

MASKS: Types of masks, their effectiveness and our recommendations

Since the Covid pandemic began, the general public have had unrestricted, free access to peer-reviewed academic research. Thanks to Open Access, the best information on Covid-19 is now public. Journal articles looking at Covid are fully accessible to all those who wish to truly “follow the science”. We have condensed some of the latest research to raise awareness of the range of scientific perspectives and to highlight the failure of Western governments and media outlets to equip the public with the best information and advice to inform their choices.

Are masks important and what is their role?

With covid infections rising for our first population peak without basic tools like testing, tracing and isolation, simple and effective mitigations including masks become increasingly essential to limit infection. Covid is spread predominantly through aerosols indoors. Aerosols are very small liquid droplets (0.3 microns in diameter or less) suspended in the air. If a person who has Covid is talking, coughing, sneezing, singing, or even just breathing, aerosols containing virus particles are released into the air, whether or not the person has symptoms. In an enclosed indoor space, these aerosols build up over time. The infected person also releases larger droplets (0.5 microns or more), and these quickly fall to the ground or other flat surfaces. While ventilation and air filters can play a part in reducing the levels of virus that build up in the air, we focus here on what masks can do to keep uninfected people safer and to reduce the chance of infected people spreading infection.

FFP2/N95 Masks



By dronepicr - Corona Face mask FFP2, CC BY 2.0,
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FFP2s provide a well-fitting seal around the face. They filter 94% of aerosol particles 0.3 microns in diameter in both directions. This protects the wearer from virus in the room and protects others if the wearer is infected. Masks with ear loops rather than head loops do not provide a perfect seal, as they allow more air leakage around the face. FFP2s can be reused many times until the material becomes dirty or wet. Some dampness occurring through breathing and long wear does not reduce particle filtration, while being submerged in water does reduce particle filtration. Even without fit-testing, it reduces particle emission by 90% where there is a good fit. The material is non-woven, meaning the fabric fibres have a random, non-uniformed arrangement. Several layers of non-woven fabric are melted or pressed tightly together and effectively filter a range of particle sizes whilst remaining breathable.

FFP3/N99 Masks

FFP3 masks filter 98% of aerosols, providing the highest protection both for others and the wearer. Similar to FFP2s in fabric and fit, FFP3s usually have head loops, which provide a better seal around the face and reduce leakage. These types of masks are commonly seen in healthcare and industrial settings to prevent against inhaling infectious diseases, dust and solvents. While manufacturers recommend it be worn for up to 8 hours, it can be reused many times until the fabric has become dirty or wet. Note that FFP3s with valves do not protect others as the air exhaled is unfiltered, while inhaled air is filtered.



Surgical Masks

These are designed to prevent the wearer from projecting droplets and fluids into their surroundings. Although they are made of non-woven water-resistant fabric, they do not prevent the wearer from releasing fine aerosol particles. Surgical masks will not be as effective in preventing aerosol transmission and spread. Surgical masks should be disposed of after each use. They are highly effective at stopping particles larger than 0.7 microns in diameter, such as those of coughs and sneezes. However, they do not prevent much aerosol spread. Wearing two surgical masks at once (double masking) was advocated by some governments, although despite the extra layers of fabric, no additional protection is possible as the masks are loose-fitting.



Cloth Face Coverings

As cloth face-coverings are made of woven fabrics, they only filter larger droplets. They do not filter small aerosol particles and so do not protect the wearer or others as effectively. Cloth masks that incorporate FFP2 filters or other non-woven material filters provide better protection against aerosols, but a good, well-fitting seal is required to achieve this. Virus or dust particles that land on the outside of cloth masks can be redistributed into the air as the wearer breathes out through them. Similarly, people infected with Covid wearing cloth masks will be able to breathe out virus-laden aerosol particles into their surroundings, albeit in a reduced way. For this reason, cloth masks must be washed after each use. Cloth masks were advocated by governments because of shortages of approved PPE at the beginning of the pandemic and to avoid the costs of providing the public with adequate masks.



The Science

A study by Cambridge University Hospitals found that when health workers working on Covid wards were given FFP3 masks instead of surgical masks, hospital-acquired infections were reduced to zero. This included 100% of patient-facing staff, whether or not they performed aerosol-generating procedures like chest-compressions or inserting breathing tubes into patients. This study strongly suggests that FFP3 masks are effective at preventing Covid infections, as all healthcare staff in the study came into contact with Covid positive patients and none of them became infected.

Another study looking at the effects of a variety of masks on aerosol spread when subjects coughed found that well-fitting masks was the most important factor in preventing spread. Surgical, cloth, valved FFP3 and un-valved FFP3 masks all reduced the extent of particle emission when the wearer coughed in comparison to no mask. Double masking with surgical masks was tested, and was not shown to further reduce the spread of coughed-out air despite the extra fabric. The findings found that well-fitting masks across all types were significant in reducing the spread of coughed-out air.

