Assessment of Indoor and Outdoor $PM_{2.5}$ and PM_1 Concentrations in Malaysian Primary Schools Near High-Traffic and Industrial Areas

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Abstract

This study investigates the indoor and outdoor concentrations of fine particulate matter ($PM_{2.5}$ and PM_1), temperature, and humidity across nine primary schools located in high-traffic and industrial zones in the Klang Valley, Malaysia, using the AS-LUNG-P Particulate Sensor. Measurements were conducted at one-minute intervals over a period of 4 to 5 days at each school. In every school, data were collected from three classrooms located at different floor levels (Level 1 to Level 4) and one corresponding outdoor site. Additionally, seven selected schoolchildren in each school wore the sensors during school hours for three days to assess personal exposure. The aim of the study was to evaluate variations in particulate concentrations between indoor and outdoor environments, as well as across different classroom levels, to assess potential differences in exposure experienced by pupils. Descriptive statistics revealed that average indoor $PM_{2.5}$ concentrations were 23.92 µg/m³, while outdoor concentrations averaged 23.77 µg/m³. For PM_1, indoor concentrations averaged 16.11 µg/m³, compared to 15.71 µg/m³ outdoors. Statistical analysis indicated no significant difference between indoor classroom and outdoor concentrations ($p > 0.05$), likely due to the use of natural ventilation in classrooms. Furthermore, personal exposure data of schoolchildren showed higher concentrations of $PM_{2.5}$ and PM_1 in areas such as field, classroom, and assembly area during school hours. These findings highlight spatial variability in air quality within school environments and suggest that classroom location and elevation may influence children's exposure to fine particulates.

Keywords: Indoor air; school; personal exposure; PM_1, $PM_{2.5}$.