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Healthcare utilization of bereaved family members following the 1999 Chi-chi earthquake: Evidence from administrative data

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ABSTRACT

Objective: Strong earthquakes not only cause death and property damage, but also have continuous repercussions on the survivors' health. This study investigates the impact of the 1999 Chi-chi earthquake to understand how an earthquake disaster affects healthcare utilization differently between individuals who lost co-resident family members (victims) and those who did not (non-victims).
Methods: We utilize the household registration records from the Ministry of the Interior as well as claim data from the Bureau of National Health Insurance in Taiwan from 1998 to 2000. Such datasets enable us to identify the relationship of the survivors with the dead and contain the residents' detailed healthcare utilization records. The difference-in-differences method is used to explore the changes in healthcare utilization.
Results: Our results indicate that the victims had a higher probability of using inpatient care than the non-victims; and the victims who lost their parents tended to use more inpatient services than the other victims. As for the changes in outpatient utilization, the difference between victims and non-victims, and among victims who lost different family members appears to be statistically insignificant.
Conclusion: Compared to non-victims, victims were more likely to use inpatient care after the Earthquake, particularly the victims who lost parents. However, the impacts of the Earthquake on outpatient care are statistically indifferent between victims and non-victims. One possible explanation is that the abundance of primary care and social support services provided by emergency medical assistance teams and/or non-governmental organizations after the Earthquake had substituted for regular outpatient utilization.

Introduction

Natural disasters affect millions of people and cause colossal property damage every year. From 2001 to 2011, eight deadly earthquakes, measured at 6.0 M_W or above, caused more than 760,000 deaths and over 343 billion US dollars in economic losses [1]. Survivors were often injured, found themselves in perilous situations, or confronted death around them. Relief works such as rescue efforts and medical care support were all aimed at meeting their immediate needs.

Since disasters continue to occur around the world, seemingly at an increasing rate, investigating their impacts on survivors' health has thus attracted considerable attention. Past studies addressing this issue mainly utilized the post-disaster survey data [2–18]. Nevertheless, such datasets have failed to remove the biases resulting from the permanent differences between the affected individuals and others. In order to avoid biases and capture more accurate impacts, some survey-based studies have employed a pre–post design [19–23]. Because survey data are often very costly and subject to limited sample size and recollection error, a few studies have recently utilized the administrative longitudinal data to overcome these obstacles [24–27].

This study adds significantly to the small body of pre–post studies of healthcare utilization by using household registration records and the claim data from the National Health Insurance (NHI). The difference-in-differences (DID) method, designed to remove the time-trend biases and the initial differences between the affected and others, was conducted to compare the impacts of severe disasters on those two groups.

Past studies based on post-disaster surveys showed that the exposed individuals experienced post-traumatic symptoms, such as sleep disturbances, depression, anxiety, and alcoholism or drug misuse [3,5,6,8,9,11]. Some demonstrated that posttraumatic stress disorder (PTSD) occurrence was correlated with the disaster severity, and loss of lives and property [3,5,9,11,14,17]. Studies that discussed the suicidal thoughts or actions of the survivors have confirmed the efficiency of social support after disasters [15,16,18]. A few studies have also found that the risk factors of physical diseases were induced by disasters [2,7,12]. The pre–post survey-based studies further displayed that the affected individuals were more likely to have PTSD, psychosomatic symptoms, psychological aftermath, and somatic symptoms [19,20,22,23].

Due to the fact that some survivors exposed to a severe disaster not only nearly experience death but also somehow lose co-resident family

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members (hereafter, we call such survivors victims in this paper), the bereavement of having lost loved ones remains with them for quite some time and probably further causes mental and physical health problems [2,5,25]. It has also been found that bereaved individuals may suffer from lowered immune system functions [28–30]. In addition, the closeness of the relationship between the victims and the dead might result in different impacts of sadness on health [4,13,25]. It is therefore expected that such victims will utilize healthcare more than non-victims. Discussing the changes in victims' outpatient and inpatient utilizations will shed some light on the health effects of severe disasters, with important policy implications.

The strengths of our datasets includes (1) the reliability of the healthcare utilization data for all people in Taiwan over many years, (2) information clearly identifying individuals who lost family members and the relationships between the living and the dead, and (3) the availability of information about relocated victims. By using these longitudinal data, we compared the outpatient and inpatient utilization changes before and after the disaster among victims and non-victims. We also investigated the impact on short-term and long-term healthcare utilizations in various disease categories.

Method

A standard DID approach was employed to investigate the effects of the Chi-chi earthquake (hereafter, the Earthquake). The Earthquake occurred at 1:47:12 am local time on September 21, 1999. It resulted in 2494 people dead or missing, 11,305 injured and more than 100,000 houses damaged or completely destroyed [31]. It was the strongest earthquake in Taiwan in the past few decades. The effects of the Earthquake were most severe in central Taiwan, and nearly 85% of the deaths in the disaster were residents of Nantou and Taichung Counties. Below, we introduce the data used in this study and briefly express the statistical methods as follows.

