



# Community wearability assessment of respiratory protection (RP) against volcanic ash from Mt Sinabung, Indonesia

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# Background

- Inhalation of volcanic ash of concern for affected communities, agencies recommend /distribute variety of RP
- Results of our lab-based studies provide valuable information on efficacy of RP typically used against volcanic ashes, and perceived effectiveness and wearability
- However, need to consider their wearability, acceptance and perceived performance in real-life settings by those affected by volcanic ash

# Aim



Mount Sinabung, Indonesia

- Identify which of the masks tested by Steinle et al (2018) were perceived to be most wearable by residents affected by the Sinabung eruptions
- Criteria based on comfort, perceived protection, fit and ease of breathing

# RP selected for wearability study



N95

Surgical

Flat-fold

Surgical Plus



# Methodology

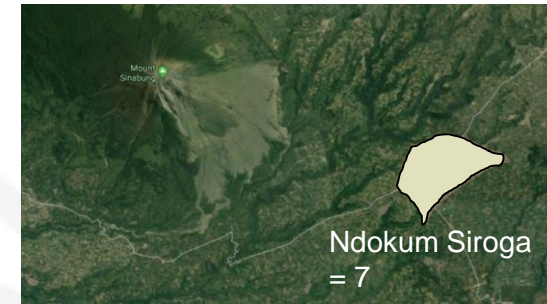
- Villages chosen for recruitment depended on where volcanic ash was falling
- Convenience sample - 30 consenting adults who fulfilled eligibility criteria
- Background demographic questionnaire completed, also asked about previous use of RP
- Order of wearing masks randomly determined for each volunteer
- Fitted mask themselves, no specific instructions

# Methodology

- Volunteers (no more than six at a time) taken on 15-min walk (predetermined route)
- At end of walk, volunteers rated the comfort, hotness, humidity, breathability, perceived protection level and fit of the mask worn (five-point Likert scale). Provide further comment if wished
- Procedure repeated for the other three masks
- Once all four walks completed, volunteers asked to compare masks, select preferred type of protection.

# Volunteer characteristics

- 53% male
- Mean age = 40 (19-57) years
- 83% achieved high school level education
- 40% were teachers, 27% farmers, 17% entrepreneurs, 17% other



# Previous use of face masks

- All reported previously using surgical masks:
  - 50% obtaining these from health centre,
  - 13% from the Indonesian Red Cross,
  - 10% from their local government,
  - Others - school, civil society organisation and a disaster management agency.
- One (3%) volunteer had used an N95 mask, obtained from Indonesian National Army
- No one had worn a Flat-fold mask
- 11 (37%) wore a surgical mask with another layer (e.g., bandana, scarf or veil over the top)





Mask	Mean scores (out of 5) for each Wearability Criteria						
	Comfort	Hotness	Humidity	Difficulty Breathing	Ease of Adjustment	Fit	Effectiveness
N95	3.0	2.3	2.0	2.8	3.2	3.5	3.3
Surgical	2.9	1.8	1.6	2.4	3.7	3.2	2.4
Flat-fold	3.6	1.5	1.3	1.8	3.9	3.5	2.6
Surgical Plus	2.8	2.3	1.9	3.0	3.1	2.8	2.8

1 and 5 representing least and greatest agreement, for a given criterion



N95

Surgical

Flat-fold

Surgical Plus

# % volunteers ranking each mask first for each wearability criterion

Mask	Wearability Criteria				
	Comfort***	Ease of Breathing***	Fit***	Effectiveness***	Overall**
N95	30	23	57	57	27
Surgical	7	20	17	10	13
Flat-fold	50	57	17	23	40
Surgical Plus	13	0	10	10	20

\*\* p < 0.01; \*\*\* p < 0.001. Note: overall % for Fit adds to 100.1 due to rounding.

