



COMPARATIVE STUDY OF IMPACT OF COVID-19 BEFORE, DURING & AFTER LOCKDOWN ON THE AIR QUALITY OF UDAIPUR CITY

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Abstract: The present paper deals with the analyses of different air quality parameters including Ambient Air Quality Index, Particulate matter, NO₂, etc. for Udaipur city throughout the various lockdown phases, which include the Pre-Lockdown phase and the Lockdown phase 1, 2, & 3. This resulted in the decrease in air pollution within the city. The data for all the phases were collected from “Rajasthan SPCB”, and compared with the help of graphs of AQI, PM, NO₂. A noticeable reduction in the concentration of air pollutants was observed, with the most significant changes occurring during the first phase of the lockdown compared to the subsequent two phases. These changes were attributed to restricted human activities.

Keywords: COVID-19, Ambient Air Quality, Air pollution, Particulate Matter, NO₂.

I. INTRODUCTION

Air pollution is one of the most severe problems faced by the people of India. It occurs due to harmful gases released from industries and factories, construction activities and commercial activities. Other major contributing sectors of air pollution include power plants, increased number of vehicles and smoke generated from them, combustion of fossil fuels, farm fires, natural calamities such as volcanic eruption, forest fires, construction activities, etc.

Air pollution pertains to the release of harmful pollutants, such as Carbon Monoxide, Oxides of Sulphur, Oxides of Nitrogen, Lead, etc. or the contamination of harmful gases in the atmosphere which lowers its quality.

The rapid industrialization is leading to deforestation and many other harmful activities which are directly affecting human and animal habitat. It is directly contaminating the soil, water, and air and further contributing to human health effects.

The air quality of the place where we live affects our lifestyle, health, environment to a great extent. It has become such a huge problem in the present scenario that even a short-term exposure to it can lead to several health and skin problems. While long-term exposure can lead to chronic diseases and can even reduce the life-expectancy of human beings.

Monitoring, tracking, improving, and maintaining the air quality of an area is no less than a challenge for the cities. The quality of air is measured in terms of Ambient Air Quality Index (AQI). According to the 2021 World Air Quality Report, India was ranked fifth among the world's most populous countries.

In addition to this, in the list of the top 100 most polluted cities in the world for the year 2022, India had 63 cities in the list, which directly links to the air quality in the country is significantly poor. The city of lakes, Udaipur is located around the Aravalli Mountain range having latitude of 24.57° N and longitude of 73.96° E.

As a result of the COVID-19 pandemic's spread within the country, a lockdown was planned for the entire nation for months in the year 2020, 2021. This not only resulted in a substantial decrease in COVID-19 cases in India but also decreased the air, and noise pollution in the country when compared from the situation before, during and after the lockdown.

