COVID-19: air pollution remains low as people stay at home

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Abstract

Coronavirus diseases 2019 (COVID-19) is transmitted worldwide in over a very short time, as it was originated in late 2019 from Wuhan city, China. To reduce the possible effects due to COVID-19, some sort of lockdown activities have been applied in many countries. In this regard, the outcomes reported bonus benefits to the natural environment showing a significant decrease in air pollution worldwide due to COVID-19. The National Aeronautics and Space Administration (NASA) and European Space Agency (ESA) released air pollution data for Asian and European countries to assess the significant changes in air quality. The main objective of the study is to compare the air quality data released by international agencies before and after the novel coronavirus pandemic.

Keywords Air pollutant · Coronavirus · COVID-19 · Nitrogen dioxide (NO₂) · NASA · ESA

Abbreviations

COVID-19 Coronavirus diseases 2019
NASA National Aeronautics and Space Administration
ESA European Space Agency
NO₂ Nitrogen dioxide
TROPOMI Tropospheric Monitoring Instrument and Ozone Monitoring Instrument

Introduction

The novel coronavirus started in Wuhan city, China, in late 2019 and it is now an ongoing global pandemic event (Gautam 2020; WHO 2020). Many researchers have reported that novel coronavirus is an acute respiratory disease, which may affect the lungs and respiratory system (Gautam and Trivedi 2020; Chen et al. 2020). As of April 24, 2020, there are a total of 2,709,483 and 190,861 persons reported as confirmed cases and as number of total deaths, respectively. There are three categories (i.e., history of smoking, older age, high blood pressure and heart diseases) which are considered important factors associated with the development of the diseases (Wu et al. 2020; Gautam and Trivedi 2020; Gautam and Hens 2020; Liu et al. 2020; Muhammad et al. 2020). According to a report released by the Italian Institute of Health, 481 patients having background diseases passed away due to novel coronavirus infection. In this regard, Fig. 1 shows the description of the background diseases evident in over 20% of the cases due to COVID-19.

The main sources of NO₂ in the ambient atmosphere are transportation, power plants, and lighting (He et al. 2020; Sharma et al. 2020; Humbal et al. 2019; Arden Pope et al. 2004) have shown that the symptoms of harmful diseases (i.e., decreased lung function, premature death, lung disease, aggravated asthma, irregular heartbeat, and nonfatal heart attacks) reported due to long exposure to toxic component (i.e., nitrogen dioxide (NO₂)). Persinger et al. (2002) reported the effects of long-term exposure to NO₂ on lungs (damage to epithelial cells) and respiratory functions. Faustini et al. (2014) stated that the mortality rate can be increased due to the short- and long-term exposure to NO₂. As per documents, a total of 2.6 million people are significantly affected due to the degradation of air quality. Cohen et al. (2017) reported respiratory and pathogenic effects due to exposure to air pollutants and also suggested a link between air pollution and sick building syndromes.

Air quality during COVID-19

Transportation activities have significantly been affected due to COVID-19 lockdowns, as there are less energy
consumption and less oil demand. The outcomes of the lockdown can be easily identified as an improvement of the environmental quality (i.e., air, water, noise). According to data recently released by the National Aeronautics and Space Administration (NASA) and European Space Agency (ESA), the environmental quality has improved and there was a 30% reduction observed in the emission of NO2. The ESA and NASA collect the data (images) through Sentinel – 5P satellite and AURA satellite images which have produced using Tropospheric Monitoring Instrument and Ozone Monitoring Instrument (TROPOMI), respectively. Figure 2 shows the NO2 reduction (%) in Asian and European countries due to COVID-19 lockdowns.

South Asian countries

A significant reduction in the percentage of NO2 in south Asian countries (i.e., China and India) can be seen (Figs. 3 and 4). The ESA collects air quality data by using TROPOMI instruments using Sentinel – 5P satellite during COVID-19 lockdowns. The results (i.e., 70% and 20–30% NO2 reduction in India and China, respectively) indicate that there are significant changes in the level of NO2 identified in Asian countries due to COVID-19.

European countries

It can be seen that there is a variation in the concentration level of NO2 before and after COVID-19 (March 2019–March 2020) (Fig. 5). According to ESA (2020), the NO2 reduced 20–30% in European countries (i.e., Spain, Italy, and France) due to lockdown applied by respective governments. The possible images were collected by satellite (Sentinel – 5P) using the TROPOMI instrument.

