

Positive Impact On Environmental And Climatic Changes During Covid

Surbhi Jain ^{a,1}, Manish Gome ^b, Ruma Arora ^{a*}

^a Engineering Science and Humanities, Chameli Devi Group of Institutions, Indore, India

^b Mechanical Engineering Department, Chameli Devi Group of Institutions, Indore, India

¹ ruma.arora@cdgi.edu.in

* Corresponding Author

ABSTRACT

The rapid spread of a new corona virus (SARS-CoV-2) in China's Wuhan city in December 2019 has attracted international interest. Dry cough, high fever, body soreness, and exhaustion are some of the symptoms of a viral respiratory infection. Evidence suggests that environmental stressors like rising temperatures, increased pollution, and the COVID-19 pandemic may have a negative impact on mental health, potentially contributing to everything from short-term mood swings to long-term conditions like anxiety, depression, PTSD, and substance abuse. Numerous questions about the connections between the emergence of novel illnesses, environmental factors, climate, and human health were highlighted by the COVID-19 outbreak. Corona virus has had some bad effects on the world, but the crisis has had some positive effects on the environment as people have moved to prevent the spread of the virus. This has resulted in less pollution and less emissions of greenhouse gases.

KEYWORDS

SARS-CoV-2;
Environmental;
Climatic



This is an open-access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license

1. Introduction

The worldwide economic [1]–[5] and healthcare [6]–[10] systems are being tested by the COVID-19 pandemic, highlighting the extent of global interdependencies and the necessity to be prepared for global health risks. The COVID-19 crisis brings to light the connections between environmental changes and the onset of infectious diseases, and serves as a warning that such pandemics are extremely difficult to regulate in our modern, worldwide society [11]–[16]. We propose that only a comprehensive global strategy that takes into consideration infectious agents and other environmental challenges at the same time can produce long-term solutions and policies that will safeguard people and ecosystems from imminent and future danger.

This report aimed to examine existing research on the potential synergistic impacts of climate change, environmental pollution, and the COVID-19 pandemic on mental health [17]–[20]. The drastic quarantine measures taken by governments throughout the world have resulted in a noticeable change in environment, which is encouraging news for the fatal global environmental issues such as greenhouse gas emissions and ozone layer depletion. In this article, we will discuss the good effects of the environmental lockdown caused by COVID-19 and the steps that can be taken to ensure that air and water contamination do not return.

2. Method

The manuscript is written with Times New Roman, a font size 11, single-spaced, left-justified, on single pages, and A4 paper (210 mm x 297 mm). The title of the article should be brief and informative, and it should not exceed 12 words. The first letter of headings is capitalized and headings. The organization of the manuscript includes **Introduction, Methods, Result, Discussion, Conclusions, and References**. Acknowledgment (if any) is written after **Conclusions and before References**. Between paragraphs, the distance in one space.

3. Results and Discussion

3.1. Environment And Climate Change During COVID-19

Pollution is the unintended and harmful change to the natural environment that results from human activity. As "an unbalance situation from an equilibrium condition in any system," it is a result of the quick and ruthless exploitation of natural resources during the urban-industrial and technological revolution. There can be no doubt that pollution of the environment is a worldwide issue, with serious long-term implications becoming increasingly recognised in both developed and developing nations. It is now accepted that environmental pollution and climate change may have deleterious effects on multiple physiological systems and organs, potentially contributing to perinatal disorders, respiratory and cardiovascular disorders, allergies, cancer, and neurological and mental disorders in people of all ages. One of the most serious repercussions of environmental pollution and climate change is the spread of disease through the vectorization and dispersal of waterborne pathogens. Indeed, there are signs that variations in some meteorological factors related with climate change may promote the epidemics, suggesting that pollution, infectious diseases, and climate change are all connected and affecting each other in various ways. To what extent the natural climatic variability observed over comparable time durations has been amplified by human actions that modify the composition of the planet's atmosphere [21]–[23].

Further, the gradual loss of wildlife habitats has the potential to weaken the natural barrier separating humans and wildlife that may be harbouring harmful microbes by introducing new contact sites (small patches of forest close to human settlements) that could set off a spillover. The stability of droplets, the viability of viruses, and the spread of epidemics are all influenced by environmental factors such as temperature, humidity, visibility, and wind speed.

