Evidencing the effectiveness of facemasks to protect from volcanic ash

Ten per cent of the world's population lives near an active volcano, mostly in low-resource countries. When a volcano erupts, humanitarian agencies often distribute facemasks to protect people from inhaling ash, but little evidence has been available on the effectiveness of facemasks, or guidance on their safe use.

Led by Durham University, this study, 'A new evidence base for respiratory health interventions in volcanic eruption crises', took place over a four-year period (2015-2019), and produced critical evidence on which facemasks provide the best protection during a volcanic eruption, and on acceptability of facemasks for users. The project directly impacted responses to volcanic eruptions in Guatemala, Hawaii and Indonesia, enabling humanitarian responders to provide the most effective masks and improving public health messaging. Supported by the Pan American Health Organization (PAHO), the study continues to inform policy and practice and has received recognition from the World Health Organization (WHO).

Title: A New Evidence Base for Respiratory Health Interventions in Volcanic Eruption Crises

Location: Indonesia, Mexico, Japan

Study type: Mixed methods (laboratory testing, questionnaires, interviews)

IMPACTS

- Strengthened capacity and improved practices in responses to volcanic eruptions in Indonesia
- Pan American Health Organization changed their advice for countries on volcanic ash eruptions
- Study's health messaging product shared and used by the public and humanitarian agencies, globally

RESEARCH IMPACT LEARNING

- Adaptation of strategy to external context to take advantage of emerging opportunities to apply relevant evidence
- Importance of capacity-building to enable application of evidence

BACKGROUND

When a volcano erupts and humanitarian agencies respond, facemasks may be taken from existing stockpiles for viral pandemics, and may be a range of different types, most commonly surgical masks. Until this study, no research had been conducted to test the public use of respiratory protection in volcanic settings.

Additionally, facemask use by communities is often inconsistent. Cheaper masks distributed often have poor facial seals and inadequately filter fine-grained particles. Using the sub-standard masks offers users a false sense of security; while higher-grade masks, offering more protection, can be costly and uncomfortable. The 'wearability' and acceptability of facemasks had previously not been examined as an important factor in enabling and supporting community members to wear masks to protect their respiratory health.

THE STUDY

The study, led by Professor Claire Horwell of Durham University, had two objectives. First, to build a new evidence base on the effectiveness and suitability of different forms of respiratory protection for general population use during volcanic crises. The aim here was to establish whether some forms of protection were better than others by testing effectiveness and acceptability of face masks, and to determine if some protection is better than no protection.

The second objective was to engage stakeholders, including operational humanitarian organisations, to promote uptake of findings and drive change in policy and practice during eruptions. By choosing three contrasting study locations, the team hoped the research outcomes would be relevant across most settings where volcanic crises and ashfall affect communities.

The team completed laboratory testing of different facemasks and undertook wearability trials amongst communities affected by volcanic ash. Questionnaires to assess social factors affecting use of respiratory protection (such as risk perceptions) were completed, alongside in-depth interviews from an anthropological perspective to explore behavioural factors and how best to tailor effective messages around protection. Two epidemiology protocols were designed for rapid deployment in future eruptions, as well as a clinical protocol for laboratory-based work to test the health benefits of wearing masks when exposed to ash.

FINDINGS

The study found that the facemasks which are most effective at filtering ash and protecting respiratory health for adults were the well-fitting, industry-certified facemasks such as N95 masks (also called P2, FFP2 or KN95 in different parts of the world).

However, surgical masks, which are commonly distributed by humanitarian agencies during volcanic eruptions, are less effective, especially as they do not fit well to the face. Counter-productively, people wearing surgical masks may feel safe, and reduce other protective measures, potentially increasing their health risks from inhaling ash. All the facemasks studied, however, provided some protection from ash, but this varied depending on materials.

Another finding was that there is often little information or communication provided by agencies about the effectiveness of provided protection, or how to best wear it. Additionally, societal and cultural context factors, such as how risk is perceived in communities, influence people's motivation to use facemasks. These contextual factors should be considered by public health actors, and targeted strategies should be developed when designing public communication campaigns about mask wearing during volcanic crises.

Street children were given free masks during the 2014 Mount Kelud eruption in Yogyakarta, Indonesia. Credit: Tri Wahyudi

COMMUNICATIONS AND ENGAGEMENT

The study team placed an emphasis on translating results into user-friendly materials tailored for local settings, such as videos. They co-developed and produced practical, capacity-building practitioner and public-focused outputs with local agencies and community representatives. A wide range of communications and guidance on the use of facemasks were produced and disseminated, and train-the-trainer courses have been delivered and tested in Indonesia, working with operational partners such as the local Red Cross and other NGOs leading responses to volcanic eruptions.

