

SYNOPSIS

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Review of “Efficacy of face masks and face coverings in controlling outward aerosol particle emission from expiratory activities”

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One-minute summary

- This report examines the efficacy of 6 types of masks and respirators at reducing outward aerosol emission of non-infectious particles from breathing, speaking, coughing and jaw-moving.
- **Changes in emission rates of aerosolized particles (0.3–20 µm)** by various mask type:
 - **surgical:** 90% reduction during speaking and coughing
 - **unvented KN95 respirators:** 74% reduction during speaking and coughing
 - **double-layer cotton:** 60% reduction in large particle during breathing and talking; 160% increase in large particles during coughing
 - **single-layer cotton:** 492% increase during breathing, speaking and coughing
- The authors concluded that **wearing surgical masks or non-fit-tested KN95 respirators substantially reduces emission of particles during breathing, talking and coughing**; wearing **cloth and paper masks likely offer some reduction in expired particles >0.5 µm**.
- In this report, the **efficacy of fabric masks for reducing emission of expired particles is unclear** due to the **possibility that some of the particles released came from the masks themselves**:
 - Particle emission rates during jaw-moving are around one order of magnitude higher when wearing paper and cloth masks compared to wearing no mask.
 - Mask fabrics rubbing together generates considerable quantity of small particles in the size range of 0.3 to 5 µm, similar to that observed for the expiratory activities performed.
- The authors suggest that this represents a potential risk for contaminated homemade fabric masks to release particulates that may carry infective microorganisms, and on this basis, recommend:
 - Disposable masks should be changed regularly.
 - Homemade masks should be washed regularly.
 - Care should be taken when removing and cleaning homemade masks.

Additional information

- **In this experiment, ten healthy volunteers (6 men and 4 women; 18–45 years old) performed four activities:**

- Breathing in gently through the nose and out through the mouth for 2 minutes.
- Reading aloud for about 100 to 150 seconds.
- Coughing forcefully for 30 seconds at rate and intensity comfortable for the participant.
- With mouth closed and breathing through the nose, moving the jaw for 1 minute as if chewing gum to assess whether particle emission rates vary with facial motion due to friction between the skin and mask or variable gap distances between the mask and skin.
- The **six types of masks and respirators tested** by the 10 volunteers:
 - surgical mask (surg.)
 - unvented KN95 respirator (KN95) (not fit-tested). (Note: [KN95](#) is the standard for evaluating respirators in China and is deemed equivalent to the N95 standard used by the National Institute for Occupational Safety and Health)¹
 - vented N95 respirator (N95) (not fit-tested; tested by only 2 volunteers due to shortage in supply)
 - homemade single-layer paper towel mask (U-SL-T)
 - homemade single-layer (U-SL-T) and double-layer cotton masks (U-DL-T)
- **Vented N95 respirators** were tested by only 2 volunteers due to a supply shortage, precluding significance testing. Overall, their ability to reduce outward particle emission rates was **comparable to those of surgical masks and unvented KN95 respirators**.
- **Qualitative friability trials were performed by rubbing a sample of each mask type between the thumb and index finger for 10 seconds.** The average numbers of particles captured per second:
 - **surgical:** 1.5 particles/s
 - **KN95 and N95:** <1 particles/s
 - **single-layer paper:** 8.0 particles/s
 - **single-layer cotton:** 7.2 particles/s (double-layer cotton slightly higher)
- **Particle emission rates reported were likely underestimated due to:**
 - Reduced counting efficacy for particles <0.5 μm in diameter.
 - Only 20% of the air pulled by the particle sizer was focused to the particle counter.
 - Only a small area directly in front of the mask was used for measurements, which would not account for leakage around the sides of the mask.
- The authors noted a **superemitter who released about 2 orders of magnitude more particles during coughing** but not during breathing or speaking.
- **Handwashing double-layer cotton masks once does not affect the particle emission rate significantly.** Change in efficacy after repeated washing was not explored.

PHO reviewer's comments

- The authors cite a small number of studies of other respiratory viruses to support the possibility of "aerosolized fomites" (e.g., dust contaminated with infectious virus). However, to date there is no consistent evidence that fomite transmission (in general) is an important route for COVID-19 spread; thus this possibility remains theoretical. Whether the virus causing COVID-19 is able to adsorb to particles and be subsequently transmitted when made airborne remains theoretical at this time.
- Current [evidence](#) supports that the use of various types of masks (including cloth masks) reduces the spread of COVID-19 at the population level.²
- Additional research will help inform the efficacy of homemade masks made of different materials and layering sequence as a source control measure in reducing the release of

expiratory particles into the air. However, such studies can only provide “proof of concept” and are not direct evidence of efficacy in reducing COVID-19 transmission.

- See also PHO’s [Wearing masks in public and COVID-19 – what we know so far](#), for a summary of the literature on masks in non-health care settings.³
- The findings presented by the authors highlight the importance of regular changing of disposable masks and cleaning of homemade masks, along with hand hygiene after carefully taking masks off.

References

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Citation

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