

HUMAN ACTIVITY IMPACT ON AIR POLLUTION (VIKRIT VAYU) DURING PRE AND POST LOCKDOWN PERIOD 2020 IN MEGACITY DELHI – LEADING TO JANAPADODHVANSA**Dr. Rahul Kumar Burolia* and Prof. Mahesh Vyas¹***P.G Scholar and ¹Professor, HOD & Dean Ph.D.

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ABSTRACT

The rapid growth of Delhi in recent times has resulted in significant increase in environmental pollution. Polluted environment plays an important role in *Janapadodhvansa* that complies from the word “*Janapada*” which means community and the word “*Udhvansa*” means the destruction. Acharya Charaka mentioned four major reasons as *Vayu* (air), *Jala* (water), *Desha* (habitat) and *Kala* (time) for the destruction of community. Among them *Vayu Vikriti* (polluted air) is a major cause of premature deaths and diseases leading to endangering health and shortening of life span. In this review, data for change in Air quality index is compared with pre and post lockdown period 2020 in the NCT Delhi. Air pollution is a complex mixture of anthropogenic pollutants and natural source. Study shows a huge difference in all the quality parameters of air during pre and post lockdown. This difference in the air quality index above the normal standard set by WHO is responsible for more than millions of deaths worldwide by causing acute or chronic disease generally related to the respiratory system leading to *Janapadodhvansa*.

KEYWORDS: Air Pollution, Janapadodhvansa, Pre - Post lockdown period.**INTRODUCTION**

Competency of working population and consistently changing lifestyle has evolved nowadays. This gives rise to less concern to self-care and environment. Environmental issues vary locally as well as globally from place to place. It is a well-known fact that pollution and large population are two major factors that sublime rapidly worldwide. From smoke in kitchens to smog that surround the cities, constitute a major health and climate hazardous issue arising globally. Among the categories of different types of pollutions (air, water, noise, soil, radioactive) air pollution is becoming a big challenge to the humankind. Air pollution, hardly discussed some decades ago, is now a major concern and gaining importance. India contributes 26.2% of the global air pollution reported in 2017^[1] In 2019 reported, in last two decades (1990-2019) deaths due to indoor or household air pollution is decline by 64.2%, while increased by 115.3% by ambient air pollution. 1.67 million Deaths were associated with air pollution in India in 2019. Out of which 0.98 million were from ambient pollutant and 0.61 million were from household pollutants. With this data, it contributes to 17.8% of the total deaths in the country.^[2] This data shows destruction of population on a mass level term as *Janapadodhvansa* in Ayurved.

Effect of air pollution in Delhi

It is well known that air pollution can be harmful to the health. It is predicted that air pollution will be the 3rd leading cause of death in upcoming years. WHO estimated that 7 million people died worldwide by air pollution. India has huge population of 1.38 billion in 2017 spread over 29 states and 7 union territories. Delhi is the second largest megacity in the world and a single contributor of the population (about 7.6%) in India.^[3] After independency rise in population and the rapid growth in the economic activity lead to the significant increase the environmental pollution and air pollution as well in Delhi. In all the district zone of Delhi where we are exposed to the particulates matter in concentration exceeding WHO air quality guidelines. After the vigorous efforts, Delhi has become the 12th in the list with the worst ambient air quality worldwide in 2012.^[4] In 2015, according to the monitored data by Central Pollution Control Board Delhi has 96% bad days, when the air quality exceeds the normal values.^[5]

In April 2018, according to WHO Delhi ranks high among the 100 world leading megacities in PM10 pollution.^[3] In NCT Delhi, for last several years, PM2.5 pollution concentration is recorded very high as per the National Ambient Air Quality Standards (NAAQS).^[6]

This magnificent increase the levels of air pollutants is causes public health problems majorly shortness of breath, chronic respiratory disorders, pneumonia, acute asthma etc.^[7] Due to this public health concern, in 2017 the Indian Council of Medical Research (ICMR) has declared community health emergency in Delhi.^[8]

MATERIAL AND METHODS

1. Study area

As the administrative and second financial capital of India Delhi has focused. National capital territory (NCT) Delhi occupies an area about 1485 km². NCT Delhi with the dual status of city and state is unified Kanjhawla, Mehrauli, Najafgarh and Shahadra blocks. Delhi is incorporated by the National Capital Regions (NCR) bordered by the adjacent cities like Sonipat (North-West), Bahadurgarh, Jhajjar and Rohtak (West), Gurgaon and Manesar (South), Faridabad (South-East), and Noida and Ghaziabad (East). Currently 34 air quality-monitoring stations are functional in Delhi to monitor air pollutants.