# Discussion – N95 mask

- Perceived to provide best fit and be most effective in providing protection
- However, volunteers had concerns about the comfort and ease of breathing
  - Could adversely impact user uptake/acceptance of RP, as well as its use over longer time periods
- One volunteer previously used N95, lack of familiarity
- Minimise through appropriate education and instruction during the masks distribution



N95

# Discussion – Flat fold

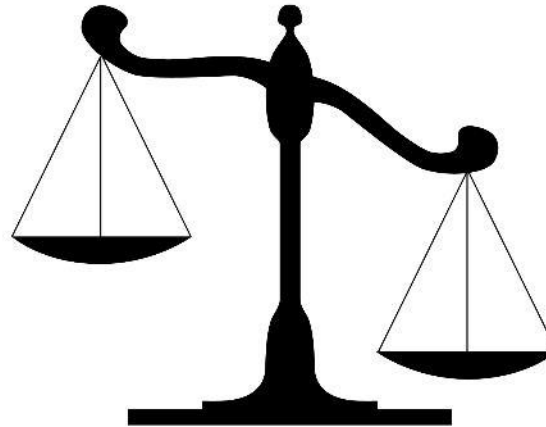
- No volunteers reported previously used this mask
- Preferred mask of those tested



Flat-fold



Comfort and  
ease of  
breathing



Fit and  
perceived  
protection

- Respondents' preference for this mask, perhaps indication of their level of concern and perceived understanding of the hazard of inhaling ash

# Discussion – surgical mask

- Surgical masks thought to be the most distributed intervention
- Despite widespread use and previous use, reported to be their least preferred mask of the four tested
- Could be because they had been made aware of the need to improve fit by adding an additional cloth layer, and because the quality of the N95 mask was so immediately apparent



Surgical



Surgical Plus

# Summary

- Study provides insight into potential barriers to uptake of the most effective RP interventions
- Evidence some agencies moving towards providing most effective RP intervention rather than most easily procured / stockpiled
- Uptake of RP will be affected by perceptions of comfort and breathability; information should encourage uptake despite these issues
- If this can be achieved, it is more likely that masks will be accepted and used by communities affected by eruption (and other particulate pollution) crises

## HOW CAN I PROTECT MYSELF FROM BREATHING VOLCANIC ASH?

### RESPIRATORY PROTECTION

A facemask should fit well to your face but should not make breathing difficult. Industry-certified masks (e.g., N95-style) provide the best protection. Cloth materials (e.g., handkerchief) will not be as effective as a well-fitting facemask.

### STAY INDOORS

The best way to reduce your exposure to ash is to shelter indoors, especially for children, older people and people with respiratory or cardiovascular disease. Close windows and doors and seal up large gaps and spaces to the outdoors. Keep indoor air as clean and cool as possible.

### CLEANING UP

Once volcanic ash has settled, carefully dampen the ash with water and remove it. Wear a well-fitting facemask whilst doing this.

CONTACT A HEALTH PROFESSIONAL IF YOU ARE CONCERNED ABOUT YOUR HEALTH

For more information see: [www.ivhhn.org/ash-protection](http://www.ivhhn.org/ash-protection)  
This poster was developed by the International Volcanic Health Hazard Response (IVHHN) team.

[www.ivhhn.org](http://www.ivhhn.org)

## HOW TO PROTECT YOURSELF FROM BREATHING VOLCANIC ASH

## HOW TO FIT A FACEMASK

With clean hands, take the mask out of the packaging. Avoid contaminating the inside of the mask with ash.




**1**

Make sure the lower strap is below your ears, towards the bottom of your head. Tighten the straps/ loops until the mask makes a seal around your face and is comfortable.



**4**

Open up any flaps and prepare the straps/ loops for tying around the head or ears.



**2**

With both hands, gently press any nose clip so that it fits well across the nose and onto the face below the eyes. Do not pinch the clip.




**5**

Fit the mask over the nose and mouth. Fit any straps to the head, with the top strap around the top of your head, above your ears.



**3**

Cover the mask with both hands, being careful not to change the fit. Breathe out sharply to check for air leakage around the mask edges. Adjust fit if there are leaks.



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