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Impact of COVID-19 on Environmental Health - A review

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ABSTRACT

At a time when health systems throughout the world are grappling with the coronavirus disease 2019 (COVID-19) pandemic, its effect on global environment is also a very important factor for consideration. It is a two-way process where the pre-COVID climate factors influenced the landscape in which the disease proliferates around the world andconsequences of the pandemic on our surroundings. The environmental health disparities will also have a long-lasting effect on public health response. The ongoing research on the novel coronavirus SARS-CoV-2 and COVID-19 must also include the role of environmental factors in the process of infection and differential severity of the disease.Studies have shown that the virus has created both positive and negative ramifications on the world environment, especially in countries that are the most critically affected by the pandemic. Contingency measures to slow down the virus like self-distancing and total lockdowns have shown improvements in air, water and noise quality with a concomitant decrease in greenhouse gas (GHG) emissions. On the other hand, waste management is a cause for concern that can result in negative effects on planetary health. At the peak of the infection, most attention has been diverted towards the medical aspects of the pandemic. Gradually, the policy makers have to shift their focus on social and economic avenues, environmental development and sustainability. The objective of this review will be to analyze the impact of the coronavirus on environment and water resources. The study shall update the readers on the various facets of the interaction between this pandemic and environmental health with a model development for long-term sustainability.

Introduction

On late December 2019 an unusual pneumonia was noticed in a hospital in Wuhan city, in China with a link to an animal market that sells poultry, fish and other animals to the public (Xu et al., 2020). According to WHO, 2020, the new strain of coronavirus (SARS-CoV-2) has affected almost the entire world including 216 countries infecting 28040853 people with 906092 confirmed deaths till date and created an unprecedented and irreversible impact. However, the new dynamics of the outbreaks seem highly variable amongst countries (Dong, Du, & Gardner, 2019). COVID-19 is an acute viral illness, instigated by coronavirus called the SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2). The symptoms of COVID-19 range from mild to severe, and include mainly fever, cough, and respiratory distress. Severe cases with pneumonia and hypoxemia result in considerable mortality (Rothan, 2020).Currently, most countries have tried to fight the spread of the virus with massive COVID-19 screening tests and establishing public policies of social distancing. It is clear that the priority revolves around people's health (Manuel, 2020).

The course of an epidemic is defined by several factors, including demographic and environmental, many of which have an unknown correlation for COVID-19 (Anderson et al., 2020). Manuel, 2020 has also mentioned that initial studies have reported a positive indirect impact on the environment. Due to the social distancing policies taken up by the governments, climate experts predict that greenhouse gas (GHG) emissions could drop to proportions never before seen since World War II according to the reports of the Global Carbon Project, 2020. Among the extra-human factors, climatic factors can play an important role in the spread of the coronavirus, which makes it crucial to understand the drivers of the disease spread, as they are vital to guide the imposition of restrictive measures (Rosario et al. 2020). Air pollution is also one of the greatest challenges of our millennium, and some early studies have highlighted a positive correlation between air pollution and the spread of the virus. Therefore, it is crucial to define which role the atmospheric particulate plays in the spread, morbidity, and mortality of the virus (Comunian et al. 2020). Covid-19, similarly to other viruses, could also have an airborne transmission, and particulate matter (PM) could act as a carrier through the aerosol, conveying the virus and increasing its spread (Qing et al. 2019).Tamerius et al., 2013 and Yuan et al., 2006 had already mentioned that the transmission and survival 50 of viruses responsible for respiratory diseases such as influenza and SARS viruses are known to be influenced by environmental conditions. With references to difference in Covid-19 cases in