2. Methodology

AQI (air quality index) usually based on maximum sub-index approaching five criteria (i.e. PM10 and PM2.5, SO₂, NO₂ and CO). In recent time, IITM, Pune has come with an additional AQI sub-index that provides the presence of ozone (O₃) values in the air.^[9] The Ministry of Environment and Forest (MoEF), Govt. of India has revised and taken twelve air Quality Standards (namely, Particulate Matter (PM) of >10 µm size (PM10), Particulate Matter (PM) of >2.5 µm size (PM2.5), Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO), Ozone (O₃), Lead (Pb), Ammonia (NH₃), Benzo(a)Pyrene (BaP), Benzene (C₆H₆), Arsenic (As) and Nickel (Ni)).^[10] Out of these 12 parameter only seven (PM10, PM2.5, SO₂, NO₂, O₃, CO and NH₃) have been analyzed individually and integrated index during the first 15 days of lockdown (23 march 2020 – 6 April 2020) and compared with the starting 15 days of Nov 2020 (i.e. 1-15 Nov 2020). Normal range of AQI class studied in ordered to investigate the difference of comparison.^[11]

Table 1.1: Showing National AQI classes, range with colour codes, health impacts and health breakpoints for the seven pollutants.

AQI class (Range)	Health impact	PM ₁₀ 24 h (µg/m ³)	PM _{2.5} 24 h (µg/m ³)	SO ₂ 24 h (µg/m ³)	NO ₂ 24 h (µg/m ³)	O ₃ 8 h (µg/m ³)	CO 8 h (mg/m ³)	NH ₃ 24 h (µg/m ³)
Concentration range								
Good (0–50)	Minimal impact	0–50	0–30	0–40	0–40	0–50	0–1	0–200
Satisfactory (51–100)	Minor breathing discomfort to sensitive people	51–100	31–60	41–80	41–80	51–100	1.1–2	201–400
Moderately polluted (101–200)	Breathing discomfort to the people with lung asthma and heart disease	101–250	61–90	81–380	81–180	101–168	2.1–10	401–800
Poor (201–300)	Breathing discomfort to people on prolonged exposure	251–350	91–120	381–800	181–280	169–208	10–17	801–1200
Very poor (301–400)	Respiratory illness to the people on prolonged exposure	351–430	121–250	801–1600	281–400	209–748	17–34	1200–1800
Severe (401–500)	Effect healthy people and impacts to those with existing disease	>430	>250	>1600	>400	>748	>34	>1800

RESULT

As the first case of corona virus named as Covid-19 in Wuhan city, china,^[12] became pandemic worldwide in a short period. As the rising cases of Covid-19 in India on 23 March 2020, Indian government the Prime Minister Narendra Modi ordered a complete lockdown of 21 days. Several studies shows the positive impact of the lockdown in the air quality^[13] as significant degradation of air pollutants (i.e. PM10, PM2.5, SO₂, NO₂, O₃, CO and NH₃). As the process of unlocking starts in the month of June 2020, and reaches Unlock 6.0 for the

