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Health Risks Due To Particulate Matter during Covid-19

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ABSTRACT: Air pollution has always been an alarming development in the modern world. The post-industrial revolution world has witnessed rapid increase in the level of air pollution. Particulate pollutant is one of the six criteria pollutant as per the World Health Organisation. Exposure to particulate pollutants can result in short- and long-term health effects. Long- and short-term exposure has a different toxicological impact on humans including respiratory and cardiovascular diseases, neuropsychiatric complications, the eyes irritation, skin diseases, and long-term chronic diseases such as cancer. In this study we analysed the effects of PM_{2.5} and PM₁₀ in industrial areas near Eloor prior to, during and after the Covid-19 lockdown in the state of Kerala. We also proposed practical measures for communicating the risk effectively and strategic measures to reduce the emission of pollutants.

KEYWORDS: Risk Communication, Long-term health risk, Short-term health risk, Particulate Matter, Air pollution, AirQ+, Covid-19

I. INTRODUCTION

The term particulate matter (PM) is used to describe the mixture of solid particles and liquid droplets present in the air. The sources of PM can either be natural or anthropogenic. Particulate matter occurs in a large range of diameters or widths. For example, PM_{2.5} represents mass per cubic meter of air with a size of generally less than 2.5 micrometres (µm) and PM₁₀ represents particles with a diameter of 10 micrometres. The natural sources of PM include volcanic eruption, forest fires etc which only account for a small percentage of PM pollution. On the other hand, the sources of PM pollution due to human activities include vehicular emissions, industrial emissions, domestic sources of smoke, secondary particulates etc. Normal wind speed and direction spreads the particulates over a wide area and under some meteorological conditions the polluted air may circulate over a very large area- a condition known as long-range transportation of air pollution. Long range transport, together with pollution from local sources, can result in short term episodes of high pollution which might have an impact on the health on those sensitive to high pollution.

The inhalation of these particulate matter pollutants has severe short- and long-term effects on human health. Although government agencies state a standard safe value of PM that a person could be exposed to during his/her lifetime, there is no actual threshold value that can eliminate the adverse effects completely. Prolonged exposure can cause age specific mortality due to cardiovascular and other diseases. Exposure to high concentration of particulates during short time can exacerbate lung and heart conditions. Children, the elderly and those with predisposed respiratory and cardiovascular diseases are highly susceptible to air pollution.

Risk communication is the multi-directional exchange of real-time information, advice and opinion on risk among the affected communities, risk assessors, risk managers and other interested parties. An overall risk communication strategy should be in effect to take decisions on aspects of risk communication. Relevant data has to be collected promptly to aid in proper decision making and implementing strategies to reduce the risks posed and should be continued throughout the period of the event.

Eloor is a suburb of Kochi and a municipality in Ernakulam District. It is an industrial area north of Cochin. It has an area of 14.21 km² formed between two distributaries of the river Periyar and is the largest industrial belt in Kerala. Eloor is a part of Kochi metropolitan area. There are more than 247 industries of different kinds. As a result of its heavy industry, the town also suffers from heavy pollution, and is rated as one of the toxic hotspots of the world by Green Peace International. Fig.1 shows the map location of Eloor.

