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The Humidity Hypothesis Of COVID-19 Spread

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Abstract:

COVID-19 pandemic resulted in 39,814,759 cases and 1,112,502 deaths as of 17 October 2020. Certain parts of the globe are experiencing an acute rise in new cases of COVID-19, whereas it is under control in certain areas. Use of mask, social distancing hand hygiene and other preventive measures played important role in the control of spread of infection. In spite of all the preventive measures, some part of the world is experiencing acute rise in new cases of COVID-19. In areas with high relative humidity, the aerosol droplet remains in the air for longer time, resulting in increased risk of infection to greater number of people.

Keywords: COVID-19, SARS-CoV-2, aerosol droplet, humidity

Certain parts of the globe are experiencing an acute rise in new cases of COVID-19. In the state of Kerala, South India, where there were relatively few cases in the first few months of the pandemic, there has been a sudden surge. This occurred in spite of the fact that people are compliant with mask use, and social gatherings are discouraged to the extent possible by the state government. Thus, social behaviour alone might not be enough to explain the surge. We would like to present a hypothesis that combines principles of physics and biology, with emphasis on prevailing weather conditions.

Thiruvanathapuram is a town in Kerala suffering a surge, with 1182 new cases of COVID-19 being reported on October 7. Located at the southern tip of the Indian peninsula, the relative humidity in Thiruvanathapuram is 93% (**Figure 1**). A surge has also been reported in Colombo, a town on the island nation of Sri Lanka located 226 miles away, where the relative humidity is 87%. Colombo recorded 539 cases on 7 October after having limited new case numbers to single digits for several months. Likewise, in Europe, cities like Prague are experiencing a surge in new cases. The current relative humidity in Prague is 84% (**Table 1**).

In contrast, the pandemic has been well under control in Pakistan and Afghanistan, in spite of high population density in the large cities. In Karachi, Pakistan, there are only 615 cases on 14 October, off a peak of 6472 new cases on 14 June. There is no known scientific explanation for the remarkable drop in cases in Pakistan yet. We noted with interest that the relative humidity at Karachi (Pakistan) now is only 26%. In Afghanistan, new cases peaked at 1241 on 17 June, and have dropped to 129 per day (13 October). In Kabul (Afghanistan), the prevailing relative humidity is 19% (**Figure 1**).

Table 1: Relation between the number of new cases of COVID-19 and humidity

Place	Population density/sq km	New cases (October 7)	Humidity (%)
Thiruvananthapuram	1509	1182	93
Colombo	13,364	539	87
Prague	4600	5339	84
Karachi	63,000	624	26
Kabul	4500	64	19

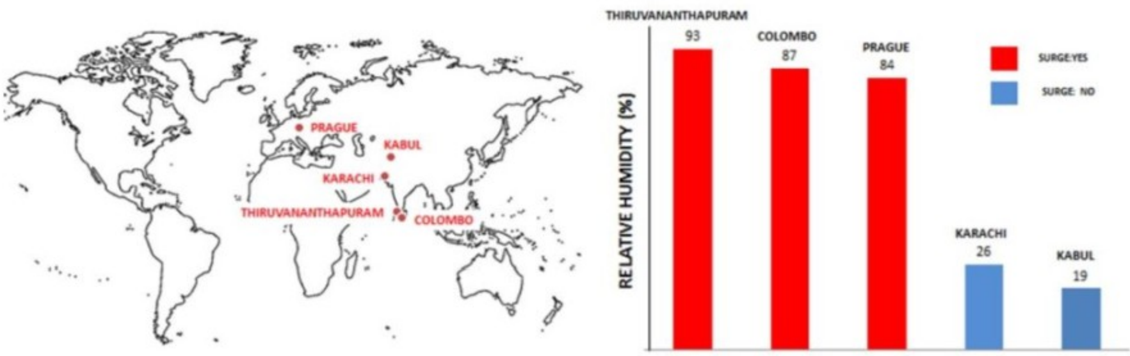

Figure 1: Geographical location, humidity and new cases of COVID-19 in some selected cities.

In Delhi, located in northern part of India, new cases have dropped by 25% since the peak on 16 September. Of note, the peak occurred soon after August, the most humid month of the year in Delhi (73%). The current relative humidity in that region is only 44%.

The virus is known to spread between people through droplets that travel through the air. When droplet size is below 5 micrometers, they remain afloat in the air for long periods of time, and are classified as aerosols. Aerosols behave more like mist and do not settle down with gravity, unlike larger and heavier droplets. The SARS-CoV-2 virus is known to stay alive in aerosol for several hours [1].