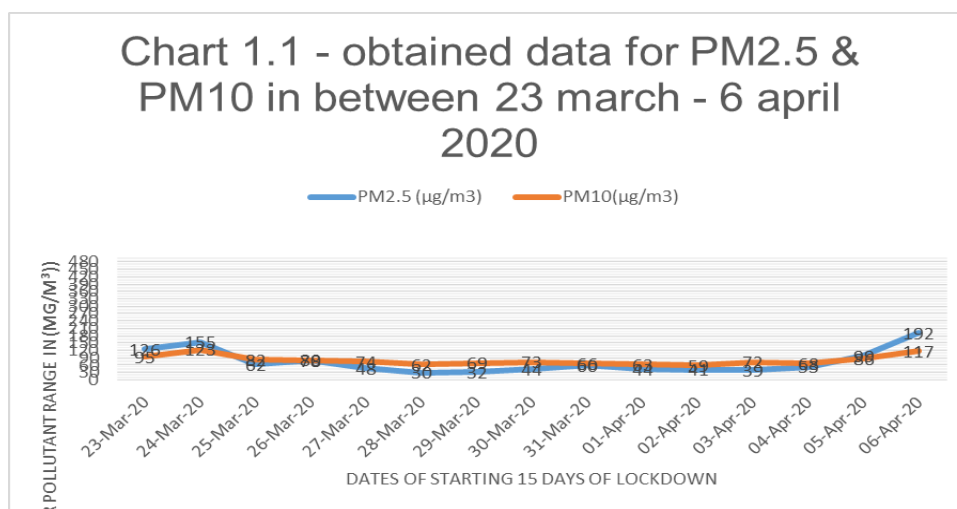
month of November 2020. There is a magnificent increase in all the sub-index of air quality pollutants is seen. For this study, all the data is collected from National Air Quality Index, Central Pollution Control Board of India website. Fifteen days data is collected of Vivek Vihar Delhi, DPCC at 19:00PM from the first day of lockdown on 23 march 2020 to 6 April 2020. In addition, compared with the data of starting 15 days of Unlock 6.0 (1 November to 15 November 2020).

