Particulate does matter: is Covid-19 another air pollution related disease?

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As Covid-19 spreads around the world, the level of uncertainty related to this infection remains high. Governments and health systems are following different and uncoordinated strategies to contain the epidemic. People are receiving confounding messages from experts and authorities: whereas some countries decided to lock down their nation, other are experimenting a wait-and-see policy, as in the hope that the problem will solve itself. According to the Lancet the actions taken so far “have been slow and insufficient” with “scrambling to implement appropriate measures to delay spread of the virus” (1).

Protecting people at the moment and therefore reducing the speed and the peak of transmission is the only possible options, until an antiviral drug or a vaccine will be ready.

However, with no shared restraint tactics and no risk communication plans in place, hand-washing seems to be one of the sole measures everyone agreed upon. Is washing hand – a solution Semmelweis suggested 150 years ago (2) – our best answer to the infection? And are we washing our hand of the environmental issue related to respiratory virus infections as well?

Airborne virus in fact can be considered bio-pollutants, and when it comes to respiratory infection, particulate does matter.

Indeed, aside from gaseous pollutants, the atmosphere can also be polluted by particles. These particles (either in suspension, fluid or in solid state), have a divergent composition and size and are sometimes called aerosols. They are often catalogued as 'floating dust', but are best known as particulate matter (PM).

As long as we know, Covid-19, like other respiratory viruses, need a watery nucleus (Flügge droplets) to travel thought the air. Nevertheless, other carriers, as the particulate matter (PM), may be effective in spreading the viruses (3, 4).

Are thus respiratory infections part of a larger cadre of diseases that are strictly related to or directly caused by air pollution, as we have suggested in our recent publication (5)?

If this is the case, the way Covid-19 can spread may mimic the epidemiology of other diseases caused by air pollutants. Therefore, some of the strategies specifically designed to protect people from air pollution may be used also against Covid-19.

Facial mask are personal protective devices that limit the amount and the quality of particulate that can reach the respiratory tract. The amount and the quality of particulate that they can block depend on the mask and on the type of pollutant. Masks can stop microorganism, but they are not bidirectional filter: germs spread in the environment from the respiratory airways via mainly via the droplets. Once in the air, microrganisms can travel and lay on surfaces or can directly reach other people’s mucosae, starting a new infection. Surgical masks are considered highly effective in reducing the risk of transmission from a positive patient to a negative one, mainly stopping the Flügge droplets. On the other hand, surgical masks are not so efficient in blocking the germs, and therefore the contagion, when a negative person is wearing the device.

In addition, most of the masks currently in production are not so effective.

The WHO recently releases a guidance on when and how to use a medical masks to reduce Covid-19 transmission (6). However, no technical details are given.

Surgical mask in fact do not provide a filter able to block smaller elements and virus.

Covid-19 diameter varies around 100 nm (7). The dimension of the particle transporting the virus depend on the carrier (1-10μm for droplets), between 0.3, to 2.5μm and 2.5 to 10μm for $PM_{2.5}$ and PM_{10} respectively (values refers to aerodynamic diameter). A mask unable to stop particles of this size is virtually invisible for the virus.

Furthermore, the effectiveness of the filter depends on several factors, as the weft or the number of impacts between the particles and the fibres of the mask. A s a consequence, unproperly designed facial masks (see figure 1) do not stop droplets, PM, or virus.

This is crucial as those who unawares wear inapt masks may expose themselves to hazardous behaviours, remaining exposed to the virus or unwillingly spreading the infection.

Future nano-technologies and active filters (active filtering fabrics and virucides) can help to overcome these problems. Though, at the moment there are no perfect and cost-effective antiviral urban mask available.

Other strategies may be studied, as the use of air cleaner with High Efficiency Particulate Air filter (HEPA) devices (class H14 or higher), which may reduce the viral load in the air of indoor confined environments.

We still do not know if Covid-19 will be washed out at the and of the epidemics, or if this infection will become endemic. What we know is that we need properly designed and cost-effective personal protective devices. We need to research and develop antiviral and virucide facial masks with a high filtering efficiency in order to tackle the infection.

However, these or other devices alone are not enough. We need a synergic strategy to promote environmental health. Our fight against respiratory viruses and against particulate matter (that causes millions of deaths worldwide every years) (8, 9) in fact has a common ground, not only because particulate can carry the virions. People must become aware of the hazards that surround them, and became committed in reducing the risk and actively engaged in the fight for a healthier environment.

When it comes to viral infection, then, particle does matter, and we can ignore that, otherwise we will not take responsibility for what is happening today with this new coronavirus epidemic.

In conclusion, Covid-19 shows how fragile is the ecosystem we live in, as well as how unprepared we are in protecting ourselves from bio-pollutants as part of a wider fight against air pollution. It is thus paramount to foster a behavioural change, taking immediate action and providing the right information to help people to adopt effective measures against pollutants.

References

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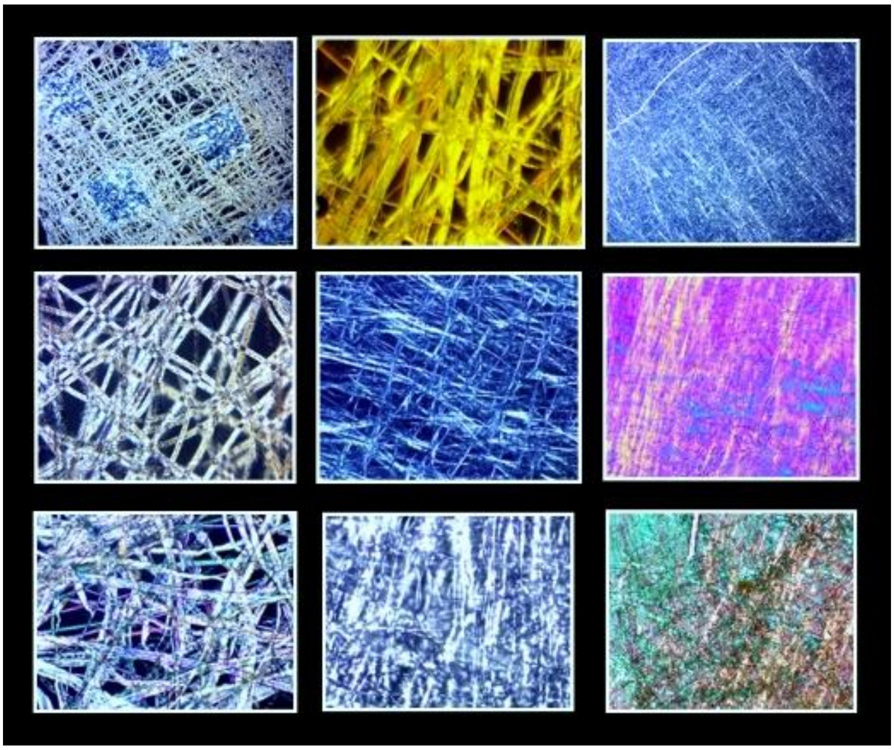

Figure 1. Structural differences that we found in different mask available on the market. The pictogram visually shows how commercial masks differ among each other, with some of the device presenting a structure inapt to block germs (from respiratory virus up to prokaryotes). *Left column*: structural layer. *Central and right column*: filtering layer. Observations in episcopic light, in polarized light, and with mixed technique (transmitted and episcopic light) *Light source:* white, colour temperature 5600K or blue, 405-450 nm. (*Microscopes:* Olympus BX 60 and Leitz Ortholux)