SARS-COV-2 AND ENVIRONMENTAL HEALTH: A BRIEF CONTEXTUALIZATION

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Abstract: COVID-19 is an infectious disease caused by the new coronavirus SARS-CoV-2 and was considered a pandemic by the World Health Organization. This brief contextualization aims to describe the role of the environment in the context of COVID-19. Therefore, the role of the environment in the transmission and proliferation of the virus is highlighted. It is concluded that changes in the environment can alter the transmission of the COVID-19 virus. In addition, understanding the environmental mechanisms that favor and maintain the pandemic is necessary for effective measures to be taken.

Keywords: Coronavirus. Environment. Environmental factors.

Resumo: O COVID-19 é uma doença infecciosa causada pelo novo coronavírus SARS-CoV-2 e foi considerada uma pandemia pela Organização Mundial da Saúde. Esta breve contextualização visa descrever o papel do meio ambiente no contexto do COVID-19. Para tanto, destaca-se o papel do meio ambiente na transmissão e proliferação do vírus. Conclui-se que mudanças no ambiente podem alterar a transmissão do vírus COVID-19. Além disso, entender os mecanismos ambientais que favorecem e mantêm a pandemia é necessário para que medidas efetivas sejam tomadas. artigos deverão vir acompanhados de um resumo em português, contendo no máximo dez linhas e três a cinco palavras-chave.

Palavras-chave: Coronavirus; Meio Ambiente; Fatores Ambientais.

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Introdution

At the end of 2019, Wuhan, China, reports an outbreak of pneumonia. In the following days, a new coronavirus, SARS-CoV-2, was identified, which causes a disease called Coronavirus Disease 2019 (COVID-19) (LI et al., 2020). The disease reached continental dimensions and, on March 11, 2020, it was declared a pandemic by the World Health Organization (WHO), demanding from governments measures of containment to reduce its spread, protect human lives and provide hospitalization for cases with worsening of the disease (JIN et al., 2020; LAM et al., 2020).

Environmental factors such as temperature, air and water quality, weather conditions and humidity are thought to play a vital role in COVID-19 spread and survival (SAMANTA; GHOSH, 2021). Several researches have been carried out in order to elucidate practices that can help to reduce the multiplication of the virus and the COVID-19 contagion rate, thus avoiding a collapse in the health area (FERNANDA; MENDES DA COSTA, 2020). Viral infections, like COVID-19, for example, can be potentiated and caused by environmental conditions (LOTFI; HAMBLIN; REZAEI, 2020). Therefore, this article aims to review how environmental factors can affect the proliferation and spread of the COVID-19 virus and how the virus and the pandemics changed the environment during 2020 and 2021.

Materials and methods

A literature search was performed using the PubMed database (National Library of Medicine of the United States) and Capes Journals Portal, until Jan 2022. Complete articles and technical notes were included, written in English, Spanish Portuguese, published in national and international indexed scientific journals that addressed the theme of environment, nutrition and COVID-19. The exclusion criteria were: articles that did not address the research topic; articles that presented only research protocols without full results. The search terms included: a) covid-19; b) environmental health and covid-19; and c) environmental and covid-19.

Results and discussions

Air quality

Several environmental factors can influence the transmission and multiplication of the COVID-19 virus. In relation to environmental factors, increasing air quality can help to decrease acute infections and chronic pathologies that are risk factors for COVID-19, as has already been demonstrated (Eslami e Jalili 2020). On the contrary, scientific evidence supports that short and long-term exposures to air pollutants are associated with adverse health outcomes. Significantly positive associations of particulate matter (PM), carbon monoxide (CO), nitrogen dioxide (NO_2) and ozone (O_3) with COVID-19 confirmed cases, while sulfur dioxide (SO_2) was negatively associated with the number of daily confirmed cases, probably because of its virucidal property. The

mechanisms involved are little known and for each atmospheric component there are different pathways (ZHU *et al.,* 2020).

