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COVID-19 AND ENVIRONMENT: A REVIEW

[1]ABHAY PUNIA, [2]SHWETA MAHESHWARI, [2]PRABHA AND [2]NALINI SINGH CHAUHAN*

[1]Department of Zoology Guru Nanak Dev University, Amritsar 143 005, (Punjab) India
[2]Assistant Professor, P.G Department of Zoology, Kanya Maha Vidyalya, Jalandhar 144 004, Punjab, India

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ABSTRACT

The COVID-19 pandemic has significant affect on every aspect of human lives. The spread of virus has been controlled by taking certain measures that have slowed down the economic activities along with significant effect on the environment. This review intends to explore the various negative and positive impacts of COVID-19 pandemic on our environment. Various lockdown measures that were used to contain the spread of virus has improved the air quality, reduced noise and water pollution, restoration of ecological systems through reduction of tourist's activities. But there are some negative impacts such as increase in medical waste and municipal waste.

KEY WORDS: COVID-19, Environment, Pollution, Medical waste, Municipal waste.

INTRODUCTION

Covid-19 pandemic occurred in late 2019 and then spread rapidly all over the world. Symptoms related to this disease are ranged from mild to severe. Most of the corona virus death cases occur in older people as they are reported as susceptible population. Several treatment options including anti-malarial drugs, antiviral agents, glucocorticoids, immunomodulators and convalescent plasma have been explored but each treatment has varying results. The person to person transmission is most likely route for the spread of COVID-19 infection (Carlos *et al.*, 2020; Chan *et al.*, 2020; Li Q. *et al.*, 2020). Some reports also suggested the spread of infection through contaminated surfaces (Ghinai et al., 2020; Yu et al., 2020).

Poor immune response has been directly linked with mortality in COVID-19 patients. People suffering from cancer, lung diseases, diabetes, chronic cardiovascular disease or even high blood pressure are at higher risk of covid-19 infection related mortality (Fang *et al.*, 2020; Giannis *et al.*, 2020; Qiu *et al.*, 2020; Shekerdemian *et al.*, 2020; Xiao *et al.*, 2020; Zhou *et al.*, 2020). Yang *et al.* (2020) have reported that the probability of acquiring severe Covid-19 infection for people suffering with previous respiratory disease, hypertension and cardiovascular disease falls between 2.4 and 3.5. Similarly smoking and obesity has been related with severe infections (Wang *et al.*, 2020a, b). Ferguson *et al.* (2020) has reported that people who are less than 60 years old have median fatality rate of <0.2% as compared to 9.3% of those adults who are more than 80 years of age. Co morbidities have been directly linked to the five times increase in mortality (Jordan *et al.*, 2020). A death rate of 5.0% is reported in Wuhan, china which is close to that of world (4.2%) but higher mortality rate is reported in Iran (7.8%), Italy (7.8%) and Spain (6.0%) (Jin *et al.*, 2020; Li *et al.*, 2020a, b). A number of vaccines are available today for curing corona virus but still, there is need of extensive isolation measures along with use of disinfection products for breaking the chain of corona virus transmission.

Earlier, the restrictions on the movement of people were implemented in different countries as the control measure for reducing mortality rate and for containing the spread of virus. Countries like India had imposed the lock down for restricting the movement of approximately 1.3 billion people which was started from March 24, 2020 (Somani *et al.*, 2020). In others countries like Italy and Britain travel restrictions along with closing of pubs, bars

were done and people were advised to stay at home. This pandemic has lead to the socio-economic disruption which directly or indirectly also affected our environment. Lock down measures due to Covid-19 has lead to the improvement in air and water quality, reduction in noise pollution along with the restoration of ecology (Chakraborty and Maity, 2020; Somani *et al.,* 2020; Saadat *et al.,* 2020) but the use of personal protective equipments such as masks, gloves, face shields etc. has generated a large amount of solid waste thus, this has created the environmental burden as there is improper disposal of this solid waste (Fadare and Okoffo, 2020; Nghiem *et al.,* 2020; Singh *et al.,* 2020). Therefore, this review will explore negative and positive impacts of Covid-19 pandemic on the environment.

