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# MEASUREMENT AND EVALUATION OF INDOOR AIR QUALITY OF CHILDREN WITH ASTHMA AND ATOPIC DERMATITIS

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**Abstract- Background: Asthma has been identified as respiratory symptoms such as difficulty breathing, chest tightness, and coughing. Asthma is a chronic airway inflammatory disease characterized by reversible expiratory airflow limitation and changes in pulmonary function. It is necessary to cope. Finally, unlike outdoor air pollution, indoor air pollution can be an important goal to prevent the deterioration of asthma by controlling the degree of exposure through environmental improvement. Methods: Asthma severity, According to the 2010 GINA guideline (Global Strategy for Asthma Management and Prevention up to date 19.3 overview of asthma management). In the first stage, symptoms of hepatic asthma occur less than once a week. We visited 30 households with asthma and allergic rhinitis and measured 7 kinds of indoor harmful substances. The investigated items were temperature, humidity, PM10, PM2.5, CO, total aerobic bacteria, total suspended mold, TVOCs and formaldehyde by light scattering, non-dispersive infrared method and solid adsorption heating method.**
**Results: The mean concentrations of formaldehyde were 47.8 μg/m3, 137.93 μg/m3 for volatile organic compounds, 0.66 ppm for carbon monoxide, 24.83 °C for temperature, 45.62 % for humidity, 31.84 μg/m3 for PM10 and 12.3 μg/m3 for PM10 , Bacteria was 175.93 CFU/m3, and mold was 128.85 CFU/m3. There were 13 asthma and 17 rhinitis. The average concentration of asthma in formaldehyde was 46.1765 μg/㎥ and the average concentration of rhinitis was 49.9231 μg/㎥.**
**Conclusions: Indoor air pollutants are known to be involved in the development and aggravation of asthma by various mechanisms such as oxidative stress, active oxygen production, and interaction with allergens. It is true that there is still no definite basis for the causal relationship between indoor air pollutants and asthma. Further research is needed to determine the effect of indoor air pollutants on asthma.**
**Key words: GINA, Asthma, Indoor air pollutants, Bacteria, Mold**

## 1. INTRODUCTION

Asthma has been identified as respiratory symptoms such as difficulty breathing, chest tightness, and coughing. Asthma is a chronic airway inflammatory disease characterized by reversible expiratory airflow limitation and changes in pulmonary function (1-2). Thus, the prevalence of asthma is increasing worldwide, including Korea, and the deterioration of asthma is detrimental to the quality of life and has a negative impact on the social economy (3-5). In Korea, the main goal is to control asthma symptoms and prevent aggravation of asthma in patients. In addition to respiratory infections, asthma exacerbations can be caused by allergens and occupational exposure, air pollutants, drugs, and exercise. Particularly, particulate matter (PM), ozone (O3), nitrogen dioxide (NO2) and sulfur dioxide (SO2) among air pollutants are known to play an important role in morbidity and worsening of asthma (6-7). In modern times, as the changes in industry and residence increase the time for people to stay indoors from work, home, and school to 80 ~ 90%, they understand how indoor air pollution affects the occurrence and progress of asthma. It is necessary to cope. Finally, unlike outdoor air pollution, indoor air pollution can be an important goal to prevent the deterioration of asthma by controlling the degree of exposure through environmental improvement (8-9).

## 2. MATERIALS AND METHODS

*2.1 Indoor air quality measurement and investigation*

Asthma severity: According to the 2010 GINA guideline (Global Strategy for Asthma Management and Prevention up to date 19.3 overview of asthma management). In the first stage, symptoms of hepatic asthma occur less than once a week. Even if the symptoms worsen, short-term or nighttime asthma symptoms are defined as less than twice a month. In stage 2, mild and persistent symptoms occur more than once a week to less than once a week, or when asthma symptoms worsen, sleep disorder or activity is defined. Night asthma symptoms are defined as more than twice a month. In stage 3, moderate persistence of asthma symptoms occurs every day, and if sleeping and daily activities interfere with deterioration, a short-acting beta 2 agonist is used daily or nighttime asthma symptoms are defined as more than once a week. In stage 4, there is daily persistent asthma symptoms, disability in activities, and very frequent exacerbations or nighttime asthma symptoms.
Indoor air quality in the target household