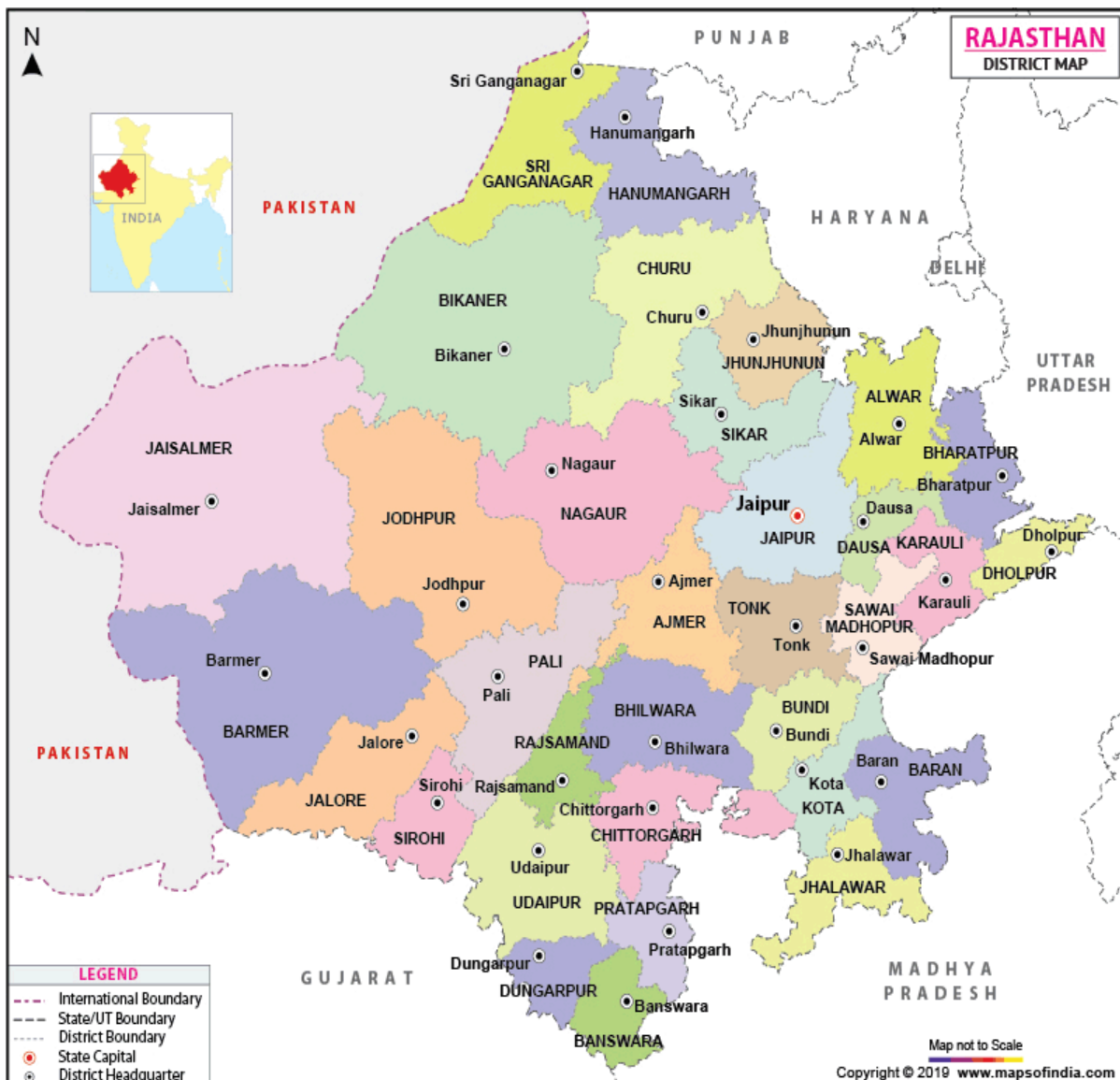
Cities witnessed a reduction in air pollution because of restrictions on the number of people traveling, which, in turn, led to a decrease in the volume of vehicles on the road (Choudhary, Jangeed, et al 2022). The air quality of the cities got better as fewer industries were working, less number of vehicles were on the roads, which meant less usage of fuels and this finally led to the decrease in air pollution.

II. AREA OF STUDY

In India, the state of Rajasthan is positioned between 27.02° N latitude and 74.21° E longitude. Udaipur, often referred to as the "city of lakes," is situated at an elevation of over 598 meters above mean sea level in the southern part of Rajasthan.

It's located on the southern slope of the Aravali range, with a latitude of 24.57° N and a longitude of 73.96° E. Udaipur is a popular destination for tourists from around the world, known for its rich heritage, traditions, and scenic beauty (Choudhary, Jangeed, et al 2023)..

The city earns its nickname "city of lakes" because it's surrounded by five major lakes: Fateh Sagar Lake, Swaroop Sagar Lake, Lake Pichola, Rangsagar, and Doodh Talai Lake. Udaipur experiences an average temperature ranging from 38.3°C in summer to 11.6°C in winter, with an annual rainfall of 637 mm.



Rajasthan map depicting different districts



Rajasthan map highlighting Udaipur district

III. METHODOLOGY

The impact of air quality in Udaipur has been done for the following time periods-

1. Pre lockdown period 15 March 2020 to 21 March 2020.
2. During lockdown period-1 22 March 2020 to 19 April 2020.
3. During lockdown period-2 20 April 2020 to 3 May 2020.
4. During lockdown period-3 4 May 2020 to 17 May 2020.

The Rajasthan State Pollution Control Board maintains an extensive network of ten Continuous Ambient Air Quality Monitoring Stations (CAAQMS) throughout the state, and one of them is situated in Udaipur.

The data includes the following air quality parameters-

1. $PM_{2.5}$ refers to particulate matter that is 2.5 μm or smaller in size.
2. PM_{10} refers to particulate matter that is 10 μm or smaller in size.
3. NO_2 refers to Nitrogen Dioxide.
4. AQI stands for Air Quality Index.

