What are the long-term health effects of earthquakes? Meta-analysis results and implications for epidemiological practice

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Population growth and urbanisation of seismic areas are leading to a constant increase in the health-related and economic toll of earthquakes. In 2014 alone, **324 natural disasters (http://cred.be/sites/default/files/ADSR_2014.pdf)** were reported worldwide, resulting in 141 million casualties and nearly $100 billion in damage. Geophysical disasters, including earthquakes, accounted for about 10% of these events.

Although the impact of earthquakes in the response phase – that is, immediately or shortly after the main seismic event – has been well studied, we have little knowledge of the effects of earthquakes in the medium and long term. This uncertainty may cause inefficient planning of post-earthquake epidemiological surveillance, resulting in potential underestimation of public health needs.

Credit: Fabrizio Bramerini. Reproduced with permission from: *Epidemiol Prev* 2016; 40 (2) Suppl 1: 10-11.

For these reasons, in **our review recently published in the IJE (https://doi.org/10.1093/ije/dyy130)**, we attempted to systematically organise the extant epidemiological knowledge about the post-response phase – that is, at least one month after

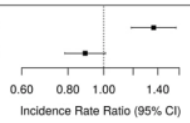
the main seismic event. We searched common medical databases as well as several sources of grey literature, and we set no limitations in our search string regarding the diseases or earthquake investigated.

From the results of our search, we analysed 52 studies conducted over the past 30 years, involving individual-level data from more than 80,000 participants, and aggregated data – in which individual participant characteristics were not available in the denominator – from more than 50 million people. We included observational studies focusing on health indicators measured at least one month after earthquakes occurred in high-income countries. Reasons for exclusion included lack of a comparison group, inability to distinguish the health effects of the earthquake from those of other disasters that occurred simultaneously, and lack of quantitative data.

In our analysis, we found increased all-cause mortality, with strong evidence of greater mortality rates from myocardial infarction and stroke, and higher mean levels of glycated haemoglobin among people exposed to earthquakes compared with those who were not exposed (see figure below). We also found evidence of an increase in gastric ulcers and consumption of antipsychotic medications, although these findings were based on individual studies, as well as mixed evidence about possible effects of earthquakes on antidepressant consumption and infectious diseases.

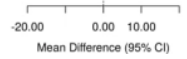
A. Binary outcomes

	Comparison	Follow-up (months)	Studies	Exposed Events/Person-years	Unexposed Events/Person-years	I^2	
Myocardial infarction mortality	Temporal	3 to 36	4	11,054/24,632,550	8,102/25,893,326	94.0%	1.36 [1.19, 1.57]
Suicides	Temporal	3 to 36	4	2,075/14,838,090	1,710/19,685,589	56.7%	0.89 [0.79, 1.01]



B. Continuous outcome

	Unit	Comparison	Follow-up (months)	Studies	Exposed Participants	Unexposed Participants	I^2	
Clinically measured diastolic blood pressure	mmHg	Temporal	2 to 79	7	5,568	5,476	98.2%	-0.91 [-5.06, 3.24]
Clinically measured systolic blood pressure	mmHg	Temporal	2 to 79	7	5,568	5,476	93.7%	-1.86 [-5.35, 1.64]
Body mass index	Kg/m²	Temporal	3 to 79	5	4,743	5,147	3.2%	-0.08 [-0.23, 0.06]
Total cholesterol	mg/dL	Temporal	3 to 79	5	4,743	5,147	21.9%	0.83 [-1.35, 3.02]
Glycated haemoglobin	%	Temporal	2 to 12	4	716	717	33.3%	0.16 [0.07, 0.25]
HDL cholesterol	mg/dL	Temporal	3 to 14	4	4,641	4,642	5.8%	-0.21 [-1.01, 0.58]
Triglycerides	mg/dL	Temporal	3 to 79	4	708	1,112	58.8%	-0.77 [-12.98, 11.44]



These findings indicate the need for improvement of current epidemiological surveillance systems.

First, our work shows that extending the follow-up after the recovery phase (at least 24 months) is useful because multiple health conditions have been associated with earthquakes in the long term.

Second, as lack of a comparison group was a common reason for exclusion of studies from our review, researchers should be encouraged to adopt an appropriate observational design for future studies – ideally, a cohort design with at least one study group that includes people not exposed to the earthquake.

Third, given the breadth and potential complexity of many health-related outcomes, future surveillance should be planned using a centralised and multidisciplinary approach, including professionals such as epidemiologists, statisticians and public health professionals, to ensure the identification of appropriate study indicators and the development of efficient, standardised protocols that enable harmonised data collection and analysis.

Finally, future studies should make more regular use of routinely collected data, such as electronic health records, which would enable detailed assessment of earthquake effects in the long term.

Read more:

Ripoll Gallardo A, Pacelli B, Alesina M, et al. Medium- and long-term health effects of earthquakes in high-income countries: a systematic review and meta-analysis. *International Journal of Epidemiology*, dyy130, **https://doi.org/10.1093/ije/dyy130 (https://doi.org/10.1093/ije/dyy130)**.

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