METHODOLOGY

In the first step we have extracted articles on the topic of interest: COVID-19 and environment. We searched journals in the Scopus and Google scholar database. Initially we search and retrived 1000 studies. After limiting language to "English" about 100 articles were left for analysis. To ensure relevance to COVID-19, we manually screened some articles by keywords, title when unsure, by assessing the full text. Finally, excluding studies focusing on earlier coronaviruses (such as MERS-CoV and SARS-CoV) or only COVID-19 (without environment), 70 studies were found relevant and selected for further analysis. All of these selected articles were studied thoroughly in detail for critical analyzing future research problems.

RESULTS

COVID-19 and its impact on environment is a trending research topic. Based on the analysis of the selected articles we had categorized our study into six clusters that are discussed under:

Air Quality

Covid-19 pandemic had restricted the human movement. People were forced to work from their homes. This has lead to the positive impact on environment. There was decline in industrial activities and refineries along with reduction in use of transportation vehicles; this has been directly linked to the decreased emission of green house gases. Lockdown in different countries has resulted in sudden and drastic decrease in levels of $NO_{2,}$ $PM_{2.5}$, PM_{10}, GHGs but in Europe and large Chinese cities the spike in ozone concentration is also seen (Chen *et al.,* 2020; Zambrano-Monserrate *et al.,* 2020; Nie *et al.,* 2021). The reduction in particulate matter, SO2, CO and NOx was observed in the Hangzhou megacity during lockdown which has lead to the significant improvement in air quality (Yuan *et al.,* 2021). In USA, the reduction in NO2 (49%) and CO (37%) concentrations were reported which was directly correlated with higher population density (Chen *et al.,* 2020).

The significant reduction in air pollution in different cities all around the world has also been documented by NASA satellites and of the Copernicus Atmosphere Monitoring Service of the European Space Agency (ESA). This reduction in air pollution in the major cities could improve the living environment and can provide significant health benefits to people (Dutheil *et al.,* 2020; Nelson, 2020). Lock-down due to Covid-19 pandemic has positive impacts in air quality but now the economy has been reopening this will again increase the pollution levels and green house gases, thus will have significant negative impact on the health of people who also have suffered due to Covid-19.

There is a direct relationship between increasing air pollution and severe outcomes of past pandemics. Particulate matter exposure has been reported for associating with increasing mortality during H_1N_1 pandemic in 2019 and Spanish influenza in 1918. Relationships have also been detected between pollution exposures and severe outcomes in the context of past pandemics. Studies found particulate matter exposure to be associated with the mortality during the H1N1 influenza pandemic in 2009 (Mishra *et al.,* 2020). Recent studies have even used historic data to show a relationship between air pollution from coal burning and mortality in the 1918 Spanish influenza pandemic (Clay *et al.,* 2018).

Water quality

Water pollution is a common occurrence in developing countries such as India and Bangladesh, where domestic and industrial wastes are dumped untreated into rivers (Islam and Azam, 2015; Islam and Huda, 2016; Bodrud-Doza *et al.,* 2020; Yunus *et al.,* 2020). During the lockdown, the major industrial sources of pollution shrank or stopped entirely, helping to reduce pollution levels (Yunus *et al.,* 2020). For example, due to the lack of industrial pollution during India's lockdown, the rivers Ganga

and Yamuna have reached a significant level of purity. It was discovered that water from 27 of the 36 real-time monitoring stations along the Ganga met the permissible limit (Singhal and Matto, 2020). The sudden drop in visitor numbers and a 500 percent reduction in sewage and industrial effluents were attributed to the improved water quality in Haridwar and Rishikesh (Singhal and Matto, 2020; Somani *et al.,* 2020). The river Ganga's physico-chemical parameters, such as pH (7.4–7.8), dissolved oxygen (DO) (9.4–10.6 mg/l), biochemical oxygen demand (BOD) (0.6–1.2 mg/l) and total coliform (40–90 MPN/100 ml), were found to be within India's surface water quality standard, according to data from the Uttarakhand Pollution Control Board (UPCB, 2020). All other parameters, with the exception of total coliform in some monitoring stations, meet the national drinking water quality standard, which can be used without conventional treatment but only after disinfection (Class A) (BIS, 2012). It was also discovered that during the lockdown, the concentrations of pH, electric conductivity (EC), DO, BOD, and chemical oxygen demand (COD) in different monitoring stations decreased by nearly 1–10%, 33–66%, 45–90% and 33–82%, respectively, in comparison to the pre-lockdown period (Arif *et al.* 2020). Furthermore, because of the ban on public gatherings, the number of tourist and water activities has decreased in many areas (Cripps, 2020; Zambrano-Monserrate *et al.,* 2020). The Grand Canal of Italy has reportedly turned clear as a result of COVID-19's lockdown, with many aquatic species reappearing (Clifford, 2020). Water pollution has also decreased in Bangladesh's, Malaysia's, Thailand's, Maldive's and Indonesia's beach areas (Kundu, 2020; Rahman, 2020). According to Jribi *et al.* (2020), the COVID-19 lockdown has reduced food waste in Tunisia, which has resulted in less soil and water pollution. However, industrial water consumption has decreased, particularly in the textile sector around the glove (Cooper, 2020). Typically, massive amounts of solid waste are generated during the construction and manufacturing processes, resulting in water and soil pollution, which must be reduced. Furthermore, as a result of the reduced export-import business, the global movement of merchant ships and other vessels is reduced, reducing emissions and marine pollution.

