



Assessment of air quality in different regions of Kolkata before and during COVID-19 lockdown: A blessings behind the ruthless curse

Indrani Banerjee, Jotishree Kolay, Sumana Saha

Department of Zoology, Barasat Government College, K.N.C., Barasat, Kolkata, West Bengal, India

Abstract

The novel coronavirus (SARS-CoV-2) had been appeared as a terrific deadly outbreak worldwide. COVID-19 was an acute respiratory infectious disease because of their capability to invade the entire respiratory system of human being. The worldwide coronavirus transmission and its deleterious effect had been introduced to transmit through interaction of human. Therefore, the countrywide lockdown had been enacted for the prevention of fast-flowing of SARS-CoV-2 through the economic production cease and limitation on the movement of the residents. According to Central Pollution Control Board of India, Kolkata, the Eastern economic pivot of India was registered as one of the worse-affected zone with respect to air pollution. It must be hypothesised that the degree of respiratory and allergic illness would be raised because of the air quality changing instantaneously in Kolkata. Therefore, the principal aim of this review study was to assess the status of air quality standard during pre-COVID-19 lockdown phase and COVID-19 lockdown phase in Kolkata, India. In this context, the purpose of the study had great importance that how much air pollution was decreased during lockdown phase and this study had also been recognized the particular sources of air pollution. The uniqueness of this study also highlighted the reality regarding standards of air quality and people health status during pre-lockdown and lockdown phase.

Keywords: SARS-CoV-2, COVID-19 lockdown, air pollution, Angiotensin-converting enzyme 2 receptor

Introduction

The disastrous novel coronavirus (COVID-19) pandemic disease breaks up the normal rhythm of global socio-economic and cultural existence. The outbreak of catastrophic coronavirus occurred during the end of December 2019 and created a terrific turmoil particularly in socio-economic backbone of the nations (Tian *et al.*, 2020) [9]. WHO had declared that the COVID-19 was a sixth Public Health Emergency of International Concern (on 30 Jan, 2020) because of the enormous aftermath of this fatal disease throughout the world (Wee *et al.*, 2020; WHO 2020c) [10, 11]. It had been originated from the novel coronavirus SARS-CoV-2. WHO had declared COVID-19 as a pandemic on 11th March, 2020 (WHO 2020d) [12]. It was notable that India had enlisted as a hot spot zone in the list of COVID-19 affected Asian countries. In India, West Bengal had witnessed the brutal strike of coronavirus, whereas Kolkata (the capital of West Bengal) was identified as the epicentre of COVID-19 pandemic in the state. Government of India had already implemented lockdown rules from March 24, 2020, and it was further continued up to May 31, 2020, to prevent the rapid outbreak of COVID-19 pandemic during global emergency.

In 2020, Sungnak *et al.* had been suggested that nasal epithelial cells might be the primary access for SARS-CoV-2 (Sungnak *et al.*, 2020) [8]. Within months of its discovery, scientists established that like SARS-CoV (Li *et al.*, 2003) [6], SARS-CoV2 infects cells through binding its spike glycoprotein to the angiotensin-converting enzyme 2 receptor (ACE2) following priming by transmembrane protease serine 2 and/or other host proteases (furin, cathepsin, etc.) (Wrapp *et al.*, 2020; Hoffmann *et al.*, 2020) [13, 5]. Elevated ACE2 expression on epithelial cells, combined with the high affinity of the SARS-CoV-2 spike

protein for ACE2 promotes viral infection *in vitro* (Wrapp *et al.*, 2020; Hoffmann *et al.*, 2020) [13, 5]. Hence, acute COVID-19 cases might result from higher tissue levels expression of ACE2, raise infection and finally greater viral load being observed. In 2020, Samavati *et al.* was concluded that SARS-CoV-2 interaction with ACE2 leads to decreased ACE2 surface expression and impaired cardiopulmonary protection (Samavati *et al.*, 2020) [7]. Exposure to air pollutants like cigarette smoke and PM_{2.5} increases ACE2 expression in upper and lower airway epithelial cells, providing more opportunities for SARS-CoV-2 binding. The fusion of SARS-CoV-2 with glycoprotein form the spike. The cleavage of spike protein was catalyzed by an endogenous protease like transmembrane protease serine type 2 in order to optimally binding to its receptor ACE2 and be internalized for replication. The reduced level of surface expression of ACE2 restricts the amount of Angiotensin II which was cleaved by ACE2 into Ang1-7. This decrease in Ang1-7 signaling through its G couple receptor MAS in favor of the pro-inflammatory AngII /AT1R pathway likely contributes to COVID-19 disease pathogenesis (Brandt, 2021) [3].