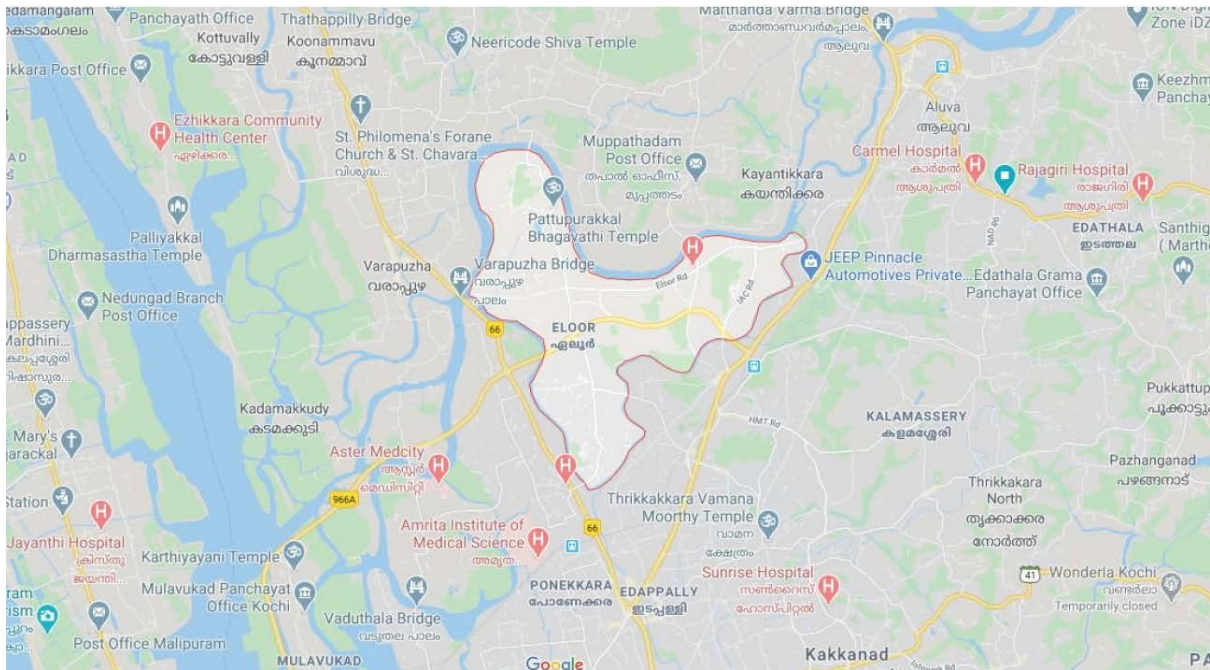


Fig.1:Geographic location of Eloor

II. MATERIALS AND METHODOLOGY

Data collection

The particulate matter pollution data of $PM_{2.5}$ and PM_{10} for a period of eight months from December 2019 to July 2020 was collected through Environmental Information System (ENVIS) of the Central Pollution Control Board (CPCB) of India. The data for every day of each month was acquired and averaged to get an average value of $PM_{2.5}$ and PM_{10} for each month. The data was averaged for each month so that it will be possible to interpret the difference in emission rates between pre and post Covid-19 lockdown stages of the state.

Data processing

The data was later interpreted using AirQ+ software developed by the World Health Organization (WHO). The platform allowed Risk analysis and Impact evaluation of both $PM_{2.5}$ and PM_{10} for long as well as short term health effects to the public. A few parameters such as population under observation, land area and impact factor were essential to run the analysis. The population and land area were obtained from the 2011 population census and land survey of Kerala respectively. The impact factor was determined after consulting hospitals and medical personnel.

The software enabled us to conduct detailed analysis of various effects caused by long- and short-term exposure to $PM_{2.5}$ and PM_{10} . It proved useful for determining the possible number of cases by common respiratory diseases, acute lower respiratory infections (ALRI), leptomenigeal carcinomatosis (LC), stroke, chronic bronchitis and chronic obstructive pulmonary disease (COPD).

The data during each month was plotted to obtain a graph which depicts the depreciation of particulate matter emission from the month of March and continues till July. The data used for analysis in AirQ+ software was divided into two. The first set of data contained average values of particulate matter emission during December 2019 and 21st March 2020 representing the level of pollution before Covid-19 lockdown and the second set of data contained the average values of particulate matter emissions during 22nd March to July 2020 representing the level of pollution during the Covid-19 lockdown and restrictions imposed by the state.



III. EXPERIMENTAL RESULTS

The results obtained after analysis in AirQ+ software is depicted in the tables below.

Table1: Analysis result of PM concentration before lockdown due to COVID-19 in Kerala
Before lockdown due to COVID-19

	Long term		Short term	
	Cause	Possible No. of cases/100000 population	Cause	Possible No. of cases/100000 population
PM 2.5	Natural causes	1301		
	Mortality due to lung cancer	1,851		
	Mortality due to ALRI	2,248		
	Mortality due to COPD	2,008		
	Mortality due to LC	1,504		
	Mortality due to IHD	2,531		
	Mortality due to stroke	2,059		
PM 10	Incidence of chronic bronchitis in adults	25,982	Incidence of asthma symptoms in asthmatic children	8,881
	Post neonatal infant Mortality	12,042		
	Prevalence of bronchitis in children	120		

Short term effects of PM_{2.5} was found to be zero because the PM_{2.5} concentration is negligible.

