

Ultrafine particles counts in elementary school in Taiwan

Wang, MC¹, Mena, KD² and Chen, PS^{1*}

¹Department of Public Health, Kaohsiung Medical University, Kaohsiung, Taiwan

²Epidemiology, Human Genetics, and Environmental Sciences, School of Public Health, The University of Texas Health Science Center at Houston

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Presenting author email: asdf800525@hotmail.com

Introduction

Previous studies showed that exposure to ultrafine particles have adverse health effects in children. Ultrafine particles also play an important role in asthma symptoms of children. Kaohsiung is a heavy industrial city with high particulate matter concentration. Therefore, it is important to assess children's exposure to ultrafine particles in Kaohsiung, Taiwan. In this study, we aimed to measure ultrafine particles concentration in the classrooms of elementary schools in Kaohsiung. Real-time monitoring of ultrafine particles for eight hours was performed. In addition, indoor and outdoor concentration was simultaneously measured in the morning and afternoon.

Materials and Methods

Three elementary schools, reference, industry and traffic schools, was selected in Kaohsiung, Taiwan. Nine classrooms were randomly selected in each elementary school with a total sample size of twenty- seven classrooms. Ultrafine particles concentration was monitoring in real-time from 8 am to 4 pm between April 2009 and June 2009 (TSI P-trak model 8525, TSI, USA). We also measured ultrafine particles concentration indoor and outdoor of classroom at 8 am and 4 pm. For comparison of indoor and outdoor concentration, Indoor/Outdoor ratio (I/O ratio) of ultrafine particles was calculated.

Results and Discussion

The average concentration for ultrafine particles in reference, industry and traffic school was 7.8×10^3 (pt/cc), ranging from 2.9×10^3 (pt/cc) to 1.2×10^4 (pt/cc), 1.7×10^4 (pt/cc), ranging from 4.3×10^3 (pt/cc) to 3.5×10^4 (pt/cc), and 1.7×10^4 (pt/cc), ranging from 2.7×10^3 (pt/cc) to 4.0×10^4 (pt/cc), respectively (Table 1). Our results showed that the average concentration in industry and traffic school was significantly higher than that of reference school ($p < 0.0001$). More sources of pollutants around traffic and industry school may be the reason. For the concentration profile (Figure 1) from 8 am to 4 pm, similar trend was observed among all the 27 classrooms that ultrafine particles concentration was the highest in the morning and decreased with time. Hourly average concentration of ultrafine particles in reference school was all lower than that of industry and traffic school.

The study showed that eight hours average concentration of ultrafine particles in industry and traffic school was significantly higher than that of reference school. For the trend of an hour average concentration, ultrafine particles concentration was the highest in the morning. In addition, the I/O ratio of ultrafine particles was all below 1.

Table 1. The eight hours average concentration for ultrafine particles in reference, industry and traffic school (N=9)

	Mean (pt/cc)	Median (pt/cc)	SD	C.V, %	Minimum (pt/cc)	Maximum (pt/cc)
Industry school	7.8×10^3	7.8×10^3	3.1×10^3	3.9×10^1	2.9×10^3	1.2×10^4
Reference school	1.7×10^4	1.6×10^4	7.5×10^3	4.3×10^1	4.3×10^3	3.5×10^4
Traffic school	1.7×10^4	1.6×10^4	8.3×10^3	4.6×10^1	2.7×10^3	4.0×10^4

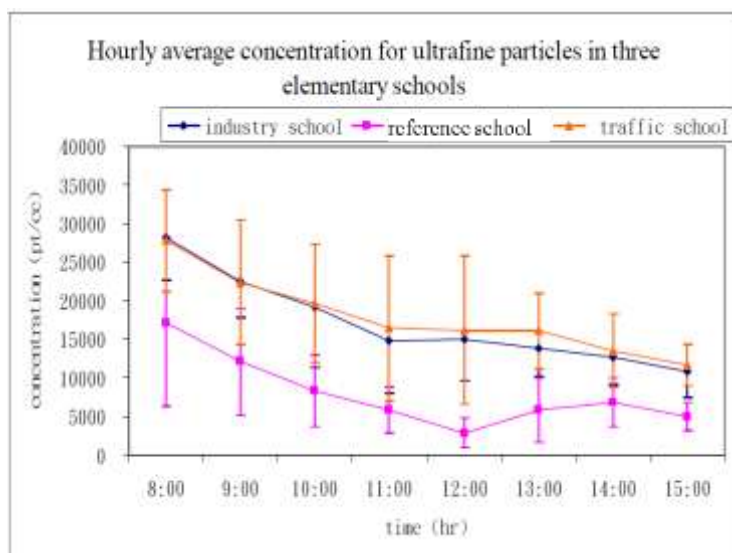


Figure 1. Hourly average concentration for ultrafine particles in three elementary schools