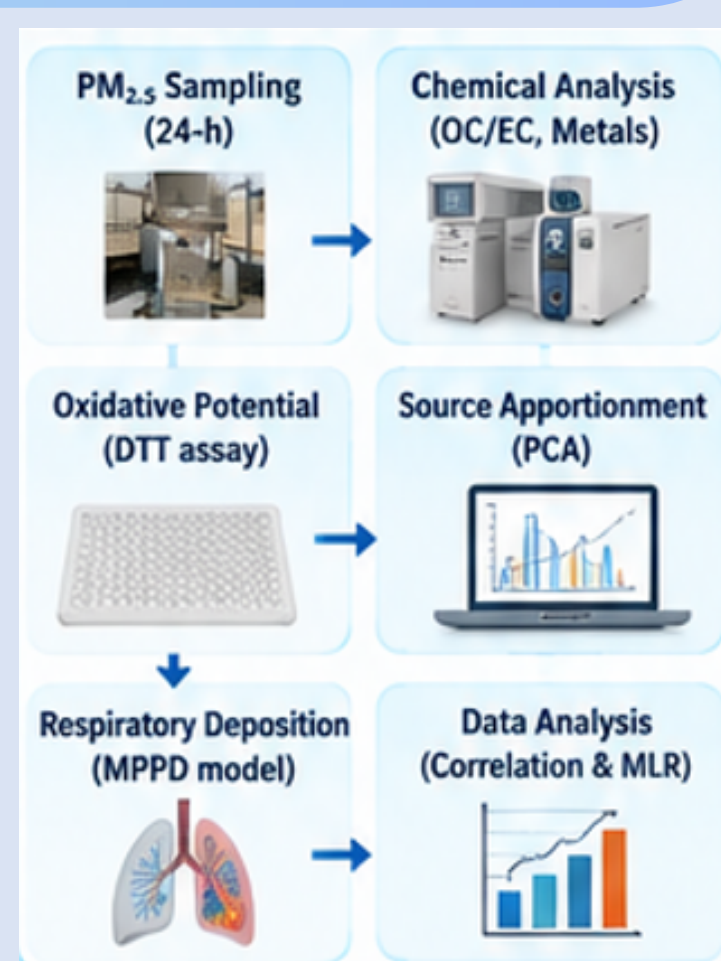


1. INTRODUCTION

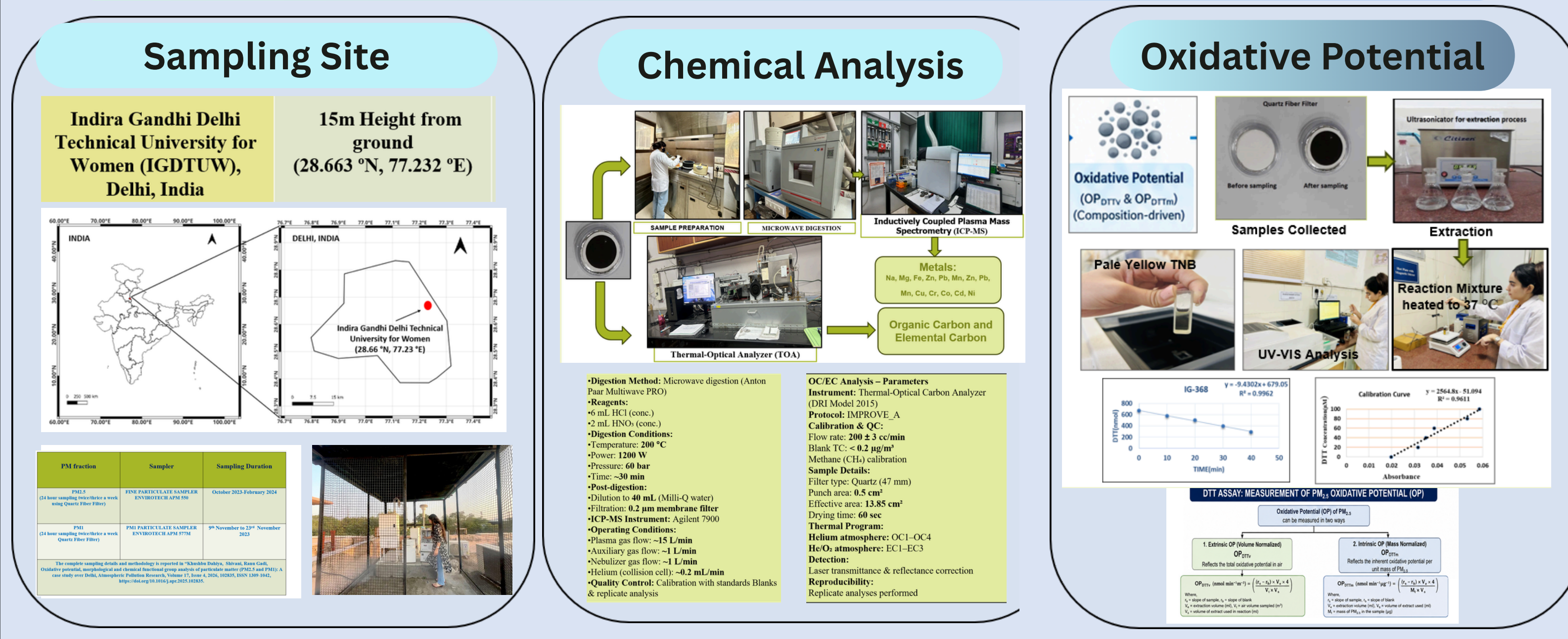
Fine particulate matter (PM_{2.5}) in ambient air is a major environmental health concern associated with respiratory and cardiovascular diseases. However, PM_{2.5} mass concentration alone does not adequately reflect its potential health impacts, as particle toxicity is strongly influenced by its chemical composition. This study investigated the temporal variability, chemical composition, and oxidative potential (OP) of PM_{2.5} over an urban site in Delhi during October 2023 to February 2024, encompassing post-monsoon and winter period. These results also presented the submicron, PM₁ and fine, PM_{2.5} toxicity through oxidative potential analysis for exposure-related health effects.

