

Determination of Personal Exposure to Particulate Matters by Pocket PM_{2.5} Sensor [Pro] in Middle-Aged Women in Myanmar

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Background and Aim

- Many epidemiological studies have reported PM_{2.5} levels relied on fixed air quality monitor station and could not be used for mobile assessment.
- Currently, our research group introduced Pocket PM_{2.5} sensor for mobile monitoring and reported real-time PM_{2.5} levels in outdoor of seven Townships of Yangon, Myanmar.
- Accurate estimation of PM_{2.5} exposure in microenvironment is necessary for studying of association between PM exposure and health risk. Thus, we designed GPS-attached new Pocket PM_{2.5} sensor (Pro) to measure personal exposure level of PM_{2.5} in microenvironments more than 24 hours.
- We designed GPS-attached new Pocket PM_{2.5} sensor (Pro) to measure personal exposure level of PM_{2.5} in including indoor and outdoor microenvironments.
- To determine the association between PM_{2.5} exposure and health risk, we measure blood pressure and lung functions in all subjects by sphygmomanometer and spirometer respectively.

Materials and Methods

New features



- Stand-alone operation (Smartphone is NO required for measurement)
- Internal GPS module
- Internal Static Memory (Max. 400 days)
- 45 hours continuous operation (When using 5,000mAh power bank)
- High accuracy and high response
- USB Mass storage convertibility with Windows PCs

Specifications

- Measuring particle : PM_{2.5}, PM₁₀
- Sensing principle : Laser scattering
- Measurement Range : 0~999µg/m³ (PM2.5/PM10)
- Response time : 10 sec
- Relative error : Maximum of ±15% and ±10µg/m³ (25°C, 50%)
- Internal modules : GPS, Static memory
- Memory : Max. 400 days (at every-second logging)
- Interface : Micro USB (for power supply and PC connection in USB mass storage mode)
- Setting function : use of setting file
- Power supply : USB Type-A 5V
- Cable : USB Type A Cable L=90cm (combined in a kit)
- Power consumption : Max. 110 mA (5V)
- Operation duration : Max. 45 hours (by 5,000 mAh external battery)
- LED : Full-color
- File format : CSV (Date, Time, PM2.5/10 consumption, GPS coordinates)
- Price : Open price
- Manufacturer : Yaguchi Electric Corporation, Miyagi (MADE IN JAPAN)