The outbreak of COVID-19 had led to a rigorous destruction of civilization globally and suddenly expose to a severe challenge regarding health, food systems and in work section. The social and economic breakdown caused by the pandemic was demolishing. The worldwide health crisis due to COVID-19 had attributed social isolate ion where inhabitants of different countries were strictly prohibited from going out and executing their normal activities, in this way, ruined the global economic condition (Atalan *et al.*, 2020) [1]. The outcome of the health restrictions abruptly put in place were the diminishing in tourist activity, debilitating of industrial deliverability, decline in demand and reduction of the human budget (Bagchi *et al.*, 2020) [2]. So, it had brutally attacked global economy and financial markets.

Therefore, the principal aim of this study was to assess the status of air quality standard during pre-COVID-19 lockdown phase and COVID-19 lockdown phase in Kolkata, India. In this context, the purpose of the study had great importance that how much air pollution was decreased during lockdown phase and this study had also been recognized the particular sources of air pollution. The uniqueness of this study also highlighted the reality regarding air quality standards and public health status during pre-lockdown and lockdown phase.

Material and Methods

Study area

The capital of West Bengal, Kolkata, was one of the worst COVID-19 hit zone within the country of India. Name of different stations of Kolkata which were studied before and during lockdown period: Ballygunge, Bidhannagar, Fort William, Jadavpur, Rabindra Bharati University, Rabindra Sarobar, Victoria. (Fig: 1).

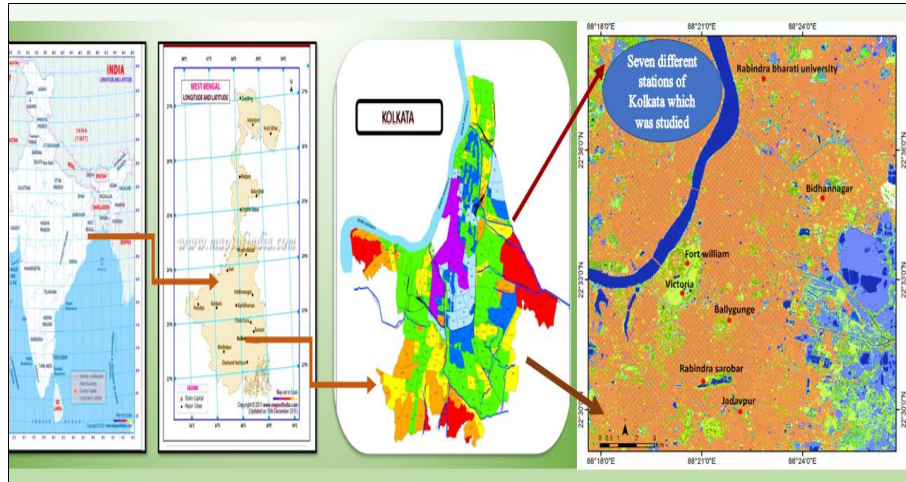


Fig 1: Study Area (Souce: Author’s own creation)

Table 1: Location of seven monitoring sites in Kolkata

NAME OF THE STATION	LOCATION
Ballygunge	22.5280° N, 88.3659° E
Bidhannagar	22.5797° N, 88.4143° E
Fort William	22.5542° N, 88.3359° E
Jadavpur	22.4955° N, 88.3709° E
Rabindra Bharati University	22.5845° N, 88.3594° E
Rabindra Sarobar	22.5121° N, 88.3637° E
Victoria	22.5448° N, 88.3426° E

Data Sources

To study the alteration in air quality during pre-lockdown and lockdown phase, the data of seven monitoring sites in Kolkata, were taken into consideration. The location of all these seven monitoring stations were shown in Fig.1 and Table.1. Data from 16 March 2020 to 24 March 2020 (just before tenure of complete lockdown) and from 25 March 2020 to 15 April (during complete locked down) were used to calculate variations in concentrations and appraised the relative change from before lockdown period to complete lockdown period. The data, which were collected from Central Pollution Control Board (cpcb.nic.in > Air / water/ Noise data > Air quality data > Live air quality index) [4] and showed the concentration of the pollutants before and during lockdown.