Brazil Rosario et al. 2020 suggested that changes in the seasons towards more temperate weather, it is of pivotal importance to know the role of environmental conditions in the transmission of the virus to raise awareness on the prevention of disease spread. It has been documented that the temperature and its variations might have affected the SARS outbreak (Tan, 2005). Temperature (Pinheiro et al., 2014) and diurnal temperature range (DTR) (Luo et al., 2013) have been linked to the death from respiratory diseases. A study demonstrated that absolute humidity had significant correlations with influenza viral survival and transmission rates (Metz and Finn, 2015). Few studies reported that the COVID-19 was related to the meteorological factors, which decreased with the temperature increasing (Oliveiros et al., 2020; C. Wang et al., 2020; M. Wang et al., 2020), but their effects on the mortality have not been reported (Ma et al. 2020). As for the anthropogenic interventions, Calma, 2020 has reported that in USA, there has been an increase in garbage from personal protective equipment such as masks and gloves. Patients and health care workers are quickly going through medical supplies and disposable personal protective equipment, like masks. Eventually all that used gear piles up as medical waste that needs to be safely discarded.

In this review article we are going to discuss about the different perspectives of the environmental factors, including climatic and anthropological parameters that have direct or indirect effects on the spreading and transmission of the COVID-19 viral disease.

Relationship between air quality and COVID- 19

Microbial agent as components of bioaerosol, move around the environment making the circulating air as their vehicle (Zhou et al. 2020). Particulate matter (PM) in the surrounding atmosphere can acts as a carrier of a transport vector, thus increasing the effectiveness of the persistent spread of viruses in the aerosol as it creates a suitable microenvironment (Setti et al. 2020). Different epidemiological and experimental studies for the evaluation of the relationship between the effect of air pollutants and viral respiratory infections were carried out by Ciencewicki and Jaspers in 2007. Chen et al. 2010 has reported a positive correlation between the spread of measles virus and PM concentration in China. PM can induce increase in infected cases by several mechanisms one of which is binding of viruses to PM particles favoured by ambient climatic conditions (Chen et al. 2017). Concerning the effect of PM pollution and the spread of viruses in the population, several recent studies have analyzed whether the different areas of the world with a high and rapid increase in Covid-19's contagion were

correlated to a greater level of air pollution. The investigation of this possible correlation should be analyzed at two levels: (a) the high level of air pollution over the last years, which has made the population more sensitive to Covid-19 (longterm exposition); or (b) the sensitivity to the virus, which is linked to the high level of air pollution in the period when the virus appeared (short-term exposition) (Comunian et al., 2020). Pansini and Fornacca, 2020, associating several annual satellite and ground indexes of air quality in China, Iran, Italy, Spain, France, Germany, United Kindom, and USA with the Covid-19 infection, found statistically significant positive correlations between the high level of air pollution and Covid-19 infections. Wu et al., 2020, has shown that 1 ug/m3 increase in long-term exposure to PM2.5 is associated with a 15% increase in Covid-19 mortality rate. The results of this article suggest that long-term exposure to air pollution increases vulnerability to the occurrence of more severe Covid-19 results. These findings are in line with the known relationship between PM2.5 exposure and many of the cardiovascular and respiratory comorbidities that significantly increase the risk of death in Covid-19 patients. Concerning the effect of the short-term PM exposition and the spread of viruses in the population, the position paper proposed by the Italian Society of Environmental Medicine (SIMA) considers PM as an important carrier that has contributed to the spread of Covid-19 (Setti et al., 2020).

Relationship with temperature and humidity

SARS (severe acute respiratory syndrome) outbreaks have always been associated with the temperature and its variations (Tan et al., 2005). Apart from providing helpful conditions for virus survival and spreading, low temperature and humidity also hinders the innate immune response (Sun et al., 2020, Kudo et al., 2019). Cold conditions reduce the supply of blood immune cells to the nasal mucosa. Low relative humidity can reduce the capacity of cilia cells in the airway to remove virus particles. In addition, low-humidity environments impair the innate immune defense system, making it vulnerable to virus invasion. For the above-mentioned reasons, several studies are being dedicated to delineate the effect of temperature and humidity on the spread of COVID-19 with contradictory conclusions. Recently, Wu et al. employed log-linear generalized additive model (GAM) to analyze the effects of temperature and humidity on COVID-19 infection and deaths in 166 countries (Wu et al., 2020). Considering both the lag and cumulative effects, a negative correlation has been discovered between temperature and relative humidity to that of daily new cases and deaths caused by SARS-CoV-2. Diurnal temperature range (DTR) is also having a