Career women

Housewives

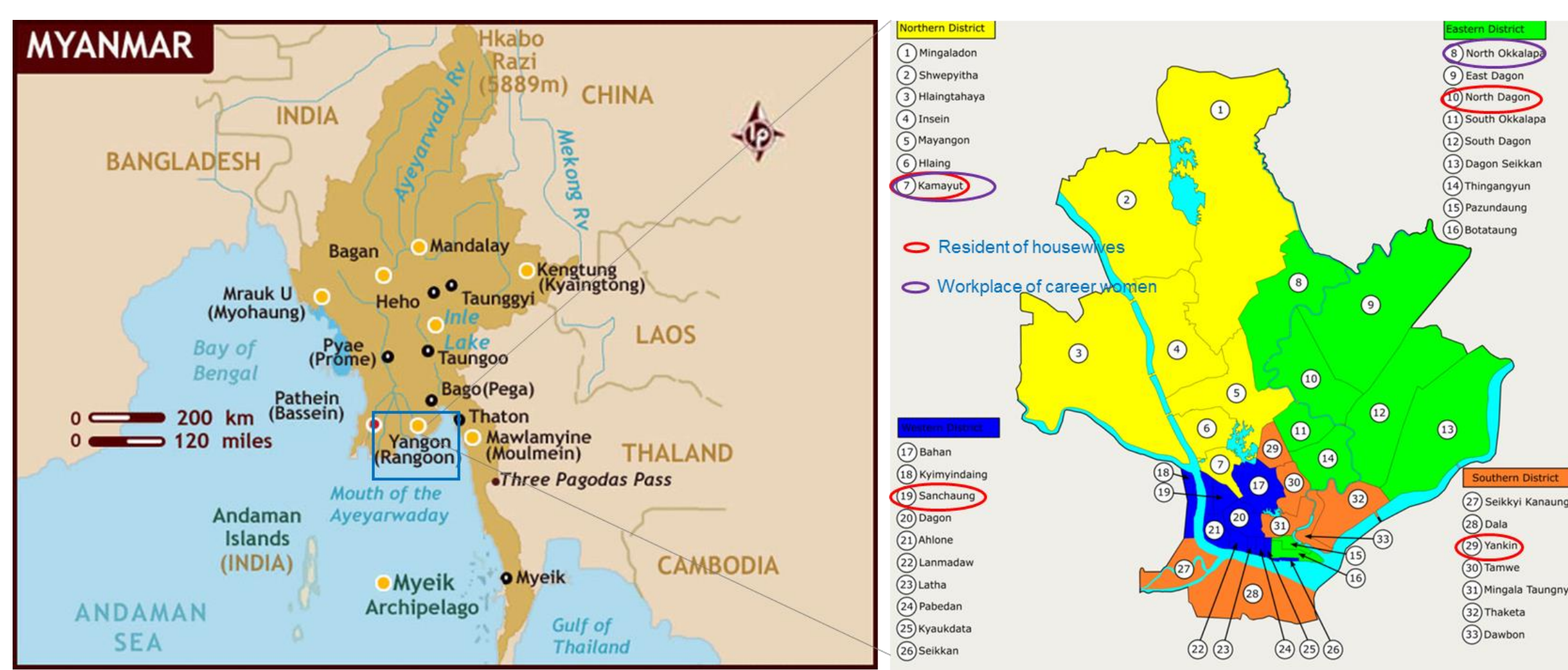


Criteria: Age 40-60 years healthy women living at Yangon
 15 career women and 15 housewives
 No smoking and no alcohol drinking
 No cardiopulmonary diseases

Variables	Housewives	Career women
Physical status		
Age (yrs)	52.5 ± 7.4	42.9 ± 3
Height (cm)	150 ± 4	160 ± 1
Weight (kg)	55.1 ± 7.2	60.5 ± 6.5
BMI (kg/m ²)	24.0 ± 2.9	24.3 ± 2.6
Clinical history		
Smoking	Nil	Nil
Alcohol drinking	Nil	Nil
Chronic disease	Nil	Nil
Educational status		
High school	4/15	0/15
University degree	1/15	0/15
Graduate degree	10/15	15/15
Indoor status		
Good ventilation	15/15	15/15
Mosquito coil	5/15 (002,008,028,029,030)	2/15 (022,024)
Repellent	1/15 (009)	0/15
Incense stick	1/15 (029)	2/15 (011,023)
Air fresher	1/15 (009)	1/15 (021)
Cleaning detergent	1/15 (002)	4/15 (011,021,023,026)

