

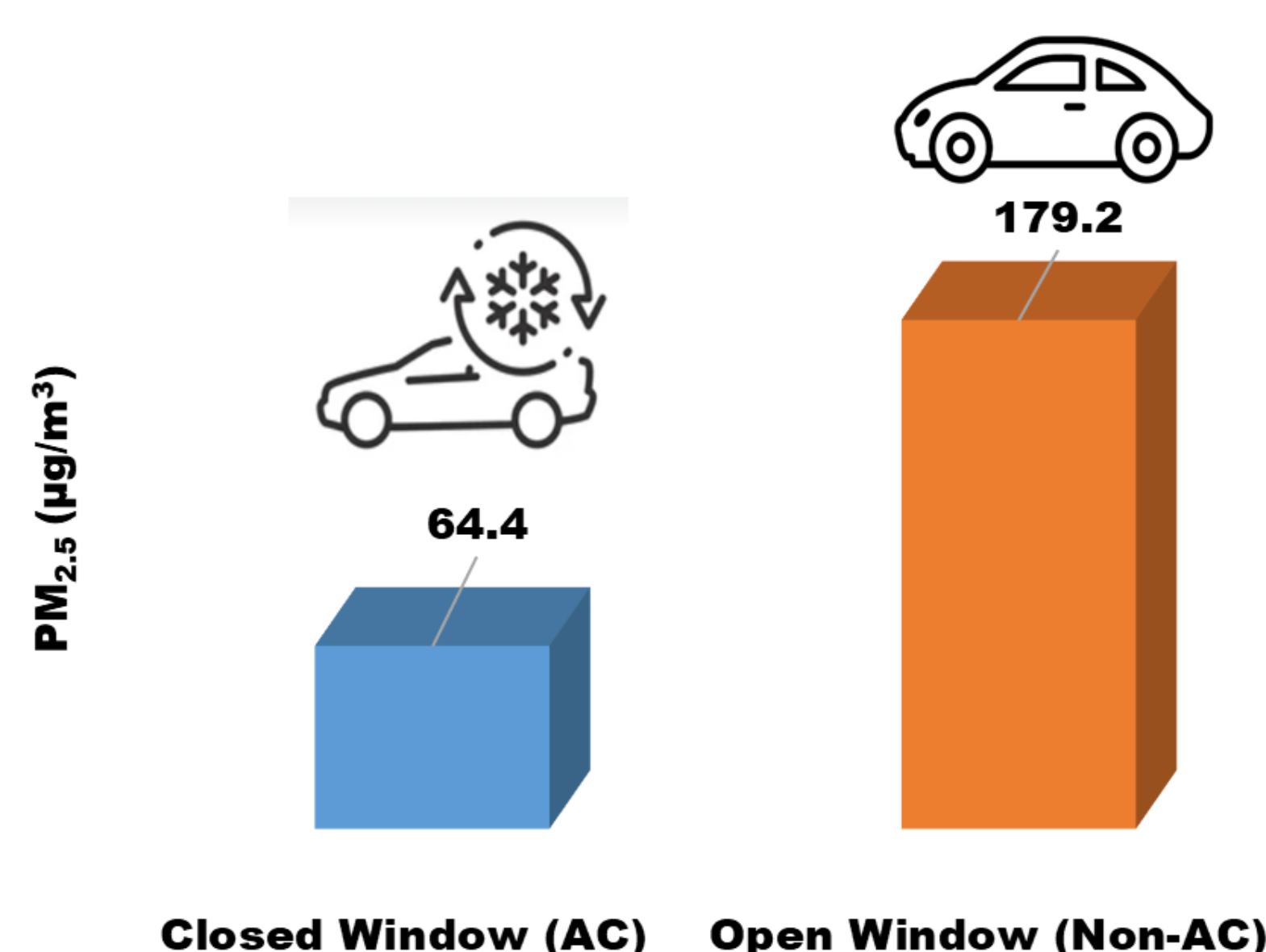
Personal exposure of traffic-related PM_{2.5} in car commuters of Patna, India

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Graphical abstract



Introduction

- Exposure to fine particulate matter (PM_{2.5}) is linked to negative health risks such as cardiopulmonary, asthmatic, respiratory, and lung cancer.
- World Health Organization (WHO) estimated that in 2012, more than 7 million premature deaths happened due to air pollution exposure, with more than 80% of those deaths in the Pacific and South Asia regions.
- Exposure to PM_{2.5} in the transport microenvironment is often very high compared to elsewhere.
- Several studies have shown that PM concentrations during transport were 2-5 times higher compared to concentrations encountered at home.
- Several studies have found that in-vehicle PM_{2.5} levels were often very high due to road traffic.
- Studies show that PM_{2.5} concentration was significantly higher in non-AC travel modes compared to AC modes.
- Car commuters spend the largest portion of their working time on roadsides which increases their PM exposure.
- In this study, we examined PM_{2.5} exposure inside vehicles under different ventilation conditions such as non-air conditioning (open window) and air conditioning (closed window) on five major routes of Patna.