3.1.1. Health, Mental Issues Changes

Multiple pathogenic and environmental stresses are a big cause for alarm [24]. Environmental stressors include poor urban design, an unhealthy eating environment, air pollution, and chemical toxicants are linked to lung, cardiac, metabolic, and obesity conditions, which in turn increase the severity of COVID-19 [25]. More and more data also points to the potential for detrimental effects on mental health brought on by climate change, environmental pollution, and pandemics like the current outbreak of COVID-19 [26]. Long before the word "meteoropathy" was coined to describe any pathological feature related to weather, it was understood that air pollution and weather fluctuations might trigger psychopathological disorders [27]. In addition, the central nervous system (CNS) has been linked to environmental pollutants, climate change, and SARS-CoV-2 infection, all of which can cause mental and/or behavioural changes via a variety of physiopathological mechanisms, including inflammation, immune system activation, oxidative stress, blood vessel damage, and neurotransmitter system dysfunctions [28]–[30]. Because they are the outcome of interactions between two complex systems—the environment, with everything (biotic and abiotic materials) filling it, and humans—it is challenging to determine the particular cause-effect correlations of these phenomena on mental health [31]. Changes in the climate can be either abrupt or gradual, but they always affect the ecosystem and the weather. A increasing body of research has focused on the potential psychological and mental effects of climate change in recent years [32], [33]. According to the existing evidence, the effects of climate change on mental health could range from relatively minor stress and distress symptoms to clinical illnesses, most commonly anxiety, sleep difficulties, depression, and stress/trauma-related diseases. Increased criminal and aggressive activity has been connected to prolonged heat waves [34]. illnesses of the mind and body, such as depression, anxiety, fibromyalgia, and suicide. Reduced temperatures are also correlated with higher hostility. Intense weariness and difficulty concentrating have both been linked to high levels of humidity. Long periods of high heat and/or drought are the most common progressive climatic shifts, forcing many people to leave their homes and communities [35]. The stress of forced relocation has been linked to negative effects on both physical and mental health [36]. Alterations in the global climate can have unintended consequences on people's mental health, albeit in a more muted fashion. Just being conscious of the reality of climate change might bring on feelings of shame, grief, fear, and demoralisation. A large percentage of adults, children, and adolescents worldwide have shown signs of mental distress, anguish, uncertainty, fear of death, demoralisation, anxiety, insomnia, distorted perceptions, risky behaviours, such as increased use of alcohol and abuse substances, and internet addiction conducts, since the outbreak of the pandemic [37].

3.1.2. Global Changes

With our improved knowledge of the ways in which population growth and urbanisation, habitat degradation, globalisation of trade, and intensive livestock farming raise the danger of transmitting zoonotic infections, the advent of a new pandemic was not unexpected [38]. Recognized as a primary driver of epidemic onset is the impact of climate change on the distribution of diseases, their animal reservoirs, and their vectors. Improving our understanding of the ecological and behavioural factors that contribute to the emergence and spread of coronavirus infections is crucial [39]. Despite the fact that the zoonotic character of SARS-CoV-2 has been established, the intermediate host(s) from which the virus was transmitted to humans has not been identified [40]. Determining the genetic underpinnings of host vulnerability is essential for comprehending the ecology and epidemiology of COVID-19, whether we're talking about reservoir animal species or human populations. Human-wildlife interactions and the spread of zoonotic diseases as a result of environmental changes such deforestation, land use, road construction, and urbanisation [41]. It is crucial, therefore, to assess the role of habitat loss on the one hand, and human activities/behaviors (farming techniques, hunting, markets, etc.) on the other, in facilitating transmission of zoonotic illnesses from wild animals to humans (in particular SARS-CoV-2) [42]. Similarly, in a climate change environment, we need a more nuanced understanding of how declining biodiversity contributes to the spread of new diseases. Understanding the social-ecology of SARS-CoV-2 necessitates the establishment of ecological health observatories to characterise the temporal and spatial patterns of the virus' occurrence in a wide variety of ecological compartments (wild and domestic fauna, water, and air) in urban and rural settings. To understand how SARS-CoV-2 spreads and evolves amongst its intermediate hosts, we need to screen wild animals for viral genomes (metagenomics) and build open-access databases. Newly emerging viruses will also benefit from this knowledge in the future [43].