Our Recommendations

FFP2 and FFP3 masks provide the best possible protection to the wearer and to others. This would reduce the opportunity for community transmission and make indoor settings much safer for all.

Fit is the most important determinant of effective protection, both of the self and others. A mask that fits the face with as little leakage as possible provides optimum protection. Masks leak most of the air around the nose, so choosing a mask with a wire nose panel is best. Head-loops also provide a better fit to the face to reduce air leakage. To fit-test or fit check, lightly hold your hands to the mask and press to see if it improves any air leakage you may have around the face. If so, adjust the positioning, straps or nose panel accordingly. If the mask moves inward as you breathe in without any cool streams of unfiltered air coming in around the face, then it is likely you have a good fit. If you believe you have a good fit, then the ability to smell will be reduced. If you cannot smell perfumes or other strong smells with your mask on, it is likely that there is a good fit.

Fabric is also important in determining the effectiveness of masks. Multiple layers of non-woven fabric work best against both aerosols and larger droplets. While well-fitting FFP masks are more expensive, it is possible to buy one or two and alternate the use of them for prolonged reusability. Simply allow a mask to dry completely at room temperature for a few days before using it again. Make sure any masks purchased feature the CE mark on the packaging to ensure legitimate, high-quality fabric is being used. Valved masks are poor and should not be used in public places or healthcare settings, as they do not protect others.

As a number of people with Covid are asymptomatic, there is a strong argument in favour of universal masking in certain situations. This would be most effective at large gatherings and other indoor settings such as healthcare facilities and hospitality and entertainment venues. The lack of adequate knowledge on effective masking, as well as the difficulty in obtaining good-quality masks and the relatively high price of them shows a serious failure of policy and information communication. Research overwhelmingly suggests that masking is effective in reducing the spread of Covid, and the public ought to have been informed that appropriate fit and material are essential to achieve this.

Brooks, J., Beezhold, D., Noti, J., Coyle, J., Derk, R., Blachere, F. and Lindsley, W., 2021. Maximizing Fit for Cloth and Medical Procedure Masks to Improve Performance and Reduce SARS-CoV-2 Transmission and Exposure, 2021. MMWR. Morbidity and Mortality Weekly Report, 70(7), pp.254-257. Available at: <https://doi.org/10.15585/mmwr.mm7007e1>

Clase, C., de Lannoy, C. and Laengert, S., 2020. Polypropylene, the material now recommended for COVID-19 mask filters: What it is, where to get it. The Conversation. Available at: <https://theconversation.com/polypropylene-the-material-now-recommended-for-covid-19-mask-filters-what-it-is-where-to-get-it-149613>

Collins, A., 2020. How long can you wear a KF94 or KN95? How to get a good face fit and more!. [video] Available at: https://www.youtube.com/watch?v=_In-nBP6WkQ

Deng, W., Sun, Y., Yao, X., Subramanian, K., Ling, C., Wang, H., Chopra, S., Xu, B., Wang, J., Chen, J., Wang, D., Amancio, H., Pramana, S., Ye, R. and Wang, S., 2021. Masks for COVID-19. Advanced Science, 9(3), p.2102189. Available at: <https://doi.org/10.1002/adv.202102189>

Ferris, M., Ferris, R., Workman, C., O'Connor, E., Enoch, D., Goldesgeyme, E., Quinnell, N., Patel, P., Wright, J., Martell, G., Moody, C., Shaw, A., Illingworth, C., Matheson, N. and Weekes, M., 2021. FFP3 respirators protect healthcare workers against infection with SARS-CoV-2.

Konda, A., Prakash, A., Moss, G., Schmoldt, M., Grant, G. and Guha, S., 2020. Aerosol Filtration Efficiency of Common Fabrics Used in Respiratory Cloth Masks. ACS Nano, 14(5), pp.6339-6347. Available at: <https://dx.doi.org/10.1021/acsnano.0c03252>

Lepelletier, D., Grandbastien, B., Romano-Bertrand, S., Aho, S., Chidiac, C., Géhanno, J. and Chauvin, F., 2020. What face mask for what use in the context of the COVID-19 pandemic? The French guidelines. Journal of Hospital Infection, 105(3), pp.414-418. Available at: <https://doi.org/10.1016/j.jhin.2020.04.036>

Protective Masks Direct, 2021. What Are the Differences Between FFP3, N95, And Surgical Masks? Protectivemasksdirect.co.uk. Available at: <https://www.protectivemasksdirect.co.uk/blog/what-are-the-differences-between-ffp3-n95-and-surgical-masks/>

Tanisali, G., Sozak, A., Bulut, A., Sander, T., Dogan, O., Dağ, Ç., Gönen, M., Can, F., DeMirci, H. and Ergonul, O., 2021. Effectiveness of different types of mask in aerosol dispersion in SARS-CoV-2 infection. International Journal of Infectious Diseases, 109, pp.310-314. Available at: <https://doi.org/10.1016/j.ijid.2021.06.029>