2. Objectives

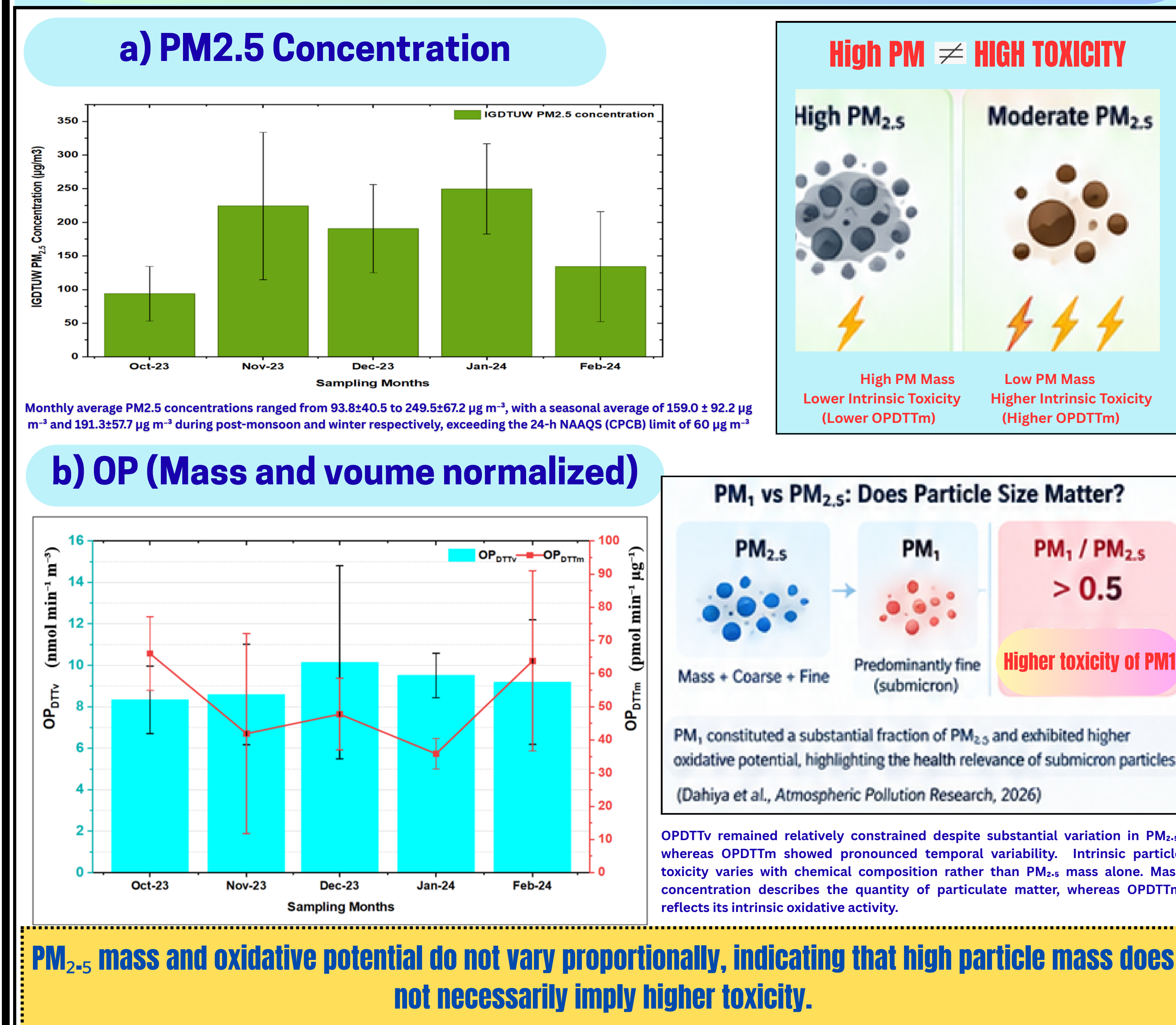
- Assess temporal variability of PM_{2.5} and its oxidative potential.
- Identify key chemical drivers and emission sources of PM_{2.5} toxicity.
- Evaluate respiratory deposition of PM_{2.5} and its associated oxidative burden.
- Examine PM₁ vs PM_{2.5} toxicity during Diwali 2023.
- Provide scientific evidence for health relevant air quality assessment.