Noise pollution

Noise pollution is defined as excessive amounts of sound produced by various human activities (for example, machines, automobiles, and building work), which can have negative consequences for humans and other living species (Goines and Hagler, 2007; Zambrano-Monserrate *et al.,* 2020). Noise has been shown to have a deleterious impact on physiological health, including cardiovascular problems, hypertension, and sleep deprivation (Kerns *et al.,* 2018). Noise pollution is said to be the cause of hearing loss in roughly 360 million people around the world (Sims, 2020). According to the World Health Organization, more than 100 million individuals in Europe are exposed to levels of noise that exceed the recommended limit (WHO, 2012). Furthermore, anthropogenic noise pollution has negative effects on animals by disrupting the predator-prey detection and avoidance balance. Unwanted noise also has a harmful impact on invertebrates, which help to regulate environmental processes that are necessary for ecosystem equilibrium (Solan *et al.,* 2016). Quarantine and lockdown procedures, on the other hand, forced individuals to stay at home, reducing economic activity and communication globally, lowering noise levels in most places (Zambrano-Monserrate *et al.,* 2020). For example, during the recent lockdown period, the noise level in Delhi, India's capital was lowered by approximately 40%–50%. (Somani *et al.,* 2020). Noise levels at Govindpuri metro station (Delhi) have been lowered by 50–60 decibels (dB) due to less vehicle movement during the lockdown period (Gandhiok and Ibra, 2020). Noise levels in residential areas of Delhi have been decreased from 55 dB (daytime) and 45 dB (night) to 40 dB (daytime) and 30 dB (night), according to India's Central Pollution Control Board (CPCB, 2020). As a result, city people can now hear birds chirping at a volume of 40-50 decibels (Gandhiok and Ibra, 2020). Furthermore, due to travel restrictions, the number of aircraft and vehicle movements has decreased dramatically around the world, lowering noise pollution levels. In Germany, for example, passenger air travel has been reduced by more than 90%, car traffic has down by more than 50%, and trains are operating at a 25% lower pace than usual (Sims, 2020). COVID-19 shutdown and limited economic activity reduced global noise pollution.

Tourism

Tourism has grown greatly in recent years as a result of technology improvements and improved transportation networks, contributing significantly

to global GDP (Lenzen *et al.,* 2018). The tourist industry is estimated to be responsible for 8% of worldwide GHG emissions (Lenzen *et al.,* 2018). However, natural beauty spots (such as beaches, islands, national parks, mountains, deserts, and mangroves) typically draw a large number of tourists, resulting in a large harsh. Many hotels, motels, restaurants, bars, and markets are created to assist and accommodate them, consuming a lot of energy and other natural resources (Pereira *et al.,* 2017). For example, Puig *et al.* (2017) assessed the carbon footprint of coastland hotel services in Spain and found that electricity and fuel usage play a significant influence, with 2-star hotels emitting the most carbon. Furthermore, visitors leave a variety of wastes, which degrade natural beauty and produce ecological imbalance (Islam and Bhuiyan, 2018). The number of tourists visiting tourist destinations around the world has decreased as a result of the COVID-19 epidemic and local limitations (Zambrano-Monserrate *et al.,* 2020). For example, Phuket, Thailand's most popular tourist resort, will be closed on April 9, 2020, because to the Covid-19 spike, with an average of 5,452 tourists per day (Cripps, 2020). Similarly, the local authority prohibited public gatherings and visitor arrivals at Cox's Bazar sea beach, which is known as the world's longest uninterrupted natural sand sea beach. The colour of the water changes as a result of the restriction, which is usually murky due to swimming, bathing, playing and riding motorized boats (Rahman, 2020). Nature takes time to adapt to human irritation, and due to pollution reduction, dolphins have lately returned to the shore of the Bay of Bengal (Bangladesh) and the canals, waterways, and ports of Venice (Italy) after a decade absence (Rahman, 2020; Kundu, 2020).

