IMPACT OF COVID-19 PANDEMIC ON ATMOSPHERIC AIR QUALITY: A REVIEW.

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Abstract
The outbreak of a novel coronavirus (SARS-CoV-2), started around December, 2019 in Wuhan city of China, has attracted world attention due to its rapid transmission. World Health Organization (WHO) code-named the deadly infectious monster as Coronavirus Disease 2019 (COVID-19) following preliminary investigation of the SARS-CoV. The disease caused by the virus results to severe respiratory infections with dry cough, high fever, body ache and fatigue as the associated symptoms. The mode of transmission of causative agent is primarily among human population through respiratory droplets or fluids from COVID-19 infected person.

As at February, 2020, WHO declared this COVID-19 outbreak a pandemic and since then affected countries of world have locked downs at various phases in their cities, industries and restricted the movement of their citizens to minimize human contacts in-order to curb the rapid spread of the virus. In spite of the negative impacts of the coronavirus worldwide, the coronavirus crises brought a respite to the natural environment. The results from this review work have shown a decline in air pollution and greenhouse gases emission. For example, 63% and 60% reduction in $PM_{2.5}$ were recorded in Pakistan and India cities respectively. Sale City, Morocco and Guangzhou recorded 92% and 57% respectively reduction in NO_2. The review survey showed 54% reduction in SO_2 from Lagos, Nigeria. Many research work carried out in the recent time have proved that this COVID-19-induced lockdown has reduced sharply the environmental air pollution globally.

Key words: Covid-19, Pollution, Pandemic, health, Lock-down, Restriction, Positive Impact.

Introduction

Historically the atmosphere, like the ocean and the earth, was viewed by Human society as a receptacle of infinite capacity. The introduction into the atmosphere of pollutants of any kind, their diffusion and their interaction in the air affect the environment. It is more dangerous because of the insidious nature of air pollution: that leads to ease spreads of pollutants and the difficulty it poses in protecting oneself against it. The usual air pollutants and their resultant environmental impacts are shown in figure 1 and 2 below respectively.

The era of Covid-19 pandemic in 2020 came eight (8) years since the emergence of Middle East respiratory syndrome (MERS) in Saudi Arabia and eighteen (18) years after the occurrence of severe acute respiratory syndrome (SARS) in China. The restriction management of the Pandemic has brought some respite to the environment, despite colossal socio-economic loss it imposed on the globe. Several Studies have shown drastic reduction in the concentration levels of criteria or classical air pollutants ranging from gaseous: NO_2, SO_2, CO, O_3, Pb and PM as well as changes in the concentration levels of green house gases: N_2O, CH_4, CFC'^{S}, O_3, CO_2[1].

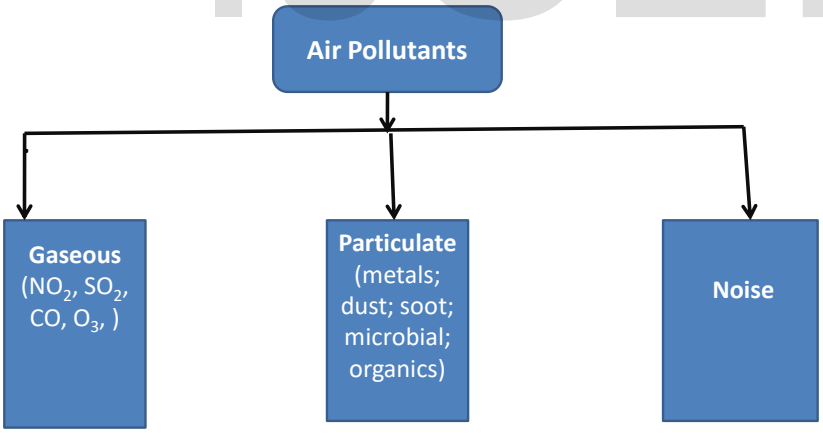


Fig.1: Forms of air pollutants

Source: [2]