The data for all the above mentioned air quality parameters have been taken from the State Pollution Control Board, Rajasthan.

IV. RESULTS

The results of $PM_{2.5}$, PM_{10} & NO_2 have been depicted in the fig. 1,2,3.

The reduction in the concentration of air pollutants, namely, $PM_{2.5}$, PM_{10} & NO_2 were more significant during the first phase of lockdown when compared by the next two phases. This was due to the restriction on relaxations which were provided to the peoples in the former lockdown and the relaxations which were provided in the later phases.

The NO₂ level has been found to lie within the permissible range as given by WHO. Huge reduction in its level was observed. WHO's current value for NO₂ is 10 µg/m³, while the value observed during the lockdown phase I, II, III has been within the same range.

In the case of PM_{2.5} & PM₁₀, there has been a marked decrease of evidence that shows that air pollution effects.

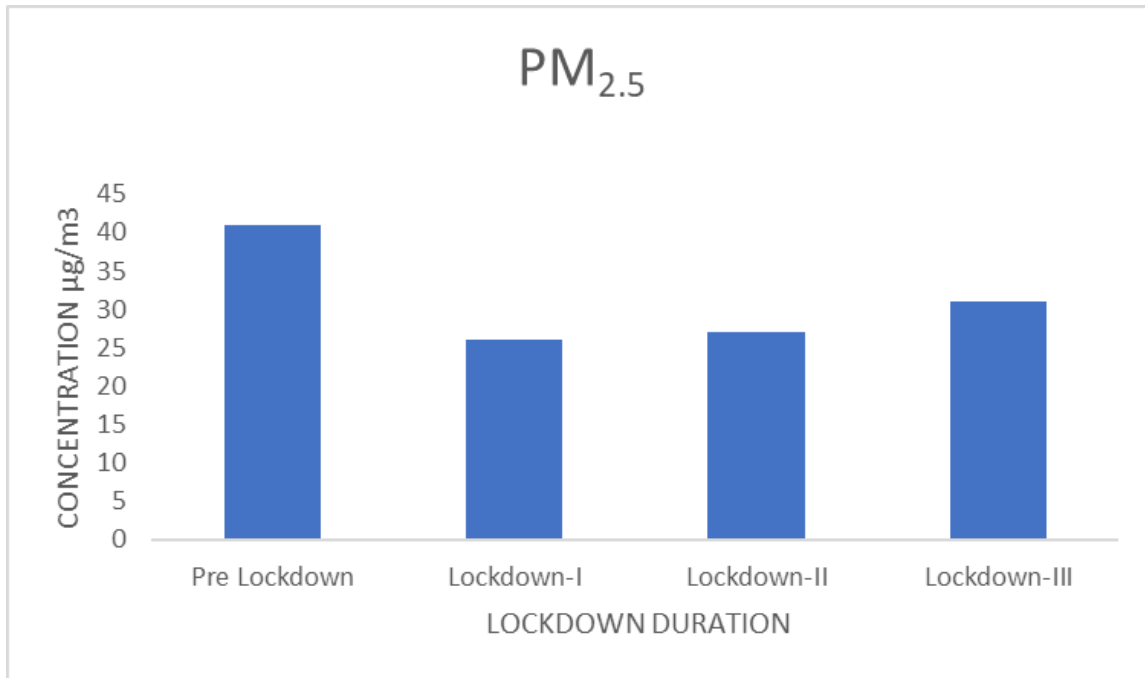


Fig. 1 Graph for PM_{2.5}

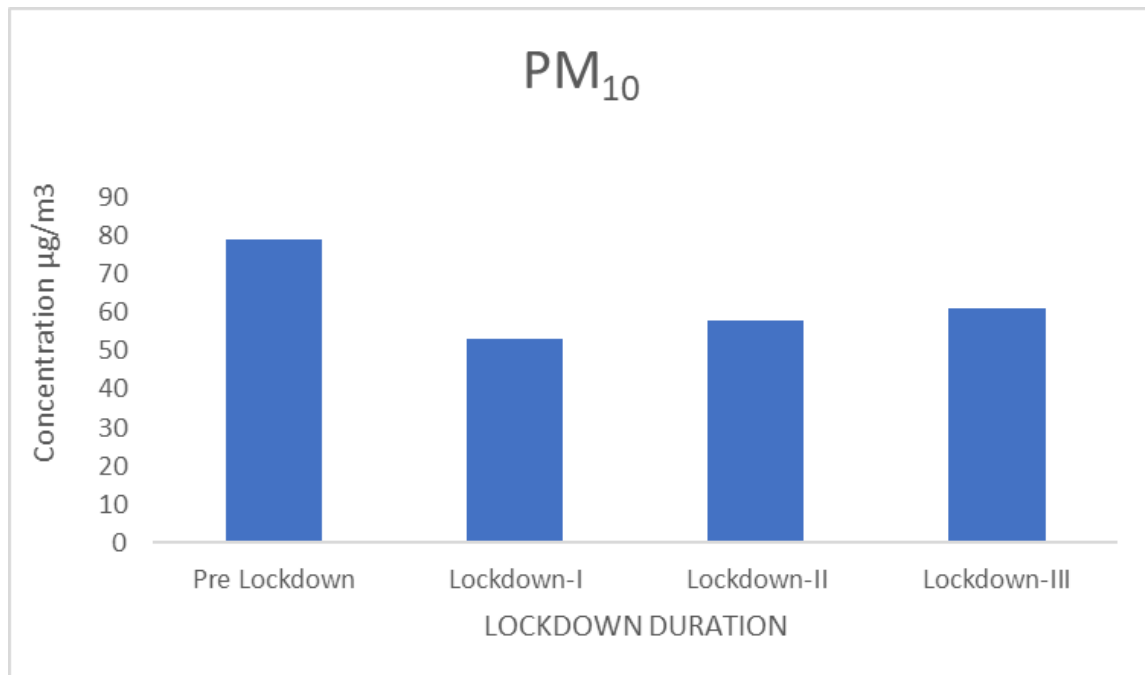


Fig. 2 Graph for PM₁₀

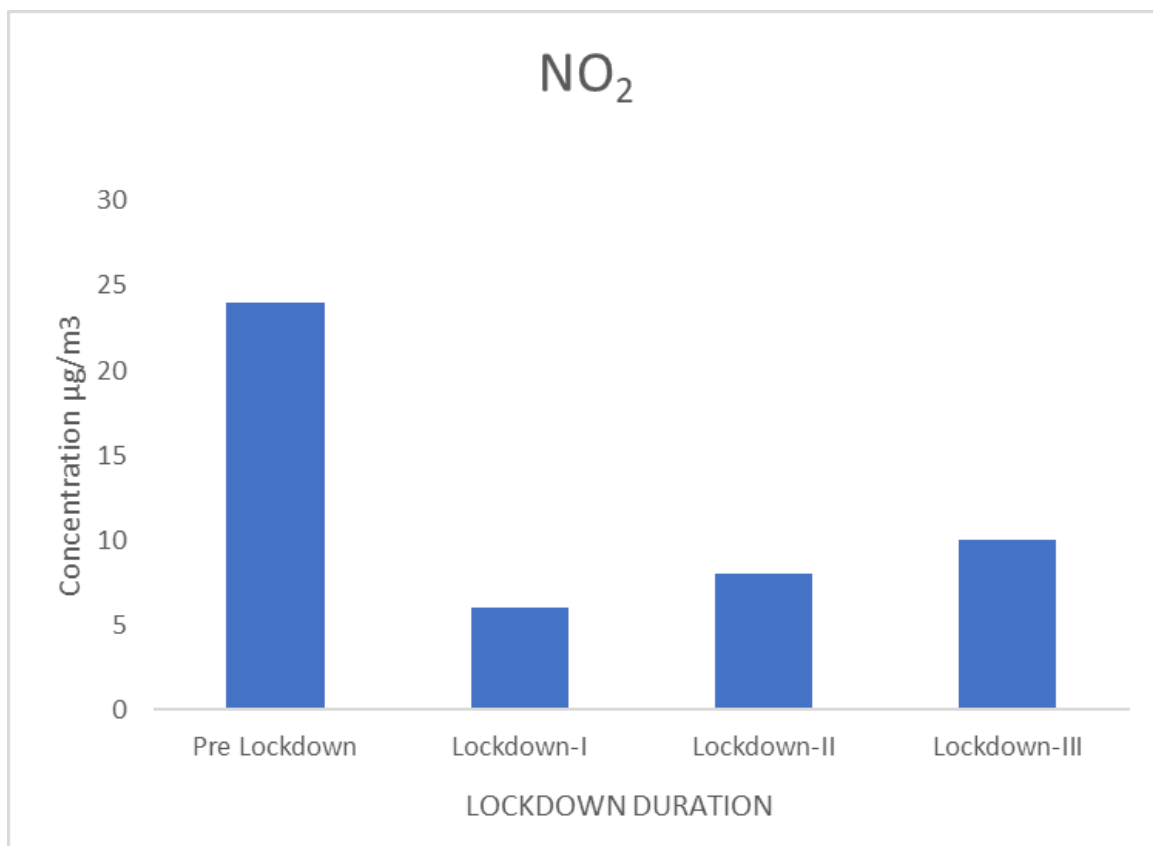


Fig. 3 Graph for NO₂

Table-I Comparative Analysis of Air Quality Parameters of CAAQMS

Comparative Statement of Air Quality Parameters of CAAQMS												
	Before The Lockdown			During Lockdown 1			During Lockdown 2			During Lockdown 3		