Characteristics of study population

Results

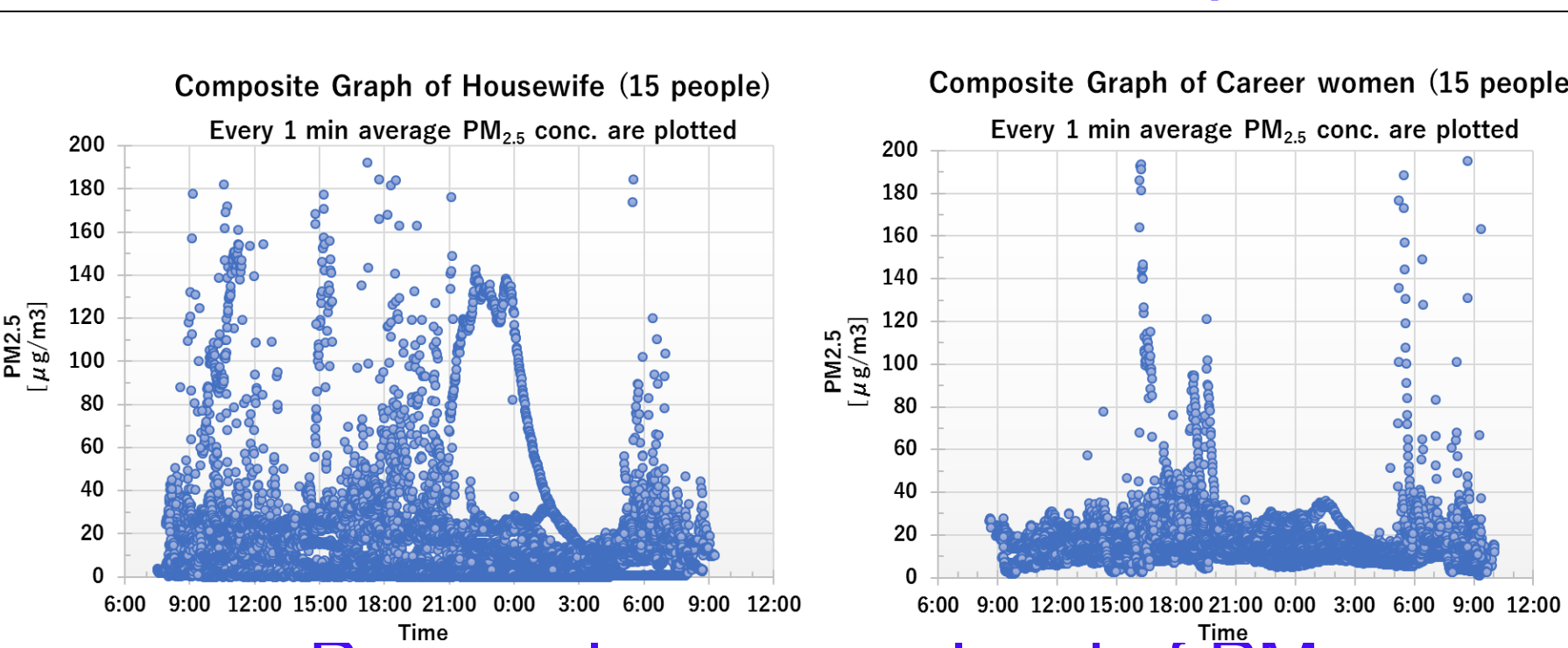


Location of residence and workplace of study population

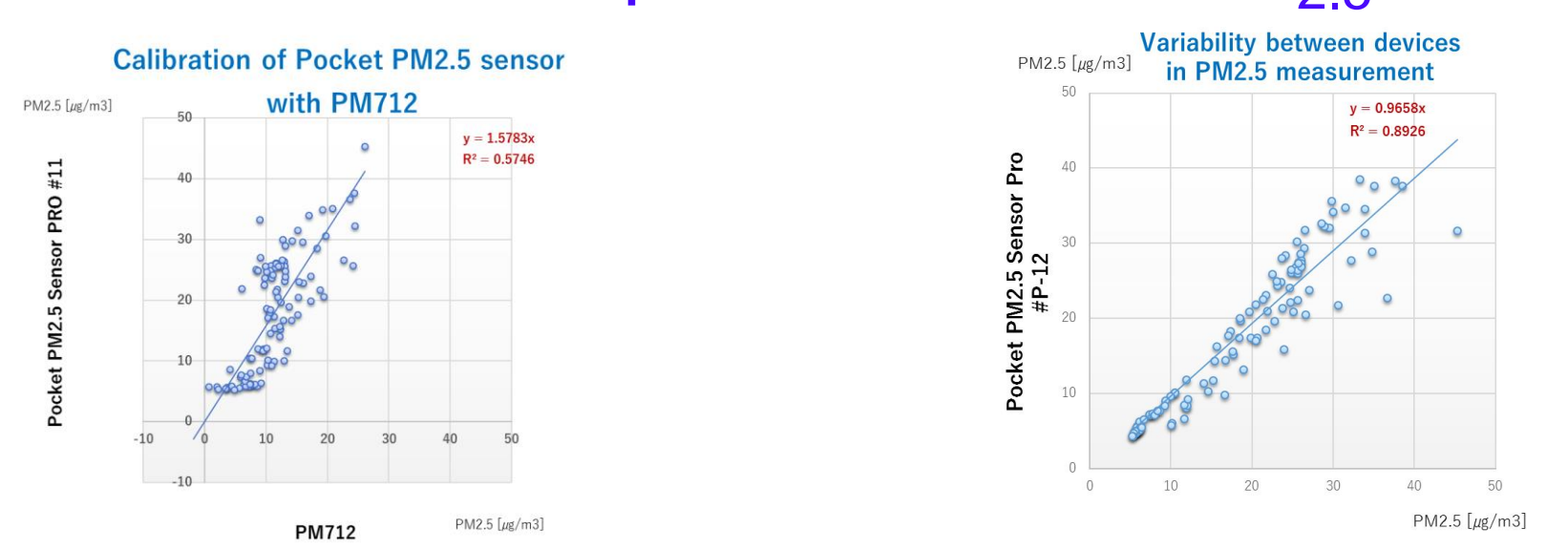
U.S. EPA PM_{2.5} AQI

AQI Category	AQI Value	24-hr Average PM _{2.5} Concentration (µg/m ³)
Good	0 - 50	0 - 15.4
Moderate	51 - 100	15.5 - 40.4
USG	101 - 150	40.5 - 65.4
Unhealthy	151 - 200	65.5 - 150.4
Very Unhealthy	201 - 300	150.5 - 250.4
Hazardous	301 - 500	250.5 - 500.4

Air quality Index (AQI)



