

Earthquake Fatality Measure Offers New Way to Estimate Impact on Countries

A new measure that compares earthquake-related fatalities to a country's population size concludes that Ecuador, Lebanon, Haiti, Turkmenistan, Iran and Portugal have experienced the greatest impact from fatalities in the past five centuries.

The new impact measure, introduced in the *Bulletin of the Seismological Society of America* by Max Wyss and colleagues at International Centre for Earth Simulation Foundation, is called the earthquake fatality load or EQFL. The EQFL of a particular earthquake is the ratio of earthquake fatalities to the population estimate for the country in the year of the earthquake.

In their study, Wyss, Michel Speiser and Stavros Tolis calculate the earthquake fatality load for 35 countries and regions, by adding up the EQFL calculated for earthquakes in these countries occurring within roughly the past 500 years, as well as a measure of EQFL per year for each country. This last measure was used to rank the countries by the impact of earthquake fatalities.

The countries in the studies collectively account for 97% of all earthquake-related fatalities from 1500 to March 2022. The EQFL measurement excludes deaths related to earthquake-caused tsunamis, said Wyss.

Although major earthquakes in places like California, Japan and China often grab the headlines by virtue of the magnitude of their earthquakes or destruction of property, the goal of the EQFL measure was to show how the most critical impact of an earthquake—loss of life—affects some countries more than others, Wyss explained.

“We wanted to look at how serious it is to absorb those losses, for a country,” he said. “When you do this quantitatively, the order of countries to worry about suddenly changes.”

Smaller countries suffer more than larger countries from earthquake fatalities, even when they experience fewer fatal earthquakes, because the losses represent a larger proportion of their population, the researchers found.

They also noted that countries without major tectonic plate boundaries—boundaries where some of the Earth's largest earthquakes occur—and countries with slow deformation accumulation rates on faults rank high in EQFL. For instance, the recent 2023 deadly earthquakes in Morocco and Afghanistan occurred along slowly deforming faults.

Wyss and colleagues also calculated that the EQFL as a function of magnitude has decreased over time in all countries analyzed. Over time, the authors suggested, buildings have become more resistant to shaking and countries have become better at quickly sending aid to earthquake zones and rescuing people trapped under rubble.

Global trends that show more people moving from villages into cities could also contribute to decreasing EQFL, Wyss noted, since buildings in cities are more likely to be constructed using materials and designs that resist ground shaking and emergency response can be quicker in a city compared to a remote village.

California, and a group of countries composed of Colombia, Ecuador and Mexico had the strongest decrease in EQFL over the past 500 years. Italy had the least amount of EQFL decrease, “likely because old buildings are preserved, renovated and lived in,” the *BSSA* authors suggest.

Wyss has long advocated for more emphasis on earthquake fatalities to determine and address the impact of earthquakes around the globe. He and his colleagues developed QLARM (Quake Loss Assessment for Response and Mitigation), a service that uses population and building stock data sets from around the world to issue a real-time calculation of fatalities, injuries and building damage due to strong shaking in earthquakes. In the United States, the U.S. Geological Survey’s PAGER (Prompt Assessment of Global Earthquakes for Response) tool provides a similar service.

People and not property are the most important potential loss in an earthquake, said Wyss, who added that the possibility of preventing fatalities using QLARM is what keeps him working without salary. “For that I’m willing to get out of bed when an earthquake happens at night for the rest of my life—as long as I’m still intelligent to do that—for people, not for money.”

###

For a copy of the *BSSA* paper, please contact press@seismosoc.org.

“The Earthquake Fatality Load: A Measure of Impact,” by Max Wyss, Michel Speiser and Stavros Tolis at International Centre for Earth Simulation Foundation, Switzerland. Wyss can be reached at max@maxwyss.ch.