positive association with daily mortality of COVID-19 (Ma et al., 2020). In general, tropical climate delays the onset of confirmed COVID-19 positive cases in comparison to tempered climates (Méndez, 2020). On the contrary, using wavelet transform coherence, partial and multiple wavelet coherence, Iqbal et al. observed that the average daily temperature between 3 °C to 21 °C does not have any significant effect on the containment of COVID-19 in Wuhan (Iqbal et al., 2020). Meteorological data from 122 cities in China showed no evidence that COVID-19 cases would reduce in warmer weather (Xie and Zhu, 2020). At < 3 °C, 1 °C rise in the mean temperature was associated with a 4.861% increase in the daily-confirmed cases.

Another study conducted in China, does not support the hypothesis that rise in temperature or ultraviolet radiation can reduce the transmissibility of the coronavirus (Yao et al., 2020). Outside of China, in USA, Bashir et al. analyzed the effect of different climate indicators on the COVID-19 pandemic (Bashir et al., 2020).

Although they found a significant association between average temperature, minimum temperature and air quality with the spread of the disease, no evidence was obtained to suggest that warm weather suppresses the virus. One probable reason for these contradictions could be that different studies were conducted with distinct data sets. Moreover, the population size and density were also different. As a result of which the probability of infection also varies between different regions. Research conducted at a global scale with larger temperature and humidity range may provide an accurate correlation between these climatic factors and the spread of SARS-CoV-2. Another challenge will be the normalization of the complex epidemiological data generated from different parts of the world. Nonetheless, there seems to be a collective effect of temperature and humidity on the spread as well as the mortality caused by COVID-19.

COVID-19 and waste management

Increase in waste

The generation of organic and inorganicwaste is indirectly accompanied by a wide range of environmental issues, such as soil erosion, deforestation, air, and water pollution (Mourad, 2016; Schanes et al., 2018). The quarantine policies in most of the countries has led to the increased number of consumers for online shopping and home delivery leading to an increased organic waste generation by households. Also, ship packed food purchased online has led to the increase of inorganic waste (Manuel et al., 2020). Medical waste is also in its rise. In Wuhan, China, hospitals produce an average of 240 metric tons of medical waste per day during the outbreak, compared to their previous average of fewer than 50 tons (Calma,

2020).

Waste recycling reduction

Waste recycling has always been a major environmental problem of interest to all countries (Liu et al., 2020) which is a common and effective way to prevent pollution, save energy, and conserve natural resources (Varotto and Spagnolli, 2017; Ma et al., 2019). Due to the pandemic, countries like USA has stopped recycling programs in some of their cities, as authorities have been concerned about the risk of COVID-19 spreading in recycling centers. In affected European countries, waste management has been restricted. For example, Italy has prohibited infected residents from sorting their waste. Also, the industry has seized the opportunity to repeal disposable bag bans, even though single-use plastic can still harbor viruses and bacteria **(Bir, 2020)**.

Conclusions

The analyses on the PM and Covid-19 correlation are the foundations to start wider research. The correlation between these factors is positive, but it is important to understand the mechanism that explains it. All mentioned studies indicate that both long-term exposure and short-term exposure to high levels of pollutants are correlated to an increase in Covid-19 contagion worldwide. Thus, it may be interesting to perform a systematic study, placing PM collection units at strategic points all over the world(Comunian, 2020).Among the indirect effects, the increase in domestic and medical waste were mentioned. The restriction to recycle waste in countries like the USA and Italy has been another negative indirect effect of SARS-CoV2. The safe management of domestic waste could be critical during the COVID-19 emergency. Medical waste such as contaminated masks, gloves, used or expired medications, and other items can easily be mixed with domestic waste. However, they should be treated as hazardous waste and disposed of separately (Manuel, 2020).

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