INDOOR AIR QUALITY IN HOUSES WHERE CHILDREN WITH ALLERGY ARE LIVING

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ABSTRACT

Indoor environment, such as air quality, temperature and humidity, is recently considered as one of main allergic factors, because children spend much of their time in their homes. We measured several pollutant levels to investigate air quality inside the houses where children with an allergy such as atopy and asthma were living in winter, 1998. Measurements were conducted at twenty houses with allergic children and ten without allergic children. Indoor NO_2, HCHO and VOCs were the target pollutants. House characteristics which were considered as determinants of indoor pollutant levels were collected using a questionnaire. Although most of indoor pollutant levels seem to be higher in non-allergic children children's houses than in allergic children's houses, all difference were not significant.

INTRODUCTION

The number of allergic children is increasing in the whole world. Indoor environment, such as air quality, temperature and humidity, has been recently considered as one of main allergic factors, because children spend much of their time in their homes [1]. However, few studies on the relationship between indoor environment and children's health have been conducted and the causal relationship is still unclear in Japan [2]. As the first step to investigate causal relationship between children's health, especially allergy, and total indoor environment, we measured several pollutant levels inside the houses where allergic children were living.

METHODS

The study area was in Yokohama-city, Japan. We selected thirty children based on the patient list of a paediatric clinic. Of the children, twenty had allergic factors such as asthma and atopy, and ten did not. The measurements of indoor pollutants were conducted at their houses for four consecutive days in winter, 1998. Indoor NO_2, HCHO, VOCs were the target pollutants. Outdoor NO_2 levels were also measured, since a major road with heavy

traffic runs through the area. NO_2 and HCHO were collected by using a passive gas tube (Sibata Scientific Technology Ltd., No.8015-069) and VOCs were collected by using a passive sampler for organic vapors (SKC, No.575-001). Each sampler was placed at the room where the children spent most of time in their houses. A measurement period was for twenty-four hours and each sampler was replaced to a new one every day. House characteristics which may be considered to influence pollutant levels, such as house structure, unvented heater use, smoking, insect repellent use, etc., were collected by a questionnaire. In this paper, we present the indoor pollutant levels stratified by several factors including allergic condition.

RESULTS

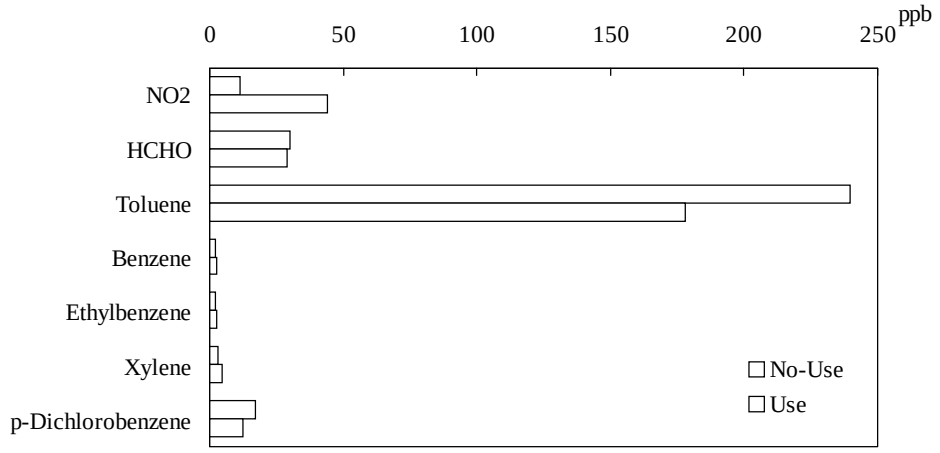
Of thirty houses, nine single-family houses (seven for allergic children and two for non-allergic) and 21 condominiums were reported. Mean years on construction for allergic children's houses was 12.4 years and 13.9 years for non-allergic. There are few difference on house type and years on construction between allergic and non-allergic children's houses. Summary statistics of indoor pollutant levels (four-days mean) are shown in Table 1. We present toluene, benzene, ethylbenzene, xylene and p-dichlorobenzene as VOCs in this paper.

Table 1. Summary of indoor levels (four days mean)

