Particle Size Distribution Patterns: A Case Study of indoor Air Under Various Conditions

arreeya CHALAE [1], somporn CHANTARA[2], nuttipon YABUENG[3]

[1]Environmental Science Program, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
Contact: arreeya_chalae@cmu.ac.th Corresponding: nuttipon.y@cmu.ac.th

Introduction

Northern Thailand experiences severe seasonal aerosol pollution, forcing students indoors. While outdoor infiltration establishes a baseline, indoor air quality is heavily dictated by building physics and human activity. This research aims to investigate the temporal variation of submicron aerosols ($PM_{0.3}$ – $PM_{0.55}$) across different student microenvironments to evaluate exposure risks and the influence of mechanical ventilation.

Methodology



- 3 study sites: Private Dormitory, 7th-Floor Classroom, and Public Library.
- Continuous 5-day monitoring per site to capture diurnal variations.
- Optical Particle Sizer (OPS) used for real-time aerosol collection and sizing.
- Data separated into localized 24-hour profiles to evaluate occupancy-driven events.

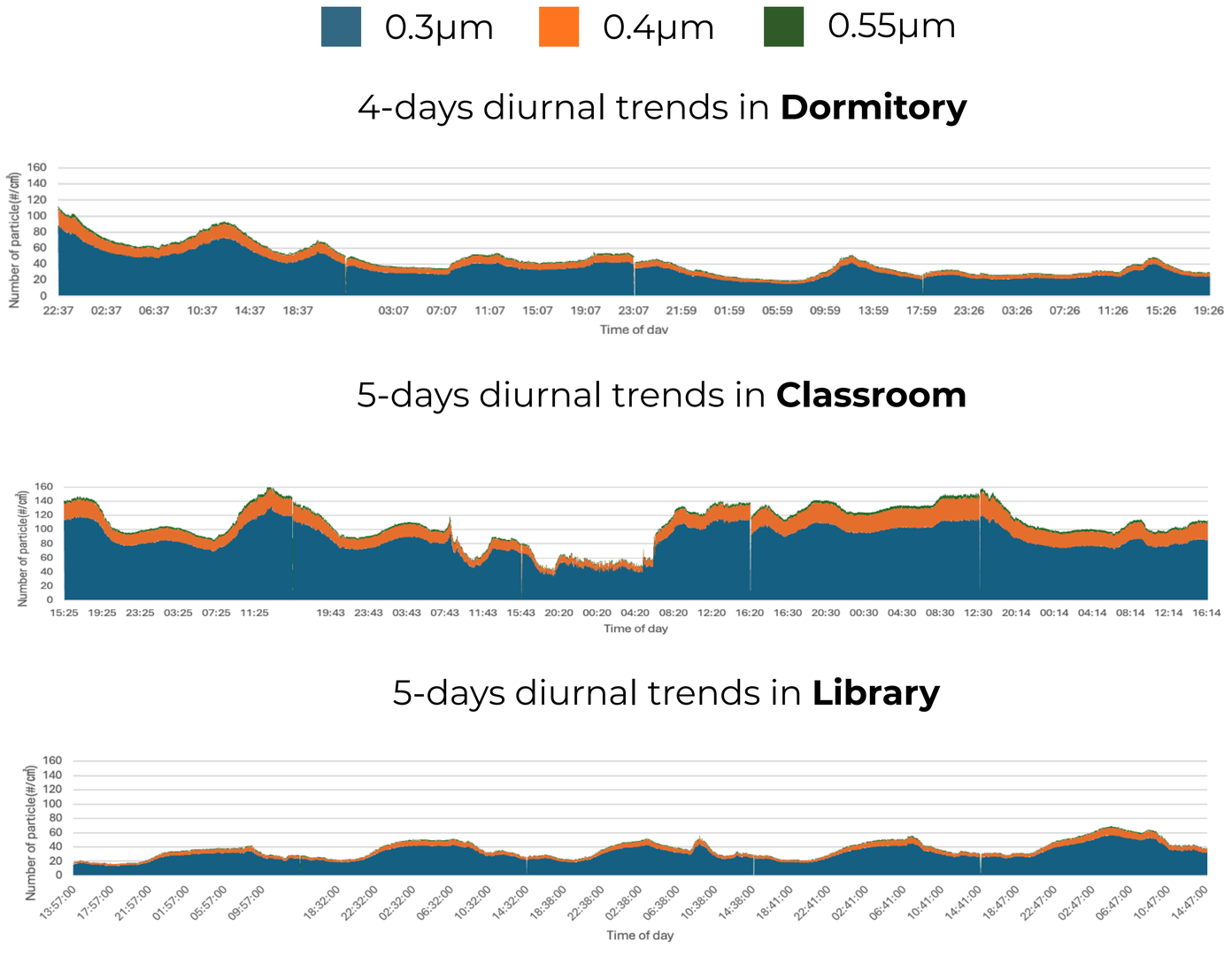
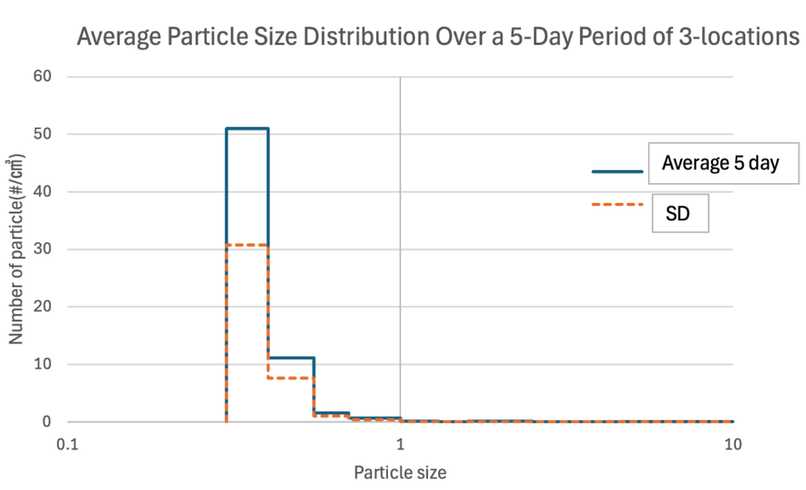
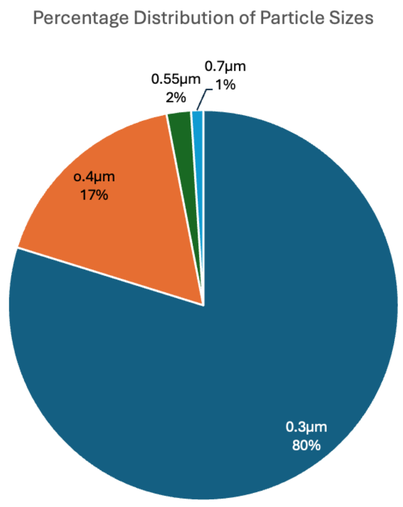