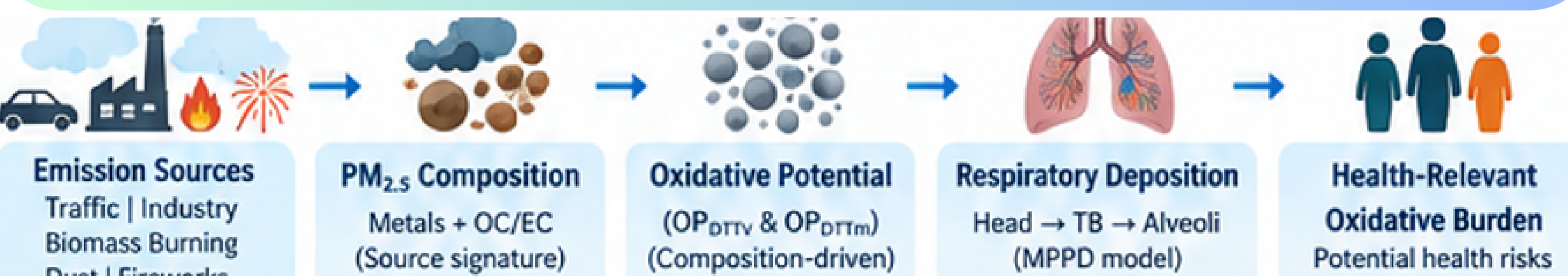
3. Sampling Site & Methodology



4. RESULT I - PM_{2.5} MASS VS OP

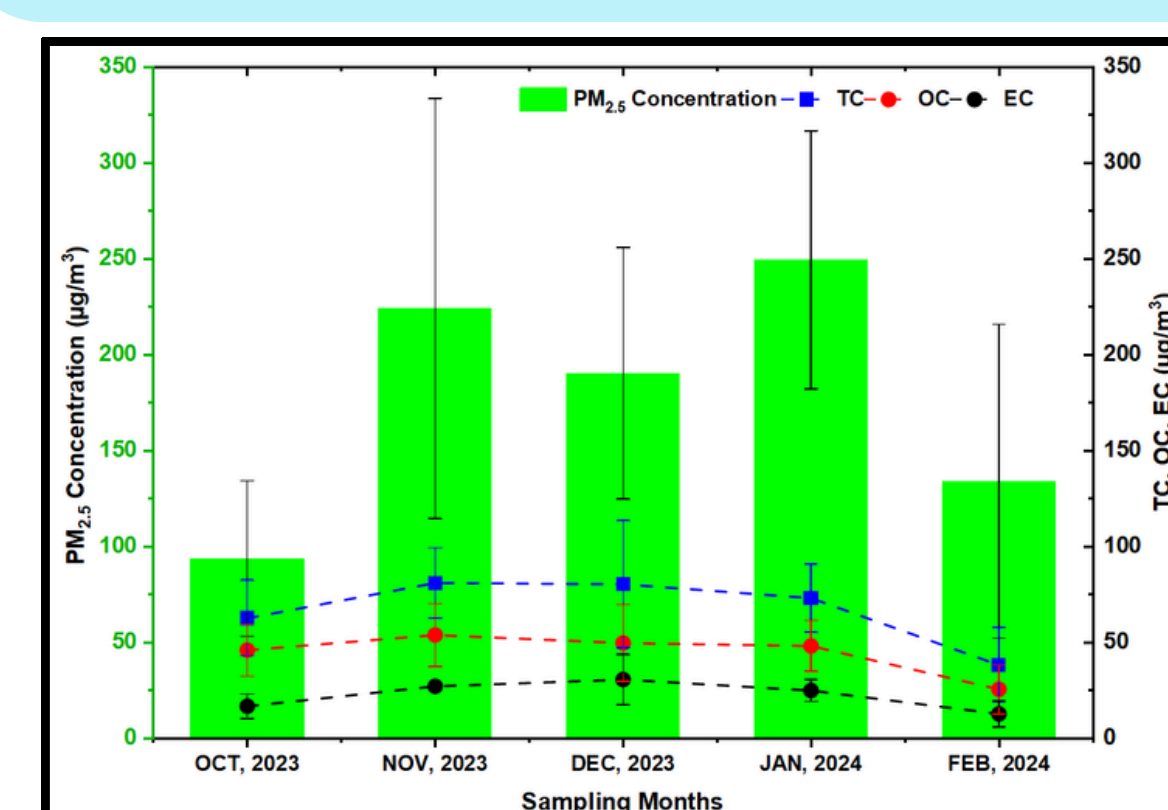


