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Original Research Paper

Air Quality Index in Mysore City, Karnataka State, India

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ABSTRACT

Air Quality Index (AQI) in seven prime localities of Mysore city was determined using the U.S.EPA AQI calculator. Index values for Particulate Matter (PM) at Manasagangotri campus and Ramaswamy Circle are categorized as unhealthy and residents in these surroundings are advised to avoid prolonged exertion. PM index at Fountain Circle and KIDB area are quite high and categorized as very unhealthy. Five Light Circle, K R Circle and Nehru Circle have highest PM indices and are categorized as hazardous. Index values for sulphur dioxide and nitrogen dioxide are below the standards prescribed in these areas. At some places they appear to be slightly high and people with asthma or other respiratory diseases, elderly persons and children are at risk. Use of electrostatic precipitation at industry levels and diesel particulate filters at vehicle levels may reduce the PM values. Alternate fuel may be another means of reducing particulate matter.

INTRODUCTION

Air pollution is the introduction of chemicals, particulate matter or biological materials such as pollen grains that cause harm or discomfort to humans or other living organisms or cause damage to the natural environment. Exposure to air pollution is associated with numerous effects on human health including pulmonary, cardiac, vascular and neurological impairments. Children are at a greater risk. Scientific techniques for assessing health impacts of air pollution include monitoring, exposure assessment, dosimetry, toxicology and epidemiology.

Air pollutants are classified as primary or secondary. Primary pollutants are emitted directly while secondary pollutants are produced in the atmosphere. Major primary pollutants produced by human activity include sulphur dioxide (SO_2), which can result in acid rain. NOx, especially nitrogen dioxide emitted from high temperature combustion, are the most prominent air pollutants. Particulate matter in air can be man-made or natural. Increased levels of fine particles in the air are linked to health hazards. Particulate matter contains very small particles of soot, dust or other matter including tiny droplets of liquids which are produced by diesel engines, power plants, industries, windblown dust, wood stoves, etc. These have serious health effects and lead to welfare effects such as visibility impairment, atmospheric deposition and aesthetic issues.

Although there are many reports on the air quality during the past years, reports on the application of Air Quality Index (AQI) and its relation to health hazards are lacking. The EPA recognizes this in its air quality index, which is an index for reporting daily air quality. Using colour-coded categories from ‘good’ to ‘hazardous’, the AQI links air concentrations of ozone, PM, carbon monoxide, sulphur dioxide and nitrogen dioxide to an index from 0 to 500. An AQI value of 100 approximates the level EPA has set to protect public health. According to the EPA, AQI values below 100 are generally thought of as satisfactory, when AQI values are above 100, air quality is considered to be unhealthy at first for certain groups of people, then for every one as AQI values get higher (U.S. EPA 2008). The present paper attempts to correlate the AQI to the possible health hazards during summer months. The levels of particulate matter, SO_2 and NO_2 in seven prime localities of Mysore city and their health effects are discussed.

MATERIALS AND METHODS

Mysore city, a historical place is attracted by a large number of tourists with a consequent increase in vehicular traffic during the past decade. The city is located at 76°42’ east longitude and 12°8’ north latitude at 770 meters above MSL. About 6 lacks petrol and diesel vehicles and about 150 medium and large scale industries exist in the city of Mysore.

The sampling sites were K.R. Circle, Ramaswamy Circle, Nehru Circle, Five Light Circle and Fountain Circle (Commercial area); Karnataka Industries Development Board Area, KIDB and Manasagangotri Campus (Reserve area).

Particulate matter (PM < 2.5 microns (24 hr average; µg/m³) was analysed as per the method prescribed in Air Pollution IS: 5182, 1973 (Part IV) using High Volume Air Sampler (Glass fibre filter No. 20.3'25.4.cms). NO_2 (NO_2, 1 hr average, ppb) was collected by glass impinge in HVAS using absorbent reagent (Sodium hydroxide + Sodium arsenate) (Jacob & Hochheiser (1958) modified.

SO_2 (SO_2 1 hr average, ppb) was collected by absorbing reagent (mercuric chloride + sodium chloride) ISM for measuring Air Pollution IS: 5182, 1969; (Part II) (West & Gaeke 1956). Air Quality Index (U.S.EPA 2008) was determined using the AQI calculator (AIR NOW online calculator). Other methods of analysis for confirmation of results were De (1992), Kratz (1977) and NEERI (1981).

RESULTS AND DISCUSSION

A number of research workers have studied the Air Quality Index as a mechanism of assessing health hazards due to air pollution. Krewski et al. (2000) assessed deaths among a random sample of men and women due to respiratory disease. Particulate Matter (PM) mortality risks to both sensitive and non sensitive individuals were reported. Dockery et al. (1996) identified the risk of developing acute bronchitis for exposure to acidic air pollution in children. Samet et al. (2000) assessed the impact of PM on people suffering from cardiovascular diseases. Whittemore & Korn (1980) studied the risk of exposure to PM over 400 juvenile and adult asthmatics. Fine particulate matter is airborne microscopic dust and droplets smaller than 2.5 microns in diameter. It is comprised primarily of sulphates, nitrates, carbon, organic substances, ground minerals and metals. It is year round pollutant and can travel long distances. It is generally the product of residential wood burning (47.5%), industry (32.6%) and transportation (17.1%). Fine particulate matter can penetrate into deepest recesses of the lungs and remain there and contribute to respiratory infections. The characteristic chemicals in particulate matter are an important determining factor in their toxicological effects. Vegetation is also altered by the deposit of particulates on leaves, which reduce light absorption and impede photosynthesis and cause necrosis. By absorbing and diffusing light, fine particulate matter creates a type of fog that reduces visibility.