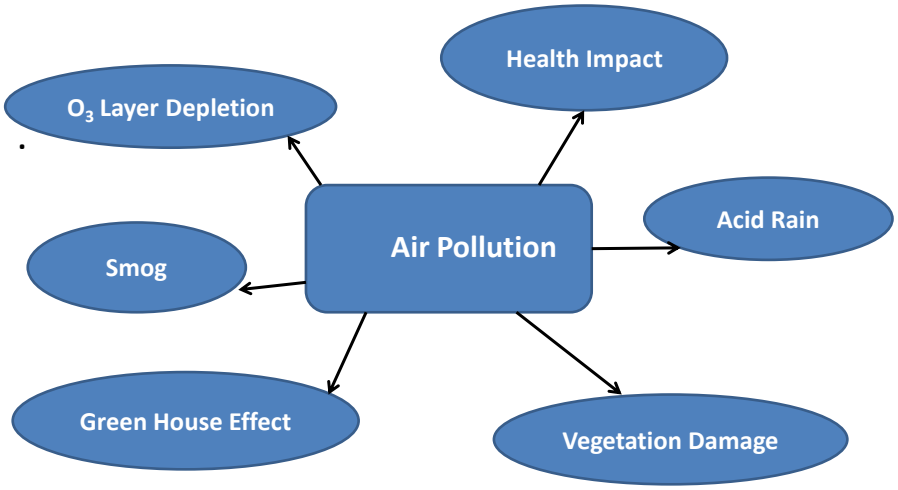


Fig. 2: Impacts of air pollution

Source: [2]

The coronavirus, historically was discovered in 1931, where a new type of upper-respiratory tract disease was diagnosed among chickens in North Dakota, US and the agent was known as infectious bronchitis virus (IBV), which later officially renamed as *Avian coronavirus().* A new brain disease of mice (murine encephalomyelitis) was discovered in 1947 at Harvard Medical School in Boston called JHM Virus. Also in 1950 a new mouse hepatitis was reported from the National Institute for Medical Research in London and the causative virus was identified as mouse hepatitis (MHV) *[3][4]).* In 1965 and 1966, Common cold human viruses were reported among school children in Epsom, England and University of Chicago and were designated B814 and 229E respectively.

Structural analyses of IBV, MHV, B18 and 229E using TEM, by June Almeida and David Tyrrel in 1967 grouped them and invented the collective name coronavirus, as all those viruses were characterised by solar corona-like projections (called spikes) on their surfaces [5]. As at 2020, 39 species of corona viruses are described in different animals with bats being the richest. Zoonotic species such as *Severe acute respiratory syndrome-related coronavirus* (SARS-CoV), *Middle East respiratory syndrome-related coronavirus* (MERS-CoV) and *Severe acute respiratory syndrome-related coronavirus 2* (SARS-CoV-2), the etiological agent of the COVID-19 pandemic. The SARS-CoV-2, is a zoonotic, bat-borne virus of the species *Severe acute respiratory syndrome-related coronavirus* (SARSr-CoV) [6] [7] [8] [9] [10]. The disease condition, Covid-19 caused by the novel coronavirus termed by World Health Organization (WHO), first emerged in late December, 2019 in Wuhan, China.

In early March 2020, due to its rapid spread, the WHO declared COVID-19 as a pandemic. Currently (as at 28th June, 2021), it spread to more than 210 countries worldwide, infecting over 180,817,269 million people, causing 3,923,238 mortalities and a total of 2,660,756,547 vaccine doses have been administered [11].