Outputs were housed on a dedicated knowledge platform, the website of the International Volcanic Health Hazard Network (www.IVHHN.org). This enabled study outputs to be widely shared, giving them credibility and visibility. The outputs were translated into local languages used by responders and communities. The IVHHN site preceded the study but was substantively developed through the grant period.

A local Indonesian government department, the Disaster Management Agency, was engaged, which led to a deep understanding of the needs of local actors and was useful in giving the study team credibility with local NGOs.

PAHO used its networks to distribute the study's key messages to 27,000 readers of its newsletter globally, as well as undertaking close engagement and training with national government stakeholders.

The lead researcher engaged directly with the public in locations experiencing volcanic eruptions via blogs and social media, to raise awareness of the outputs available. As a result, she has received proactive approaches from organisations wanting expert advice on facemasks, helping to expand the influence of her findings into new locations such as Guatemala.

Trainers learn how to properly fit facemasks at a train-the-trainer workshop in Indonesia. Credit: Claire Horwell

UPTAKE AND IMPACT

Informed by the findings, thousands of effective N95 masks were distributed by key humanitarian actors involved in emergency response to volcanic eruptions in Indonesia (Mount Agung eruption, 2017), Hawaii (Kilauea eruption, 2020) and Guatemala (Fuego eruption, 2018). Evidence shows a direct link between the study findings and engagement and this instrumental impact. For instance, in Indonesia, the Mount Agung Relief consortium distributed 55,000 facemasks based on the results.

"Based on Dr. Claire Horwell's findings [...] we focused on distributing only N95 masks to evacuees in our relief effort. [...] we prioritized vulnerable community members, including people over 65 years old, those with existing respiratory illnesses, pregnant and breastfeeding women, as well as children (when children's masks were available)"
– Testimonial member of the Mount Agung Relief consortium.

The World Health Organization endorsed the Ash Protection Guidelines and facemask fitting guides produced by the study.

819 local responders from 73 Indonesian agencies and NGOs were trained by the International Society for Respiratory Protection in facemask use. Training materials were integrated into a university module at Medical Polytechnic of Yogyakarta for 150 students.

PAHO, an international public health agency and World Health Organization Regional Office covering thirty-five countries, changed their advice on how to protect communities in eruptions, based on the study. They also used study findings to inform new regional response tools and protocols, with the potential to further inform national emergency plans for nine Latin American countries.

"I would like to specially recognize Durham University for this essential collaboration towards a more resilient health sector in the Americas."
– Dr. Ciro Ugarte, Director, Health Emergencies, PAHO

The project's interdisciplinary nature sparked ongoing collaborations with legal scholars on the ethics of facemask policies, which informed public debate during COVID-19. It enabled continued partnerships between Durham and Indonesian partners, and between the lead researcher and other NGOs leading on disaster preparedness.

The lead researcher, Professor Claire Horwell, was awarded the 2020 Plinius Medal by the European Geosciences Union, which recognised her interdisciplinary research on natural hazards.

RESEARCH IMPACT LEARNING

ADAPTATION OF STRATEGY TO EXTERNAL CONTEXT

It became apparent during the study that demand for external evidence and expertise on this topic, and appetite for collaboration, was higher in Indonesia than in Mexico or Japan. The team therefore decided to allocate increased resources to engagement in Indonesia where there was greater opportunity for impact. They decided also to release preliminary data and outputs to contribute to the Mount Agung eruption response in 2017. According to the lead researcher, this decision 'changed the course of the project' and helped build relationships and influence.

CAPACITY BUILDING FOR EVIDENCE USE

Engagement approaches which focus on building capacity of stakeholders to translate and apply evidence to implementation can drive significant impact. Here, joint work with operational partners in development of tailored, evidence-informed training products and public information helped to deliver and sustain impacts in Indonesia and at other eruptions around the globe.

PARTNERS

Durham University; Kagoshima University; University of Indonesia; Institute of Occupational Medicine; University of Mexico (UNAM); Pan American Health Organization (PAHO); Save the Children Indonesia; Red Cross Indonesia; International Society for Respiratory Protection

ABOUT ELRHA

Elrha is a global organisation that finds solutions to complex humanitarian problems through research and innovation. This study was funded by Elrha's Research for Health in Humanitarian Crises (R2HC) Programme which aims to improve health outcomes by strengthening the evidence base for public health interventions in humanitarian crises.

R2HC is funded by the UK Foreign Commonwealth and Development Office (FCDO), Wellcome, and the Department of Health and Social Care (DHSC) through the National Institute of Health Research (NIHR).

R2HC captures detailed case studies through a process that triangulates and validates evidence on uptake and impact. The case study methodology and full version of this summary case study including references are available on request.

r2hc Research for health in humanitarian crises | elrha

www.elrha.org

https://twitter.com/Elrha

www.linkedin.com/company/elrha/