Master Econométrie, Statistiques, Parcours Econométrie Appliquée

Impact of the 2015 Gorkha Earthquake in Nepal on Cough Prevalence in Children Under Five: A Difference-in-Differences Approach Using Demographic and Health Surveys

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3 June 2024

On 15 April 2015 a Ritcher Scale 7.8 magnitude earthquake struck the Gorkha district of Nepal, followed by a strong after-shock of 7.3 magnitude in Dolakha on 12 May, causing numerous health problems in all affected areas. The study focuses on the potential consequences the seismic event had on the incidence of cough in children under five. Data from Demographic and Health Surveys (DHS) are used, employing the Difference-in-Differences (DiD) empirical strategy, based on the minimum distance to the two major epicentres to distinguish impact exposure and intensity. In this synthesis, one of the paper's findings will be summarized, which regards an increase in cough prevalence in children under five within 80 kilometres of either of the two earthquake's epicentres.

Keywords: Earthquakes, Nepal, Children, Cough, Difference-in-differences, R, Stata

1. Research Statement and Study Framework

Earthquakes, being one of the most devastating natural phenomena on Earth, can cause great damage to human health, fostering, in addition to numerous emotional damages, the emergence of diseases. Among them, cough can reduce the quality of life of those who suffer from it, and its frequency in the population may increase after an earthquake, given the resulting dust and pollution, the loss of economic means and the worsening of the quality and quantity of clinical services available, among others. Children under five represent a group of individuals in society who are particularly susceptible to diseases, while their physical and emotional well-being is essential for their development as individuals. The analysis seeks to identify the extent of damage caused, in terms of prevalence of childhood coughing, by the 2015 Nepal Gorkha earthquake.

2. Data

In the study, Demographic and Health Surveys datasets are utilized, a set of nationally representative surveys that collect information on health and demographics in developing countries. Conducted by ICF International and funded primarily by the United States Agency for International Development (USAID), these surveys address topics such as infant mortality, nutrition, reproductive health, and family planning, providing detailed and internationally comparable information. DHS contain several data files for different family members, such as woman, man, children, and households. In the analysis, children and households' files regarding the country of Nepal for the years 2011 (5,038 observations) and 2016 (5,306 observations) are managed. Additionally, geographic coordinates of each surveyed household were required to compute distances to the earthquake's epicentres, a key aspect of the research. Geospatial data have also been included to specify control variables in the model.

3. Econometric methodology

The Difference-in-Differences empirical strategy is employed in the study, an econometric technique used to estimate the causal effect of an intervention or policy by comparing changes in outcomes over time between a treatment group, made up of units who receive the intervention, and a control group that serves as counterfactual for treated individuals (i.e. what would have happened to the treatment group in the absence of the intervention). In this case, the earthquake is interpreted as the intervention. Therefore, we consider that individuals under the treatment are children living in areas close to epicentres, whereas the control set is composed of children who live in remote areas. I have measured the impact on cough prevalence considering as treated the children living within a wide range of kilometres of either of the two epicentres (Gorkha district on 15 April, 7,8 magnitude; and Dolakha district, on 12 may, 7,3 magnitude), with the remaining area of the country as control units, the main results of which will be shown below. The mathematical equation is presented in the methodological framework:

Methodological framework

$$Y_{it} = \alpha + \beta_1 Treatment_i + \beta_2 Post_t + \beta_3 (\mathrm{Treatment} * \mathrm{Post})_{it} + \beta_4 \mathrm{X}_{it} + \beta_5 \mathrm{D}_{it} + \epsilon_{it}$$

Where Y reflects the outcome of interest (cough prevalence) for individual i at time t; α is a constant; β the coefficient of each correspondent variable; $Treatment$ indicates whether the child belongs to the treatment area (1 if that is the case, 0 otherwise); and $Post$ takes the value 1 if individuals belong to the post-earthquake group, 0 if not. X corresponds to a set of control variables and D represents region fixed effects. Finally, ϵ is the error term.

