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Letter to the Editor

Climatic factors and possible influence on the spread of SARS-Cov2: is the role of droplets physics underestimated?

Dear Sirs,

it is debated whether climatic variations represent an influencing factor in the contagiousness of the SARS-CoV2 virus[1,2] and therefore in its spread. Previous studies[3,4], conducted on respiratory viruses including SARS-CoV, suggest that the increase in both temperature and relative humidity (in the atmosphere) inhibit the virus. On the contrary, the virus transmission vehicle, represented by the saliva droplets (and nasopharyngeal secretions emitted from an infected individual), evaporates more rapidly with high temperature and low humidity[5], lowering the possibility of contagion.

During the common breathing process, and much more during coughing or sneezing, when a droplet of infected saliva/secretions is released into the environment, it is subject to phenomena of nature both fluid- dynamic and thermal[4,6], that are able to influence the trajectory traveled by a single or a cloud of droplets. The fluid-dynamic parameters are the emission speed and the turbulence of the motion (e.g., due to the presence of wind in the environment), while the thermo-hygrometric parameters act through the evaporation processes, that are capable of modifying the volume of the droplet and indirectly the motion itself until neutralization.

Approximating each droplet to a sphere, it is possible to divide these into respirable droplets*, with a diameter of ≥5 μm and inspirable droplets**, ≤5 μm in diameter. Respirable droplets stop at the upper airways, while inspirable droplets can reach bronchioles and could be potentially more dangerous4. Due to evaporation, larger droplets can shrink below the 5 μm threshold.

The predictable droplet's trajectory toward the ground is the basis of the recommendations that indicate the value of 1 (other recommend distance values greater than 1 meter) meter as a social distance to prevent inhalation[7]: in fact it results that already at 0.77 m over 70% of the droplets emitted during normal breathing have precipitated[1], while other studies[8] report that breathing or conversation can push droplets up to 1.8 m. These values are respected in the event that the speed of the air in the environment is zero. In fact, if air speed takes on values higher than 0 km/h, the droplet can travel at greater distances (6 m with wind at 4 km/h): the presence, for example, of air conditioners or fans in a closed environment can cause turbulent motions capable of pushing the droplets to greater distances[9]. Furthermore, in the event that the emission occurs through sneezing or coughing, the exit speed can reach values of 160 km/h for sneezing and 80 for coughing. The distances covered by the droplets in this case can reach 8 m.

Models we find in literature[9], assimilate the single droplet of saliva to a drop of water with the same geometric dimensions and predict that evaporation is influenced by environmental conditions, the initial size of the droplets and the time taken by the single droplet to travel from the mouth to a given distance. For instance, drops of 70-80 μm would reduce their diameter by about 40% in 10 s in the absence of wind[1,10]. In the presence of turbulent motions, the reduction of the diameter is accelerated due to a more rapid evaporation of the aqueous component. Evaporation, reducing the diameter of the droplets, could make the propagation of the virus more insidious (changing the droplets from respirable to inspirable), but at the same time it can determine two consequences that might reduce viral dissemination.

First, we must consider that the model that equates saliva with water does not take into account the constituent components of saliva, such as electrolytes, mucus and enzymes and their relationship with the virus once the water component has evaporated. Concentration of the solid components could have a detrimental effect on the survival capacity of the virus.

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Secondly, the concentration of the solutes increases the specific weight of the residual droplet and facilitates its fall to the ground and shortens the trajectory.

These considerations give place to the necessity of investigating two aspects, of which there is no evidence in the literature: influence of solutes present in the saliva droplet on the survival of the virus and of increase of specific weight of the vector droplets. However, the fact that the infection from SARS-CoV2 is slowed down by the onset of the hot season[2] could just be a consequence of the rapidity with which the evaporation process of the carrier droplet develops.

In conclusion, it can be stated that the spread of the SARS-CoV2 virus by air is influenced by many physical and physico-chemical factors connected to the vector, interacting with each other with final effects not easily predictable.

Conflict of interest

The Authors declare that they have no conflict of interests.

*The term respirable droplet refers to all those droplets that get stuck in the upper airways due to their size.

**The term inspirable droplet (aerosol) refers to all those droplets having such dimensions as to be able to reach the lungs.

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