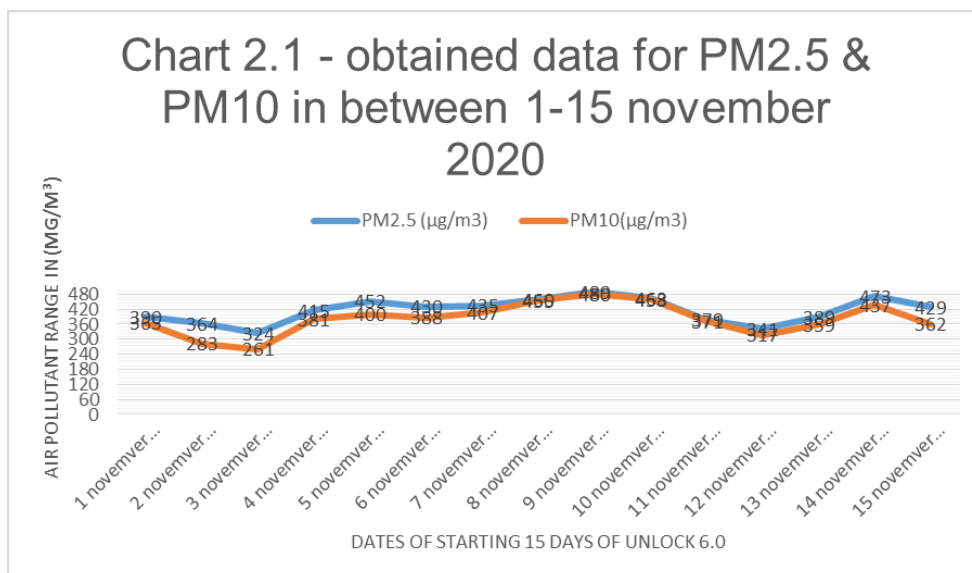
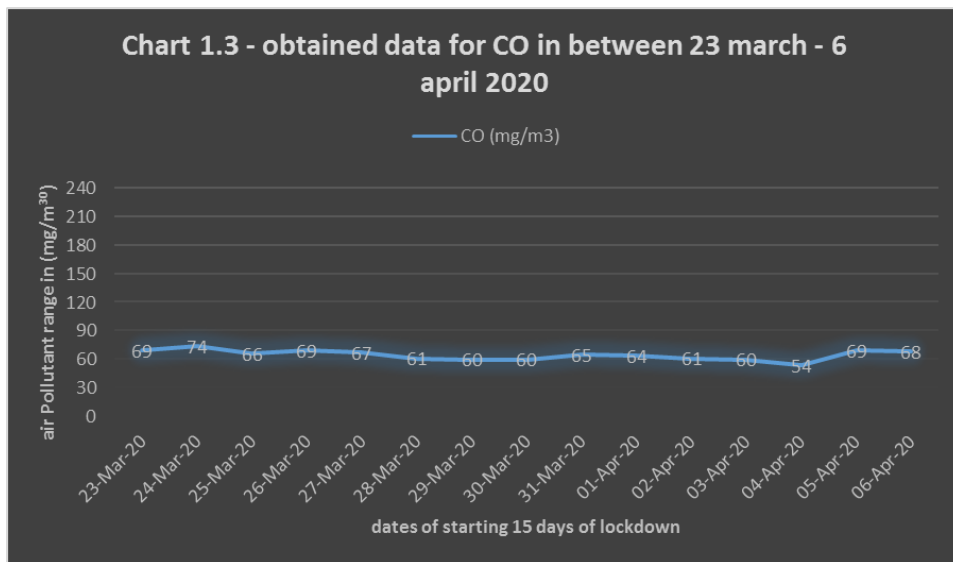
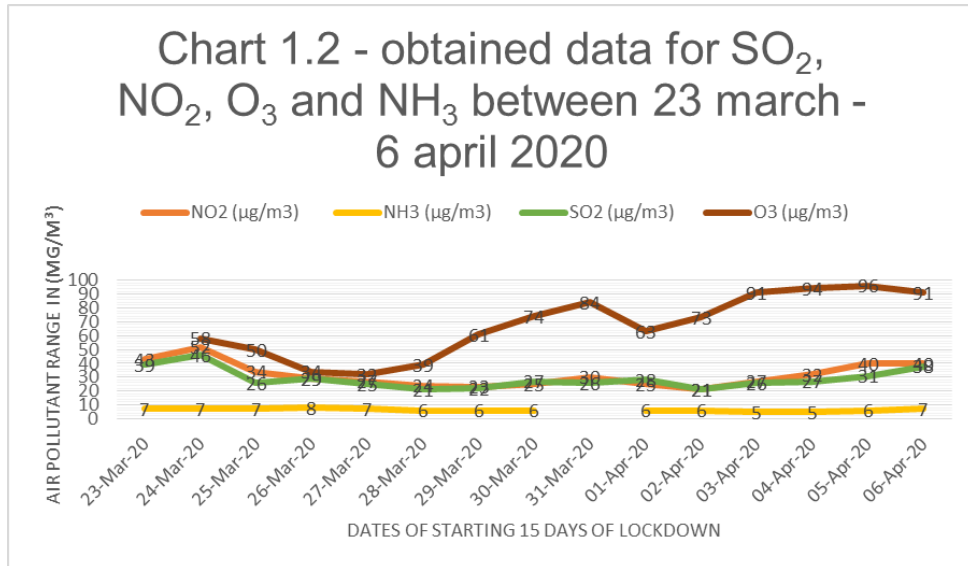
Table 1.2: Is showing data collected from 23 March – 6 April 2020.