3.1.3. Air Pollution and COVID

Pollutants in the air can take the form of gases or particles and are typically characterised by their unique chemical and physical compositions and wide-ranging impacts on air quality, climate, and human health. Some of these substances affect air quality indirectly, via their reactions with other atmospheric compounds. Common greenhouse gases include carbon dioxide (CO₂), methane (CH₄), ozone (O₃), nitrogen oxides (NO_x), and fluorinated gases. Industrial, agricultural, vehicular, and energy production sources, including building heating, account for three of the main sources of gaseous pollutants in the environment. They are the primary contributors to global warming and thus the driving force behind climatic shifts, and are also known by the name greenhouse gases because of the effect they have on the Earth's atmosphere. Condensed (solid or liquid) materials in suspension in the atmosphere are referred to as particulate matters (PMs) or aerosol particles. The upper respiratory system is particularly vulnerable to the negative effects of PM₁₀ and other such particles. The current COVID-19 epidemic has been linked to elevated levels of air pollution, particularly air PM levels, according to a growing body of research [44]. Air pollution, especially PMs, has been linked to the dissemination, incidence, and fatality rates of COVID-19 [45], [46]. Fine particles, having a diameter of less than 2.5 μm, and coarse particles, with a diameter of between 2.5 and 10 μm, appear to be the most harmful PMs that can be inhaled. The number of verified cases of COVID-19 also rose in tandem with the amounts of PMs, NO₂, CO, and SO₂ [47]. The poor prognosis seen in respiratory diseases like SARS and COVID-19 is often attributed to immune dysregulation [17], [48]–[51]. Air pollution is well-known as a cause of chronic inflammation, which in turn can trigger an overactive innate immune response. There is evidence to suggest that people who live in polluted areas of the world are more likely to contract the deadly COVID-19 virus. Chronic and acute exposure to air pollution, notably particulate matter PM_{2.5} and PM₁₀ and nitrogen dioxide, increases the risk of morbidity and mortality from COVID-19 [52]. Total COVID-19 cases, new cases every day, and deaths were significantly impacted by high levels of urban air pollution [53]–[56]. There was a correlation between chronic exposure to high levels of PM₁₀, NO₂, CO, and sulphur dioxide and the incidence of stress, low quality of life, depression diagnosis, and suicidal ideation. Intriguingly, studies have linked the development of schizophrenia to exposure to air pollution, specifically PM₁₀, PM_{2.5}, SO₂, NO₂, lead, and tetrachlorethylene, and being born in the winter or early spring. Several pieces of data showed that people who were exposed to air pollutants had a higher incidence of depression and anxiety, with high levels of NO₂, O₃, PM₁₀, and PM_{2.5} being

linked to an increased risk of depressive symptoms. Significant anxiety symptoms were more common in subjects exposed to high levels of PM10 and PM2.5. Nose, mouth, throat, sinuses, and lungs are all susceptible to infection by SARS-CoV-2. It has been hypothesised that this virus can spread both between humans and between humans and animals. The most plausible vector of infection is the infected person's own respiratory droplets [57]–[60]. The virus is dispersed into the air and can enter a host's respiratory system through the mouth and nose. The virus triggers an inflammatory response in the lungs, which damages the pulmonary cells. Severe inflammation can cause nausea, vomiting, diarrhoea, extreme exhaustion, and high temperature [57], [58], [61]–[63].

