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CONCENTRATIONS OF PM2.5 AND PM10 IN AMBIENT AIR BEFORE AND DURING PANDEMIC IN PUNJAB: A COMPARATIVE ANALYSIS

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Abstract:
During this pandemic, all the industries, transport other sources of pollution are standstill, whichwere the major contributor to pollute the air quality. Air quality during the COVID-19 pandemic January-June 2020 and before the COVID-19 January-June 2019 is compared. The air pollutionquality is compared on the basis of particulate matter $PM_{2.5}$ and particulate matter PM_{10} which are major causes of air pollution. Other factors like visibility of objects at long distancesand easiness in breathing specifically in urban areas are also observed. The paper highlights thecomparison of air pollution before and during the pandemic time of Ludhiana city (hub ofindustry). The data is collected, processed and analyzed. A noticeable change has been found in$PM_{2.5}$ and PM_{10} during the mentioned period. According to the survey in the local region,health issues are reduced which were due to air pollution. In this paper, future direction is alsoprovided that can be followed after pandemic effects.
Keywords: COVID-19, $PM_{2.5}$, PM_{10}, Ambient Air, Air Pollution

1. Introduction:

The human society has been significantly affected due to the COVID-19 pandemic, with which the health care, social relationships, and financial structures are also affected. A worldwide response that incorporates terminations of associations and social removing has shaped top-notch neighborhood outcomes.The health impacts ofpandemic COVID-19 remains the uppermost priority, it is however unknown but the pandemic might also additionally moreover have a touching on numerous factors, especially the threat of pollutants. Air pollutants message is a partner essential and chronic chance problem for respiratory and metabolism health results (Shaddick et al., 2018). But ambient air pollutants are affected throughhugedisorders in thebehavior of pandemic COVID-19 and will furnish essential clues related to health and control of air pollutants emissions (Burnett et al., 2018).

In maiden evaluations, a wilt in human-made ambient air pollution has been examined in the nations which are responding to the pandemic COVID19. The satellite derived concentrations of various pollutants in northern India from March 2020 which is as low as 20 years ago has been found by NASA (Patel et al., 2020). After the implementation of the lockdown it has been observed that not only the air quality has been improved in the various cities, but this thing has also headed to the decrease in the usual temperature also in this time (Khanna, 2020). From March 2020 onwards. It has been reported that $PM_{2.5}$ and PM_{10} shows a decline of 14% to 30% as compared to 2019. In any case, whereas distantly detected air contamination tiers deliver a superb gauge of expansive shows, there's a characteristic incentive for validation of contamination styles the use of in-situ estimations (Bechle et al., 2013).

The Ground primarily based total estimations communicate to the standard terrific stages for poison fixations and are the tool for body consistency. The calculable fixations should be applied to come to a decision air contamination changes, chiefly the situation hearty checking systems that exist.

Our survey has explored the present impact of the pandemic COVID19 on Ludhiana city pollution in India using Punjab Pollution Control Board air pollution network. We hypothesize a drastic decrease in the $PM_{2.5}$ and PM_{10} fine particulate matters during COVID-19 pandemic lockdown in the consequent to reduced public and non-public traffic along with the industrial business.

2. Material and Methodology

The ambient air pollution has been acquired along with the measurements in Ludhiana, India for $PM_{2.5}$ and PM_{10} from January 1-June 31st 2019 to January 1-June 31st 2020 through Online Environmental Pollution Monitoring (PPCB, 2020). The matched pollution data from the dates has been taken from the central pollution control board. Each monitor was assigned with the daily $PM_{2.5}$ and PM_{10} 24-h mean values. Monitors were restricted in the Ludhiana city only and have been also restricted to the $PM_{2.5}$ and PM_{10} concentrations only to make a consistent comparison.

We have classified our data in two groups: the COVID-19 pandemic period spans January 1-June 30th, 2020 with the time the pandemic has attacked the world level and had been affecting the various industries and vehicle movement. The pre-COVID-19 period data from January 1-June 30th, 2019. The nation worldwide has been imposed on the 24th March 2020 and which started affecting the business and the vehicle moments. The Ludhiana city which is also called as hub of the industry has been also affected with the same scenario, the industries along with the businesses has been came to close.