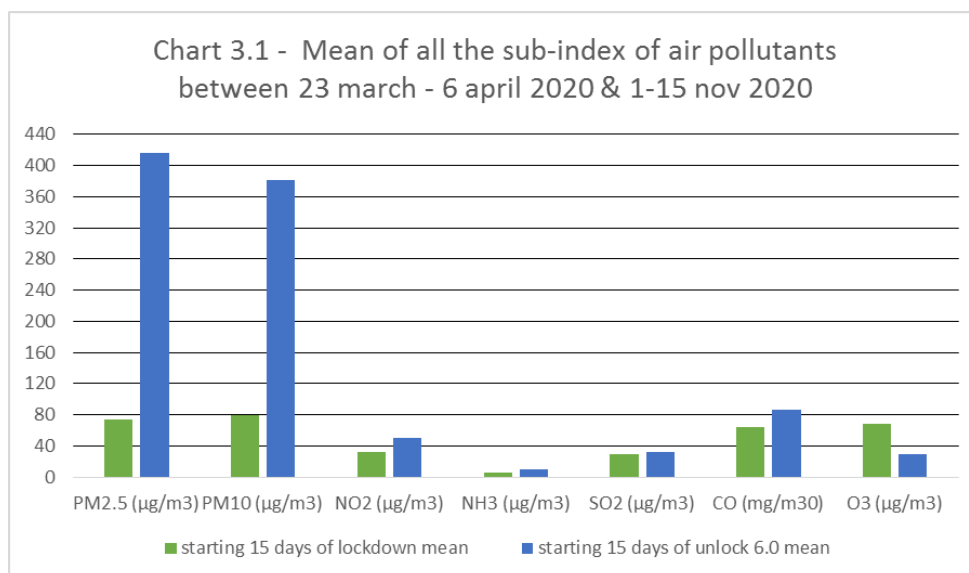
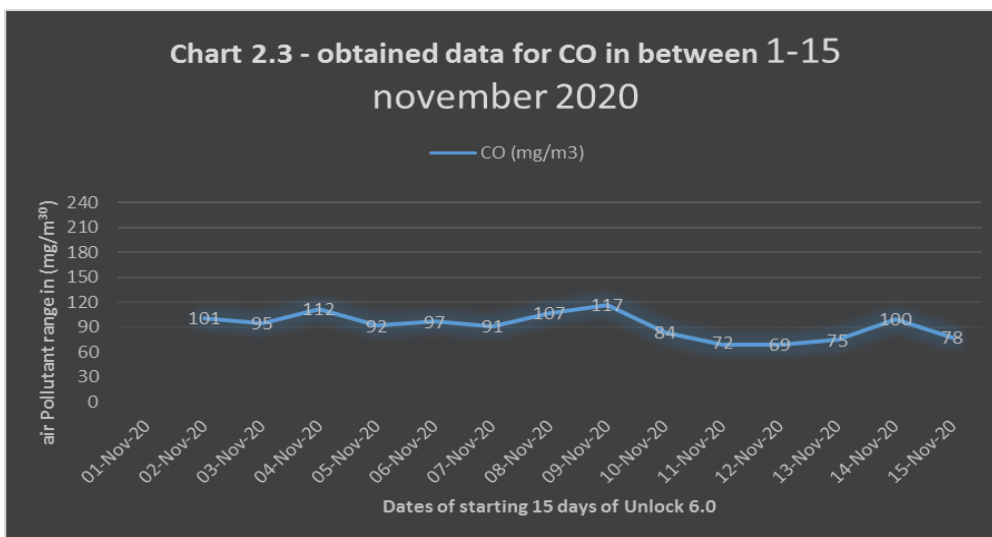
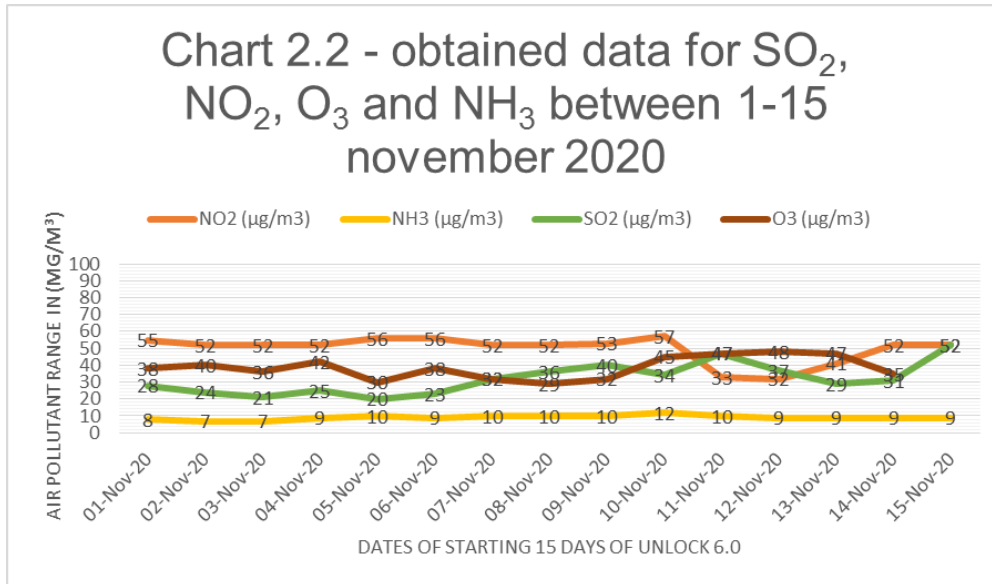
Date	Average concentration of pollutants from 23 March to 6 April 2020						
	PM2.5 ($\mu\text{g}/\text{m}^3$)	PM10 ($\mu\text{g}/\text{m}^3$)	NO ₂ ($\mu\text{g}/\text{m}^3$)	NH ₃ ($\mu\text{g}/\text{m}^3$)	SO ₂ ($\mu\text{g}/\text{m}^3$)	CO (mg/m ³)	O ₃ ($\mu\text{g}/\text{m}^3$)
23 March 2020	126	95	43	7	39	69	84
24 March 2020	155	123	52	7	46	74	58
25 March 2020	62	82	34	7	26	66	50
26 March 2020	80	78	29	8	29	69	34
27 March 2020	48	74	27	7	25	67	32
28 March 2020	30	62	24	6	21	61	39
29 March 2020	32	69	23	6	22	60	61
30 March 2020	44	73	25	6	27	60	74
31 March 2020	60	66	30		26	65	84
1 April 2020	44	63	25	6	28	64	63
2 April 2020	41	59	21	6	21	61	73
3 April 2020	39	72	27	5	26	60	91
4 April 2020	53	68	32	5	27	54	94
5 April 2020	99	86	40	6	31	69	96
6 April 2020	192	117	40	7	38	68	91