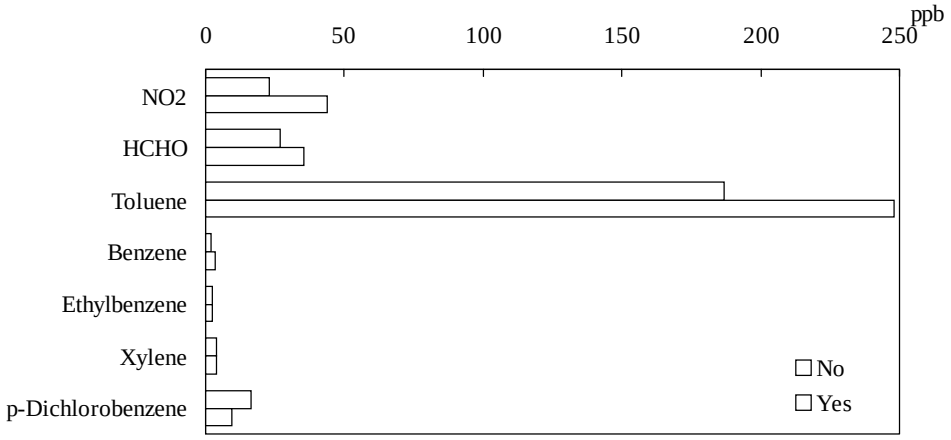
	All houses (n=30)	Allergic (n=20)	Non-Allergic (n=10)
NO_2	28.8 (26.9)	22.7 (20.0)	41.0 (35.1)
HCHO	29.3 (10.4)	29.2 (11.6)	29.5 (8.1)
Toluene	201.7 (142.7)	173.4 (143.8)	258.2 (128.7)
Benzene	2.5 (1.3)	2.1 (0.8)	3.2 (1.8)
Ethylbenzene	2.4 (1.5)	2.1 (1.0)	3.0 (2.2)
Xylene	4.0 (2.6)	3.5 (1.6)	4.9 (3.9)
p-Dichlorobenzene	15.0 (21.5)	13.9 (16.5)	17.1 (30.0)
NO_2 (Outside)	12.4 (4.0)	11.3 (2.4)	14.5 (5.6)
HCHO (Outside)*	4.9 (2.0)	4.6 (1.3)	5.5 (2.8)

mean (standard deviation) unit: ppb
* 29 houses (19 allergic houses)

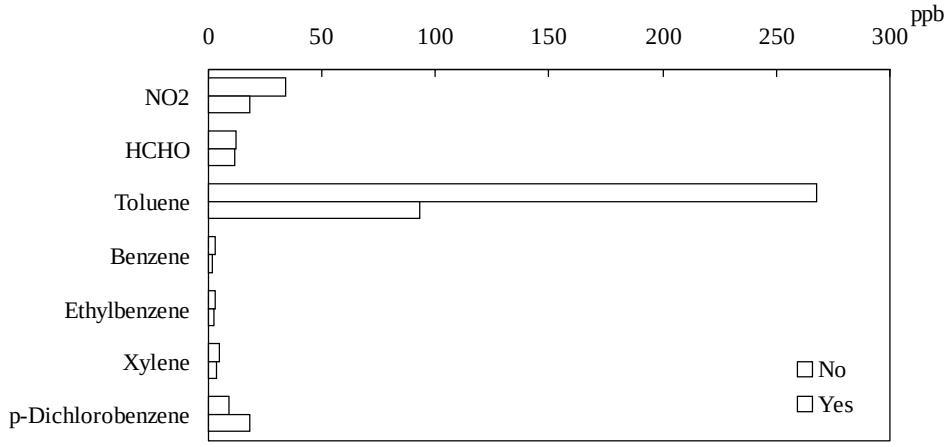
Mean value of NO_2 was 28.8 ppb, which was much higher than outdoor NO_2 level (12.4 ppb). Although some houses faced onto a main traffic road, the outdoor levels are relatively low. It may be due that the samplers were placed at the opposite side from the side facing to the road because of no appropriate setting places on the latter side. Indoor HCHO level (29.3 ppb) was also higher than outdoor level (4.9 ppb).Mean levels were 201.7 ppb for toluene, 2.5 ppb for benzene, 2.4 ppb for ethylbenzene, 4.0 ppb for xylene, and 15.0 ppb for p-dichlorobenzene.



1) Unvented heater use



2) Smoking in the house



3) Insect repellent for clothes in the chest at the measurement room

Figure 1. Mean concentrations of pollutants stratified by several characteristics

The results of the stratified analysis by several house characteristics (unvented heater use, smoking in the house, and use of insect repellent for clothes) are described in Figure 1. For most of other characteristics, many houses were assigned into one category, and we don't show the results about them in this paper. NO_2 levels were highly associated with unvented heater use (p=0.004). Smoking contribution to indoor NO_2 levels were observed in this study. However, eight houses among nine houses with smokers used unvented kerosene heaters. Benzene level in the houses with smokers are higher than non-smoking houses (3.4 ppb vs. 2.1 ppb, p=0.061). Use of insect repellent for clothes contributed to p-dichlorobenzene levels (18.4 ppb vs. 9.2 ppb), although the difference was not statistically significant. Insect repellent was also related to benzene, toluene and NO_2 levels.

DISCUSSION

Although most of pollutant levels seem to be higher in the houses where non-allergic children are living than the non-allergic children's houses, the difference were not significant. The reason why mean values are different between allergic and non-allergic children's houses is that very high levels are observed in some allergic children's houses. The specific consideration for the factors/sources of high concentrations will be needed.

We measured only chemical pollutants in this study. Biological contaminants such as dust mites and mold should be more important for children's allergy than chemicals. We will conduct the measurement study of biological contaminants as well as chemical pollutants, and also investigate the relationship between children's allergy and indoor environment. Also, we must carefully consider time-dependent relationship among indoor environment, house characteristics and incidence of allergy.

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