UNDERSTANDING THE PHYSICS OF CORONAVIRUS TRANSMISSION

Relevant for: Developmental Issues | Topic: Health & Sanitation and related issues

Across the world, the COVID-19 pandemic has forced governments into mandating the use of face masks. | Photo Credit: Deagreez

When physicists say that there is physics in everything, they mean literally everything, including how a disease is transmitted. From the generation of virus-laden respiratory droplets to dispersing in the air to inhalation or deposition on surfaces, a team from Johns Hopkins University in the U.S tried to decode the flow physics of coronavirus transmission.

The paper published in the *Journal of Fluid Mechanics* notes that this can help us be better prepared to tackle disease outbreak in the future. The paper also lists preventive measures such as “use of face masks, hand washing, ventilation of indoor environments, and social distancing.”

The fluid dynamic analyses helped to understand the mechanisms behind how the droplets are generated in the respiratory tract, and also characterise the density, size and velocity of ejected droplets. The team also tried to estimate the settling distance, evaporation time and transport of the particles. They also looked at the effect of external factors such as air currents, temperature and humidity.

“This topic [fluid dynamics of respiratory diseases] has been studied before but only sparingly and we now find out with COVID-19 that there are significant gaps in our knowledge,” explains Rajat Mittal, from the Department of Mechanical Engineering at Johns Hopkins University in an email to *The Hindu.* He is the first author of the paper.

Previous studies have shown that a single sneeze can generate thousands of droplets, with velocities above 20 metre per second, whereas coughing generates 10–100 times fewer droplets than sneezing with velocities of approximately 10 metre per second. Breathing and talking generate jet velocities less than 5 metre per second. Taking all this into consideration, the paper notes that this is why a three to six feet social distancing guideline is issued.

Summarising airborne transmission, the paper notes that most of the droplets evaporate within a few seconds to form droplet nuclei — consisting of virions and solid residue — of approximately 10 micrometre in size. These can remain suspended in the air for hours and given the approximately one-hour viability half-life of the SARS-CoV-2 virus these nuclei play an important role in the transmission. “The evaporation process...and the composition of droplet nuclei require further analysis because these have implications for the viability and potency of the virus that is transported by these nuclei,” adds the paper.

The final stage of airborne transmission is the inhalation of the virus-laden particles and its deposition in the respiratory mucosa. Face masks provide ‘inward’ protection by filtering these particles. Masks also provide ‘outward’ protection by trapping the virus-laden droplets expelled by an infected person.

“We are now using computational modeling to examine the aerodynamics for a variety of scenarios such as talking, sneezing and coughing,” adds Dr. Mittal. In a release, he notes: "Some of what we are doing now to combat COVID-19 in 2020 is based on science from papers published in the 1930s. We've learned so much since then, but policy needs to catch up."

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