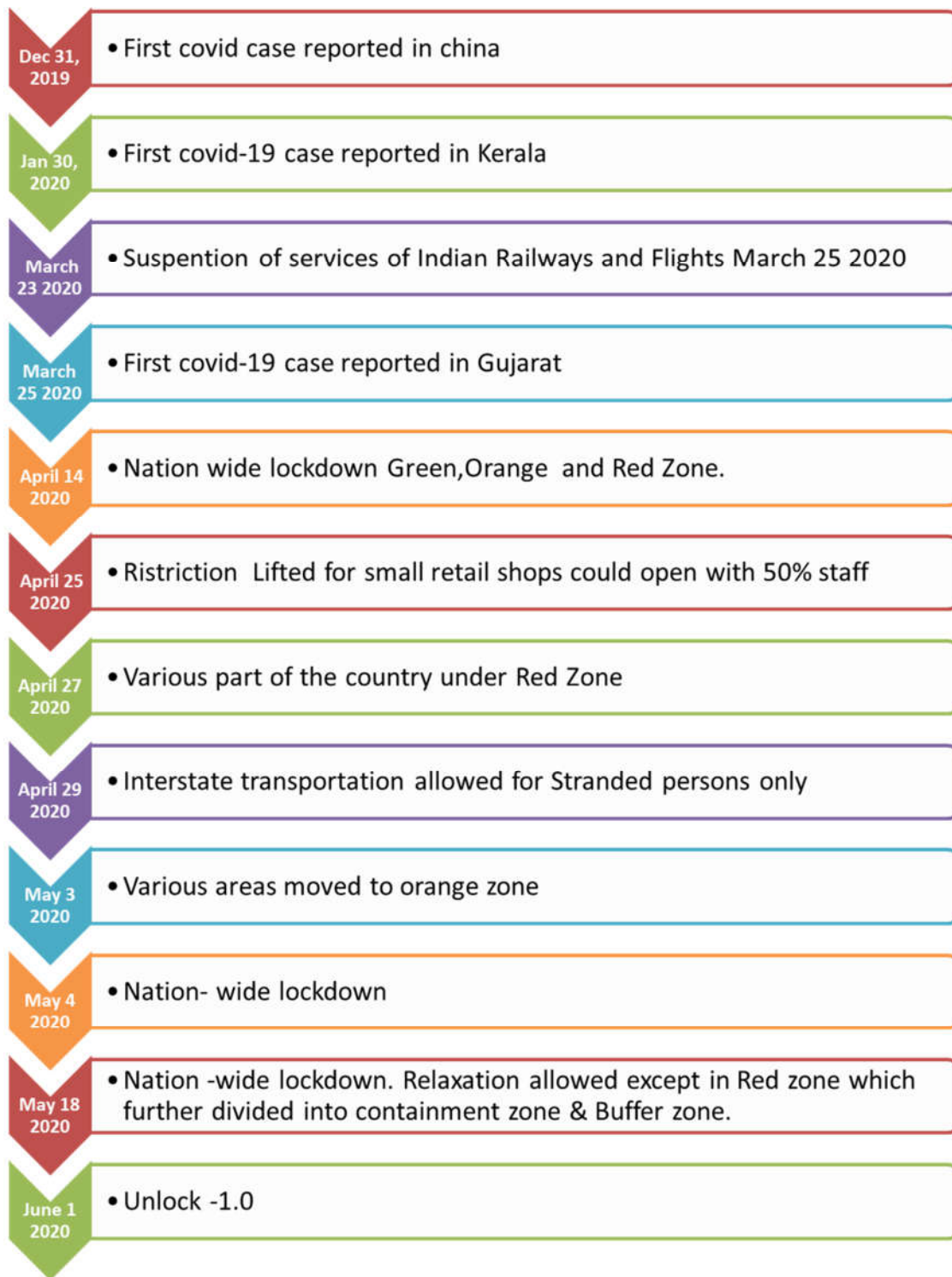


Fig. 1.Timeline of Pandemic COVID-19

3.2. Positive Impact Of Covid 19 On Environment

Markets were closed, places of worship were closed, public gatherings were forbidden, travel restrictions were in place, construction activity is halted, and the economy and stock market around the world have fallen as a result of the COVID-19 quarantine, which is unprecedented in human history. On the other hand, the world was witnessing many beneficial features of the corona virus epidemic from a climatic viewpoint during the lockdown. Recent months have seen a marked improvement in air quality, particularly in hard-hit areas, thanks to people staying indoors. Although the world's waterways and rivers have a reputation for being filthy, they appear cleaner now that the corona virus has caused lockdowns in many parts of the world. The air was also clearer, the smog has disappeared, the haze has dissipated, and wildlife has returned to the open areas.

3.2.1. Improvement In Air Quality Due To Lockdown

One of the most harmful pollutants is a particulate matter (PM) called PM 2.5. The lockdown brought on by COVID-19 has significantly reduced PM 2.5 levels, protecting thousands of lives from the disease's worst effects. The exhaust from cars and factories emits nitrogen dioxide (NO₂), a chemical known to cause health problems. When this gas is present in concentrations higher than 200 g/m³, it can cause inflammation in the respiratory track, which can lead to asthma, according to the World Health Organization. Because to the present lockdown, transportation has been severely curtailed and factories have been shut down, resulting in a dramatic decrease in the atmospheric concentration of nitrogen dioxide (from 5.6 g/m³ to 0.2 g/m³) in cities around the world. Climate change is caused by human activity, specifically the release of carbon dioxide (CO₂). Carbon dioxide emissions are largely attributable to the transportation sector, industrial processes, and energy generation. Since the coronavirus outbreak, countries have taken measures to reduce their CO₂ output. Global air traffic dropped by 60 percent during the lockout, resulting in a temporary drop in CO₂ emissions from their pre-crisis levels.

3.2.2. Impact On Socioeconomic Balance

Balancing the need for reduced economic activity to minimise disease spread with the need for restored economic activity to avoid the terrible social and health repercussions of a shutdown is a major difficulty in reacting to COVID. Equally difficult is striking a balance between reverting to "normal" before the COVID outbreak and resetting our economy in a healthier way that prevents the health dangers, injustices, and environmental depredations of recent decades. Although this is a terrible time, it presents a unique chance for positive, long-term change that benefits the earth as a whole.