Monitoring Dates	15 th March 2020 to 21 th March 2020			22 nd March 2020 to 19 th April 2020			20 th April 2020 to 3 rd May 2020			4 th May 2020 to 17 th May 2020		
	PM _{2.5}	PM ₁₀	NO ₂	PM _{2.5}	PM ₁₀	NO ₂	PM _{2.5}	PM ₁₀	NO ₂	PM _{2.5}	PM ₁₀	NO ₂
Udaipur	41	75	24	26	53	6	27	58	8	31	61	10

Table-II Comparative Statement of Air Quality Parameters of CAAQMS (Percentage Increase/Decrease Lockdown with respect to Pre lockdown)

Comparative Statement of air quality parameters of CAAQMS									
Percentage Increase/Decrease Lockdown with respect to before the lockdown									
Dates of Monitoring	Between Pre lockdown & Lockdown 1			Between Pre lockdown & Lockdown 2			Between Pre lockdown & Lockdown 3		
Monitoring Stations	PM _{2.5}	PM ₁₀	NO ₂	PM _{2.5}	PM ₁₀	NO ₂	PM _{2.5}	PM ₁₀	NO ₂
Udaipur	-37	-29	-75	-34	-23	-67	-24	-19	-58

Table-III Average AQI & Percentage Fluctuations

Monitoring Stations	Average AQI				Percentage fluctuation (in %)		
	During Pre Lockdown	During Lockdown 1	During Lockdown 2	During Lockdown 3			
	March 15, 2020, to March 21, 2020	March 22, 2020, to April 19, 2020	April 20, 2020, to May 3, 2020	May 4, 2020, to May 17, 2020	Between Pre lockdown & Lockdown 1	Between Pre lockdown & Lockdown 2	Between Pre lockdown & Lockdown 3
Udaipur	88	61	70	70	-31	-20	-20

V. CONCLUSION

- i.) There has been a positive change in the air quality of Udaipur was noted during the lockdown period. The best results for AQI, PM₁₀ & PM_{2.5}, NO₂ were obtained during Lockdown phase 1.
- ii.) The air quality experienced fluctuations during this period not so good during the pre lockdown period. But, it began to get better conclusion of the pre-lockdown period and during the transition into lockdown phase 1. Slowly after this, its value again increased in phase 2, 3 due to the relaxations provided in the city.
- iii.) During the pre lockdown phase, the PM₁₀ & PM_{2.5} concentrations were quite high. But a sudden reduction in their concentration was observed during lockdown phase 1. After this, the concentrations of PM₁₀ & PM_{2.5} began to increase again.

iv.) Also, the NO₂ concentration in the city was notably high during the pre-lockdown phase, but it decreased during lockdown phase I. After which, it increased but was within the permissible values as given by the WHO.

(v) The data shows a noticeable decrease in the concentration of all three parameters, namely PM₁₀, PM_{2.5}, and NO₂, during lockdowns I, II, and III compared to the pre-lockdown period. This decline is attributed to movement restrictions.

(vi) Despite the relaxation of restrictions in the later stages of lockdown, the concentration of pollutants has consistently remained significantly lower than the levels observed prior to the lockdown period.

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