

## Abstract

Air pollution is a major risk factor to human health in Lahore, Pakistan because of its large population and abundant industrial, immense vehicular emissions, and anthropogenic sources. The present study aims at the spatial distribution of (PM<sub>2.5</sub>, PM<sub>10</sub>, CO<sub>2</sub>, CO, SO<sub>2</sub>, NO<sub>2</sub>, O<sub>3</sub>, VOCs, and CH<sub>4</sub>) in indoor (n=317) air in selected households and outdoor (n=89) including streets/alleys or roads were assessed. In addition, associated health impacts on residents were investigated and sources were identified via a questionnaire-based survey. Moreover, the non-sampling point air pollutants trends were predicted via inverse distance weighting (IDW). The concentration of indoor and outdoor pollutants showed a significant difference of PM<sub>2.5</sub> (179.56  $\mu\text{g}/\text{m}^3$ , 0.344  $\mu\text{g}/\text{m}^3$ ), PM<sub>10</sub> (192.76  $\mu\text{g}/\text{m}^3$ , 6.13  $\mu\text{g}/\text{m}^3$ ), CO

(666.07 mg/m<sup>3</sup>, 179.56 mg/m<sup>3</sup>), O<sub>3</sub> (124.71  $\mu\text{g}/\text{m}^3$ , 33.51  $\mu\text{g}/\text{m}^3$ ), SO<sub>2</sub> (0.73  $\mu\text{g}/\text{m}^3$ , 192.76  $\mu\text{g}/\text{m}^3$ ) and NO<sub>2</sub> (177.52  $\mu\text{g}/\text{m}^3$ , 666.1  $\mu\text{g}/\text{m}^3$ ). Moreover, studied pollutants exceeded the standard limit of PEQS in considered localities (indoor) except for SO<sub>2</sub> and O<sub>3</sub>.

Furthermore, the concentration of the SO<sub>2</sub>, NO<sub>2</sub>, and CH<sub>4</sub> concentrations were recorded higher in the outdoor air. The weather parameters (temperature, humidity, cloud cover, air pressure, visibility, and wind speed) showed a significant relationship with PM<sub>2.5</sub>, PM<sub>10</sub>, O<sub>3</sub>, NO<sub>2</sub>, and CH<sub>4</sub>. The Normalized Difference Vegetation Index (NDVI) of studied area (0.1-0.2 scale indicating built up area) showed a positive relationship between PM<sub>2.5</sub> and PM<sub>10</sub>. The health risk assessment of the selected residents showed, the studied population was at risk as HQ >1 for PM<sub>2.5</sub>, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>2</sub>, VOCs, O<sub>3</sub>, and CH<sub>4</sub> concentrations. Furthermore, the increase in hospital visits were noted with the rising value of the Air Quality Index (AQI) of Lahore. Succinctly putting, air pollution caused by the aforementioned contaminants demands serious attention at local and national scales to save the residents of Lahore from airborne diseases.