Table 1.3: is showing data collected from 1 November – 15 November 2020.

Date	Average concentration of pollutants from 1-15 nov 2020						
	PM2.5 ($\mu\text{g}/\text{m}^3$)	PM10 ($\mu\text{g}/\text{m}^3$)	NO ₂ ($\mu\text{g}/\text{m}^3$)	NH ₃ ($\mu\text{g}/\text{m}^3$)	SO ₂ ($\mu\text{g}/\text{m}^3$)	CO (mg/m ³)	O ₃ ($\mu\text{g}/\text{m}^3$)
1 Nov 2020	390	365	55	8	28		38
2 Nov 2020	364	283	52	7	24	101	40
3 Nov 2020	324	261	52	7	21	95	36
4 Nov 2020	415	381	52	9	25	112	42
5 Nov 2020	452	400	56	10	20	92	30
6 Nov 2020	430	388	56	9	23	97	38
7 Nov 2020	435	407	52	10	32	91	32
8 Nov 2020	460	455	52	10	36	107	29
9 Nov 2020	489	480	53	10	40	117	32
10 Nov 2020	463	458	57	12	34	84	45
11 Nov 2020	379	371	33	10	47	72	47
12 Nov 2020	341	317	32	9	37	69	48
13 Nov 2020	389	359	41	9	29	75	47
14 Nov 2020	473	437	52	9	31	100	35
15 Nov 2020	429	362	52	9	52	78	59







These changes in air pollution sub-index in Delhi in the starting of the complete lockdown in March 2020 and in

the unlock 6.0 in the month of November shows significant increase in the air pollutants. During this

period, there is increase of 456.56% in PM_{2.5} pollutant while PM₁₀ pollutant is increase by 302.62% from the mean average of starting 15 days of lockdown to Starting 15 days of unlock 6.0. While other air pollutant also show considerable variations in both the data. As the changes in the NO₂ levels are increased by 58.29%, level of NH₃ increased by 55.93%, level of SO₂ increased by 10.86%, level of CO increased by 33.41%, while there is significant decline in the level of O₃ by 41.60%.