Positive Impact of Covid-19 on Air Quality

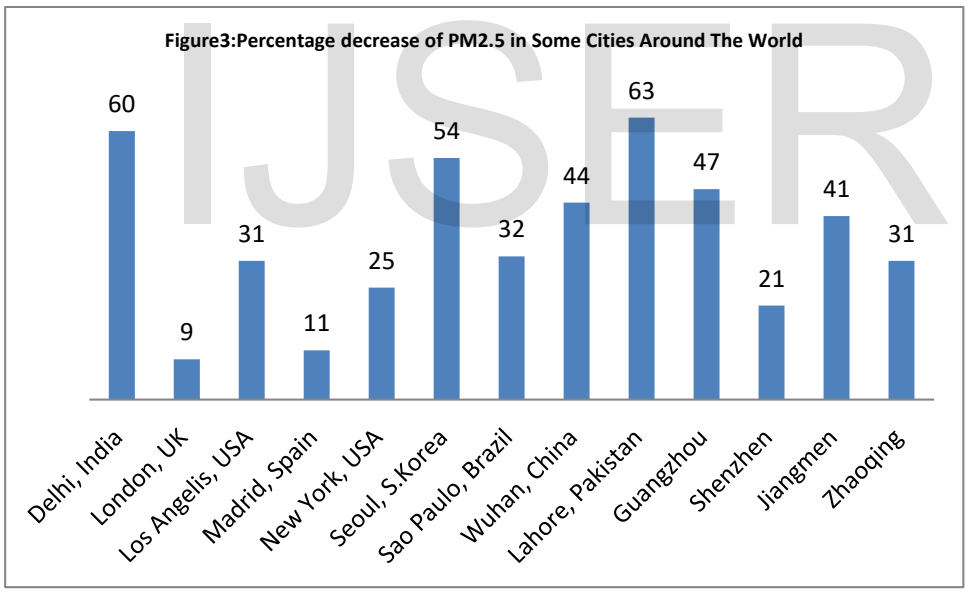
While the socio-economic devastation due to COVID-19 has been colossal around the world, which required "a wartime" plan from every corner of the world [12], it has also come as the silver lining for the environment [13][14]. The United Nations Environment Program chief Inger Andersen believes these environmental changes are temporary [12], as the global environment had a small respite before industrial activities resumed since February 2020. Recent studies have reported improvement in air quality due to restrictions placed upon industrial activities during the lockdown. Climate scientists have indicated that greenhouse gaseous (GHGs) concentration could drop to levels not seen since World War II. Highly industrialized cities located in cold climate zones observed a higher reduction in air pollution. Lockdown in various countries viz., France, Germany, Italy, Spain, Nigeria, and China led to shutting down of power plants, transportation, and other industries which resulted in drastic decrease in concentration levels of GHGs, NO2, PM2.5, PM10 and CO but spikes in ozone concentration simultaneously, primarily in Europe and large Chinese cities [15][16][17][18][19]. The air quality changes during COVID-19 lockdown over the Yangtze River Delta Region and Hangzhou suggest that the reduced human activity and industrial operations lead to significant reduction in PM2.5, NO2, and SO2 [17][20].

Reduction of air pollutants ($PM_{2.5}$, NO_2, SO_2, and CO)

The concentrations of the Four main primary air pollutants (PM10, NO_2, SO_2, and CO) have reduces drastically as reported by many researchers. For instance, in São Paulo and Rio De Janeiro, the two most populated cities, PM10, NO_2, and SO_2 were reported to have declined wherein, the CO levels showed the most significant reductions (up to 100%) which was related to light-duty vehicular emissions due to strict counter measures limiting population's mobility and prohibiting almost all avoidable activities was evaluated in the in Salé city (North- Western Morocco) [21][22]. Particulate matter ($PM_{2.5}$) reductions during the various lockdown phases in some cities around the world are shown in table 1 and figure 3 below. The survey had a highest of 63% and lowest of 11% reductions in $PM_{2.5}$ from Lahore (Pakistan) and Madrid (Spain) respectively.

Table 1: Percentage $PM_{2.5}$ Reduction In Some Cities Around The World

S/N		% Decrease	Period of lockdown	Source
1	Delhi, India	60	March 23rd to April 13th, 2020	***[23]***
2	London, UK	9	March 23rd to April 13th, 2020	
3	Los Angelis, USA	31	March 23rd to April 13th, 2020	
4	Madrid, Spain	11	March 23rd to April 13th, 2020	
5	New York, USA	25	March 23rd to April 13th, 2020	
6	Seoul, S.Korea	54	February 26rd to March 18th, 2020	
7	Sao Paulo, Brazil	32	March 23rd to April 13th, 2020	
8	Wuhan, China	44	February 3rd to February 24th, 2020	
9	Lahore, Pakistan	63	March 23rd to April 13th, 2020	
10	Guangzhou	47	January 23 to February 19, 2020),	*[24]*
11	Shenzhen	21	January 23 to February 19, 2020),	
12	Jiangmen	41	January 23 to February 19, 2020),	
13	Zhaoqing	31	January 23 to February 19, 2020),	
14	Italy	24.1	March/April, 2020	*[25]*



The cities lockdown phases recorded various percentage reductions in Nitrogen dioxide (NO_2) as reported by several researchers (see Table 2 and Figure 4). The reports recorded reduction as high as 67% and average minimal of 1.1% of the NO_2 from Sale City, Morocco and Portharcourt, Nigeria respectively.