Table 2: Analysis result of PM concentration after lockdown due to COVID-19 in Kerala
After lockdown due to COVID-19

	Long term		Short term	
	Causes	Possible No. of cases/100000 population	Causes	Possible No. of cases/100000 population
PM 10	Incidence of chronic bronchitis in adults	16,018	Incidence of asthma symptoms in asthmatic children	4,722
	Post neonatal infant Mortality	65		
	Prevalence of bronchitis in children	11,905		

Long- and short-term effects of PM_{2.5} was found to be zero since the concentration of PM_{2.5} was well below WHO guidelines.

Fig.2 shows the graphical representation of particulate matter pollution levels at the study area during the month of December 2019 to July 2020. It shows the monthly variations in the concentration levels of PM_{2.5} and PM₁₀.

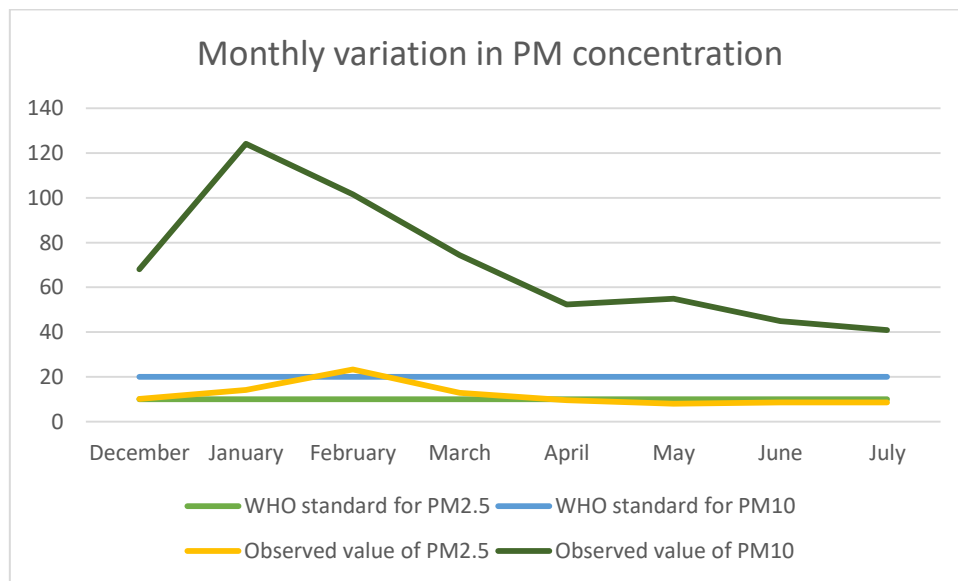


Fig.2: Levels of particulate matter pollution

From the graph it is clear that prior to the lockdown due to COVID-19 issued by the government, during December, January and February, the PM₁₀ and PM_{2.5} concentrations are well above the standards set by the World Health Organization (20µg/m³ and 10µg/m³ respectively). The observed levels of PM₁₀ concentration is highly alarming. As the state entered a stage of lockdown from the month of March, a considerable decrease in the particulate matter output was observed and the level of PM_{2.5} emissions was within the standards prescribed by WHO.

Proposals for effective risk communication and mitigation measures:

1. Extensive media campaign to increase public awareness about air quality, environmental and public health issues.
2. With the help of government officials, the risk due to pollution concentration can be addressed to population under study area.
3. Awareness can be given at school level to encourage students to reduce the air pollutant emission right from their home.
4. Improving public transport systems.
5. All industries must have pollution control equipment as per regulations and must ensure that those equipments are maintained in good conditions.
6. Roads should be maintained in peak condition so that vehicles will be able to operate most efficiently.
7. Pollution testing centres should be installed inside the industries to check the condition of the transports leaving the industry.
8. Using clean sources of energy such as compressed natural gas (CNG), liquified natural gas (LNG) etc.

IV. CONCLUSION

The number of people affected by long-term effects due to PM_{2.5} before lockdown was in the range of 1000 to 2000 which then dropped to inconsequential levels during lockdown. Similarly, PM₁₀ used to cause up-to 25000 cases which dropped to 16000. Air pollution and public health has to be maintained all over the world for a better future. The sources of pollution have to be identified, inspected and detailed report must be made so that the stakeholders are able to take informed decisions and communicate the risks involved effectively. Particulate Matter pollution is alarming in high concentration because it can lead to short term as well as long term health effects and ultimately death in community. By enforcing simple but effective guidelines such as promotion of public transport over private vehicles can bring about huge reduction in the pollution levels. The people must be made aware that it is not the big acts of the powerful, but the small everyday acts of the common man that can heal the world.



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