

# Multidisciplinary Cooperative Research to Mitigate Medical Consequences after the Earthquake

by

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## ABSTRACT

One important role of the epidemiologists in disaster research is to assess the relationships between possible causal variables and health outcomes. Accordingly, it is essential to evaluate the association between certain factors and health effects in the disaster-affected population. Past studies suggest that post-earthquake "stress" condition could be related with the medical consequences in the immediate, short, and long term periods. The objective of the present study is to design a proposal to evaluate the association between the inconvenience of daily life due to the lifeline disruption and indirect health effects such as the incidence rate of coronary heart disease. Understanding of causal variables enables us to determine the most rational method to allocate resources toward minimizing adverse health outcomes, and to improve the decision-making process at the central (governmental disaster managers) as well as the local (community) levels. More efforts are required to evaluate the relationship between environmental factors and indirect health effects.

Multidisciplinary cooperation is most essential to elucidate causing factors.

**KEYWORDS:** multidisciplinary research  
lifeline disruption  
indirect health effects  
risk factor

## 1. INTRODUCTION

The roles of epidemiologists in the disaster research have been discussed (Western, 1972; Noji, 1992) and non-experimental (observational) studies have been performed to identify the risk factors influencing the health outcome (Jones, 1990). Multidisciplinary cooperative researches following earthquakes have evaluated the association between the structural elements and mortality and morbidity directly caused by the structural damages (Jones, 1994). For example, fatalities were examined to estimate the relationship with certain types of the buildings after the Armenian earthquake in 1988 (Noji, 1990). Precast concrete frame was associated with highest mortality per building.

The causal variables related with indirect health effects, however, have not been fully discussed. This "indirect health effect", defined as all health problems not caused directly by the structural damages, are usually reported as long-term health effects. Past studies have suggested that post-disaster stress conditions could be related with indirect health effects.

Some environmental factors or personal experiences such as material loss or death of family members can be indicative of "stressors".

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The disruption of the lifeline, availability of utilities i.e., electricity, water, gas, etc., on which the population depend, is the characteristics of urban disasters. The magnitude of the damage in such disasters has been estimated as the number of the affected population due to the lifeline disruption and the duration required for the reconstruction. These numbers are not sufficient to quantify the total influence on the affected population. The modified indicator should be developed to estimate the overall impact on the population due to lifeline disruption. "The overall impact" should include the stress due to the disruption.

## 2. OBJECTIVES

The objective of the present study is to establish a proposal which clarifies the causal mechanism and the degree of indirect health effects due to the lifeline disruption after an earthquake.

To achieve this general objective, the specific objective is to assess the association between the inconvenience of daily life due to the lifeline disruption and the incidence of coronary heart disease (CHD) rate and several medical consequences after adjusting the possible confounding factors. The incidence rates of CHD and the other medical consequences should be compiled in a population-based study.

## 3. BACKGROUND AND IMPORTANCE OF PROJECT

The roles of epidemiologists in the disaster research are three folds;

1. To monitor the health effects on the affected population
2. To investigate the causal relation between environmental factors and the health effects
3. To develop the preparedness strategies

in the health sector and to evaluate their effectiveness.

Various studies have investigated the damage of structural elements as risk factors for the health outcomes following earthquakes in Guatemala (Glass, 1977) and in Italy (de Bruycker, 1985) and in Armenia (Noji, 1990). Rescue and medical care were analyzed to determine the effective preparedness strategies to reduce the human casualties (Noji, 1993). De Ville stressed the importance of epidemiologic surveillance to monitor the health effects after the Guatemala earthquake (de Ville, 1976). From the engineering standpoint, there have been investigations on earthquake mortality to define the affecting factors (Coburn, 1987) and to develop the prediction model (Shiono, 1991b).

Most studies after earthquakes, however, were focused on the direct health effects or indirect health effects in rural communities. Investigations on the indirect health effects in urban disasters have been limited.

Indirect health effect refers to all medical health consequences not directly caused by structural damages from the seismic activities during the earthquake. There are a few studies describing indirect health effects (Logue, 1981b). Rapid increase of the mortality from coronary heart disease as reported after the Greece earthquake (Katsouyanni, 1986). Logue emphasized physical and mental disorders among the affected population after a hurricane as indirect health effects (Logue, 1978, 1979, 1980, 1981a). The long-term health effects after the Great Hanshin-Awaji earthquake have also been reported. The importance of long term observations were addressed, and social support such as the provisions and maintenance of daily life was regarded as important elements (Sato, 1997).

Considering the duration and the number of

the cases of the indirect health effects, the overall impact on the affected society cannot be overlooked.

#### 4. RESEARCH AND METHODOLOGY

##### (1) Hypotheses

The indirect health effects after an earthquake in this study is defined as "any kind of health outcomes in both short and long terms after the impact phase which were not caused by structural damages of seismic activities".

