

REVIEW ARTICLE

COVID-19 and Environment

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ABSTRACT

Environmental and demographic factors played an important role in the transmission of COVID-19. This review discusses the potential impact of climatic variables such as temperature, humidity, Air Quality Index (AQI), air pollutants, wastewater and different surfaces on the spread of SARS-COVID-2 virus. Different studies have demonstrated the significant effect of ambient rise in temperature and humidity on Corona cases. However, air quality index and air pollutants are more significantly associated with the mortality rate of corona patients. Furthermore, COVID-19 can survive longer on smooth surfaces as compare to the rough surfaces. The presence of the virus is also detected in stool samples of the patient and wastewater but no study has shown transmission of disease through drinking contaminated water. Hence, meteorological and environmental factors have significant impact on the occurrence of the virus and its spread.

Key Words: *Corona Virus, Climate Variations, Environment.*

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Introduction

SARS-COVID-19 outbreak was first reported in the city of Wuhan, China, in December, 2019 and initially treated as pneumonia of unknown etiology.¹ Afterwards, Center for Disease Control (CDC) present in China, analyzed the respiratory samples of the patient and declared that the pneumonia is caused by a novel corona virus and they named it as Novel Coronavirus Pneumonia (NCP).² Later on the International Committee on Taxonomy of virus named it as Severe Acute Respiratory Syndrome Coronavirus-2.³ World Health Organization (WHO) named it as COVID-19 on 11th February, 2020 and declared it as pandemic.⁴

In an attempt to understand the pandemics like coronavirus, studies have inspected the factors that could influence the spread of coronaviruses.⁵ In general, three major factors are affects the epidemiology of communicable diseases. These includes agent for transmission, host and environment.⁶ In history, the occurrence of

pandemics like SARS were partly affected by climatic variations such as air pollutant, air temperature and humidity.⁷ Recent studies also reported the connection between environmental variables and COVID-19. All studies have consensus that the transmissibility of COVID-19 are more communal in winter season as compare to summers, further they evaluated that air quality is also impacting the severity of COVID-19, as lungs function become compromised due to certain air contaminants.^{8,9} Moreover, the viruses like corona virus can stay on different material surfaces for many hours.¹⁰ Furthermore, the behavior of humans is also contributing to the spread of these pandemic. Human behavior depend on the demography, population size, migration, agriculture growth, contact with domestic and wild animals and climate change which includes soil erosion, habitat invasion and deforestation and pattern of rainfalls.^{11,12}

To prevent COVID -19 rapid spread is a global challenge., because variability of this disease also depends upon the type of the environment and climate factors. This aspect need thorough investigation. This review aimed to examine the role and effect of various environmental factors such as temperature, humidity, air quality, water and surfaces, on the prevalence and transmission of COVID-19 pandemic (Figure 1).

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Fig 1. Environmental Factors affecting COVID-19 Persistence

Impact of Temperature and humidity on COVID-19

Currently, the primary concerns for the prevalence of the COVID-19 is the relationship between air temperature and relative humidity with the spread of corona virus.⁷ Till now many studies revealed the direct connection between rising temperature and humidity on the pervasiveness of COVID-19. One study from China demonstrated the impact of wind speed and humidity on the per day positive corona cases. They gathered data from five big cities and concluded that the increase in humidity and wind speed decreases the spread of COVID-19., Another study from Italy reported that every one degree rise in temperature and upsurge in relative humidity significantly reduces the per day positive corona cases.¹³ Moreover, Chin et al., 2020, stated that the SARS-COVID-2 remains resistant for very long time at 4 °C, while its resistance decline to only 5 mins at 70 °C. According to WHO, 2020¹⁴ sunlight, heat and high and low pH can easily kills corona viruses. However, one study results has shown, corona virus can remain stable at pH ranges between 3-10.¹⁵ A study published from Italy, in which they studied the observed growth rate of COVID-19 worldwide and relate it with their environmental data present at meteorological department. They include air temperature, relative humidity, demography and population size as environmental parameters. On the basis of observed values and data they concluded

that high temperature and high level of humidity have synergistic negative effect on the spread of COVID-19 by decreasing the number of daily cases. Furthermore, they predicted that the spread of corona virus will decrease at southern hemisphere in the months of October and onwards, as temperature will start increasing in southern hemisphere, moreover the cases will increase at northern hemisphere due to decrease in temperature. The per day corona positive cases is highly dependent on the local climate, demography and population size.¹⁶