The aerosol droplet is essentially a spherical blob of liquid which is bound together by surface tension. Its behaviour in varying weather conditions has been studied previously [2]. Relative humidity measures the water vapour content in the air. When humidity is low, evaporation is faster. As a result, the size of the droplets reduces quickly, resulting in loss of surface stability and eventual rupture of the droplet (**Figure 2**).

When relative humidity is high, the droplet retains its original size and shape for a longer period of time. The virus is able to remain in the air for longer, and travel further. In crowded settings, this translates to greater droplet load which can potentially infect greater number of people who happen to share the space during the lifetime of the droplet.

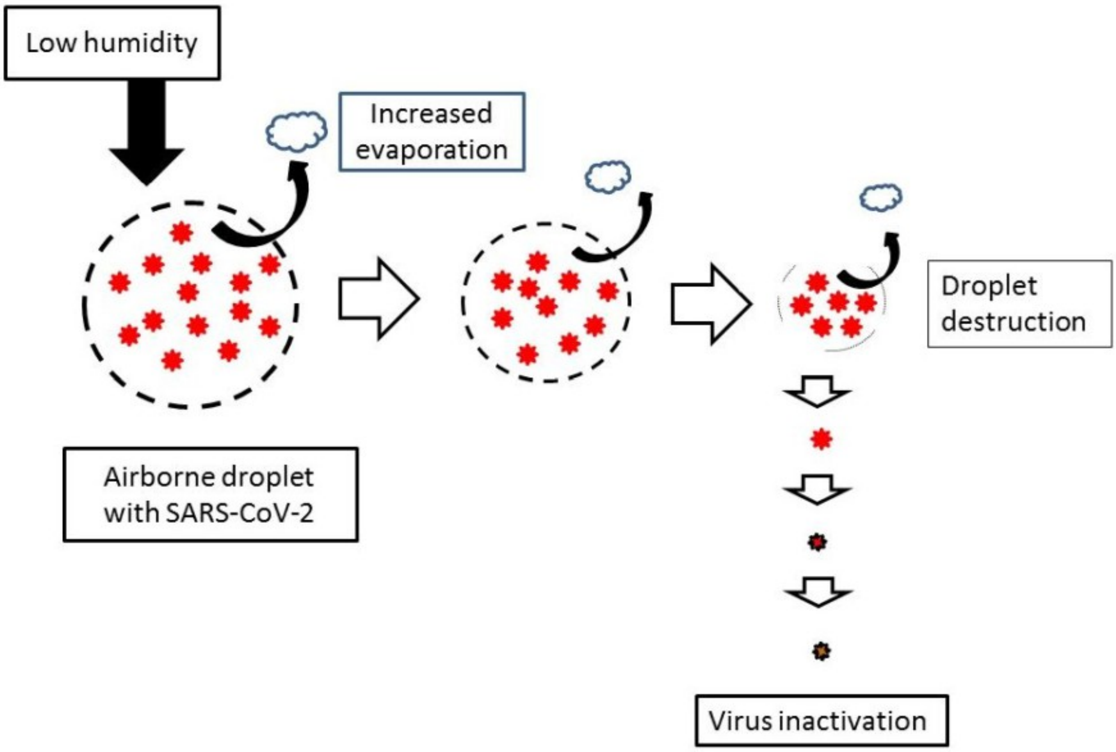

Figure 2: Effect of humidity on airborne droplet

Knowledge of all factors that influence viral transmission is essential in limiting the spread of the pandemic. The R-0 of the SARS-CoV-2 virus is known to vary in different social and geographic settings within the same country, depending on population density, housing conditions and social behaviour. Basically, the virus spreads whenever there is a chance of other people inhaling the droplets generated by an infected person. High relative humidity is one such factor that increases the droplet load and spread in indoor as well as outdoor settings. Therefore, we postulate that the ability of the virus to spread between people will also depend on relative humidity.

In the absence of a universal vaccine or antiviral medication, non-pharmacological interventions are the mainstay of pandemic management. If the humidity hypothesis is confirmed, it will not only help to explain the selective decline in cases in certain parts of the world like Pakistan and Afghanistan, but also fine-tune non-pharmacological interventions worldwide. Since humidity patterns can be predicted, more stringent curbs on social behaviour during the months of high relative humidity might significantly limit the spread of the pandemic in each region.

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