Materials and Methods

Study Area:

Patna Municipal Corporation area

Study Routes:

- R1: Digha Rotary – Gai Ghat (12 km)
- R2: Kurji More – Gurudwara Gai Ghat (10 km)
- R3: Dak Bunglow Chauraha – Saguna More (10.5 km)
- R4: Patna Airport – Rajendra Nagar Tr. (9 km)
- R5: Patna AIIMS – Zero Mile (16.5 km)

Instrumentation:

Atmos™ (Respirer Living Sciences Private Limited, Pune, India) portable low-cost air sensor

Vehicles used for air monitoring survey:

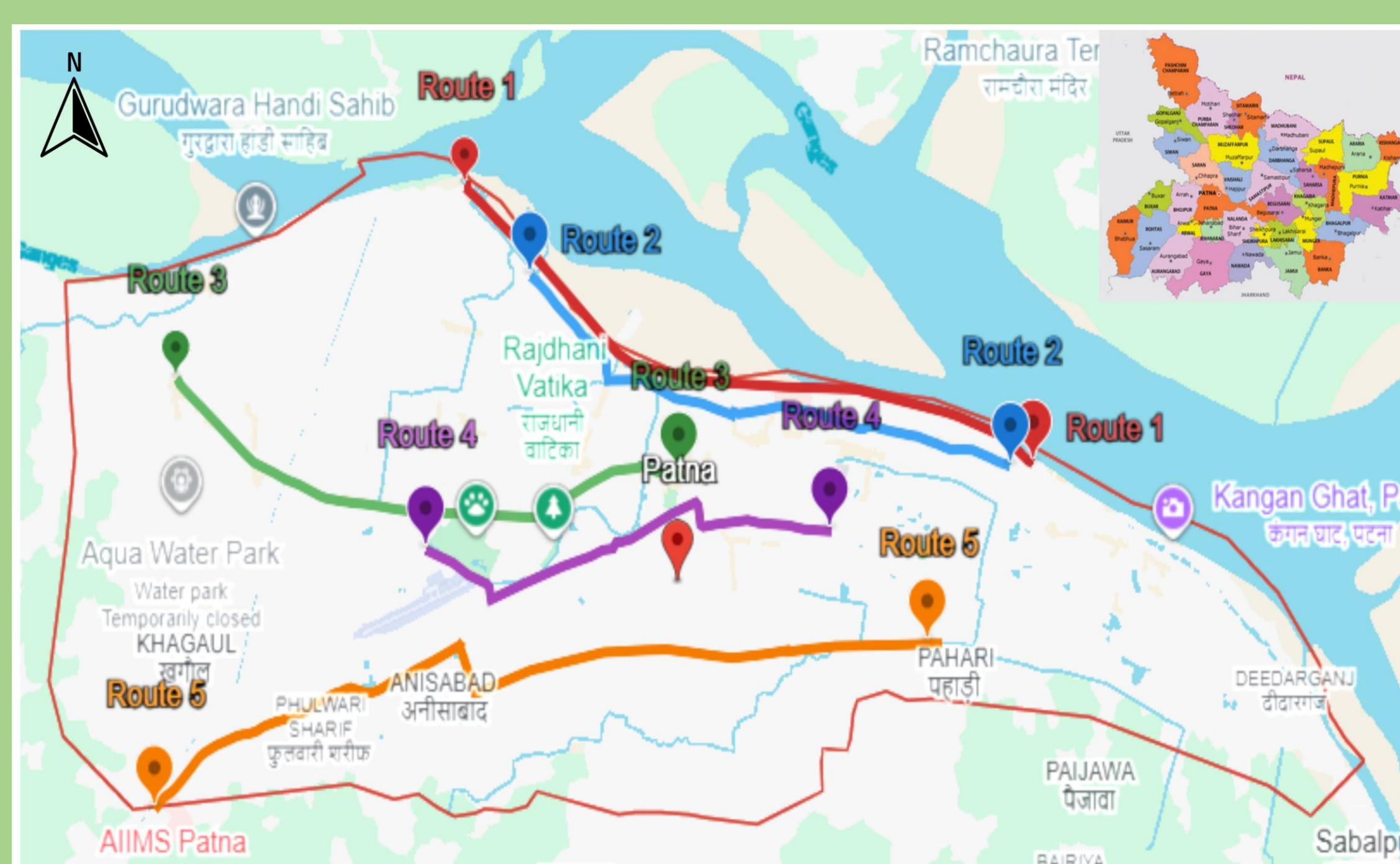
- Maruti EECO; petrol-driven private car
- Maruti Dzire ZXI; petrol-driven private car

Sampling condition:

- Open Window (non-AC)
- Closed Window (AC)

Sampling period:

September 5 to November 16, 2023



Mixed traffic fleet in Patna



Results and Discussion

- In the vehicle, PM_{2.5} concentrations (µg/m³) were found to be higher during the non-air conditioning (open window) scenario than during air conditioning (closed window) as shown in the following table.

Route	Closed Window (AC)	Open Window (non-AC)
Route 1	56.3	117.8
Route 2	58.3	176.3
Route 3	66.1	213.3
Route 4	62.1	149.0
Route 5	79.4	239.7

- The highest concentrations of PM_{2.5} were found on Route 5 while travelling on the Patna AIIMS to Zero Mile route in a non-air conditioning scenario as compared to other routes.
- In Patna, PM_{2.5} levels were found to be 2 to 3.2 times higher when driving a car with open windows and without air conditioning.

Conclusions

- In this study, PM_{2.5} concentrations were observed to be almost 3 times higher as compared to AC cars.
- The higher PM_{2.5} concentrations in non-AC cars can be attributed to the penetration of particles from the outside environment through open windows.
- Thus, the present study provides useful information to create a scientific foundation for future studies in human epidemiology.

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