Geophysical Research Abstracts
Vol. 21, EGU2019-14444, 2019
EGU General Assembly 2019


# Earthquake Losses in Schools: a review of events from 1988 to 2018

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Context
Earthquakes have historically caused a large proportion of natural disaster losses worldwide. The impact of earthquake losses in schools – both in terms of student and teacher casualties and longer-term societal disruption – has been particularly severe. For example, in the 1988 Spitak earthquake in Armenia, 6000 children are estimated to having died in schools, a quarter of the total fatalities. More recently, in the 2015 Gorkha earthquake in Nepal, few children died in schools as the event occurred out of school hours but approximately 5000 school buildings collapsed, causing severe disruption to education. To address this challenge, governments and non-governmental organisations have made long-term investments in seismic risk reduction for schools. The objective of the work is to describe the impact of earthquake losses related to schools and identify possible risk factors associated with these outcomes.

Methods
A historical review of earthquake events over the period from 1988 to 2018 was carried out using multiple databases. Events were screened using the criteria of a minimum magnitude (Mw) of 5.5 and a minimum of number of 20 reported fatalities. Then, a systematic literature review of publications was performed to identify the number of fatalities for events were schools were occupied and the number of damaged or collapsed schools for each event. Fatalities due to landslides and tsunamis triggered by the main event were excluded. Analysis included descriptive statistics, preparation of categorical data related to school vulnerability factors and hierarchical cluster analysis for selected risk factors.

Findings
For the selected earthquake events, from 1988 to 2018, there were approximately 35000 fatalities in schools and approximately 55000 school buildings damaged by earthquakes (of which 23000 were reported as collapsed). From analysis of categorical data, school fatalities and damage were associated with vulnerabilities such as pre-seismic code construction, non-ductile structural systems, evidence of poor materials and major building modifications (such as construction of additional storeys). The clustering analysis suggests clusters of medium and high fatality events in countries with lower levels of economic development and in countries with higher levels of corruption; this is in agreement with broader studies on risk factors for earthquake losses.

Conclusion
We presented the first systematic collection of earthquake loss data for schools. This loss data and the findings from the preliminary analysis will be disseminated as open data, to inform school risk reduction activities and related research including seismic risk portfolio analysis.