The results of the present study and the Air Quality Index are presented in Table 1. The values of AQI for particulate matter at Manasagangotri Campus and Ramaswamy Circle range between 160 and 193 and these areas are categorized as unhealthy. Sensitive groups of people in these areas are those with respiratory or heart diseases, the elderly and children are most at risk. The health effects in these areas may result in aggravation of heart or lung diseases and premature mortality in persons with cardiopulmonary diseases and increased respiratory effects in general public. Some of the cautionary statements for such people is to avoid prolonged exertion including the general public. PM index at Fountain Circle (216) and KIDB area (201) were very high and these two localities are characterized as very unhealthy. As a cautionary measure people in these localities should avail any outdoor activity and prolonged exertion. Five Light Circle (216), K.R. Circle (306) and Nehru Circle (386) have very high PM and are characterized as hazardous. Health effects in these localities are serious aggravation of heart or lung diseases, and serious respiratory problems in the general population. People of these localities with respiratory or heart diseases, children and elderly persons should remain indoors. An Air Quality Index Descriptor is presented in Table 2.

Sulphur dioxide is a colourless gas with an acrid odour that is generally the product of industry and combustion of fossil fuel containing sulphur. High levels of this pollutant are found near industrial sources. Industries release about 88.3% SO_2 while transportation produces 7.6%. SO_2 is an irritant gas that acts in combination with other pollutants most notable with particulate matter. Exposure to this gas produces coughing and reduced lung capacity. Asthmatics are particularly sensitive to SO_2. Long term exposure to this gas increases the risk of developing a chronic respiratory illness. The AQI for SO_2 in the present study ranged between a minimum of 23 at Manasagangotri Campus to a maximum of 50 at the Five Light Circle. The AQI indicates that all the areas can be categorized as 'good'. However, at certain localities of study people with asthma are the group most at risk. Declines in industrial SO_2 emissions over the last two decades can be attributed to improved industrial processes and better filtration systems.

Nitrogen dioxide (NO_2) is an irritant gas that is a by-product of combustion. At high temperatures, airborne nitrogen and oxygen combine to form nitric oxide (NO), which transforms relatively quickly into NO_2. NO_2 reduces visibility and at high concentrations contributes to the formation of ozone. The principal sources of nitrogen oxides are transportation (84.6%) and industrial burning (10.3%). At high concentrations NO_2 can cause pulmonary oedema. Asthmatics and people with bronchitis are most sensitive to NO_2. The levels of NO_2 at all places are well below the standards prescribed and range between a minimum of 15 and a maximum of 35, and these areas are categorized as 'good'. Nevertheless, people with asthma or other respiratory diseases, the elderly and children are the groups most at risk.

CONCLUSION

The AQI in the present study indicates that the health hazards due to nitrogen dioxide and sulphur dioxide are not severe and the levels are categorized as 'good'. The index results for particulate matter at most of the localities are alarming

Table 1: Air quality parameters and AQI in different localities of Mysore city (During summer, 2010).

Locality	Height in feet	Particulate Matter (PM< 2.5)		Nitrogen dioxide (NO_2)		Sulphur dioxide (SO_2)	
		E. Value	Index	E. Value	Index	E. Value	Index
K.R.Circle	20-25	256	306	21	20	29	41
Ramaswamy Circle	6-7	139	193	16	15	27	39
Nehru Circle	6-7	336	386	21	20	31	44
Five Light Circle	6-7	430	454	28	26	35	50
Fountain Circle	6-7	166	216	31	29	31	44
KIDB Area	15-20	151	201	23	22	28	40
Manasagangotri campus	20-25	81	160	37	35	16	23

Particulate matter as µg/m^3; < 2.5 microns, 24 hour average; NO_2 and SO_2 as ppb, 1 hour average. E. value is estimated value.

Table 2: Air Quality Index Descriptor (U.S.EPA 2008).

Descriptor	AQI	Risk measure
Good	0 to 50	No message
Moderate	51 to 100	Usually sensitive individuals
Unhealthy for sensitive live groups	101 to 150	Identifiable groups at risk; different groups for different pollutants
Unhealthy	151 to 200	General public at risk; sensitive groups at greater risk
Very unhealthy	201 to 500	General public at greater risk; sensitive groups at greatest risk

and sensitive groups of people are at risk. Residents living around Five Light Circle and Nehru Circle are at maximum risks and the air quality index ratings are hazardous. People in these localities with respiratory and heart diseases; children and elderly persons are advised to remain indoors for a maximum duration. Smoke testing and idling restrictions may provide particulate matter control to a greater extent. Diesel Particulate Filters (DPFs) at vehicle level also offer retrofit opportunities. Reducing emissions through transport system improvement include synchronized traffic signals, ban on certain types of old outdated vehicles, mandatory fuel quality standards, requirements for improved vehicle emission control engine technology and use of alternate transport fuels. Reduction of particulate matter in certain localities of Mysore is of prime importance in the present study.

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