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A Study on Indoor and Personal Exposures Concentrations to Carbon Monoxide in the Asan Area

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Abstract

Indoor carbon monoxide (CO) concentration and personal CO exposures were measured Asan where CO poisoning resulting from twenty coal usage briquette as a domestic fuel to cook and space heating. Twenty-five were houses selected from the Asan area for the survey conducted in February 1997. Newly developed passive CO samplers were placed in the kitchen and living room for the indoor concentration measurement and were worn by homemakers for personal exposure monitoring. The daily average of indoor CO concentration was 16ppm in the kitchen and 10ppm in the living room. The indoor concentration and personal exposures to CO were different in types of the space heating system. House ventilating methods and socioeconomic conditions were also important factors in determining the indoor and personal CO level in Asan

I. Introduction

Over the past three decades there has been a rapid increase in urbanization and industrialization in Korea. Dramatic increase in the number of houses, office buildings, manufacturing facilities, and motor vehicles is result of these social and industrial changes. Industrial emissions and emissions from motor vehicles are believed to be the major causes of ambient air pollution in most cities in Korea. Such emissions have immediate implications to the indoor environment as several studies have demonstrated in that ambient air impacts the indoor environment.

With regard to indoor pollution, it is also significant that many houses in Korea continue to rely upon coal briquettes as heating and cooking fuel, which may lead to elevated indoor carbon monoxide (CO) levels, particularly during cold winter months.

Although bottled propane and natural gas are replacing coal briquettes for cooking and heating, these replacements present their own problems when not handled in an appropriate manner. In addition, many Korean houses, offices and restaurants use portable kerosene devices to provide supplementary heating during the winter. When not vented properly, such devices can increase indoor pollution to extreme levels.

In this paper, a preliminary field study using newly developed passive CO monitors was conducted to investigate the distribution of personal CO exposures and to seek determinant factors of indoor pollution in Asan.

II. Materials and Method

The sampling was conducted by using three passive CO samplers in each home for 24 hours

Twenty-five participants in Asan City in February 1997 took part. Two samplers the indoor measurements were placed in a kitchen and living room. One sampler for monitoring the personal exposure was carried by a housewife. Some outdoor samplers placed at the outside of several participants houses were also used.

The passive CO sampler consisted of a glass tube with one side sealed by a rubber cap. The CO adsorbent packed in the glass tube was made from Zn-Y-zeolite. The sampling rate of CO was controlled with a narrow diameter of polyethylene tube inserted into the center the adsorbent layer through a septum fixed to the other end of glass tube. Analyses of the samplers was carried out by thermal desorption of CO, followed by gas chromatography with a flame ionization detector. We obtained the information on participant's smoking habits and house characteristics.

Ⅲ. Results and Discussion

Characteristics of 25 house structures are summarized in Table 1. There were many Korean style houses in Asan, which were less spacious and mostly made of wood.

Summary statistics, indoor CO concentrations and personal exposure levels are shown in Table 2. The mean CO concentration in the kitchens and living rooms were 16ppm and 10ppm, respectively. The average personal CO exposure, 13ppm, was between the average of the two indoor measurements. Half of the participants were exposed to high levels of CO exceeding the ambient air quality standard in the USA which an 8-hour average is 9ppm, and a 24-hour average is 10ppm in Japan. The 90 percentile of personal CO exposures was 15ppm.

When comparing indoor CO concentration by types of ondols, houses with the ondol boiler had lower concentration than houses using the traditional ondol (Table 3).

The average personal CO exposures was highest for wives using the traditional ondol in Asan. The kitchen fan, which ventilates exhaust to outside, reduced indoor CO levels. Average kitchen CO concentrations in kitchens with smoke discharger were lower than those without smoke dischargers, which were attached to the top of cooking stoves(Table 4 & 5).

Table 1. Characteristics of 25 house structure and heating type

	asan
	No. of house (%)
Type of Heating	
Traditional ondol	10 (40%)
ondol boiler	15 (60%)
Structure	
Korean style	16 (64%)
Western style	2 (8%)
Korean - Western Mixed style	7 (28%)

Table 2. Summary statistics of CO concentration (ppm)

	Mean	S.D*	n
Indoor			
living room	10	6	25
kitchen	16	12	25
Personal	13	10	21

* Standared deviation

Table 3. Mean CO concentration (ppm) by type of heating

	Ondol Boiler		Traditional Ondol	
	mean	(s.d.)	mean	(s.d)
Living room	4	(2)	30	(3.5)
Kitchen	14	(2)	37	(1.8)
Personal	6	(3)	12	(9)

Table 4. Mean CO concentration (ppm) by presence of ventilation in house

		Living room			Kitchen			Personal		
		mean	(s.d)	n	mean	(s.d)	n	mean	(s.d)	n
Ventilation	Yes	6	(3)	10	6	(3)	7	11	(9)	8
	No	12	(6)	15	19	(10)	18	10	(5)	17

Table 5. Mean CO concentration (ppm) by presence of smokers in house

	smokers					
	Yes			No		
	mean	(s.d)	n	mean	(s.d)	n
Living room	10	6	17	8	3	8
Kitchen	16	11	19	15	16	6
Personal	11	5	16	17	12	9

It was found that indoor and personal exposure levels depended considerably on the type of ondol system. Also, house ventilation methods and socioeconomic conditions were found to be important factors that determined the indoor CO levels in conventional houses in Korea.

We could not investigate the interactions of determinant factor because of the small sample size. However, several types of health effects might have occurred at the exposure levels shown in this study. We have to investigate many houses to confirm the results and establish the control methods.

Ⅳ. Conclusion

The types of heating systems were found to be one of the determinant factors of indoor CO concentration and personal CO exposures. Indoor CO levels for houses with traditional ondols were higher than houses with ondol boilers in Asan area. Particularly kitchen CO concentrations of the traditional ondol house in Asan exceeded 50 ppm. Personal CO exposure was between indoor CO concentrations in the living room and kitchen in most cases.

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