A Case-control Study of the Effect of Indoor Environments on Health Problems among Japanese Children

Part 1: Outline of Field Survey and Results of Indoor Humidity Evaluations

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1 Introduction

In recent years, the population of Japan has experienced an increase in allergy-type ailments such as asthma and other forms of respiratory distress, particularly among members of the younger generation. While the reasons behind this upsurge in allergy-type symptoms are not yet well understood, it is deemed likely that indoor environmental conditions provide some of the strongest contributory factors. Therefore, an epidemiology study was conducted on the health of 4th and 5th grade school students in Japan. The study was divided into three phases, the first of which was a field survey that investigated the prevalence of adverse health conditions among such students. A case-control study was conducted in the second phase, and in the final phase, field measurements for case-control were performed.

This paper provides an overview of the field survey in final phase, as well as the results of an indoor thermal environment investigation into the case-control groups. Approximately 100 student dwellings, selected from the prior questionnaire survey, were examined during the winter season (November 2008 to February 2009) and during the rainy season (June 2009). The study included measurements of temperature, humidity, VOC, a fungal index (Abe. K. 1996). The case group includes the children who have the symptom of some allergic diseases evaluated by the ATS-DLD interview sheet for the prior survey. The case group accounts for 70% and 60% of the winter and rainy season investigation, respectively.

2 Measurement Methods

During the study, measurements were taken on indoor temperature, humidity, concentrations of VOC and mite allergens in the collected house dust. Measurement kits were sent to each dwelling selected for examination. Residents were requested to set up the equipment in specific locations. Some dwellings were visited by investigators who collected airborne fungi using an air sampler, and house dust from floor surfaces using a special vacuum cleaner. All measurements were conducted in the living room and the children's rooms.

Indoor temperature and humidity: During the winter study period, temperature and humidity sensors were placed near the centers (approximately 1.0 m above the floor surface) and at the northeast corners of both the living rooms and children's rooms. The total number of measurement points per dwelling was set at

four. During the rainy season study period, the sensors were only placed near the center of the living rooms and the children's rooms. Temperatures and humidity levels were monitored for two to four weeks during the measurement period. The measured data was recorded every 10 minutes.

Concentration of VOC: In order to measure the concentration of chemical compounds in the rooms under examination, two chemical samplers were suspended from the ceiling. These samplers passively absorbed indoor air over a 24 hour period.

Concentration of dust mite allergens: House dust was collected from a 1 m^2 floor area using a special vacuum cleaner for a two minute period. The concentrations of Group-1 allergens (i.e. Der f1 and Der p1) derived from mite excrement particles were analyzed using the ELIZA method.

3 Results of Indoor Humidity Analysis

Figure 1 shows the statistical values obtained from an analysis of the relative humidity (RH) levels detected in the living rooms and children's rooms during the winter. It shows that RH levels in the children's rooms were higher than those found in the living rooms during each month studied, and that the average RH level of the case group exceeded that of the control group in December. Even though the mean RH levels of the living rooms showed similar values for the months of November and February, the differences between the maximum and minimum values were greater in the case group.

Dwellings that showed RH ratios in excess of 70%rh during the measurement periods were divided into case and control groups. These are shown in Figure 2 along with their percentile rankings. It has been reported that RH levels of 70% and above will influence the growth rate of various types of mold. Figure 2(a) shows the results recorded for the northeast corners of the living rooms investigated. The differences between the case and the control groups were substantial, as it was confirmed that the RH excess rate of the case group was higher than that of the control group in 50% of the dwellings examined. Statistically, this case group value (t-test) is significantly higher than the control group ($p<0.05$). It was also found that, during rainy season examination period (Figure 2(b)), the overall values of the case group in the vicinity of the living room centers tended to be higher ($p<0.2$) than those of the control group.

4 Conclusions

The results of our study showed that the number of case group dwellings with residents suffering from allergy-type ailments tended to be higher than the control group when the ratio of RH levels exceeded 70%rh. In particular, it was determined that the ratio of RH levels exceeding 70%rh near the floor area of the living rooms was significantly higher in the case group than in the control group.

Abe K., et al. 1996. Assessment of Indoor Climate in an Apartment by Use of a Fungal Index. *Applied and Environmental Microbiology*, Vol. 62, pp. 959-963

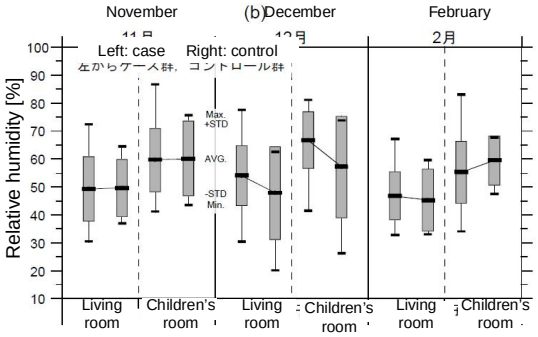
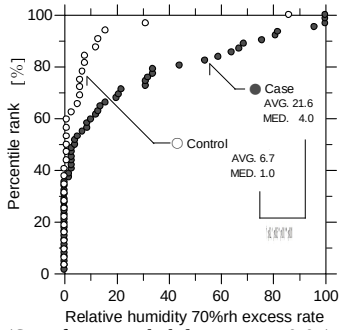


Figure 1: Statistical values of the indoor humidity in winter.

(a) Northeast corner of living room in winter



(Significant probability: **, $p<0.05$)

(b) Center of living room in rainy season

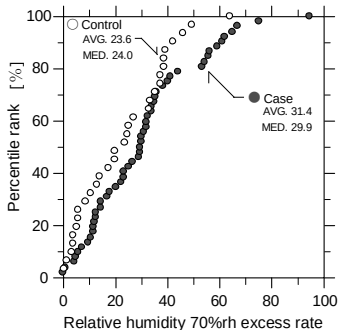


Figure 2: Percentile rankings of dwellings with RH rates exceeding 70%