9. KEY MESSAGE: FROM PM_{2.5} SOURCES TO HEALTH IMPACTS



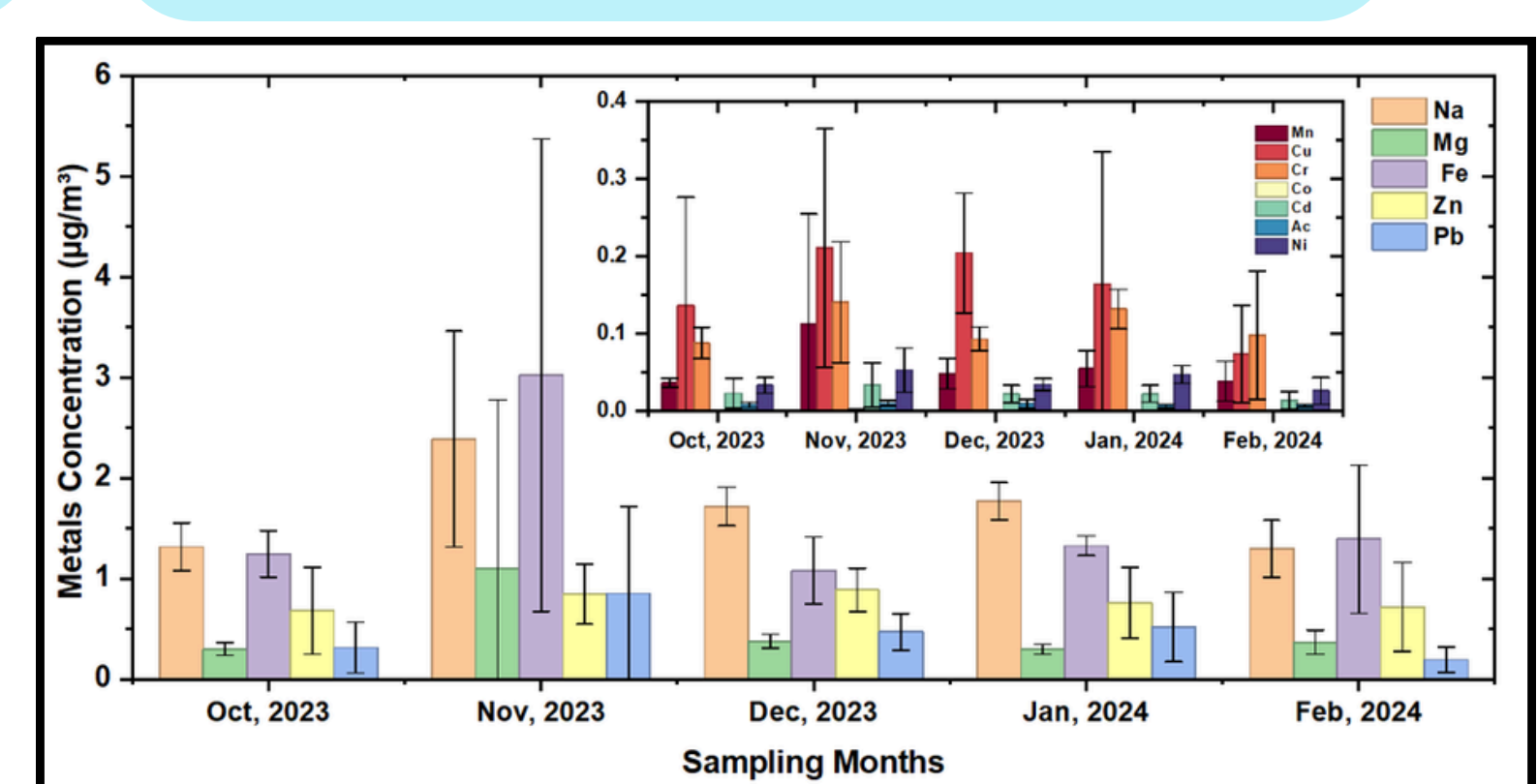
5. RESULT II - PM_{2.5} CHEMICAL COMPOSITION