Table 2: Percentage Reduction of NO_2 in Some Cities Around the World

S/N	CITY	% NO_2	Period	Source
1	Guangzhou	67	Jan. 23 to Feb. 19, 2020	*[24]*
2	Cairo, Egypt	15	March 15th to April 1st , 2020	*[26]*
3	Alexandria, Egypt	33		
4	U. S. A	49		*[15]*
5	Auckland, New Zealand	57		*[27]*
6	Hat Yai, Thailand	33.7	March to April, 2020	*[28]*
7	Baghdad, Iraq	40		*[29]*
8	Sale City, Morocco	92	March 2nd , 2020	*[21]*
9	Barcelona, Spain	51	March 14th , 2020	*[30]*
10	Yangtze,RiverDelta, Region	45.1		*[17]*
11	Lagos, Nigeria	1.4	March to April, 2020	*[16]*
12	Kaduna, Nigeria	3.0		
13	Portharcourt, Nigeria	21.8		
14	Lagos, Nigeria	1.1	March to April, 2020	*[31]*
15	Kaduna, Nigeria	3.0		
16	Portharcourt, Nigeria	21.8		
17	UK	31.9	March/April, 2020	*[25]*
		41.6	May, 2020	
18	Spain	46.8	March/April, 2020	
		35.4	May, 2020	
19	Italy	41.1	March/April, 2020	
		31.4	May, 2020	
20	France	38.2	March/April, 2020	
		30.7	May, 2020	
21	Sweden	13.9	March/April, 2020	
		15.9	May, 2020	

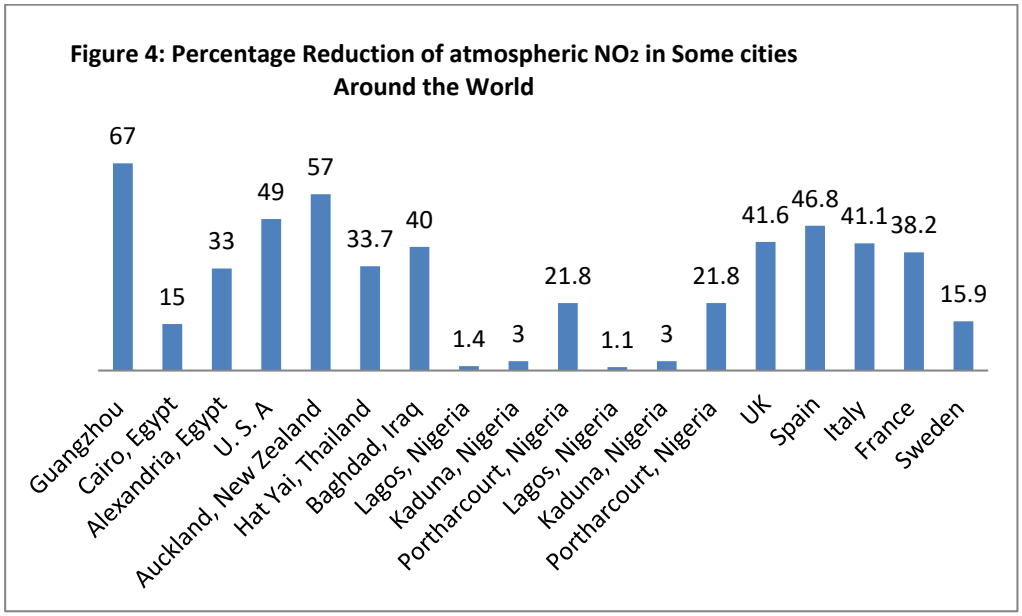
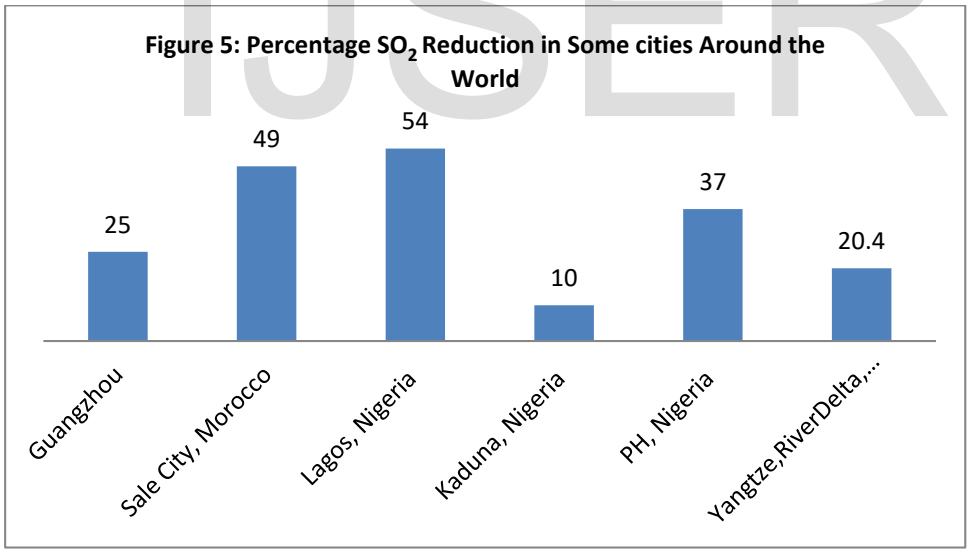


