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Title: Development of air quality index and its interpretation for metropolitan city of Delhi

ABSTRACT

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ABSTRACT

Urban ambient air pollution and its impact on people's health and the environment is a great matter of concern in many parts of the world. Ambient pollutant concentrations are the resultant of primary pollutant emissions from the emission sources, atmospheric transformation processes including the formation of secondary pollutants, and dispersion influenced by local topographical features and meteorological conditions. The inhabitants of a typical urban centre may be exposed to more than 100 different chemical species. An extensive literature has demonstrated the associations between exposure to the classical pollutants and ill-health endpoints such as increased hospital admissions for respiratory-cardiovascular diseases and congestive heart failure, increases in asthma attacks, increases in acute bronchitis and decreased lung function.

Worldwide, many cities continuously assess air quality using monitoring networks. In the AQI System, different index values are proposed on the basis of potential health and environmental impacts of air pollutant concentrations to enable health risk communication of air pollution level. Air quality indices are used for local and regional air quality management in many metro cities of the world. The main objective of the Air Quality Index (AQI) System is to measure the air quality with respect to its effects on the human health. Air quality indices synthesize multiple and multiscale measurements of air quality in a standardized indicator to enable the public to

understand the likely health and environmental impacts of any given day's monitored air pollutant concentration levels. Such health-risk communication may have several objectives—to enable the public to understand the likely severity of the adverse health effects at the monitored concentration levels, to encourage a reduction in activities that contribute to air pollution, to enable sensitive groups such as asthmatics to take precautionary measures or to enable the public to assess pollution trends and to increase awareness of the public health implications of air pollution. Air quality index values are divided into ranges, and each range is assigned with a standardized public health advisories.

The present research calculates the health burden of air quality with the available record of vital statistics and thereby proposes an AQI system for the metropolitan city of Delhi. To estimate the short-term effect of criteria air pollutants on daily all-cause mortality (excluding accidental deaths) city average pollutant concentration in a given days is considered as the estimate of population level air pollution exposure to the given pollutant. Generalized Additive Model (GAM) or Semi Parametric Regression technique is one of the most common statistical technique to estimate short term effect of daily air pollution on daily health outcome, adjusted for time varying nonlinear confounding effects due to weather parameters.

Significant association of all the criteria air pollutants (viz. PM_{10}, SO_2, NO_2, CO, O_3) has been observed on daily non-trauma-mortality in relation to day to day variations in ambient air pollutant concentration. The model estimates a log mortality ratio of 0.14% increase in all-cause mortality for PM_{10} and 1.002% for NO_2 per 10-$\mu g/m^3$ increase in pollutant concentration. The effect of SO_2, O_3 and CO has been observed to be significant after controlling effects of NO_2.

To construct the Air Quality Index (AQI) the excess risk of mortality from short-term exposure to different air pollutant concentration values have been calculated for the observed concentration range of pollutant concentration during the period. The excess mortality risk levels have been categorized into 6 categories representing 6 category of air quality: "Good", "Satisfactory", "Moderate", "Poor", "Very Poor" and "Hazardous". An equal weightage have been considered for each category of air quality and the observed range of pollutant concentration have been equally distributed into 6 category of air quality on the basis of excess risk of mortality due to pollutant exposure.

The study has been conducted to show the air quality status of Delhi in relation to the AQI scale values and the inter-relationship of AQI sub index values with mortality and morbidity rate prevailing among the population of Delhi. The present finding has significant societal and economic benefit. The development 'outcomes' of the research is establishment of the relationship of air pollution level and its potential health implications. The AQI developed as an output of this research will increase the overall public awareness of the air pollution.