4. Conclusion

Natural, global catastrophes like climate change, pollution, and virus-triggered outbreaks like the current COVID-19 pandemic have similar effects on health and economic security at the individual and societal levels, albeit on different time scales. Many scientists now believe that emissions of greenhouse gases and other air pollutants, including carbon monoxide, methane, ozone, and nitrous oxide, are the primary drivers of global warming. Furthermore, the COVID-19 pandemic has been linked to both air pollution, particularly fine PM, and environmental damage due to climate change. High rates of negative emotional reactions, such as guilt, pain, anxiety, and demoralisation, and full-fledged psychiatric disorders, especially anxiety and depression disorders, stress/trauma-related disorders, substance abuse, and suicidal thoughts and intentions, are all consequences of climate change on mental health. Social isolation, lockdown, and reduced contact between humans and the natural world after a crisis actually benefited the environment. Evidence from everywhere over the world suggests that the global lockdown prompted by the spread of COVID-19 is having a beneficial effect on environmental circumstances, particularly with regards to air and water quality. Restoration of once-lost ecosystems is encouraging evidence that human-caused environmental deterioration can be undone. Regrowth of natural areas is visible to the unaided eye in just a few short months. There is a message here that we need to decipher and act upon. Those in positions of power must act to ensure that the current period of recovery is sustainable.

Acknowledgment

Special thanks to the internal funder for community service from the University of Muhammadiyah Yogyakarta.

Author Contribution

The activity plan in order to implement the solutions offered that there are five series of activities, namely coordination, logo design, socialization of covid, marketing, and marketing education.

Funding

Special thanks to the internal funder for community service from the University of Muhammadiyah Yogyakarta.

Conflict of Interest

The authors declare no conflict of interest.

References

- [1] Y. Jiang, D. Cai, and S. Shi, "Economic evaluations of inactivated COVID-19 vaccines in six Western Pacific and South East Asian countries and regions: A modeling study," *Infect. Dis. Model.*, vol. 7, no. 1, pp. 109–121, Mar. 2022.
- [2] Y. Liu et al., "Optimising health and economic impacts of COVID-19 vaccine prioritisation strategies in the WHO European Region: a mathematical modelling study," *Lancet Reg. Heal. - Eur.*, vol. 12, no. November 2021, p. 100267, Jan. 2022.
- [3] J. Ahmed, M. H. Jaman, G. Saha, and P. Ghosh, "Effect of environmental and socio-economic factors on the spreading of COVID-19 at 70 cities/provinces," *Heliyon*, vol. 7, no. 5, p. e06979, May 2021.
- [4] S. Thomson, J. A. García-Ramírez, B. Akkazieva, T. Habicht, J. Cylus, and T. Evetovits, "How resilient is health financing policy in Europe to economic shocks? Evidence from the first year of the COVID-19 pandemic and the 2008 global financial crisis," *Health Policy (New York)*, vol. 126, no. 1, pp. 7–15, Jan. 2022.
- [5] P. C. Campbell et al., "Impacts of the COVID-19 economic slowdown on ozone pollution in the U.S.," *Atmos. Environ.*, vol. 264, p. 118713, Nov. 2021.
- [6] E. Ogundepo et al., "An exploratory assessment of a multidimensional healthcare and economic data on COVID-19 in Nigeria," *Data Br.*, vol. 33, p. 106424, Dec. 2020.
- [7] S. Islam, R. Islam, F. Mannan, S. Rahman, and T. Islam, "COVID-19 pandemic: An analysis of the healthcare, social and economic challenges in Bangladesh," *Prog. Disaster Sci.*, vol. 8, p. 100135, Dec. 2020.
- [8] F. Lanza, V. Seidita, and A. Chella, "Agents and robots for collaborating and supporting physicians in healthcare scenarios," *J. Biomed. Inform.*, vol. 108, no. June, p. 103483, Aug. 2020.
- [9] A. M. Warren et al., "Early psychological health outcomes among United States healthcare professionals, essential workers, and the general population during the COVID-19 pandemic: The influence of occupational status," *Psychiatry Res. Commun.*, vol. 1, no. 2, p. 100005, 2021.
- [10] L. R. Darwish, M. M. Farag, and M. T. El-Wakad, "Towards Reinforcing Healthcare 4.0: A Green Real-Time IloT Scheduling and Nesting Architecture for COVID-19 Large-Scale 3D Printing Tasks," *IEEE Access*, vol. 8, pp. 213916–213927, 2020.
- [11] M. Javaid, A. Haleem, R. Pratap Singh, and R. Suman, "Pedagogy and innovative care tenets in COVID-19 pandemic: An enhance way through Dentistry 4.0," *Sensors Int.*, vol. 2, no. July, p. 100118, 2021.
- [12] I. Duek and D. M. Fliss, "The COVID-19 pandemic - from great challenge to unique opportunity: Perspective ☆," *Ann. Med. Surg.*, vol. 59, no. August, pp. 68–71, 2020.
- [13] A. Asadzadeh, S. Pakkhou, M. M. Saeidabad, H. Khezri, and R. Ferdousi, "Information technology in emergency management of COVID-19 outbreak," *Informatics Med. Unlocked*, vol. 21, p. 100475, 2020.
- [14] S. Gautam, S. Setu, M. G. Q. Khan, and M. B. Khan, "Analysis of the health, economic and environmental impacts of COVID-19: The Bangladesh perspective," *Geosystems and Geoenvironment*, vol. 1, no. 1, p. 100011, Feb. 2022.