Prolonged exposure to NO_2, an ambient trace-gas, increases the synthesis of pro-inflammatory cytokines causing an inflammatory response, which is associated with several diseases. In addition, this exposure can generate some harmful secondary pollutants, such as nitric acid (HNO_3) and O_3, in addition to contributing to high COVID-19 fatality rates (OGEN, 2020). Moreover, recent studies explored the possible role of NO_2 in interference in Angiotensin converting enzyme 2 (ACE2). The expression of ACE2 is high on lung alveolar epithelial cells and it is the human cell receptor of the virus agent of COVID-19. Chronically can cause thromboembolism that facilitates infections (COPAT *et al.*, 2020).

PM is a group of pollutants made up of dust, smoke and other types of materials that remain suspended in the atmosphere because of their size. Recently, the research group of Setti et al. 2020 gave first preliminary evidence that SARS-CoV-2 RNA can be present on outdoor PM, thus suggesting that, in conditions of atmospheric stability and high concentrations of PM, it could represent a potential early indicator of COVID-19, although it does not give information regarding COVID-19 progression or severity. In addition, ambient air pollutants are associated with chronic diseases such as asthma and bronchitis, which lead to an increased risk of more serious illness if infected with SARS-CoV-2 (COPAT *et al*., 2020).

Paradoxically, the decrease or interruption of several economic activities and the circulation of people apparently improved the air quality in several cities as recorded by satellite images and environmental agencies from different countries and published in dozens of scientific articles with data from different regions of the world. Thus, at the beginning of the pandemic there was a reduction of NO_2 and PM (NAKADA; URBAN 2020; MUHAMMAD *et al*., 2020). This reduction in the emission of polluting gases explained by the stoppage of transport and some industries was quantified by two researches (BERMAN; EBISU, 2020). According to them, there was a reduction in atmospheric NO_2 concentrations by 25.5% in the US, in urbanized states this rate reached 26% and in rural countries, 16.5%. In India, these figures reached 34%, and when it comes to PM, the data reach 46% (GAUTAM; HENS, 2020). Whether these declines will continue for the next few years remains to be seen, but it appears they will not have a long-term effect as productive activities returns to normal (FORSTER *et al*., 2020). Some researchers have also found positive relationships between wind speed and SARS-CoV-2 contagion, that is, the higher the wind speed, the greater the contagion (ŞAHIN, 2020; ZHU *et al.,* 2020).

Humidity and temperature

Another issue to be raised is the air humidity and ambient temperature. Different seasons can spread a variety of respiratory virus infections, such as COVID-19. Human coronavirus shows peak incidences in the winter months, like Influenza. In winter, people tend to stay close to each other indoors, leading to person-to-person contagion. Dry and unventilated air can increase opportunity to spread virus infections, as the virus can survive in aerosols for days and low relative humidity is better for the virus's stability. Inhalation of dry air causes loss of epithelial cilia in the airways, detachment of epithelial cells and inflammation of the trachea, which facilitates viral infections. SARS-CoV-2 can persist for at least 14 days in aerosols in the air or surfaces at temperatures of 4 °C, 2 days at 37 °C and 5 minutes at 70 °C, showing its susceptibility at high heat. It is assumed that temperature and humidity modulate the viability of viruses by affecting the properties of viral surface proteins and lipid membrane (MORIYAMA *et al.,* 2020). Sunlight can, also, modulate the virus. The UVB sunlight may inactivate SARS-CoV-2 rapidly on surfaces, suggesting that persistence and exposure risk may vary significantly between indoor and outdoor environments. As during the winter season people stay away from the sun to remain cozy indoors, the virus keeps strong (AZUMA *et al*., 2020).

Water quality and consumption

Water is a source of the spread of other diseases that weaken the immune system acutely. Some studies have identified the presence of SARS-CoV-2 strains in dirty water from sewage and its contagion via excrement has already been confirmed in several countries such as the USA, Spain and Japan (D. ATOUFI; LAMPERT; SILLANPÄÄ, 2021).

The virus has been identified in fecal excretions, and wastewater from hospitals and households has a high viral concentration of 10^4 genomic copies/L (GC/L). That means that the virus could have the dirty water as a secondary transmission mechanism. Therefore, effective disinfection of drinking water, in addition to the prevention of sewage leakage and its treatment, are part of an agenda to combat viral spread (GIRÓN-NAVARRO; LINARES-HERNÁNDEZ; CASTILLO-SUÁREZ, 2021).