a) Carbonaceous Aerosols



OC: 49.9±5.6 to 41.1±11.1 µg m⁻³
EC: 21.9±7.4 to 22.7±7.5 µg m⁻³
Persistent carbonaceous aerosol loading throughout the study period indicating strong contributions from combustion-related sources.

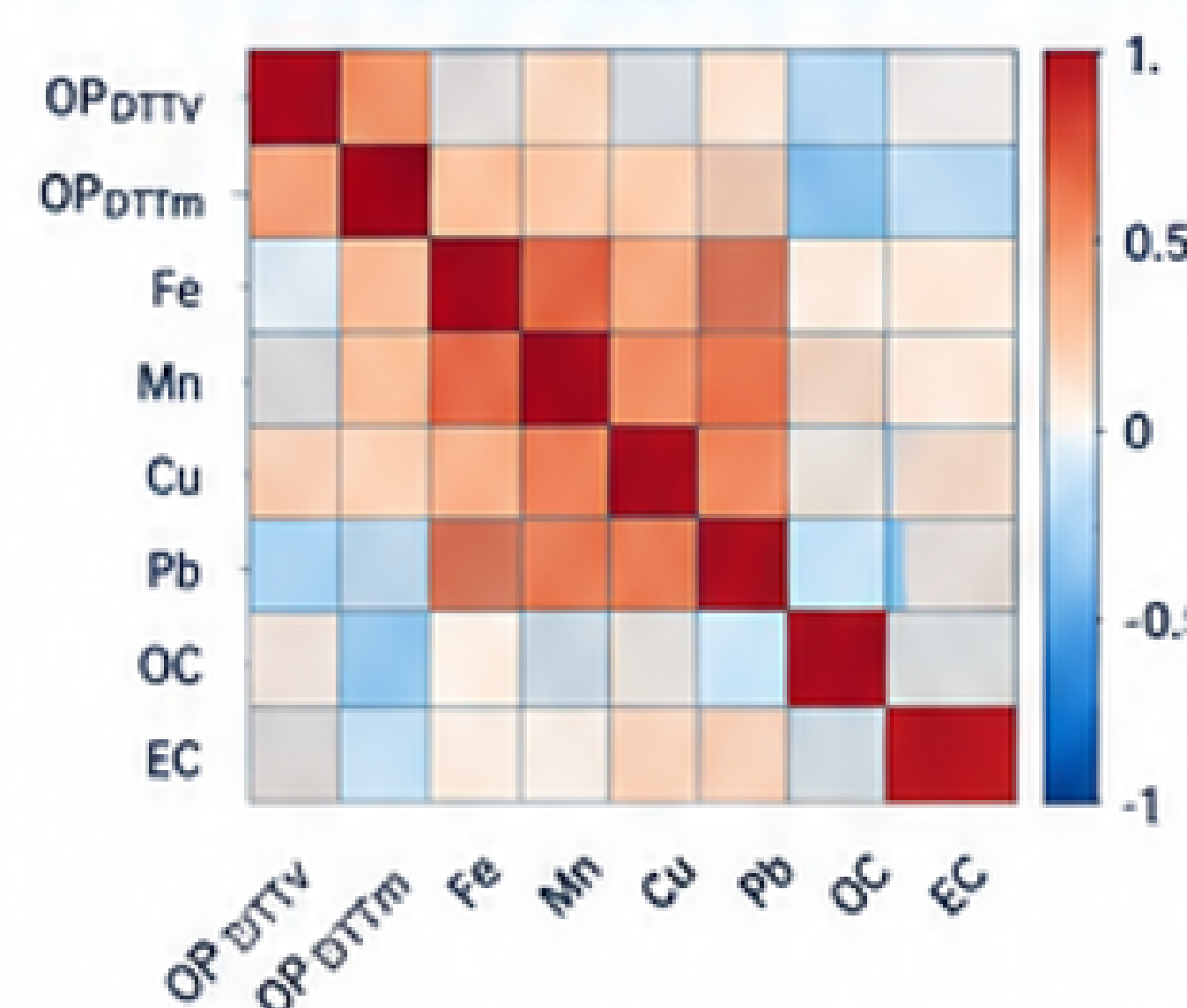
b) Trace Metals



Pb and Cu showed noticeable concentrations suggesting