- [15] A. Soltany et al., "A scoping review of the impact of COVID-19 pandemic on surgical practice," *Ann. Med. Surg.*, vol. 57, no. June, pp. 24–36, 2020.
- [16] F. J. Foo et al., "Colorectal cancer surgery in Asia during the COVID-19 pandemic: A tale of 3 cities," *Asian J. Surg.*, no. xxxx, 2021.
- [17] Y. Siriwardhana, C. De Alwis, G. Gur, M. Ylianttila, and M. Liyanage, "The Fight Against the COVID-19 Pandemic With 5G Technologies," *IEEE Eng. Manag. Rev.*, vol. 48, no. 3, pp. 72–84, Sep. 2020.
- [18] M. E. H. Chowdhury et al., "Can AI Help in Screening Viral and COVID-19 Pneumonia?," *IEEE Access*, vol. 8, pp. 132665–132676, 2020.
- [19] H. Jelodar, Y. Wang, R. Orji, and S. Huang, "Deep Sentiment Classification and Topic Discovery on Novel Coronavirus or COVID-19 Online Discussions: NLP Using LSTM Recurrent Neural Network Approach," *IEEE J. Biomed. Heal. Informatics*, vol. 24, no. 10, pp. 2733–2742, Oct. 2020.
- [20] M. Berquedich, A. Berquedich, O. Kamach, M. Masmoudi, A. Chebbak, and L. Deshayes, "Developing a Mobile COVID-19 Prototype Management Application Integrated With an Electronic Health Record for Effective Management in Hospitals," *IEEE Eng. Manag. Rev.*, vol. 48, no. 4, pp. 55–64, Dec. 2020.
- [21] M. Garcia-Haro et al., "Decontamination of filtering facepiece respirators using a low-temperature-steam-2%-formaldehyde sterilization process during a pandemic: a safe alternative for re-use," *J. Hosp. Infect.*, vol. 108, pp. 113–119, Feb. 2021.
- [22] M. A. Mohammed et al., "Benchmarking Methodology for Selection of Optimal COVID-19 Diagnostic Model Based on Entropy and TOPSIS Methods," *IEEE Access*, vol. 8, pp. 99115–99131, 2020.
- [23] A. Waheed, M. Goyal, D. Gupta, A. Khanna, F. Al-Turjman, and P. R. Pinheiro, "CovidGAN: Data Augmentation Using Auxiliary Classifier GAN for Improved Covid-19 Detection," *IEEE Access*, vol. 8, pp. 91916–91923, 2020.
- [24] M. Jamshidi et al., "Artificial Intelligence and COVID-19: Deep Learning Approaches for Diagnosis and Treatment," *IEEE Access*, vol. 8, no. December 2019, pp. 109581–109595, 2020.
- [25] J. Yawney and S. A. Gadsden, "A Study of the COVID-19 Impacts on the Canadian Population," *IEEE Access*, vol. 8, pp. 128240–128249, 2020.
- [26] R. Niu, E. W. M. Wong, Y.-C. Chan, M. A. Van Wyk, and G. Chen, "Modeling the COVID-19 Pandemic Using an SEIHR Model With Human Migration," *IEEE Access*, vol. 8, pp. 195503–195514, 2020.
- [27] I. F. Adi Badiozaman, H. J. Leong, and W. Wong, "Embracing educational disruption: a case study in making the shift to a remote learning environment," *J. Appl. Res. High. Educ.*, vol. 14, no. 1, pp. 1–15, Jan. 2022.
- [28] A. M. Ibrahim and M. A. Hassanain, "Assessment of COVID-19 precautionary measures in sports facilities: A case study on a health club in Saudi Arabia," *J. Build. Eng.*, vol. 46, no. November 2021, p. 103662, Apr. 2022.
- [29] S. Jamaludin, N. A. Azmir, A. F. Mohamad Ayob, and N. Zainal, "COVID-19 exit strategy: Transitioning towards a new normal," *Ann. Med. Surg.*, vol. 59, no. October, pp. 165–170, 2020.
- [30] O. Tutsoy, S. Colak, A. Polat, and K. Balikci, "A Novel Parametric Model for the Prediction and Analysis of the COVID-19 Casualties," *IEEE Access*, vol. 8, no. November 2020, pp. 193898–193906, 2020.
- [31] Y. Hanafi et al., "The new identity of Indonesian Islamic boarding schools in the 'new normal': the education leadership response to COVID-19," *Heliyon*, vol. 7, no. 3, 2021.
- [32] J. De Moura et al., "Deep Convolutional Approaches for the Analysis of COVID-19 Using Chest X-Ray Images From Portable Devices," *IEEE Access*, vol. 8, pp. 195594–195607, 2020.
- [33] P. Zhang, Y. Zhong, Y. Deng, X. Tang, and X. Li, "Drr4covid: Learning Automated COVID-19 Infection Segmentation From Digitally Reconstructed Radiographs," *IEEE Access*, vol. 8, pp. 207736–207757, 2020.
- [34] W. A. Zoghbi et al., "Multimodality Cardiovascular Imaging in the Midst of the COVID-19 Pandemic," *JACC Cardiovasc. Imaging*, vol. 13, no. 7, pp. 1615–1626, Jul. 2020.
- [35] K. Mathi, Y. Rosenberg-Hasson, H. Maecker, D. J. Carlo, and R. B. Moss, "Brief report: Tempol, a novel antioxidant, inhibits both activated T cell and antigen presenting cell derived cytokines in-vitro from COVID-19 patients," *Clin. Immunol.*, vol. 231, p. 108828, 2021.