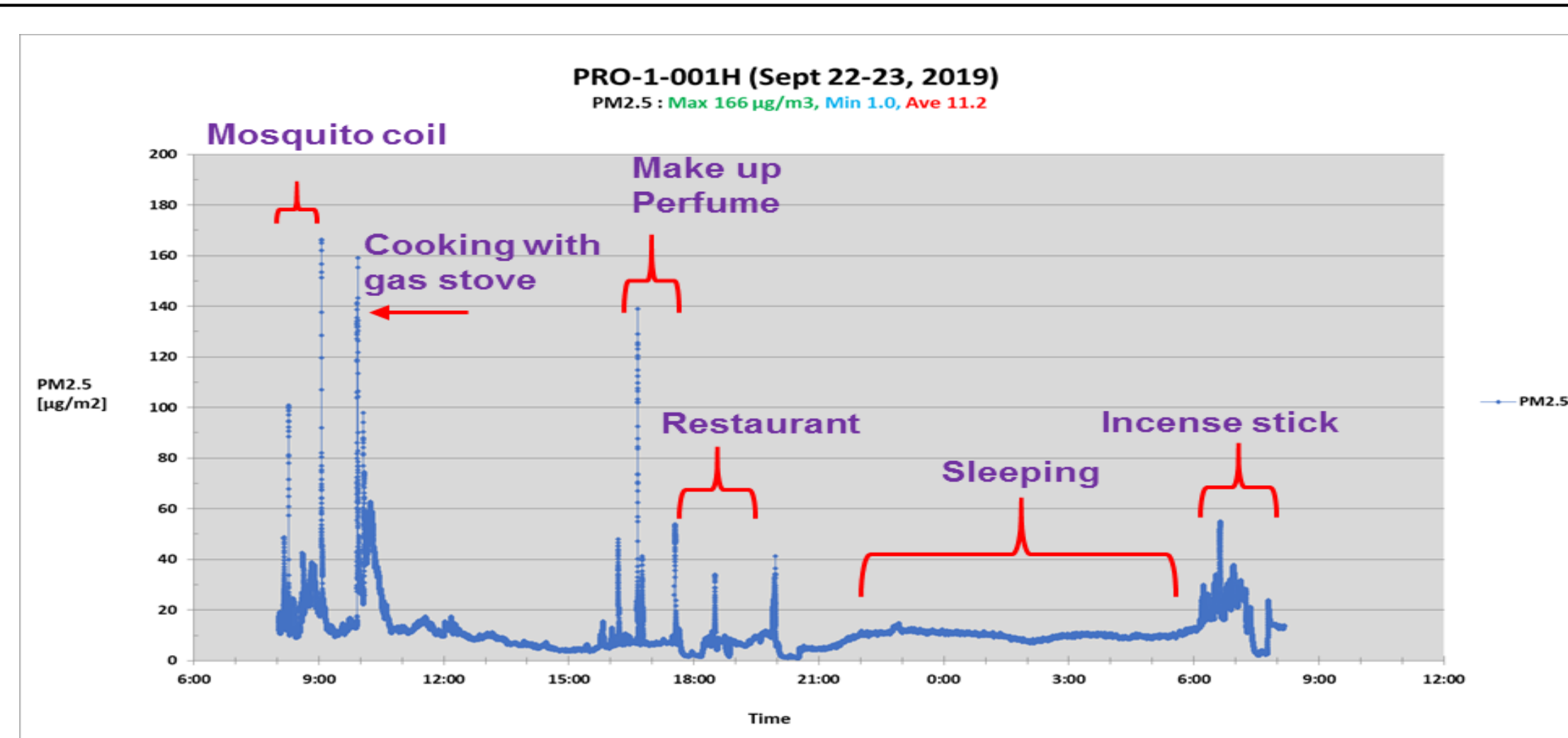
Personal exposure level of PM_{2.5}



Calibration with PM712 (NIES) Variability between devices

Cardiopulmonary examination

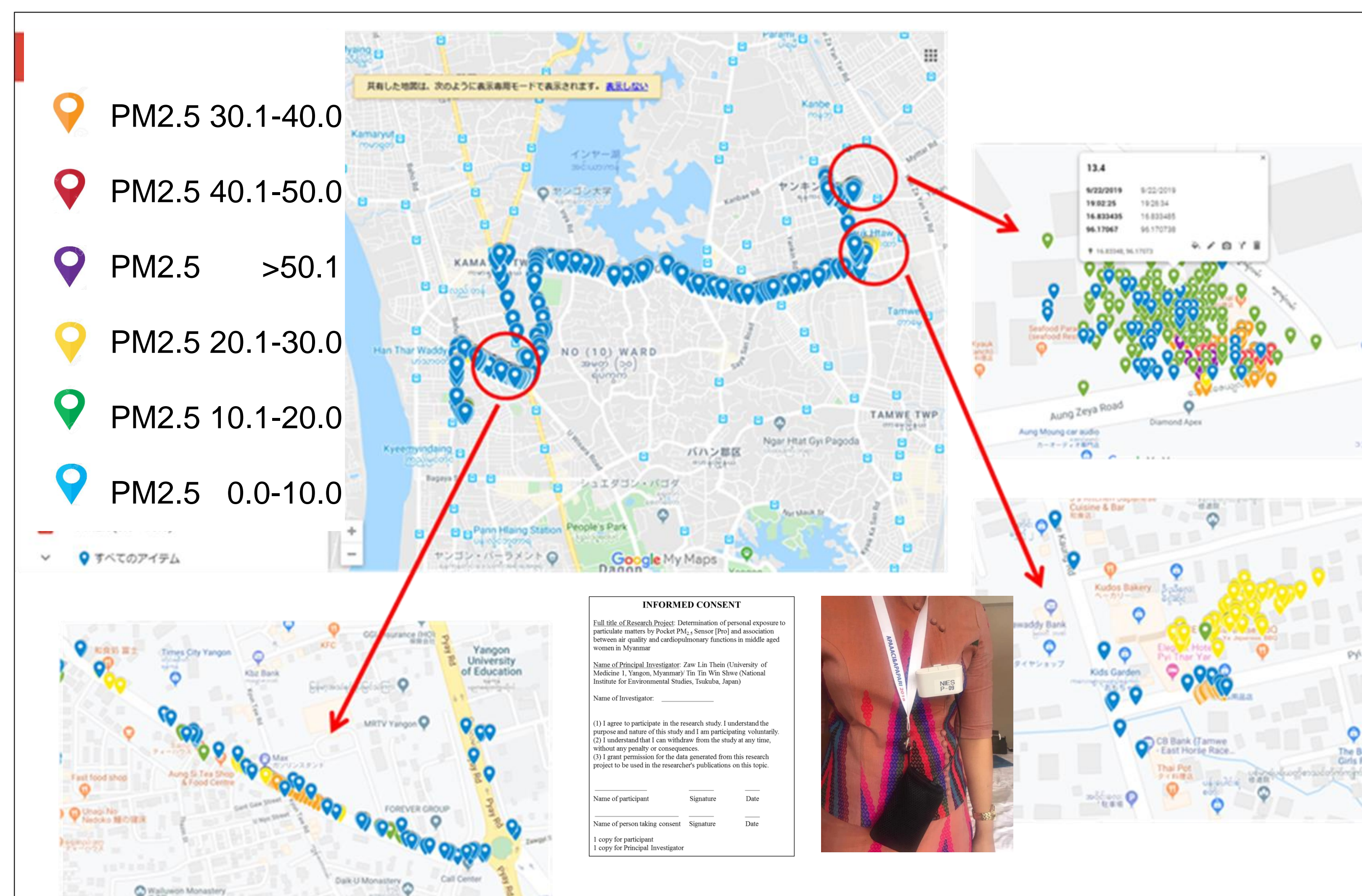
Variables	Housewives	Career women	Normal value
Cardiovascular test			
HR (beats/min)	76.9 ± 8.3	78.0 ± 10.1	50-100
SBP (mmHg)	113.3 ± 9.4	114.2 ± 14.8	90-130
DBP (mmHg)	75.6 ± 8.1	77.3 ± 10.8	60-80
MAP (mmHg)	88.1 ± 7.9	89.6 ± 11.9	90-110
Lung function test			
FVC (% predicted)	98.5 ± 16.1	95.3 ± 8.6	> 90%
FEV1 (% predicted)	96.5 ± 16.1	99.1 ± 10.4	> 90%
FEV1/FVC (% predicted)	97.5 ± 11.4	103 ± 8.9	> 90%
FEF 25-75 (% predicted)	97.6 ± 31.0	114.9 ± 36.3	> 90%



Personal exposure levels of PM_{2.5} in housewife (PRO-001)



Routine daily activities



Mapping of PM_{2.5} level in housewife (PRO-001)

Discussion and Conclusion

- The average PM_{2.5} exposure levels during 24 h were 16.1 ± 10 µg/m³ in housewives and 15.8 ± 4 µg/m³ in career women.
- Personal PM_{2.5} exposure levels varied with different microenvironments in housewives accompanied with their daily routine activities and were partial stable in working hours in the office in the career women.
- The present study provides new insights regarding importance of personal exposure assessment of PM_{2.5} in microenvironment. Further studies are needed to confirm association between long-term personal exposure to PM_{2.5} and health risk.