DISCUSSION

In Ayurved Acharya Charaka has described the quality of *Vikrit Vayu* (polluted air) which is responsible of widespread of diseases (*Roga/ Vyadhi*) and high morbidity or annihilation of population in a mass level. This can be related to the term *Janapadodhvansa* that stands for the destruction of community. There are four common factors that are responsible for the destruction of community namely *Vayu* (air), *Udaka* (water), *Desh* (geographical area), *Kala* (time / season). Some of described Characters of *Vikrit Vayu* (polluted air) are similar to the defined air pollution in today's scenario like presence of micro or macro particles of sand, dust and smoke in air.^[14] Air pollution is defined as the presence of harmful pollutants in air such as hydrocarbons, CO, CO₂, NO, NO₂, SO₃, O₃ etc. for a long period. Among all the cities in India, Delhi shows some of the worst level of air pollution in few last years. As resulting in devastating impact including environmental air pollutant concentration and reducing life expectancy. The main source of air pollution in Delhi is vehicle emission, heavy and small level industries like brick factories, suspended dust on roads, construction, combustion of fuel for cooking, open waste burning etc.^[15] Outdoor air pollution ranked 5th leading cause of death in India by Global Burden of Disease in 2017. High particulate matter concentration is responsible for reducing 3.2 years for 660 million Indians life expectancy.^[16] India share 26% of global disability affected life years (DALY) attributable to air pollution. In Delhi, total DALYs due to particulate matter concentration increased from 339296.03 to 750320.60 from average year 1995 to 2015.^[11] A study reveals that in Delhi air pollution is responsible for approximately 10000-30000 deaths annually, which is 20 times greater than 1995 data by Centre for Science and Environment (CSE). This means NCT Delhi loses 80 lives every day due to air pollution.^[17] As the Covid-19 strikes India, air pollution level reduced drastically and remains in satisfactory category for most of time as result of complete lockdown without any major relaxation between 23 March – May 2020. By the end of October 2020, the level of air pollution turned severe again. According to Central Pollution Control Board (CPCB), ten days of November 2020 in the city recorded in severe category.^[18] Despite having a comparatively better air pollution level due to strict lockdown, NCT Delhi loss of around 24000 lives in the first half of 2020, which ends up with 54000 by the end of the year.^[19,20] Factors responsible for these premature deaths like *Bhuta*

(Affliction with demons, virus and bacteria), *Visha* (poison), *vayu* (polluted air) and *Agni* (fire), improper availability of *Ahara* (food) and *Prateekara* (treatment) can be related to *Akala* (untimely death) explained by Acharya Charaka.^[21] Among them polluted air is one the reason which is also a responsible factor for *Janapadodhvansa* (annihilation of community).

CONCLUSION

Climate of Delhi is deteriorating because of a rise in air pollution. Air quality in Delhi is getting worse as there is increase in human activity followed by traffic and industrialization. Most of the air pollutants parameters are present in high concentration as per WHO guidelines. As there was an implement of lockdown and less population was on Delhi's roads there is decrease in poor air quality while when step up unlock starts and rush over roads is seen, with that there is remarkable increase in almost all the air pollutants in Delhi. Population difference in Delhi with other megacities in India is main reason for the difference in the air quality. Delhi encompasses a total population of 16.7 million, density of 11,297 persons/km. with this number of population there is increase in vehicle emissions and over continuous construction, which contribute a major part in air pollution causing a high number of premature deaths in Delhi as *Janapadodhvansa*.

Source of Conflict

Nil.

REFERENCE

- Balakrishnan, Kalpana, Sagnik Dey, Tarun Gupta, R. S. Dhaliwal, Michael Brauer, Aaron J. Cohen, Jeffrey D. Stanaway et al, [last assessed 28/01/2021, 10:20Am] "The impact of air pollution on deaths, disease burden, and life expectancy across the states of India: the Global Burden of Disease Study." The Lancet Planetary Health, 2017; 31(2019): e26-e39.
- Pandey A, Brauer M, Cropper ML, Balakrishnan K, Mathur P, Dey S, et al. Health and economic impact of air pollution in the states of India: the Global Burden of Disease Study, 2019. Lancet Planet Health, 2021 Jan 1; 5(1): e25–38.
- Mahato, Pal, and Ghosh, [last assessed 20/01/2021, 11:030pm] "Effect of Lockdown amid COVID-19 Pandemic on Air Quality of the Megacity Delhi, India."
- Geneva: World Health Organization; 2016. [Last accessed on 2016 Jul 30]. Ambient Air Pollution Database. Available from: http://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/[Google Scholar]
- Kamyotra SJ, Sinha D. CPCB Bulletin: Central Pollution Control Board. 1 Delhi; 26 July, 2016. Available from: <http://www.cpcb.nic.in> . [Google Scholar]
- Mohan M., Kandya A [last assessed 20/01/2021, 12:04pm]. An analysis of the annual and seasonal

