the structural damage and non-structural damage in terms of inconvenience of daily life (IDL). The questions regarding indirect health effects were included to compare IDL according to their occurrence. IDL was high in Nada and Higashi-Nada districts of Kobe City and Ashiya City, and low in Itami City. IDL is an indicator to measure living conditions of the affected population in not only impact phase but also early recovery stage. Further analysis is required to define the meaning of IDL to decrease overall indirect health effects.

KEY WORDS : Inconvenience of daily life
(Daily living disruption)
Indirect health effects

1. INTRODUCTION

We presented regional variation of acute myocardial infarction (AMI) mortality among the affected populations[(1)] to show the magnitude of indirect health effects (any kind of health effects, not caused by seismic force) after the 1995 Great Hanshin-Awaji Earthquake. Nada and Higashi-Nada district suffered from large indirect health effects in terms of duration and magnitude of increased AMI mortality. Increased cardiac mortality had continued for a few months after the 1995 Great Hanshin-Awaji Earthquake[(1),(2)]. The period was much longer than those previously observed in USA[(3),(4)], Austraria[(5)], Greece[(6),(7)]. These results have made us recognize the need to analyze living conditions of the affected people to explain regional variation of indirect health effects.

There are very few studies to measure life conditions after an earthquake and compare among the regions. To estimate overall impact on the affected population, we conducted population-based survey regarding living conditions in several regions; Nada and Higashi-Nada district of Kobe City, Ashiya, Nishinomiya, Itami City and the Hokudan area of Awaji Island.

In addition to several questions regarding indirect health effects, inconvenience of daily life activities from post-earthquake suspension of utility services was measured, and their regional variation was analyzed.

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2. METHODS

We conducted simple random sampling between two and three years after the 1995 Great Hanshin-Awaji earthquake to select households and send self-administered questionnaires in Nada and Higashi-Nada district of Kobe City, Ashiya, Nishinomiya, Itami City and the Hokudan area of Awaji Island. The household selection was based on the voters registries at that time.

The questionnaires mainly consist of two parts. The one is about structural and non-structural damage including inconvenience of daily life activities from post-earthquake suspension of utility services[8],[9]. The other part is about indirect health effects.

We numerically evaluated difficulties people experienced in daily life at home due to water, power and gas suspension. We measured the extent of inconvenience in terms of a numerical score named the difficulty index, DI.

The difficulty index was defined as:

$$DI = \Sigma \{(\text{Degree of Difficulties})_i \times (\text{Duration of Difficulties})_i\}$$

Degree of Difficulties is a numerical score between 0 and 10 and shows the extent to which a daily life activity is restricted compared with that before the earthquake; 10 for total restriction and 0 for no restriction. Duration of Difficulties is in the number of days during which an activity was restricted due to lifeline disruption. The difficulty index is summed up regarding the following five life activities;

1) cooking
2) toilet use
3) washbasin use
4) taking a bath
5) washing clothes.

In addition, the following questions to indicate the occurrence of indirect health effects were included in the questionnaires:

1) Did you visit a doctor (excluding visits due to injuries) within six months after the earthquake?
2) Were you sick in bed and did you stay at home within six months after the earthquake?
3) Were you been hospitalized (excluding hospitalization due to injuries) within six months after the earthquake?
4) Did you suffer from any chronic diseases before the earthquake?
5) Did you discontinue your treatment or medication after the earthquake?

The questionnaire included age and sex of respondents.

Statistical analysis to compare IDL among groups were performed using the SAS variance component procedure PROC ANOVA.

3. RESULT

Table 1 shows completion proportions of the questionnaires in the six regions. They ranged from 31.9 to 38.6 percents.

Table 2 shows 95% confidence interval (CI) for a population mean of inconvenience of daily life (IDL) and a population proportion of completely destroyed houses (total damage rate). IDL was high in Nada (CI:

977-1295) and Higashi-Nada (CI: 1019-1229) and Ashiya (CI: 904-1154). Proportions of completely destroyed houses were high in Nada (CI: 25.2-33.1), Higashi-Nada (19.8-27.2), and Hokudan (CI: 16.2-32.4), followed by Ashiya (CI: 14.6-24.6) and Nishinomiya (CI: 13.6-17.9). In Hokudan, a proportion of completely destroyed houses was high, but IDL was low (CI: 247-485) in comparison with other regions.

Table 3 shows means and standard deviation (SD) of IDL according to the level of structural damage of the houses. IDL was high among the most damaged group and low among the least damaged group in Nada, Higashi-Nada, Nishinomiya and Hokudan. On the other hand, this finding was not observed in Ashiya and Itami. The difference in IDL among the regions was statistically significant ($P<0.001$) at all the levels of structural damage.

Table 4 shows 95% confidence interval for a population proportion regarding the occurrence of indirect health effects within 6 months after the earthquake. Itami City, which was less damaged, had lower proportions that people visited a doctor more than once or were sick in bed and stayed at home. There was no difference between regions regarding proportions that people had suffered chronic diseases before the earthquake. Proportions that affected people with chronic diseases could continue their medication as usual was lowest in Nada (39.6%) followed by Higashi-Nada (41.1%), Hokudan (57.7%), Ashiya (58.0%) and Nishinomiya (63.4%). The proportion was highest (86.9%) in Itami.

Table 5 shows analysis of variance of inconvenience of daily life (IDL) according to the occurrence of indirect health effects within 6 months after the earthquake. The group who suffered indirect health effects had higher IDL than the other. The difference between them was statistically significant ($P<0.01$ and $P<0.001$).