Table 3: Percentage Reduction of SO_2 in Some Cities Around the World

S/N	CITY	% reduction In SO_2	Period	Source
1	Guangzhou	25	Jan. 23 to Feb. 19, 2020	*[24]Wang et al, 2020*
2	Sale City, Morocco	49	March 2nd , 2020	*[21]Otmani et al., 2020*
3	Lagos, Nigeria	54	March-April, 2020	*[31]Olusola et al, 2021*
4	Kaduna, Nigeria	10		
5	Portharcourt, Nigeria	37		
6	Yangtze,RiverDelta, Region	20.4		*[17]Lili et al., 2020*

The percentage SO_2 reductions are shown in Table 3 and figure 5. The values ranged between 10% to 54% for Kaduna and Lagos both from Nigeria for maximum and minimum reduction respectively.



Reduction of environmental Noise

Environmental noise are generated by commercial or industrial activities, as well as human activities, such as transportation (railway, road traffic, and aircraft), and melodies at high volume [32. High exposure to noise may lead to release of stress hormones and

also cause some diseases, such as arteriosclerosis, hypertension, a stroke, or myocardial infarction [33].

The restriction have significantly decreased the level of environmental noise in Egypt by about 75% and a decrease of 70% was recorded in another work in Cairo, Egypt by Xiao et al 2020 [34][35], similar to other cities around the world.

Improvement In Ozone (O_3) Level

Mostafa et al [26] reported that an increase in Ozone concentration levels in Cairo, Egypt and Alexandria similar to other researcher reports. This generally elevation in the concentrations of O_3 can be attributed to "lower than normal emissions of NO due to restrictions placed on industrial activities and travel. Therefore, this increase in O_3 concentrations is mainly explained by an unprecedented reduction in [nitrogen oxides] emissions leading to a lower O_3 titration by [nitric oxide]," the researchers explained.

Health Cost Benefit of Covid-19

The cleaner air will not only result in superior health outcomes, it will also help reduce costs of diseases associated with air pollution, including Parkinson disease, Alzheimer disease, multiple sclerosis, diabetes, obesity, age-related macular degeneration, adverse pregnancy outcomes, and emphysema, to name a few.

Exposure reduction due to mask-wearing and stay-at-home orders have reduced exacerbations among patients with chronic obstructive pulmonary disease (COPD).

Many patients who had COPD got the information that they were at high risk and have been doing, I would say overall, a fairly good job of staying at home," said Meilan King Han, MD, a professor of internal medicine in the Division of Pulmonary and Critical Care at the University of Michigan in an interview with *The American Journal of Managed Care* [36]. Similar situations have played out across the asthma, allergy, and immunology fields (see Table 4 below). In some recently published studies focusing on populations in the United Kingdom and South Korea found the number of individuals receiving care for asthmatic episodes decreased during the pandemic [37].

Table 4: Reduction of Some Air Pollution Disease Cases During Covid-19

S/N	Country	Asthma	COPD	Pneumonia	Period
1	Scotland	41			23rd March, 2020
2	Wales	30			23rd March, 2020

3	Korea	47	58	53	Feb. to July, 2020

Source: [37] [38]

Conclusion

This review study was able to highlight some relevant positive impacts of coronavirus on environmental air quality by compiling the recently published data from various researchers. This positive impact is not sustainable since research results fluctuate between the restriction phases, even within pandemic periods from one country to another. It is therefore suggested that stringent environment laws and policies should be made to protect the environment at all time worldwide.

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