- [36] F. F. Mendes, "COVID-19 and resuming elective surgery. How do we get back to normal?," *Brazilian J. Anesthesiol. (English Ed.)*, vol. 70, no. 5, pp. 455–456, Sep. 2020.
- [37] M. T. Eisenberg, C. Tingey, O. Fulton, J. Owen, and T. Snyder, "Quadrilateral space region inflammation and other incidental findings on shoulder MRI following recent COVID-19 vaccination: Three case reports," *Radiol. Case Reports*, vol. 16, no. 10, pp. 3024–3028, 2021.
- [38] L. Zhou et al., "A Rapid, Accurate and Machine-Agnostic Segmentation and Quantification Method for CT-Based COVID-19 Diagnosis," *IEEE Trans. Med. Imaging*, vol. 39, no. 8, pp. 2638–2652, Aug. 2020.
- [39] Q.-V. Pham, D. C. Nguyen, T. Huynh-The, W.-J. Hwang, and P. N. Pathirana, "Artificial Intelligence (AI) and Big Data for Coronavirus (COVID-19) Pandemic: A Survey on the State-of-the-Arts," *IEEE Access*, vol. 8, no. Cdc, pp. 130820–130839, 2020.
- [40] J. J. Ng, S. Navaretnam, and J. Lee Qiong Wei, "Considerations for IT Management in a COVID-19 World," *IEEE Eng. Manag. Rev.*, vol. 48, no. 3, pp. 16–18, Sep. 2020.
- [41] M. Quayson, C. Bai, and V. Osei, "Digital Inclusion for Resilient Post-COVID-19 Supply Chains: Smallholder Farmer Perspectives," *IEEE Eng. Manag. Rev.*, vol. 48, no. 3, pp. 104–110, Sep. 2020.
- [42] Y. Wang, R. Xu, M. Schwartz, D. Ghosh, and X. Chen, "COVID-19 and Retail Grocery Management: Insights From a Broad-Based Consumer Survey," *IEEE Eng. Manag. Rev.*, vol. 48, no. 3, pp. 202–211, Sep. 2020.
- [43] Y. Ye et al., "Alpha-Satellite: An AI-Driven System and Benchmark Datasets for Dynamic COVID-19 Risk Assessment in the United States," *IEEE J. Biomed. Heal. Informatics*, vol. 24, no. 10, pp. 2755–2764, Oct. 2020.
- [44] M. N. Islam and A. K. M. N. Islam, "A Systematic Review of the Digital Interventions for Fighting COVID-19: The Bangladesh Perspective," *IEEE Access*, vol. 8, pp. 114078–114087, 2020.
- [45] E.-S. M. El-Kenawy, A. Ibrahim, S. Mirjalili, M. M. Eid, and S. E. Hussein, "Novel Feature Selection and Voting Classifier Algorithms for COVID-19 Classification in CT Images," *IEEE Access*, vol. 8, pp. 179317–179335, 2020.
- [46] G. S. Dlamini et al., "Classification of COVID-19 and Other Pathogenic Sequences: A Dinucleotide Frequency and Machine Learning Approach," *IEEE Access*, vol. 8, pp. 195263–195273, 2020.
- [47] H. Wu and X. Zhu, "Developing a Reliable Service System of Charity Donation During the Covid-19 Outbreak," *IEEE Access*, vol. 8, pp. 154848–154860, 2020.
- [48] T. Ravindran and W. F. Boh, "Lessons From COVID-19: Toward a Pandemic Readiness Audit Checklist for Small and Medium-Sized Enterprises," *IEEE Eng. Manag. Rev.*, vol. 48, no. 3, pp. 55–62, Sep. 2020.
- [49] M. Ndiaye, S. S. Oyewobi, A. M. Abu-Mahfouz, G. P. Hancke, A. M. Kurien, and K. Djouani, "IoT in the Wake of COVID-19: A Survey on Contributions, Challenges and Evolution," *IEEE Access*, vol. 8, pp. 186821–186839, 2020.
- [50] S. Temiz and D. G. Broo, "Open Innovation Initiatives to Tackle COVID-19 Crises: Imposter Open Innovation and Openness in Data," *IEEE Eng. Manag. Rev.*, vol. 48, no. 4, pp. 46–54, Dec. 2020.
- [51] B. Wang, Y. Sun, T. Q. Duong, L. D. Nguyen, and L. Hanzo, "Risk-Aware Identification of Highly Suspected COVID-19 Cases in Social IoT: A Joint Graph Theory and Reinforcement Learning Approach," *IEEE Access*, vol. 8, pp. 115655–115661, 2020.
- [52] K. Li, "Hierarchical Pooling Strategy Optimization for Accelerating Asymptomatic COVID-19 Screening," *IEEE Open J. Comput. Soc.*, vol. 1, no. October, pp. 276–284, 2020.
- [53] M. T. Rahman, R. T. Khan, M. R. A. Khandaker, M. Sellathurai, and M. S. A. Salan, "An Automated Contact Tracing Approach for Controlling Covid-19 Spread Based on Geolocation Data From Mobile Cellular Networks," *IEEE Access*, vol. 8, pp. 213554–213565, 2020.
- [54] Z. Wang, Q. Liu, and Q. Dou, "Contrastive Cross-Site Learning With Redesigned Net for COVID-19 CT Classification," *IEEE J. Biomed. Heal. Informatics*, vol. 24, no. 10, pp. 2806–2813, Oct. 2020.
- [55] J. Wang et al., "Prior-Attention Residual Learning for More Discriminative COVID-19 Screening in CT Images," *IEEE Trans. Med. Imaging*, vol. 39, no. 8, pp. 2572–2583, Aug. 2020.
- [56] L. Sun et al., "Adaptive Feature Selection Guided Deep Forest for COVID-19 Classification With Chest CT," *IEEE J. Biomed. Heal. Informatics*, vol. 24, no. 10, pp. 2798–2805, Oct. 2020.