Medical waste

Medical waste creation has surged significantly since the advent of COVID-19, posing a significant risk to human health and the environment. Many infectious and biological wastes are generated from hospitals for sample collection of suspected COVID-19 patients, diagnosis, treatment of a large number of patients, and disinfection purposes (Somani *et al.,* 2020; Zambrano-Monserrate *et al.,* 2020). For example, during the outbreak, Wuhan, China, produced more than 240 metric tonnes of medical waste per day (Saadat *et al.,* 2020), which is over 190 metric tonnes more than average (Zambrano-Monserrate *et al.,* 2020). Again, during the first phase of the lockdown, the amount of medical waste generated in Ahmedabad, India, increased from 550-600 kg/day to around 1000 kg/day (Somani *et al.,* 2020). COVID-19 generates approximately 206 million tonnes of medical waste per day in Dhaka, Bangladesh's metropolis (Rahman *et al.,* 2020). Other cities, including as Manila, Kuala Lumpur, Hanoi, and Bangkok, had similar increases, creating between 154 and 280 million tonnes of medical waste each day, compared to before the pandemic (ADB, 2020). The local waste management authorities have been faced with a huge issue as a result of the unexpected increase in hazardous trash and its correct management. According to recent research, the SARS-CoV-2 virus can survive for one day on cardboard and up to three days on plastics and stainless steel (Van-Doremalen *et al.,* 2020). As a result, medical waste (such as needles, syringes, bandages, masks, gloves, used tissue, and wasted pharmaceuticals) should be carefully managed to prevent future infection and environmental contamination, which is now a global concern.

Municipal waste

Increased municipal waste generation (both organic and inorganic) has direct and indirect effects on the environment, such as pollution of the air, water, and soil (Islam *et al.,* 2016). Quarantine policies implemented in many countries as a result of the pandemic have resulted in an increase in the demand for online shopping for home delivery, which has resulted in an increase in the amount of household garbage (Somani *et al.,* 2020; Zambrano-Monserrate *et al.* 2020). Waste recycling, on the other hand, is an efficient approach to reduce pollution, save energy, and protect natural resources (Ma *et al.,* 2019). However, due to the pandemic, many governments postponed garbage recycling initiatives in order to prevent viral infection transmission. For example, the US government limited recycling activities in numerous places (almost 46%) due to concerns about the spread of COVID-19 in recycling facilities (Somani *et al.,* 2020).

FUTURE RESEARCH

Further attention should be given to the factors that are particularly associated with a decline in pollution during COVID-19 lockdown. Future research can involve the replication of studies on the

impacts of COVID-19 on the environment in the context of different countries. These studies can further analyze the impact lockdown on environmental quality (Wang and Su, 2020). More emphasis should be made on meteorological factors and further test that can determine the effect of lockdown on air quality (Dantas *et al.,* 2020). More studies should be done by utilizing more data sources and methodologies as a reference point to conduct cross-country studies for determining similarities and differences in the findings. Right now, lockdown is being lifted across countries. Therefore, the post-lockdown period is very important to maintain a lower level of environmental pollution. It is crucial to take necessary steps to dispose the harmful medical waste for controlling the spread of COVID-19 and other infectious diseases.

CONCLUSION

Globally, the outbreak of Covid-19 has resulted into limited social freedom as the various lockdown measures are being implemented to contain the pandemic. Furthermore, as a result of the reduced export-import business, the global movement of merchant ships and other vessels is reduced, reducing emissions and marine pollution. Moreover, better air quality, reduction in greenhouse gas emissions, reduced noise and water pollution, restoration of ecological systems through reduction of tourist's activities reduced road transport, reduced industrial, educational and other activities has also been recorded. But there are some negatives impacts as the medical waste creation has surged significantly since the advent of COVID-19, posing a significant risk to human health and the environment. Thus in the long term, the evaluation of the impact that the COVID-19 virus infection brings is uncertain at the environmental level and on human health, so it is imperative that epidemiological actions should focus on possible transmission routes, influence of the environment on the spread of the virus between people and possible reservoirs.

DECLARATIONS

Ethical approval: Not applicable

Conflict of interest: The authors declare that there is no conflict of interest

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