Results and Discussion

During the lockdown phase, over 40% reduction in PM2.5, 44% in PM10 levels and 38% reduction in SO₂ levels were observed. CO average levels also decreased in a similar manner with 39% reduction during the lockdown phase. However, NO₂ levels reduced 66% and also Benzene levels

decreases 69% was observed during the lockdown period. This was due to the reduction of number of on-road vehicles. 24 hourly average PM_{2.5} (Fig: 2), PM10 (Fig: 3), NO₂ (Fig:4), SO₂ (Fig:5) and Benzene (Fig:6) levels were within National Ambient Air Quality Standards for all days in the lockdown phase. Lowest PM10, PM2.5 and NO₂ 24 hourly average levels during the period of lockdown were recorded as 38 µg/m³, 18 µg/m³ and 6 µg/m³.

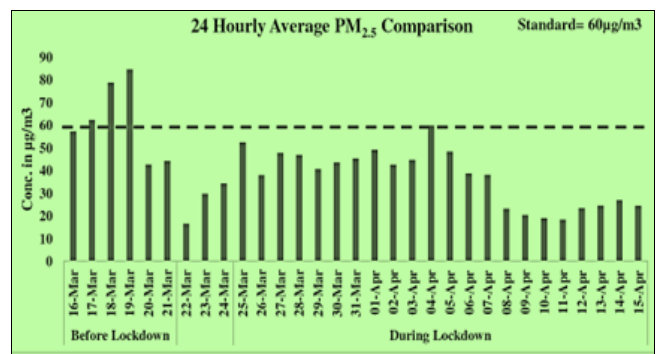


Fig 2: Graphical representation shows 24 hourly average PM 2.5

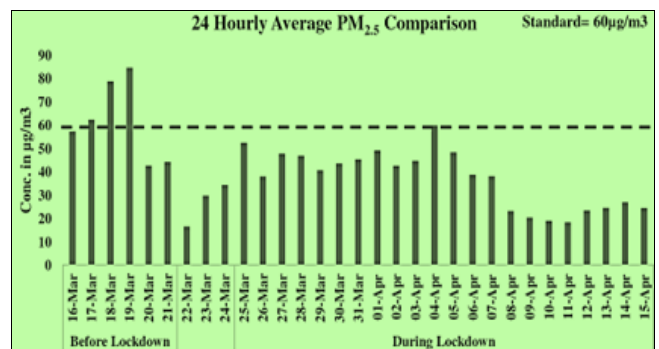


Fig 3: Graphical representation shows 24 hourly average PM 10

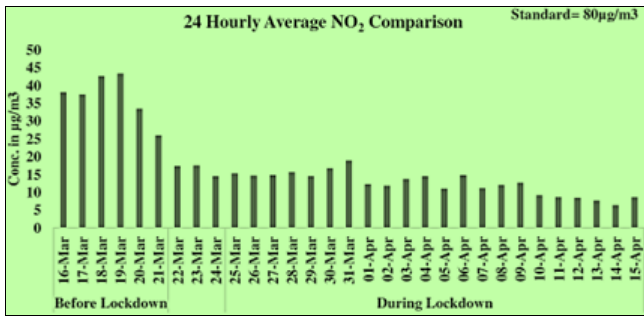


Fig 4: Graphical representation shows 24 hourly average NO₂

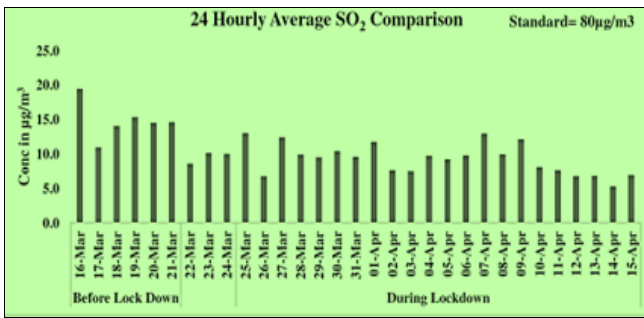


Fig 5: Graphical representation shows 24 hourly average SO₂

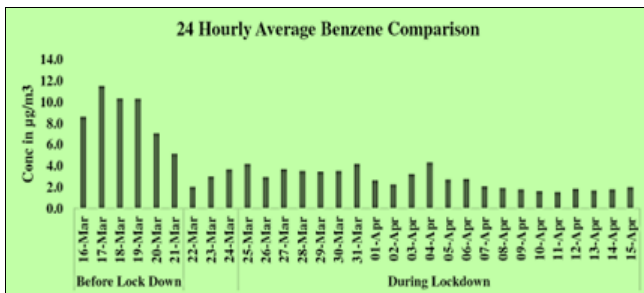


Fig 6: Graphical representation shows 24 hourly average Benzene comparison

Therefore, the 24-hourly average comparison of concentration values showed a diminishing trend in levels of PM₁₀, PM_{2.5}, NO₂, SO₂, Benzene during the period of lockdown. This was due to the declining of non-essential vehicles and combustion activities in industrial and commercial sites. Kolkata's diurnal variation of pollutants was characterized by lower concentrations during the day and accumulation of pollutants during night-time. So, the concentrations of pollutants were reduced due to the lack of daytime activities like vehicular movement and industrial operation (Fig: 7 and 8).

