Evaluating the Effectiveness of Common Masks
Environmental Geology—Air Quality[1]
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ABSTRACT

The purpose of this study was for undergraduate and graduate students at SMU to evaluate the effectiveness of various types of face masks in filtering particles small enough to carry SARS-CoV-2, the virus that causes COVID-19. Air samples were collected from underneath facial masks (being worn by a human subject) and compared to ambient atmosphere. Overall, masks and face shields blocked particles when compared to non-filtered atmospheric samples, but the filtration effectiveness varied significantly. Masks and various combinations included: N95, KN95, a cotton/polyester fabric mask, an unwashed and newly made home-produced double-lined cloth mask, a surgical mask (as found at grocery stores and pharmacies), and a plastic face shield. The preliminary results are excellent for showing trends and the methods provide excellent information for a more comprehensive experiment.

BACKGROUND

As a result of the global coronavirus pandemic, since the beginning of 2020, various governments throughout the United States have instructed and advised the general public to wear masks. There are dozens of choices ranging from home-made masks to inexpensive general dust masks to expensive designer styles.[3] Only the NIOSH labeled N95 or greater respirator masks are regulated and certified as having met protection standards of 95% filtration of all particles by the Centers for Disease Control and Prevention's National Institute for Occupational Safety and Health (or NIOSH).[4] SARS-CoV-2, the virus that causes COVID-19, is a virus ranging in size from approximately 50 to 140 nanometers.[5] (There are 1 million nanometers in a millimeter). As an infected person exhales, SARS-CoV-2 commonly travels on respiratory particles ranging in size from 0.5 to 10 microns. (There are 1,000 microns in a millimeter.). The virus can travel on particles larger than 10 microns, but the residence time in the atmosphere is short and the likelihood of transmission is not as great when compared to particles less than 10 microns in size.[6] There is confusion about which masks are the most protective of public health. Masks were compared against normal atmosphere to answer the question, which common masks filter the greatest concentration of particles less than 10 microns?

RESULTS

An estimated 132,554 particles were collected, counted, and analyzed to present the findings listed below.

% of mask filtration for particles less than 10 microns	
Masks	**% reduction of particles 10 microns or less**
Double-layered Cloth under surgical	97%
KN95 under a surgical (a)	93%
KN95 under a surgical (b)	93%
N95 under face shield (a)	92%
KN95 under face shield	91%
Double-layered Cloth	89%
N95 under a surgical mask	88%
N95 under face shield (b)	85%
N95	79%
Surgical (a)	61%
Surgical (b)	60%
Cotton/Polyester	56%
KN95 (a)	28%
KN95 (b)	26%
Face shield	9%

END NOTES

[1] Environmental Geology—Air Quality (GEOL 3363/6363) is taught in the Roy M. Huffington Department of Earth Sciences at Southern Methodist University (SMU).

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[3] CDC Guidance for Wearing Masks. Accessed April 10, 2021. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover-guidance.html; CDC Guidance on Types of Masks. Accessed April 10,2021. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/types-of-masks.html#:~:text=KN95%20masks%20are%20a%20type,in%20the%20United%20States.

[4] NIOSH-Approved N95 Particulate Filtering Facepiece Respirators. Accessed April 29, 2021. https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/n95list1.html.

[5] The Size of SARS-CoV-2 and its Implications. Accessed April 29, 2021. https://www.news-medical.net/health/The-Size-of-SARS-CoV-2-Compared-to-Other-Things.aspx.

[6] Lee, Byung Uk. "Minimum Sizes of Respiratory Particles Carrying SARS-CoV-2 and the Possibility of Aerosol Generation." *International journal of environmental research and public health* vol. 17,19 6960. 23 Sep. 2020, doi:10.3390/ijerph17196960.