contributions from traffic emissions, industrial activities, and fossil-fuel combustion, while Na and Fe remained the dominant elements, reflecting both natural and anthropogenic sources.

6. RESULT III - CHEMICAL DRIVERS OF OP

Correlation Heatmap (Spearman)



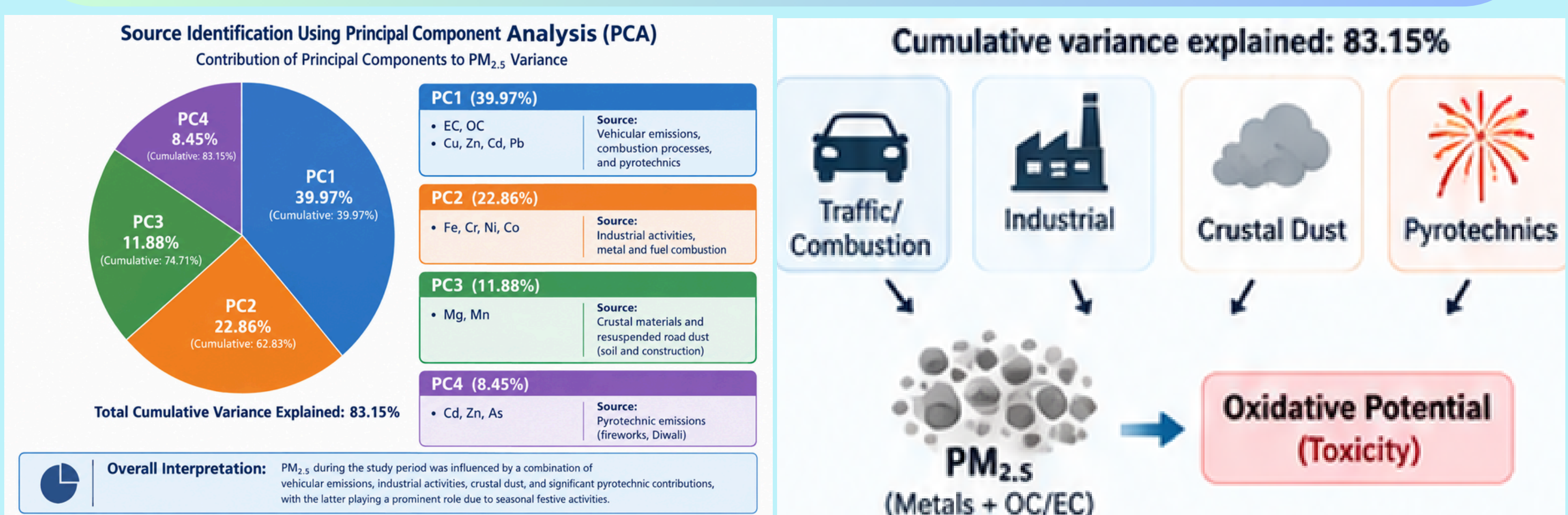
Multiple Linear Regression (OP_{DTTM})