We have calculated the summary statistics for both PM_{10} and $PM_{2.5}$ before pandemic COVID-19 and during pandemic COVID-19 periods. The data has been taken in the daily concentration and then has been converted to the monthly average concentration by using arithmetic mean formula i.e. “Arithmetic Mean = (1/N) * (x1 + x2 + … + xN)” (Brownlee, 2019). Comparison has been done between the before COVID-19 and during COVID-19 pandemic by two-sided t-test. We have acquired both the data, which is absolute differences in pollution as well as the percentage change in pollution from before and during pandemic. Data along with the software’s which has been used in this research are publically available.

3. Result

We have illustrated the pollutant differences of $PM_{2.5}$ and PM_{10} concentrations during January-June 2019 to January-June 2020 in table 1, which is before and during the pandemic COVID-19. The change in the pollution for $PM_{2.5}$ were arithmetically significant and the reduction of up to 58% in total value. The statistically decrease in the number of $PM_{2.5}$ concentrations can be seen in the regards to when the lockdown was imposed and the non-essential businesses were closed. The similar difference and decline in PM_{10} can be also seen in the regards to the same as of 47%.

Fig 1 and Fig 2 provides a visual comparison between the both time-spans for Ludhiana city. The Measurements of $PM_{2.5}$ and PM_{10} reveled drastic drop in the concentrations. However the mixed responses can be seen in the early January to March but later when lockdown was imposed nationwide the huge change can be seen in the concentration. AOD visual comparison can be seen in Fig 3 over India from 2019 to 2020. The concentrations of aerosols are near to surface then the optical depth can be 1 or above and results to the hazy conditions, whereas if thickness of the same is less than 0.1 onto the whole atmospheric then it is considered as clean (Patel et al., 2020).

4. Results

Our findings have presented the significance that the measured pollution in the ambient air has been drastically decreased in the Ludhiana city duringpandemic COVID19 which also include a decrease of 58% in $PM_{2.5}$ and 47% in PM_{10}. The contribution of multiple non-transport sources, such as the industries, biomass burning and food industries are included in this. Moreover these reduction can be seen in the month of the April 2020 which was the total lockdown period for small businesses and the large industries also. There is a possibility that the pandemic COVID19 continues, which can result to the broader decline in the Particulate $Matter_{2.5}$ and Particulate $Matter_{10}$ concentrations.

Table 1

Ambient Air Pollution concentration during current and before timeframes of Ludhiana city for daily concentration of $PM_{2.5}$ and PM_{10}.

$PM_{10}\mu g/m^3$				
Month	Before COVID-2019 (Pandemic) (January-June 2019) Mean (sd)	During/Current COVID-2019 (Pandemic) (January-June 2020) Mean (sd)	Before and Current Means Difference	Change in %
January	142.24	85.99	56.25	39.54%
February	147.54	99.44	48.1	32.60%
March	87.4	60.24	27.16	31.07%
April	82.03	43.5	38.53	46.97%
May	83.85	76.19	7.66	9.13%
June	101.24	86.33	14.91	14.72%
$PM_{2.5}\ \mu g/m^3$				
January	49.66	44.6	5.06	10.18%
February	48.7	45.69	3.01	6.18%
March	50.19	30.72	19.47	38.79%
April	45.24	19.03	26.21	57.93%
May	51.49	36.74	14.75	28.64%
June	46.44	32.61	13.83	29.78%