The hypotheses to be tested in this investigation is the indirect health problems attributed to the inconveniences of daily life due to lifeline disruption after the Great Hanshin-Awaji earthquake.

##### (2) Study rationale

After the Great Hanshin-Awaji earthquake, the increased prevalence of hypertension, coronary heart disease and mental disorders has been reported (Sato, 1997). Some studies have suggested that the post-earthquake stress caused adverse medical outcomes after the earthquake. Knowledge of the causal mechanism of indirect health effects enables us to decide the most rational way to allocate resources especially in the early rehabilitation stage. These points are essential to minimize the overall health effects. The cohort study on health-effects after the Armenia earthquake (Melkonian, 1997) showed higher risks of morbidity, especially for CHD in persons exposed to more stressors.

In this report, the stressors included major losses such as financial property or death of family members. The magnitude of mental and physical stress that the people receive during the response and rehabilitation phases should be measured, and causal mechanism should be fully analyzed.

##### (3) Study design and study subjects

Three different methods are proposed.

##### a) Case-control study (Proposal 1)

The CHD cases are compared with control cases regarding the inconvenience of daily life due to lifeline disruption. The cases are selected by the hospital record at the major hospitals in the affected area. The controls are selected among the patients who visited the same hospitals for common medical problems on the same day and had lived in the same district as the cases. Both cases and controls should be restricted to persons who remain in the same residence from the onset of the earthquake to the sampling point. We will then compare the strength of the association with the inconveniences of daily life between cases and controls.

##### b) Retrospective cohort (Proposal 2)

b-1) The inhabitants who had received annual health checks before the earthquake are followed up. We compare the results of both occasions with respect to blood pressure, EKG, blood examinations including liver function.

b-2) The incidence rate of CHD is measured by the claim history file of national health insurance. We will calculate relative risk of inconvenience of daily life for occurrence of indirect health effects, after adjusting for the effects of socio-demographic data and personal damage due to the earthquake.

##### c) Ecological study (Proposal 3)

The correlation between the inconvenience of daily life and the incidence rate of CHD would be examined across all district which was affected by the earthquake.

#### (4) Variables to be measured

The following variables are measured in each study.

- a) Personal damage due to the earthquake
- b) Inconvenience of daily life due to the lifeline disruption
- c) Socio-demographic data
- d) Possible confounders
- e) Indirect health effects

##### a) Personal damage due to the earthquake

Personal damage due to the earthquake is an important factor in estimating individual stress. The data to be measured include loss of family members and property damage.

##### b) Inconvenience of daily life due to lifeline disruption

The inconvenience of daily life due to the disruption of lifeline system is measured as possible causal factors for the stressors after the Great Hanshin-Awaji earthquake.

The extent of inconvenience due to post-earthquake suspension of utility service (electric power, water and gas supplies) is calculated in terms of a numerical score consisting of the degree of restriction and the period of restriction. "Degree of restriction" is defined as the extent to which living activities (cooking, toilet use, bathing and washing clothes) is restricted, compared with those of the pre-earthquake condition. "Period of restriction" represents the number of days during which activities are affected. Estimating "degree of restriction" requires detailed information on the suspension pattern of the three utilities and living pattern of the affected people (the level of dependence on the utilities).

The inconvenience of daily life was investigated after the Chiba-Ken-Toho-Ok

earthquake in 1987 (Shiono, 1989 and 1991a). It was originally aimed at developing a prediction model to estimate the difficulties that people would experience due to the disruption of three utility services: gas, water, and electric power. The study measures more direct impacts on the population than just the number of the affected people and the days required for the recovery.

In the prediction model, the validity was established, based on the comparison of the predicted result and direct observation with a survey method.

In summary, the inconvenience can be estimated on the individual bases from the existing data when the study subjects continue to reside in the same residence before and after the earthquake.

##### c) Socio-demographic data

The relationship between psychosocial factors and coronary heart diseases has been suggested (Haynes, 1978). All of known risk factors for CHD should also be measured.

##### d) Possible confounders

In order to avoid confounding bias, we should measure the obesity level and smoking habits.

##### e) Indirect health effects

Determining a standardized classification and definition of the earthquake-related health effects is required to assess the relationship between health outcomes and causing variables.

In the case-control study (proposal 1), the occurrence of CHD is investigated. In the

retrospective cohort (proposal 2), the results of the annual health checks including blood pressure, EKG and blood examination is compared between before and after the earthquake. The incidence rate of CHD is measured by the claim history file of national health insurance. In the ecological study (proposal 3), the incidence rate of the CHD is measured.

#### (5) Methodological problems and limitations

The above formula, developed to predict the inconvenience due to lifeline disruption in future disasters, is based on data pertaining to individual households. We, therefore, should restrict the study to subjects who remain living in the same household after the disaster.

### 5. SUMMARY

The epidemiological approach is very useful in the investigation to identify the risk factors and to elucidate the causal relation. Multidisciplinary cooperation is essential in analyzing the consequences after the disasters.

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