Predictor	β	p-value
Pb	0.42	< 0.001
Cu	0.36	< 0.001
OC	0.28	0.003

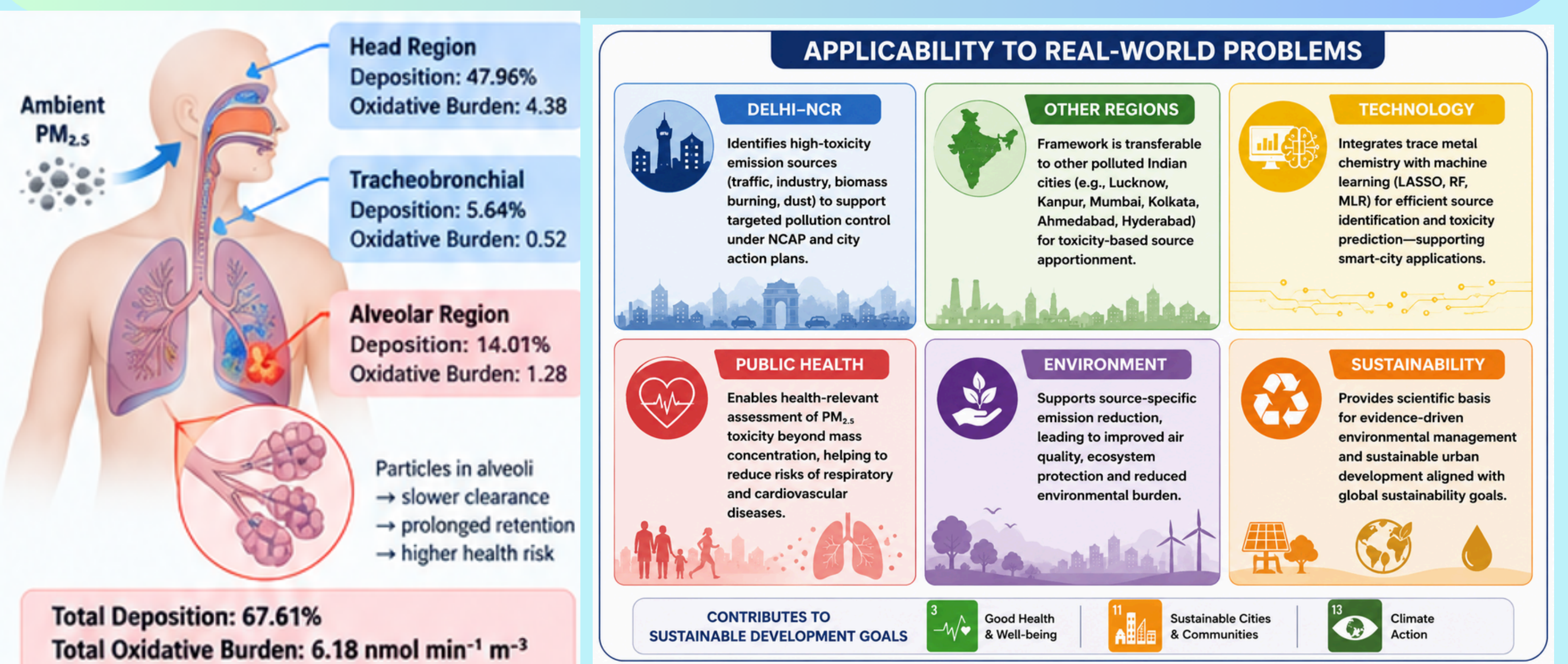
R² = 0.58 Adjusted R² = 0.46

Metal-associated chemical components explain OP variability better than bulk carbonaceous aerosols alone.

7. RESULT IV- SOURCE IDENTIFICATION



8. RESULT IV- RESPIRATORY DEPOSITION AND OXIDATIVE BURDEN



10. CONCLUSION AND IMPLICATIONS

The findings underscore that PM toxicity is governed by chemical composition and source characteristics rather than bulk mass concentration alone. This revealed the limitation of mass-based metrics in accurately representing health risks, highlighting the need for composition-driven air quality assessment and management strategies. Current NAAQS are based on PM_{2.5} mass concentration; however, this study indicates that comparable oxidative potential can occur even during periods with lower PM_{2.5} mass, highlighting the need to complement mass-based monitoring with toxicity-based indicators. The National Clean Air Programme (NCAP, 2019) should incorporate toxicity analysis alongside PM_{2.5} mass monitoring to better assess PM_{2.5} health risks.

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