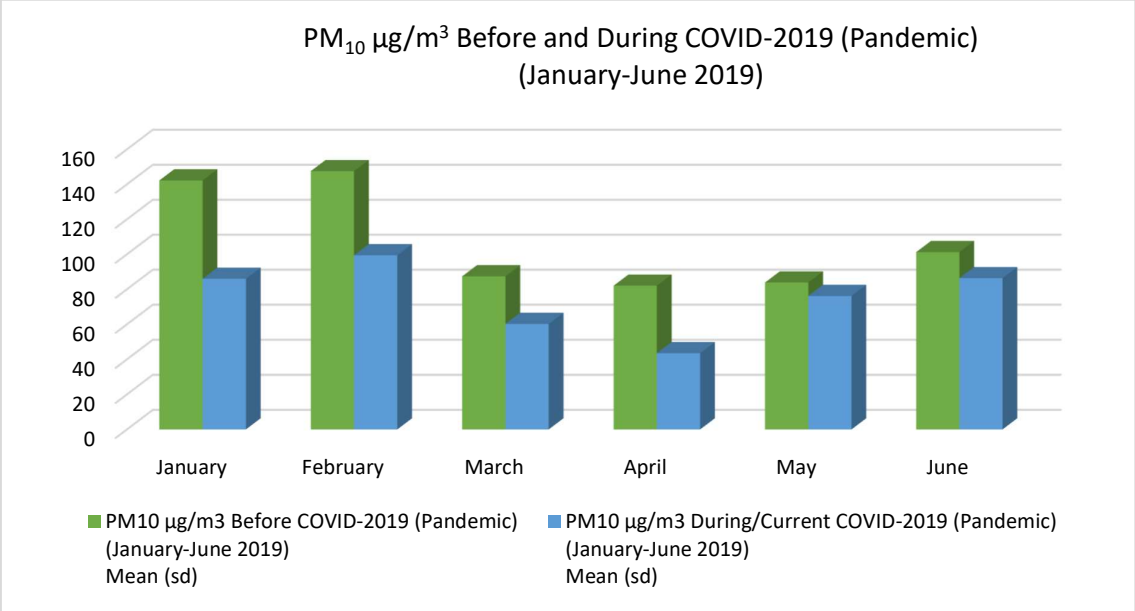

Figure 1: During (January-July 2020) and Before (January-July 2019) Ludhiana city concentration of PM_{10} in $\mu g/m^3$

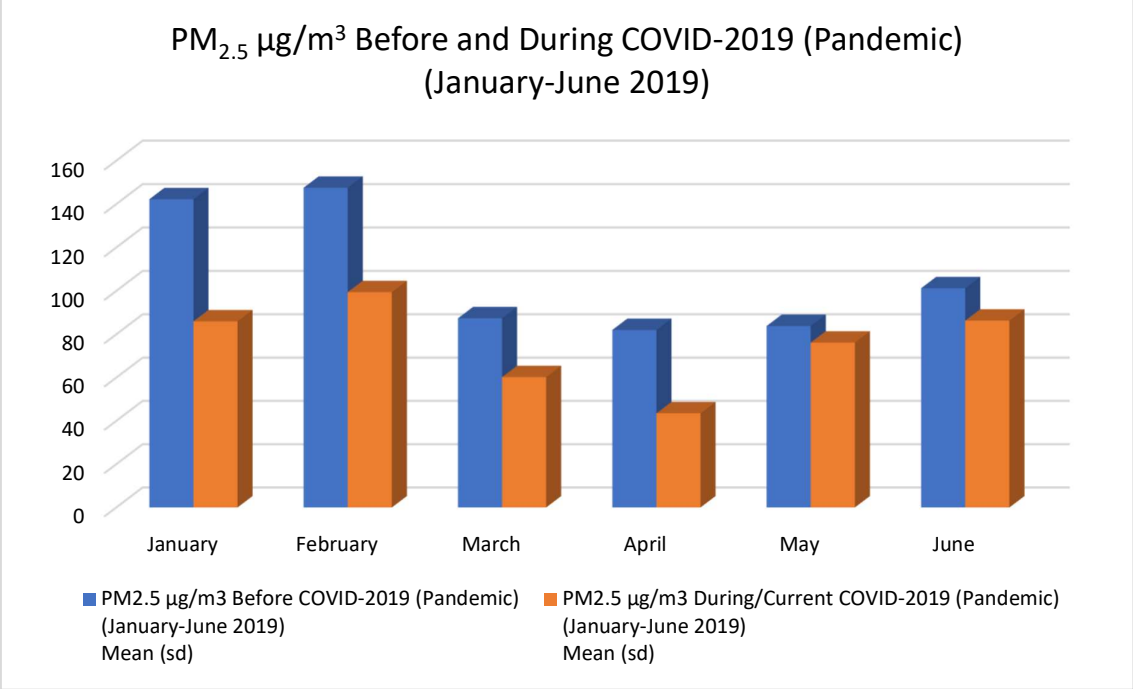

Figure 2: During (January-July 2020) and Before (January-July 2019) Ludhiana city concentration of $PM_{2.5}$ in $\mu g/m^3$

