심포지엄 3) Relationship between Indoor and Outdoor Particulate Matter Concentrations in Japan

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1. Introduction

Recently people have a big concern on particulate matter(PM) among ambient air pollutants, and environmental standards for PM especially for $PM_{2.5}$(particulate matter less than 2.5μm in aerodynamic diameter) have been set in many countries. We have been conducting a $PM_{2.5}$ epidemiologic study and evaluating health risks of ambient $PM_{2.5}$ in Japan. However, PM sources such as smoking exist inside homes as well as outside, and personal exposure levels should be contributed by indoor sources more than outdoor sources, because people spend much time inside homes. In this presentation, we show the results of indoor and personal $PM_{2.5}$ measurements in the epidemiologic study, and the relationship between indoor and outdoor PM concentrations. The results of other studies on indoor $PM_{2.5}$ measurement are also described.

2. Outline of the $PM_{2.5}$ epidemiologic study and methods of exposure assessment

Japan Environmental Agency launched the epidemiologic and toxicologic studies to investigate the relationship between ambient $PM_{2.5}$ and its health effects. The studies started since 2001. To validate the study, it is necessary to evaluate whether a concentration of $PM_{2.5}$ at a monitoring site is representative of personal exposure levels around the site. We selected a PM sampler suitable for the study, and then measured the $PM_{2.5}$ personal exposure levels, the concentrations inside and outside residences. The subjectpersons/residences of $PM_{2.5}$ measurement were selected among non-smoking persons/houses of the study subjects. Therefore, it might be difficult to discuss the general indoor environment in Japan from the results of this study.

We selected ATPS-20H impactor(Sibata Scientific Technology Ltd.) as a sampler for the epidemiologic study among three types of sampler, because of two-stage filters to enable to collect $PM_{2.5}$ and $PM_{10-2.5}$(particles smaller than 10mm in diameter but larger than $PM_{2.5}$) simultaneously, low-volume(1.5L/min) and low-noise sampling which is important for the survey inside homes,and the lower price than other samplers. Twenty-four-hour indoor and outdoor PM measurements over 7 consecutive days were taken simultaneously using the impactor each season(spring, summer, fall, and winter). Almost 20 residences from each study area(7 cities across Japan) were selected as the subjects of the indoor and outdoor measurements. Personal $PM_{2.5}$ and $PM_{10-2.5}$ exposure levels were measured for almost ten parents/guardians of the subject children of the cohort study in each area, and the $PM_{2.5}$ concentration at the monitoring stations was measured by TEOM and the gravimetric method.

3. Requirement of indoor PM measurement in an ambient air pollution epidemiology

The objectives to measure indoor and outdoor PM concentrations and to investigate the relationship between indoor and outdoor should be as follows.

Possibility of personal exposuresurrogate
Modifier for the health effect of ambient airpollution
Specific indoor PM sources
Distribution of PM concentrations among houses as well as among areas

4. Results of indoor and personal $PM_{2.5}$ measurements

The measurement design in the air-pollution epidemiologic study was mainly to compare with several areas expected as with different ambient $PM_{2.5}$ levels, and the study areas were selected based on monitoring data of some pollutants. Unfortunately for the study, outdoor $PM_{2.5}$ concentration levels were not so different among areas, because some pollution reduction strategies such as diesel exhaust filter equipment may have worked well.

The concentrations outside and inside homes,and personal exposure levels were similar in most areas(Figure 1). Therefore, it should be possible to estimate the personal $PM_{2.5}$ exposure level from the outdoor $PM_{2.5}$ concentration, when no source exists inside the residences. On the other hand, $PM_{10-2.5}$ concentrations outside the home were lower than inside, and personal exposure levels were the highest.

Indoor PM concentrations of some city were higher than outdoor in the autumn and the winter. Daily variation of indoor concentrations and personal exposures were similar as outdoor concentrations in all areas. When indoor PM concentration is higher than outdoor, it is suggested that there are some unknown sources for PM inside houses even in no-smoking houses. Then the correlation between indoor and outdoor concentrations should be smaller.

5. Other studies related to indoor $PM_{2.5}$ concentrations

People may haveanother concern whether indoor and outdoor $PM_{2.5}$ concentrations closed to the heavy trunk road are higher than far from the roadside. We have investigated indoor $PM_{2.5}$ concentrations related to outdoor concentrations in another study. $PM_{2.5}$ concentrations did not decrease according to the distance from the roadside. On the other hand, indoor smoking apparently increases $PM_{2.5}$ concentration. Around half of the fine mass inside homes within 150 meters of major roads with heavy traffic use is indicated as being attributable to tobacco smoke, and diesel powered automobiles makes up 30 percent of the indoor $PM_{2.5}$.

No relationship between weekly mean level of indoor airborne mite allergen(Der 1) and indoor $PM_{2.5}$ are observed in some study. Indoor $PM_{2.5}$ including tobacco smoke and its health effects have to be discussed in the future.

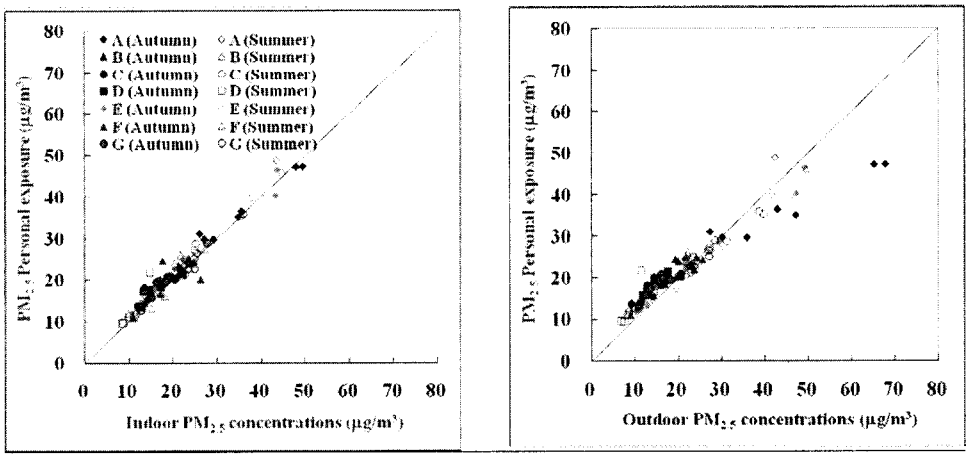

Fig. 1. Relationship among indoor and outdoor $PM_{2.5}$ concentrations, and personal exposure levels.