Face mask debris – possible risk to face mask users?

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Rationale:
Urgency to continuously update face mask guidelines due to COVID-19 and California Wildfires
COVID-19: Performance study of microplastic inhalation risk posed by wearing masks

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Need for assessing the inhalation of micro(nano)plastic debris shed from masks, respirators, and home-made face coverings during the COVID-19 pandemic

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Covid-19 face masks: A potential source of microplastic fibers in the environment

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Specific Aims

1. Determine size and morphology of particles from new and aged N95, surgical, and fabric masks:
   Scanning Electron Microscope (SEM) and Raman Spectroscopy

2. Determine biological effects of the particles:
   Intranasal instillation in mice, followed by pulmonary function test (PFT) and bronchoalveolar lavage
Inhalable Particles: <10 μm
Respirable Particles: <2.5μm

Figure 2  Comparison of particle size fractions including particulate matter (PM), bioaerosols and reference particles. Adapted, with permission, from Kaiser J, 2005 (66).
Hypothesis

Face masks have the potential to generate particles with potential health implications.

Aged face masks have the potential to generate more debris.
Methods

1. Particle Collection
2. Filter Prescreening
3. Scanning Electron Microscopy
4. Raman Spectroscopy
5. Experimental Animal Test
1. Particle Collection

Prefilter DI Water with 0.4-micron filters.

Ultrasonicate masks in prefiltered DI water for 30 minutes.

Filter 100mL of the solution onto 0.8-micron filters.
2. Filter
Prescreening

Bright Field
Microscopy
3. SEM Analysis

- Image Capturing
- 100 Particle Count for 3 samples of each mask category
Control: Prefiltered DI Water
Non-Inhalable Particles
Inhalable Particles

2.5 μm
4. Raman Spectroscopy

BYD Single-use Surgical Mask consists of three layers of nonwoven material:

- **Outer Layer**
  Polypropylene spunbond nonwoven fabric

- **Middle Layer**
  Polypropylene melt-blown nonwoven

- **Inner Layer**
  Polypropylene spunbond nonwoven fabric
4. Raman Spectroscopy
5. Experimental Animal Test

Experimental Groups

• Strain: C57 mice
• Age: 8-10 weeks
• Sample Size: 5 mice per each group = 25 total
• Groups:
  • Control DI Water
  • N-95
  • Surgical Mask
  • Fabric Mask
Pulmonary Function & Lavage

Procedure

Intranasal Instillation
25 μL of 1μg/1μL particle + saline solution every 24 hours for 3 days prior to PFT

Methacholine Challenge

PFT

Bronchoalveolar Lavage Fluid (BALF)

Cell Differentials and Total Cell Count
Methacholine Challenge

Bronchoconstrictive agent administered at increasing doses to measure changes in airway resistance
Conclusion

- Particles under 2.5μm
  - New Masks: N95 > Surgical > Fabric
  - Aged Masks: N95 > Fabric > Surgical

- Fibrous particles
  - New Masks: Fabric > N95 > Surgical
  - Aged Masks: Fabric > Surgical > N95

- Particle instillation in mice did NOT cause
  - Airway sensitivity
  - Inflammatory changes
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