Indirectly, the pandemic has reduced the pollution of some beaches due to the lower flow of people, as reported in Acapulco, Barcelona and Salinas (ZAMBRANO-MONSERRATE; RUANO; SANCHEZ-ALCALDE, 2020).

In poor countries, especially South Americans, Sub-Saharan countries and South Asia, many people do not have access to clean water to perform asepsis against the virus. Furthermore, these countries have an inadequate sanitation treatment, that´s why more attention are needed to prevent infected wastewater discharge to the environment, that could spread the virus among the population (PEREIRA MATIAS; TAMBASCO MAESTEGHIN; MARIA IMPERADOR, 2020).

With the pandemic lockdown, the dynamics of water consumption among social sectors underwent some changes. According to researchers from Joinville, Brazil, water consumption before March 18 increased in the residential sector but

decreased in the other sectors in 2020. Commercial and industrial water consumption fell by 42% and 53%, respectively; while residential consumption grew by 11%. Adding up all the sectors studied, the overall drop was 15% (KALBUSCH *et al.,* 2020).

Environmental pollution

During the pandemic, the use of personal protective equipment (PPE) intensified. The main protection product is face masks, which are used by the entire population since they are effective in reducing the spread of the virus. However, not only the masks are part of this package: gloves, hairnet, goggles, gowns increased, especially by the medical centers. According to a study, hospitals generated 240 metric tons of medical waste per day compared to 50 tons per day in the pre-COVID-19 period (ZAMBRANO-MONSERRATE; RUANO; SANCHEZ-ALCALDE, 2020). Since most PPE is fabricated with plastic polymers, there were changes in the dynamics of pollution of this material (PRATA *et al.,* 2020).

The number of masks and gloves used by the population per month is estimated at 129 billion and 65 million, respectively (PRATA et al., 2020). From these data, assuming the weight of a mask is 3.5 g, and that of a pair of gloves is 5.5 g, then if only 1% of all masks and gloves are disposed of in the environment, the total plastic dumped is about 8.1 kilotons per month (D. ATOUFI; LAMPERT; SILLANPÄÄ, 2021).

Plastic breaks down into smaller particles over time, becoming microplastics. However, during this process of natural degradation, the particles are ingested by marine animals or can hinder the photosynthesis of aquatic plants, which triggers an imbalance in the transport of energy by the local community – these substances can get into the food web. Microplastics can impact on survival, growth, reproduction and feeding of aquatic life (PATRÍCIO SILVA *et al.,* 2021). Other elements can be found in PPEs such as polyethylene, vinyl and latex. Even if brief, the consequences of this have already begun to appear: in September 2020, a young female penguin was found dead with face masks found in her stomach on Juquehy Beach. In Thailand, high concentrations of microplastic were detected in the intestines of some marine animals (GALLO NETO *et al.,* 2021; PRADIT *et al.,* 2021).

Since the beginning of the pandemic, businesses have had to adapt to take-away format to keep their doors open. Thus, questions related to the virus's ability to transmit through packaged foods were raised but brought down by subsequent research that concluded that foods, food packages and food handlers are not risk factors for contagion (ESLAMI; JALILI, 2020). Although the need for online shopping and takeaway services has grown by 78% in the US and 65% in Singapore, for example, the use of reusable plastic packaging is not indicated by the risk of contamination for shop workers as there has already been contamination by food container and food packaging (GERMAN FEDERAL INSTITUTE FOR RISK ASSESSMENT, 2022; PARASHAR; HAIT, 2021). In

addition, the incorrect disposal of paper and plastic from the delivery system can represent another polluting vector (CHU; LIU; SALVO, 2021).

Noise pollution

The anthropic noise is quantified by the vibration in the Earth's crust caused by many human activities such as driving cars and industries. During the pandemic, drops in noise levels were recorded by seismodromes in different countries: Royal Observatory in Belgium detected 30 to 50% drops in sound rates compared to the beginning of the year, northern Italy reported 50% decreases in noise in the 1 to 10 Hz frequency and China detected a 4 to 12 dB decrease in range from 1 to 8 Hz frequency (MARWAH; AGRAWALA, 2022).