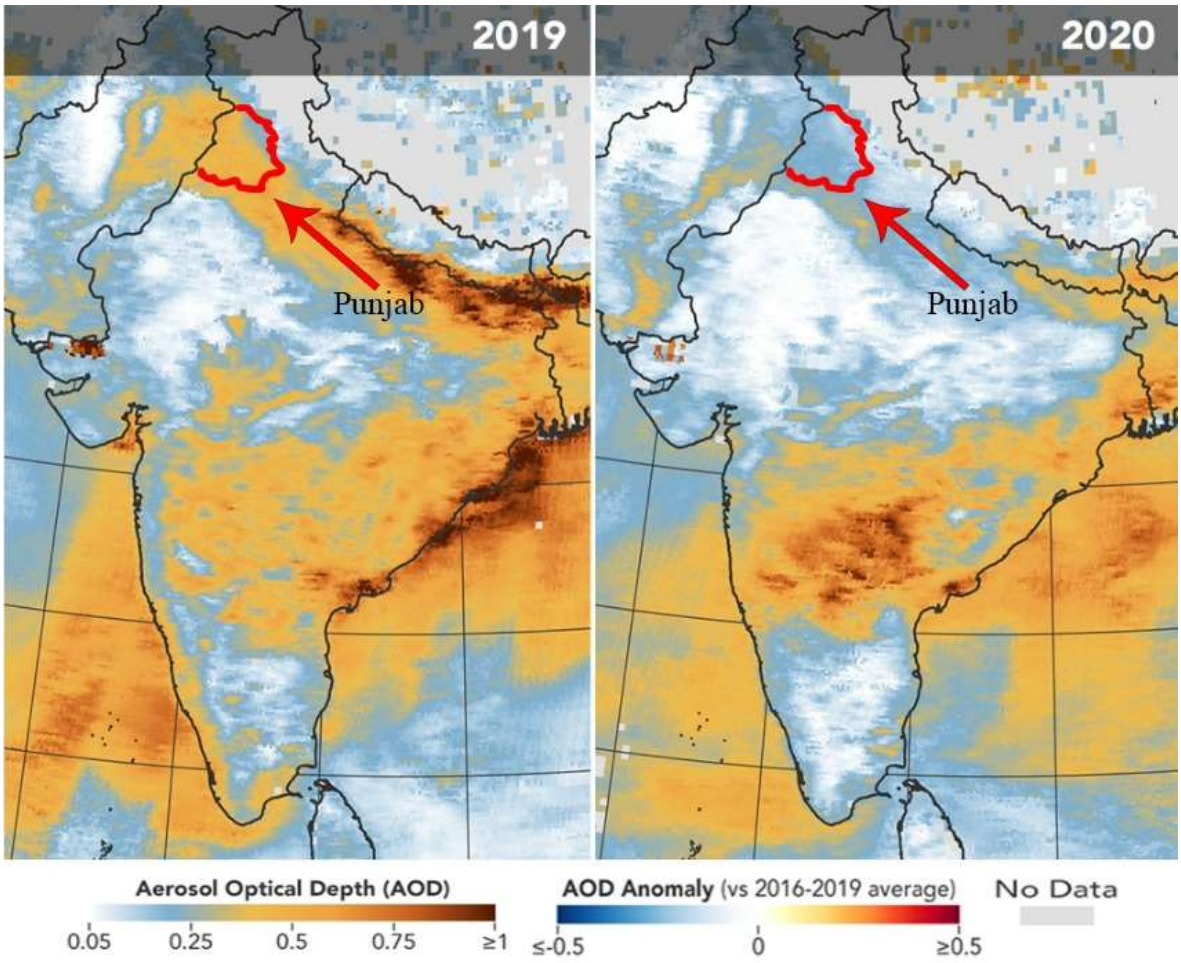

Figure 3: The visual comparison of AOD over India from 2019 to 2020.

The health related consequences has been occurred due to thepandemic COVID19. 1 μg/m^3 can increase the exposure of 15% for $PM_{2.5}$ and PM_{10} and increase in the mortality (Wu et al., 2020). The increase in the pollution in the ambient air increase in the fatality rates which are varying from the severe acute respiratory syndrome (SARS) in China (Cui et al., 2003). These research alsoindicate a position for ambient air pollutants to worsen pandemic COVID19 and have an effect on the pointy disparities found amongst patients. Our findings hashighlightedthe importance of the persisted ambient air excellent enforcement to well shield the public.

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