4. Results

Findings have demonstrated a significant impact up to a distance of 80 kilometres. Table 1 presents the estimates obtained from the above equation considering this distance range. β_3, the coefficient corresponding to the variable Treatment*After, is the DiD estimator which measures the causal effect of the treatment. Its significance at the 10% threshold indicates a significant difference, over the two periods analysed, in the cough rate in the areas affected by the earthquake relative to non-affected regions. The positiveness of the sign indicates that being within 80 kilometres of in the post-treatment group increases the likelihood of coughing compared to the remaining areas.

Table 1: DiD results

Dependent variable:	Cough
After	0,1389** (0,0589)
Treatment	0,1318 (0,1078)
Treatment*After	0,2638 * (0,1366)
Constant	-0,82*** (0,14)
Control	Yes
Region fixed effects	Yes
Observations	10,297
R^2	0,0259

Note: Robust standard errors in parentheses
*p< 0.1; **p<0.05 ; ***p<0.01

Figure 1 shows the evolution of cough prevalence in both treatment and control groups from the year 2001. We can observe how the cough incidence index, measured from 0 to 1 as a proportion of the sample analysed, has decreased for both groups in the ten years prior to the earthquake, although it increased slowly in 2011 relative to 2006. After the shock in 2015, the proportion of children suffering from the disease goes up, even if not in a very pronounced way, for treated children. The control region, on the contrary, slightly lowers its cough incidence. The groups compared do not perfectly exhibit parallel trends during the pre-earthquake period, although they are high similar. Even though covariates have been included in the model, possibly they would not have followed an exactly parallel evolution in the absence of treatment, and this could represent some source of little bias in the results. Figure 2 exhibits a map of Nepal showing the two major epicentres as well as the households surveyed who have been found to be injured by the earthquake.

Figure 1: Cough evolution by group

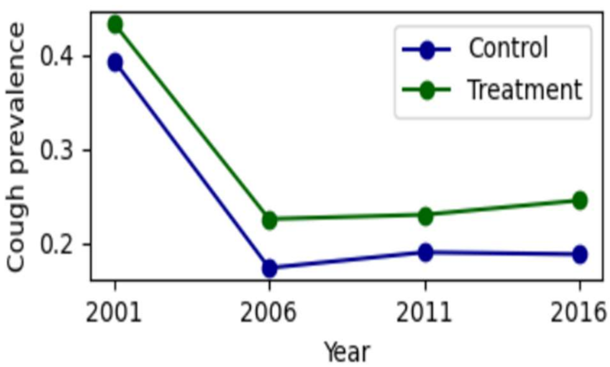
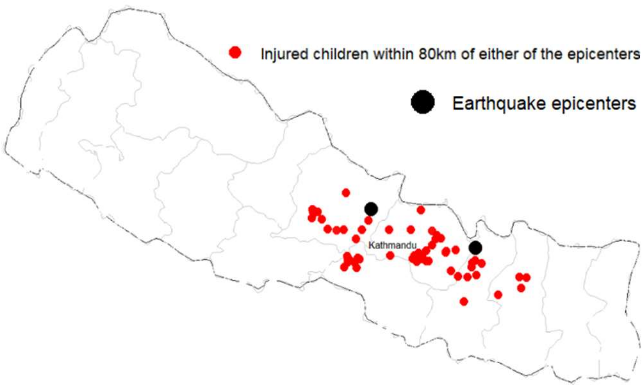


Figure 2: Injured children by the earthquake



5. Conclusion

In conclusion, the study has analysed the impact that the 2015 Gorkha earthquake of Nepal had on the prevalence of cough in children under five. For that, groups close to epicentres have been compared to the remaining regions of the country over time. Results have revealed an increase in the rate of the disease in areas within a circle of up to 80 kilometres of any of the two major epicentres. Given the frequency of earthquakes in Nepal and its low buildings construction quality, it is recommended to invest in resistant material to these hazards. Likewise, the importance of counting with health services and qualified professionals after such an event is highlighted. Children are the future of society, and their care is crucial for their development and happiness.