Although it seems harmless, noise pollution causes complications in human health. Currently, it is known that exposure to loud noise, in a short or long time, leads to unrefreshing sleep, anxiety, noise-induced hearing loss (NIHL), in addition to diabetes and heart attacks. Studies show that for every 5 decibels increased, the risk for heart attack and stroke increases by 34% (CLARK; PAUNOVIC, 2018; OSBORNE *et al*., 2020).

It is evident, therefore, that there is a correlation between the beginning of the pandemic and a decrease in noise pollution. However, is noise pollution capable of intensifying COVID-19, as the pandemic situation is ending and noise pollution levels will soon return to normal? A Spanish study found it did. Patients positive for COVID-19 experienced greater severity if exposed to loud noise. The paper also proposes three possible explanations for this, one of them being the stress caused by noise, which modulates the immune system from the release of cortisol, changes in sleep patterns and increase of oxidative stress (DÍAZ *et al*., 2021). Figure 1 summarises the impacts of meteorological factors on COVID-19 transmission and how COVID-19 changed the environment during pandemic.

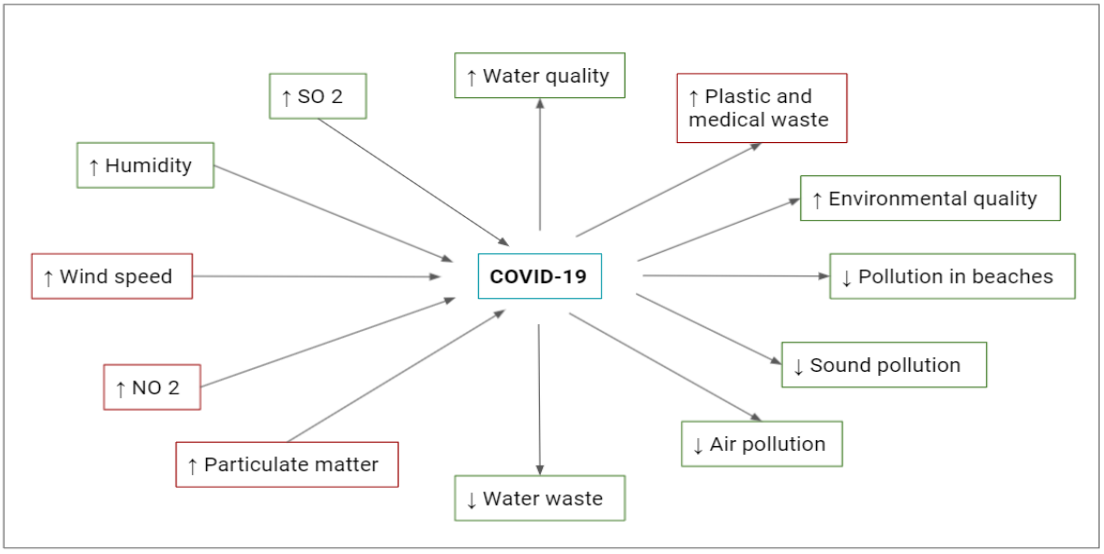

Figure 1: Covid and its relations with the environment. Arrows coming out of COVID demonstrate the impact of the disease on the environment. The arrows heading towards COVID demonstrate how environmental factors favor the contagion of the disease. Green colors symbolize benefits and red colors symbolize harm. **Source:** The authors (2022).

Conclusions

The present study reviewed some environmental factors that may facilitate or hinder the multiplication of the COVID-19 virus and how the pandemic affected the environment. Deforestation, low temperatures, urbanization, decreased air quality can help to multiply and spread the virus. Furthermore, prolonged exposure to NO_2, PM, CO and O_3 increases the production of inflammatory cytokines which play an important role in the severity of COVID-19. SO_2 seems to have negative contagion factors. COVID has increased environmental pollution with hospital waste and personal protective materials, while decreasing air, water and noise pollution. In addition, there has been a drop in water consumption and raises questions about how poor countries without access to clean water can protect themselves from the virus.

Along with environmental factors, during social isolation, eating habits tend to be more challenging, which may favor or intensify chronic conditions favorable to contagion and increase the risk of mortality.

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