Impact of Air Quality on COVID-19

Many contradictive studies have been published to show the impact of air quality on the spread of Corona cases. Some studies have shown the positive correlation with the air pollutants and severity of COVID-19. According to one study published from China they gathered data of Air Quality Index (AQI) of various cities of China and correlate it with the number of positive cases in

each city. They declared a significant correlation between AQI and severity of active corona cases in the cities having high AQI (highly polluted) while the cities with low AQI (less polluted) had less number of cases of low severity.¹⁷ They predicted that particulate matter of less than 5µm in size might be the major carrier for the translocation of viral particles to human respiratory tract. As it can easily get attached with the surface of virus and inhaled and penetrate to the alveolar region.¹⁷ However another study from UK suggested a positive correlation between infectivity of COVID-19 and particulate matter, however mortality rate is directly associated with the other air pollutants such as sulphur dioxide, nitrogen dioxide and nitrogenous oxides.¹⁸ Moreover, according to the study held in Department of Environment Health, Social Determinants of Health Research Center, Kashan University of Medical Sciences, Iran¹², the air diffusion is not an evident route for the transmission of corona virus, but induction of sputum, nebulization, mask and bag ventilation, non-invasive ventilation, extubation and bronchoscopy are the principal reasons for the air borne release of COVID-19 aerosols.¹⁹ Based on the literature available further studies needed to clearly insight the correlation between the air pollution and number of positive corona cases.

Wastewater and COVID-19

Assessment of the total viral load in a surrounding community through environmental surveillance by monitoring its sewer system is a new approach to calculate the real viral load circulating in the environment. Many studies have been made through wastewater surveillance to investigate the spatial and temporal trends of COVID-19 circulating in the given community as presented in Table 1.

Country	No of Samples/sites	COVID +	COVID -
Holland	7 sites	6	1
Italy	12	6	6
Paris	3 WWTP	3	0
Australia	2	2	0
Massachusetts	2 WWTP	2	0
India	2 WWTP	2	0
China	4	0	4
China	9	7	2

Wastewater based epidemiological studies mainly referred as WBE, in which wastewater is screened for the real time calculation of the viral load, is well recognized as public health surveillance tool. WBE technique is mostly applied for the detection of fecal coliforms, foodborne and waterborne viruses excreted by the patients with their faeces.²⁰ Preliminary studies have been reported from different parts of the world indicating the presence of genomic viral RNA in wastewater. Till now SARS-COV-2 detection in wastewater have been reported from USA²¹, France²², Italy²³, Netherlands²⁴, India²⁵ and Australia.²⁶ Wastewater surveillance is an important tool to take a complete picture of the pandemic and also helpful in calculating the total number of infected individual present in that community both symptomatic and asymptomatic. All the WBE based approach studies have given an estimation of the total number of infected cases which was 15% higher in number as compared number shared by the clinical records. This is because the asymptomatic patient's record was not present in the hospital but they were shedding the virus through fecal route.²³ The presence of viral RNA of COVID-19 in wastewater indicates survival of the viruses in water. Hence wastewater surveillance can not only depict the actual number of positive cases at the time of pandemic but can also serve as early

warning system for the re-emergence of the pandemic in urban areas by continuously monitoring the viral load in the water samples. Moreover, further in depth study of WBE can demonstrate its applicability for prompt detection of SARS-COVID-19 in wastewater.

COVID-19 interactions with surfaces

SARS-COVID-2 transmission mainly occurs due to human to human contact, when they are at communal stage of disease with mild or no symptoms.²⁷ SARS can be transmitted through skin to skin contact, through droplets, infected hands or by contact with contaminated inanimate surfaces.²⁷ According to one study COVID-19 remain active for longer time on smooth surfaces as compared to rough ones at room temperature and 50% humidity.²⁷ Moreover it is suggested that the spread of virus can also occur by sharing printers, keyboards, desktops, telephones and door handlers.²⁸ According to one wet-lab study the survival time of COVID-19 at room temperature and 50% humidity is different for different surfaces.¹⁰ Surface type and survival time of the SARS-COVID-2 is given in Table 2.

Table 2: COVID -19 survival time on different types of surfaces¹⁰

Surface type	Survival Time
Glass	4 days
Banknotes	4 days
Steel	7 days
Plastic	7 days
Fabric	2 days
Wood	2 days

However, till now complete information about the viral load of COVID-19 on different surfaces is not present therefor one can limit its transmission by limiting the frequent contact with different surfaces and by continuous disinfection of the surfaces.

Conclusion

Reviews and studies suggested that climate variables has strong impact on the survival rate of COVID-19. Temperature and humidity have synergistic impact on COVID-19. Increase in air temperature and humidity decrease the severity of the virus. Air quality index and air pollutants have significant relation with severity of the disease and mortality. Moreover, virus can survive on the inanimate surfaces for a very long time, hence frequent disinfection of the surfaces and washing hands at regular intervals is highly recommended.

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