Data

This study used the household registration records and the death application forms maintained and updated by the Taiwan government as well as the claim data from the Bureau of NHI. NHI was implemented in 1995. It is a compulsory and single-payer scheme with universal coverage for both outpatient and inpatient care. The content of the household registration record includes information about the household as well as its members, such as the household registration number, each member's name, individual identification number, date of birth, gender, education level, marital status, aboriginal identity and relationship with the household head. The contents of the death application form include the dead person's identification number, his/her spouse's identification number, date of death, cause of death, place of death, as well as the household registration number. The content of healthcare claim data includes individuals' identification numbers and the outpatient and inpatient records, such as disease classifications, and date of outpatient visit or inpatient admission.

The deaths resulting from the Earthquake in this study were defined as those who appeared on the death applications during the period from September 21, 1999 to September 30, 1999 with the causes of death being earthquake, suffocation and exhaustion. 1491 people were identified as having died as a result of the Earthquake in Taichung and Nantou Counties, coming from a total of 1088 households. Based on the household identification number, we can further identify the relationships between the survivors and the dead within each household.

The study group consisted of all residents who lived in Taichung and Nantou Counties and lost their co-resident family members in the Earthquake; while the control group comprised those who lived in the same counties but did not suffer from any loss of co-resident family members. Since the control group consists of too many qualified individuals, a stratified random sampling was conducted on the basis of the population's distribution of gender, age, and residence with 0.4% of the population being sampled. To investigate the healthcare demand induced by the Earthquake and to fairly compare the results between the study and control groups, we further restricted our sample to individuals alive during the study period and omit individuals who had lost family members before September 21, 1999. As a result, there were 3748 individuals who lost co-resident family members due to the Earthquake in the study group and 13,890 individuals in the control group. Hereafter, the individuals in the study group are referred to as victims and those in the control group are referred to as non-victims.

Due to the chaos right after the Earthquake, some nearby clinics and hospitals could not keep healthcare records for several days. In Taichung and Nantou Counties, the weekly healthcare claim records from September 21 to 27, 1999 dropped by 31% from the 16-week average value (from August 30 to December 20, 1999) and then appeared to return to the normal level a week after the Earthquake. We thus excluded the data from September 21 to 27, 1999. Hence, the sample used in this study consists of two periods: September 28, 1998 to September 20, 1999 and September 28, 1999 to September 20, 2000.

The diseases are classified into 18 groups based on the International Classification of Diseases, Ninth revision, Clinical Modification (ICD-9-CM, 1992). It is well known that the affected individuals are more likely to have injuries and certain medical illnesses, such as circulatory diseases [2,7], respiratory diseases, digestive diseases, genitourinary diseases, and infectious and parasitic diseases [2,7,12,32,33]. Having PTSD may also place individuals at a high risk of suicidal thoughts and actions as well as make them more prone to a range of symptoms, signs, ill-defined conditions and diseases of the musculoskeletal system and connective tissue. Thus, in addition to studying the overall healthcare utilization, we also analyzed the short-term and long-term healthcare utilizations by disease categories.

Short-term healthcare utilization is defined as the outpatient care occurring (or inpatient admissions issued) within 3 months after the Earthquake; while long-term is defined as the utilization from the fourth month to a year. To compare the short-term healthcare utilization before and after the Earthquake, we used data from September 28 to December 20, 1998 and from September 28 to December 20, 1999. In contrast, data from December 21, 1998 to September 20, 1999 and from December 21, 1999 to September 20, 2000 were used to study the long-term impacts of the Earthquake.

Statistical analysis

The DID method adopted in this study is widely used to measure the changes induced by an event between the study and control groups [34]. The total pre–post effects between victims (individuals in the study group) and non-victims (individuals in the control group) on healthcare utilization can be broken down into three parts: (1) the pre-disaster difference between victims and non-victims, (2) the aggregate effects induced by the Earthquake or trends on non-victims' utilization, and (3) the impacts of the Earthquake between victims and non-victims. The DID method enabled us to identify each of them separately. That is to say, we could obtain the third part by controlling not only the pre–post trends but also the initial differences, such as the degree of urbanization, in healthcare utilization between victims and non-victims.

Three hypotheses were tested: (1) compared to the non-victims, the victims would tend to utilize healthcare more after the Earthquake; (2) the victims who lost only one family member in a household would tend to utilize healthcare less than the victims who lost two or more family members; (3) the victims who lost spouses or parents would tend to have a higher rate of healthcare utilization than other victims.

According to the above hypotheses, the logistic regression with the DID specification was therefore employed to investigate the changes