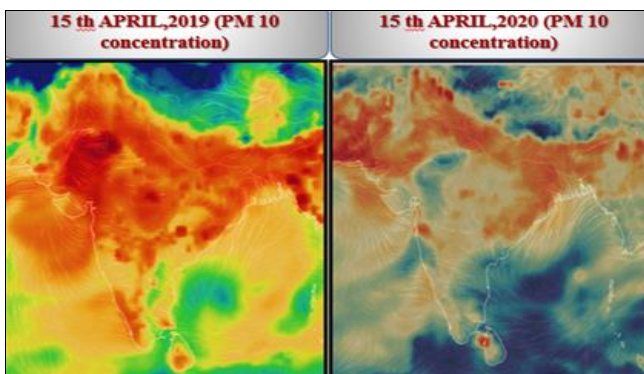


Fig 7: Change in concentration from 15 April 2019 to 15 April 2020 of PM₁₀ (Source: <https://earth.nullschool.net>)

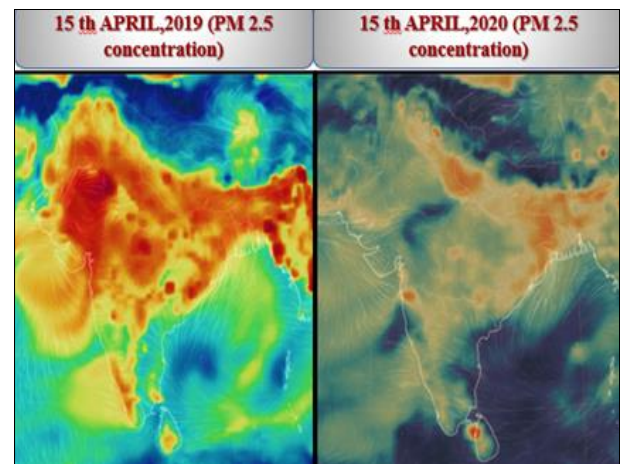


Fig 8: Change in concentration from 15 April 2019 to 15 April 2020 of PM_{2.5} (Source: <https://earth.nullschool.net>)

Conclusion

The lockdown policy due to COVID-19 pandemic offers a significant message globally for recuperating the quality of environment and also natural ecosystem stability. Apparently, COVID-19 pandemic and constant lockdown becomes a curse towards several peoples and the world economy face a hostile situation due to the unfavourable and unnatural incidents. In the meantime, the modification of environment along with its air quality standard has become certainly the precious gifts of transient lockdown strategy during these emergency period. In Kolkata, increasing standard of air quality and diminishing the trend of surface temperature certainly bringing the environment become healthy during these unpleasant situations. Our study documented that NO₂, CO, PM₁₀ and PM_{2.5} concentration over the Kolkata city during lockdown period were sufficiently decreased as compared with pre locked down period. Hence, the fatality of COVID-19 pandemic offers a great opportunity to revitalize environment health. At last, the lockdown policy reclaimed the scintillation of environment by means of increasing the standard of quality of air all over the city of Kolkata.

So, temporary lockdown would be advantageous for the recovery of the environmental health, especially for City Kolkata. Therefore, the temporary lockdown system should be act like an environmental blessing behind the ruthless curse.

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