4. DISCUSSION

We conducted population-based survey regarding the structural damage and non-structural damage in terms of inconvenience of daily life (IDL). IDL was high in Nada and Higashi-Nada and low in Itami. It suggests IDL was high in a group with severe structural damage. On the other hand, Hokudan had relatively lower IDL even with severe structural damage. Considering the proportions regarding health episodes in the questionnaires, Nada and Higashi-Nada and Hokudan had suffered more indirect health effects. The group with more indirect health effects had higher IDL.

Our previous analysis [(1)] with respects to acute myocardial infarction (AMI) mortality following the 1995 Great Hanshin-Awaji Earthquake showed increased mortality in several regions such as Nada and Higashi-Nada district. The results of the questionnaires in this study agree with those findings. Prolonged duration of increased AMI mortality suggests that some factors in not only impact phase but also early recovery stage may be related with the occurrence of indirect health effects. Inconvenience of daily life due to lifeline disruption is an indicator to represent life

conditions after the earthquake. More detailed analysis will be required to show the relationship between IDL and indirect health effects. We should also estimate quantitatively the impact of disruption of their medication or treatment to chronic diseases. It may lead to increase of health effects.

This population-based survey was conducted under limited conditions (2 or 3 years after the earthquake). It resulted in relatively low completion proportion. Ecological study is very useful to develop the hypothesis about the etiology of some health effects. Population-based study is essential for this purpose even though high population movement after the earthquake makes it difficult.

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Table 1 Completion proportions to the questionnaires in the six regions

Region	Total number of households	Total number of mail surveys	Number of responders	Completion proportions (%)
Nada District, Kobe City	54,800	1,530	507	33.1
Higashi-Nada District, Kobe City	73,600	1,299	502	38.6
Ashiya City	33,400	705	240	34.0
Nishinomiya City	160,300	3,262	1,105	33.9
Itami City	68,200	1,380	456	33.0
Hokudan area	2,600	335	107	31.9

Table 2 95% confidence interval (CI) for a population mean of inconvenience of daily life and a population proportion of completely destroyed houses

Region	95% CI for a population mean of inconvenience of daily life	95 % CI for a population proportion of completely destroyed houses (%)
Nada District, Kobe City	977-1295	25.2-33.1
Higashi-Nada District, Kobe City	1019-1229	19.8-27.2
Ashiya City	904-1154	14.6-24.6
Nishinomiya City	741-843	13.6-17.9
Itami City	131-199	1.2-4.1
Hokudan area	247-485	16.2-32.4

Table 3 Means and standard deviation (SD) of inconvenience of daily life according to the level of structured damage of the houses

Region	Level of structural damage			
	Level 1	Level 2	Level 3	Level 4
Nada District,Kobe City	2429±2818 (N=51)	1044±717 (N=95)	905±560 (N=102)	576±342 (N=55)
Higashi-Nada District, Kobe City	1508±1387 (N=45)	1274±1000 (N=103)	931±597 (N=144)	715±434 (N=18)
Ashiya City	756±532 (N=12)	1176±831 (N=47)	1031±716 (N=63)	714±416 (N=17)
Nishinomiya City	1338±1212 (N=81)	926±718 (N=157)	724±534 (N=366)	517±442 (N=146)
Itami City	138±113 (N=7)	257±411 (N=80)	133±211 (N=135)	119±203 (N=54)
Hokudan area	706±706 (N=11)	320±360 (N=30)	278±314 (N=11)	108±78 (N=4)

Level 1; The house was completely destroyed.

Level 2; The house was partially destroyed.

Level 3; The house was slightly damaged (structural damage was less than that of level 2).

Level 4; The house was not damaged.

Table 4 95% confidence interval for a population proportion regarding the occurrence of indirect health effects within 6 months after the earthquake

Indirect health effects within 6 months after the earthquake (excluding those due to injuries)	95% confidence interval for a population proportion (%)					
	Nada	Higashi-Nada	Ashiya	Nishinomiya	Itami	Hokudan
1) Visiting a doctor more than once	42.4-51.3 (N=230)	45.1-54.0 (N=239)	35.7-48.5 (N=96)	34.3-40.1 (N=393)	19.5-27.4 (N=104)	36.9-56.9 (N=45)
2) Being sick in bed and stay at home	20.0-27.7 (N=113)	23.8-31.8 (N=133)	17.5-28.5 (N=52)	21.1-26.2 (N=247)	10.3-16.8 (N=57)	14.2-31.4 (N=21)
3) Being hospitalized	3.6-7.8 (N=27)	2.6-6.2 (N=21)	4.7-11.9 (N=19)	3.9-6.6 (N=55)	2.1-5.8 (N=17)	2.9-14.5 (N=8)
4) Suffering chronic disease before the earthquake	29.5-38.1 (N=157)	24.1-32.3 (N=131)	24.8-36.7 (N=71)	25.9-31.4 (N=293)	25.8-34.7 (N=123)	20.3-40.0 (N=26)

Table 5 Analysis of variance of inconvenience of daily life according to the occurrence of indirect health effects within 6 months after the earthquake

Indirect health effects within 6 months after the earthquake (excluding those due to injuries)		Mean ± SD	P-value
1) Visiting a doctor more than once	Yes	1046±1182 (N=677)	
	No	683±684 (N=1137)	P<0.001
2) Being sick in bed and stay at home	Yes	1069±995 (N=384)	
	No	744±752 (N=1403)	P<0.001
3) Being hospitalized	Yes	1148±1197 (N=78)	
	No	806±903 (N=1714)	P<0.01