- trends of air quality index of Delhi. *Environ. Monit. Assess*, 2007; 131(1–3): 267–277. [PubMed] [Google Scholar]
7. Rizwan S.A., Nongkynrih B., Gupta S.K. A [last assessed 20/01/2021, 12:14pm]. Air pollution in Delhi: its magnitude and effects on health. *Indian J. Community Med*, 2013; 38(1): 4. [PMC free article] [PubMed] [Google Scholar]
 8. Chowdhury S., Dey S., Guttikunda S., Pillarisetti A., Smith K.R., Di Girolamo L. [last assessed 20/01/2021, 12:19pm] Indian annual ambient air quality standard is achievable by completely mitigating emissions from household sources. *Proc. Natl. Acad. Sci.*, 2019; 116(22): 10711–10716. [PMC free article] [PubMed] [Google Scholar]
 9. Beig G., Ghude S.D., Deshpande A. [last assessed 20/01/2021, 14:50pm] Indian Institute of Tropical Meteorology, 2010. Scientific Evaluation of Air Quality Standards and Defining Air Quality Index for India. [Google Scholar]
 10. Pollution.pdf [Internet]. [Cited 2021 Jan 20, 15:00PM]. Available from: <https://www.ksndmc.org/Uploads/Pollution.pdf>
 11. S R. How to read India's new colour-coded Air Quality Index. *The Hindu* [Internet]. 2015 Apr 9 [cited 2021 Jan 20]; Available from: <https://www.thehindu.com/opinion/blogs/blog-datadelve/article7083985.ece>
 12. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med*, 2020; 382(8): 727–733.
 13. Srivastava S, Kumar A, Baudhdh K, Gautam AS, Kumar S. [last assessed 21/01/2021, 10:00Am] 21-Day Lockdown in India Dramatically Reduced Air Pollution Indices in Lucknow and New Delhi, India. *Bull Environ Contam Toxicol*, 2020 Jun 3; 1–9.
 14. Charaka samhita with Chakrapani Teeka Ayurvedipika, edited by Vd. Yadavji Trikamji Acharya, Prolouged by Prof. R.H Singh, Chaukhamba Surbharti Publication, Varanasi, Viman Sathan, 3/6: 241.
 15. Sarath Guttikunda, [last assessed 28/01/2021, 12:20Am] “Air pollution in Indian cities: Understanding the causes and the knowledge gaps,” Centre for Policy Research, December 14, 2017.
 16. Cohen, Aaron J., Michael Brauer, Richard Burnett, H. Ross Anderson, Joseph Frostad, Kara Estep, Kalpana Balakrishnan et al, [last assessed 28/01/2021, 10:30 Am] “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.” *The Lancet*, 2015; 389(10082(2017): 1907-1918.
 17. Delhi loses 80 lives to air pollution every day, says study [Internet]. [cited 2021 Jan 28]. Available from: <https://www.downtoearth.org.in/news/delhi-loses-80-lives-to-air-pollution-every-day-says-study-50222>
 18. Air pollution in Delhi-NCR: Lockdown gains made and lost. *The Hindu* [Internet]. 2020 Dec 30 [cited 2021 Jan 20]; Available from: <https://www.thehindu.com/news/cities/Delhi/air-pollution-in-delhi-ncr-lockdown-gains-made-and-lost/article33453719.ece>
 19. Air pollution caused around 24,000 deaths in Delhi in first half of 2020: Greenpeace. *The Hindu* [Internet], 2020 Jul 10. [cited 2021 Jan 28, 13:05 PM]; Available from: <https://www.thehindu.com/news/cities/Delhi/air-pollution-caused-around-24000-deaths-in-delhi-in-first-half-of-2020-greenpeace/article32039651.ece>
 20. Air pollution caused 54,000 deaths, \$8.1 billion loss in Delhi in 2020 [Internet]. *Business Today*. [cited 2021 Aug 5]. Available from: <https://www.businesstoday.in/latest/economy-politics/story/air-pollution-claimed-54000-lives-in-delhi-last-year-one-death-per-500-people-claims-greenpeace-study-288776-2021-02-19>.
 21. Charaka Samhita with Ayurveddipkia, Hindi Translation by Prof. Banwari Lal Gaur- Easna, Viman Sathan, 3/38; 326.