-
- [57] M. R. Hossain, S. Chakma, F. Tasnim, and Z. Zahra, "Socio-economic predictors of public understanding of the COVID-19 pandemic," *Heliyon*, vol. 7, no. 6, p. e07255, Jun. 2021.
- [58] A. Werikhe, "Towards a green and sustainable recovery from COVID-19," *Curr. Res. Environ. Sustain.*, vol. 4, p. 100124, 2022.
- [59] M. Roberts, "Tracking economic activity in response to the COVID-19 crisis using nighttime lights – The case of Morocco," *Dev. Eng.*, vol. 6, no. January, p. 100067, 2021.
- [60] F. Syed and A. Ullah, "Estimation of economic benefits associated with the reduction in the CO2 emission due to COVID-19," *Environ. Challenges*, vol. 3, no. January, p. 100069, Apr. 2021.
- [61] J. Bulchand-Gidumal, "Post-COVID-19 recovery of island tourism using a smart tourism destination framework," *J. Destin. Mark. Manag.*, vol. 23, p. 100689, Mar. 2022.
- [62] Z. Parolin and E. K. Lee, "The Role of Poverty and Racial Discrimination in Exacerbating the Health Consequences of COVID-19," *Lancet Reg. Heal. - Am.*, vol. 7, p. 100178, Mar. 2022.
- [63] M. Blofield et al., "A diagonal and social protection plus approach to meet the challenges of the COVID-19 syndemic: cash transfers and intimate partner violence interventions in Latin America," *Lancet Glob. Heal.*, vol. 10, no. 1, pp. e148–e153, Jan. 2022.