Figure 3. Continuous multi-day diurnal trends of sub-micron particle number concentrations across the three student environments: dormitory, classroom, and library.

Results & Discussion

Sub-micron Dominance (Figures 1 & 2): The indoor aerosol load is overwhelmingly dominated by the finest detectable fractions. $PM_{0.3}$ constitutes 80% of the total particle count (averaging 50.97±30.72 #/cm³), followed by $PM_{0.4}$ (17%) and $PM_{0.55}$ (2%). This highlights a severe respiratory exposure risk across all microenvironments.





- Classroom: Exhibited the highest PM peaks. Continuous movement by 25–30 students prevents fine particles from settling, causing sustained daytime pollution.
- Library: Maintained the lowest daytime PM despite high occupancy (120–130 people). The large room volume, HVAC, and active purification effectively dilute and remove particles.
- Dormitory: Showed a stable baseline from outdoor infiltration. Brief, intense spikes occurred only during personal morning routines and decayed rapidly once vacated.

Figure 1. Average particle number concentration (#/cm³) and standard deviation across 13 size channels for the 5-day sampling period.
Figure 2. Percentage contribution of primary size fractions (0.3 µm, 0.4 µm, 0.55 µm, and 0.7 µm) to the total particle count.

Acknowledgement

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Department of Environmental Science, Chiang Mai University

References

You, H., & Wan, M. P. (2015). Experimental investigation and modelling of human-walking-induced particle resuspension. Indoor and Built Environment, 24(4), 564–576.

Benabed, A., Beji, H., Limam, K., & Abadie, P. (2022). PM_{10}, $PM_{2.5}$, PM_{1}, and $PM_{0.1}$ resuspension due to human walking: Experimental study and development of a new empirical model. Building and Environment, 218, 109151.