According to the overall assessment of NO2 reduction during COVID-19 lockdowns, it can be observed that lockdown is more effective in Asian countries compared with that in European countries. Asian countries’ fight against the COVID-19 outbreak has been unique. While Asian countries placed travel restrictions relatively early and many states quickly shut off access to public places, the country’s high population density, overburdened public health infrastructure, high prevalence of non-communicable diseases, and the prospect of transmission from younger people to the elderly in joint families all stack the odds against effective containment. Moreover, the total number of confirmed cases and deaths is more in the European than in Asian countries. For further studies, the relationship between NO2 variation and the number of deaths due to novel coronavirus should be carried out.
Fig. 3 Variation in the concentration of NO\textsubscript{2} in China during the COVID-19 lockdowns (ESA 2020)

Fig. 4 Variation in the concentration of NO\textsubscript{2} in India during COVID-19 lockdowns (ESA 2020)
Conclusion

In this study, the variation of NO\textsubscript{2} which was collected from the satellite (Sentinel – 5P) was used to indicate the significant reduction in the level of NO\textsubscript{2} in Asian and European countries due to COVID-19 lockdowns. The outcomes indicated that the novel coronavirus is considered a blessing in disguise. The current status of air quality may be temporary but there is a very good opportunity for us (scientists/researchers/students/individuals) to learn/understand from the applied
lockdown activities on how to minimize the concentration level of air pollutants on a long-term basis.

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References

Arden Pope C, Burnett Richard T, Thurston George D, Thun Michael J, Calle Eugenia E et al (2004) Cardiovascular mortality and long-term exposure to particulate air pollution. Circulation 109:71–77

Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, Li J, Zhao D, Xu D, Gong Q, Liao J, Yang H, Hou W, Zhang Y (2020) Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet 20:30360–30363

Cohen AJ, Brauer M et al (2017) Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. Lancet 17:30505–30506

ESA (2020) ESA, 2020. doi. https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P

Faustini A, Rapp R, Forastiere F (2014) Nitrogen dioxide and mortality: review and meta-analysis of long-term studies. Eur Resp J. https://doi.org/10.1183/09031936.0014713

Gautam S (2020) The influence of COVID – 19 on air quality in India: a boon or inutile. Bull Environ Conta Toxicol. https://doi.org/10.1007/s00128-020-02877-y

Gautam S, Hens L (2020) SARS-CoV-2 pandemic in India: what might we expect? Environ Develop Sustain 22:3867–3869

Gautam S, Trivedi UK (2020) Global implications of bio-aerosol in pandemic. Environ Develop Sustain 22:3861–3865

He MZ, Kinney PL, Li T, Chen C, Sun Q, Ban J, Wang J, Liu S, Goldsmith J, Kioumourtzoglou MA (2020) Short- and intermediate-term exposure to NO2 and mortality: a multi-county analysis in China. Environ Pollut 261:114165

Humbal C, Gautam S et al (2019) Evaluating the colonization and distribution of fungal and bacterial bioaerosol in Rajkot, western India using multi-proxy approach. Air Qual Atmos Health 12(6):693–704

Liu W, Tao ZW, Lei W, Ming-Li Y, Kui L, Ling Z, Shuang W, Yan D, Jing L, Liu HG et al (2020) Analysis of factors associated with disease outcomes in hospitalized patients with 2019 novel coronavirus disease. Chin Med J. https://doi.org/10.1097/CM9.0000000000000775

Muhammad S, Long X, Salman M (2020) Covid – 19 pandemic and environmental pollution: a blessing in disguise? Sci Tot Environ 728:138820

National Aeronautics, Space Administration (2020) NASA:2020 https://earthobservatory.nasa.gov/images

Ogen Y (2020) Assessing nitrogen dioxide (NO2) levels as a contributing factor to coronavirus (COVID-19) fatality. Sci Tot Environ 726:138605

Persinger RL, Poynter ME, Ckless K, Janssen-Heininger YMW (2002) Molecular mechanisms of nitrogen dioxide induced epithelial injury in the lung. Mol Cell Biochem 234:71–80

Saeha S, Bai L et al (2020) Association between road traffic noise and incidence of diabetes mellitus and hypertension in Toronto, Canada: a population-based cohort study. J Am Heart Assoc 9:013021

Sharma S, Zhang M, Anshika GI, Zhang H, Kota SH (2020) Effect of restricted emissions during COVID-19 on air quality in India. Sci Tot Environ 728:138878. https://doi.org/10.1016/j.scitotenv.2020.138878

World Health Organization (2020) Coronavirus disease (COVID-2019) situation reports. Geneva: World Health Organization. Retrieved March 23, 2020 from (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/). opens in new tab.

Wu C, Chen X, Cai Y, Xia J, Zhou X, Xu S, Huang H, Zhang L, Zhou X, Du C, et al. (2020) Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. JAMA Intern Med. https://doi.org/10.1001/jamainternmed.2020.0994Published online March 13,2020.5Y. Ogen / Sci Tot Environ 726: 138605

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