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We visited 30 households with asthma and allergic rhinitis and measured 7 kinds of indoor harmful substances. The investigated items were temperature, humidity, PM10, PM2.5, CO, total aerobic bacteria, total suspended mold, TVOCs and formaldehyde by light scattering, non-dispersive infrared method and solid adsorption heating method (Table 1). After the measurement, the researchers confirmed the average value of some data of the light scattering and nondispersive infrared methods on the spot. In addition, the samples using the collision method, the solid adsorption heating method and the 2,4-DNPH cartridge were kept at low temperature After bringing it to the laboratory and analyzing it, it sent out "environmental measurement result paper" to each family.

Table 1. Indoor air quality measurement items and methods

| Metrics | How to measure |
|---|---|
| CO | NDIR (non-dispersion infrared method) |
| PM10 | Light scattering type: DT-9881M |
| PM2.5 | light scattering formula: DT-9881M |
| Total floating bacteria | method / (48 hours culture) |
| Total floating mold | attack method / (48 hours culture) |
| Total Volatile Organic Compounds (TVOCs) | 2,4-DNPH cartridge (HPLC analysis) / 30 minutes |
| Formaldehyde | solid adsorption heat method (GC / MS analysis) / 30 minutes |

## 3. STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS 23.0 program. T-test was performed to compare indoor air concentrations of asthma and rhinitis. According to the 2010 GINA guideline for asthma and allergic rhinitis severity, the indoor air quality of 30 persons with disabilities was determined. The air quality of indoor air is compared with the indoor air quality from May to November, 2018.

## 4. RESULTS

*4.1 Average concentration of indoor air of the subject*

The mean concentrations of formaldehyde were 47.8 μg/m3, 137.93 μg/m3 for volatile organic compounds, 0.66 ppm for carbon monoxide, 24.83 ° C for temperature, 45.62 % for humidity, 31.84 μg/m3 for PM10 and 12.3 μg/m3 for PM10 , Bacteria was 175.93 CFU/m3, and mold was 128.85 CFU/m3.

Table 2. Average concentration of indoor air material

| Measuring substance (unit) | N | Minimum | Maximum | Average |
|---|---|---|---|---|
| Formaldehyde (μg/m3) | 30 | 13 | 82 | 47.8 |
| VOCs (μg/m3) | 30 | 26.5 | 440.5 | 137.93 |
| CO (ppm) | 30 | 0 | 1.5 | 0.66 |
| PM10 (μg/㎥) | 30 | 10.4 | 163.7 | 31.84 |
| PM2.5 (μg/㎥) | 30 | 4.5 | 28 | 12.3 |
| Bacteria (CFU/㎥) | 30 | 39.1 | 640.2 | 175.93 |
| Fungi (CFU/㎥) | 30 | 15 | 345.5 | 128.85 |
| Temperature (°C) | 30 | 17.3 | 31.8 | 24.83 |
| Humidity (%) | 30 | 21 | 67.4 | 45.62 |

*4.2 Average concentrations of indoor air in asthma and rhinitis subjects*

There were 13 asthma and 17 rhinitis. The average concentration of asthma in formaldehyde was 46.1765 μg/㎥ and the average concentration of rhinitis was 49.9231 μg/㎥. The average concentration of VOCs in asthma households was 131.5 μg/㎥ and the average concentration of rhinitis households was 146.4 μg/㎥. The average concentration of CO in asthma households was 0.5706 ppm and the average concentration of rhinitis households was 0.7846 ppm. The average concentration of asthma in PM10 was 27.2077 μg/㎥ and the average concentration of rhinitis was 25.382 μg/㎥. The average concentration of asthma in PM2.5 was 11.7154 μg/㎥ and the mean concentration of rhinitis was 12.7529 μg/㎥. The average concentration of asthma in Bacteria was 152.6 CFU/㎥ and the average concentration of rhinitis was 163.8 CFU/㎥. The average concentration of asthma in Fungi was 132.1 CFU/㎥ and the average concentration of rhinitis was 126.4 CFU/㎥.

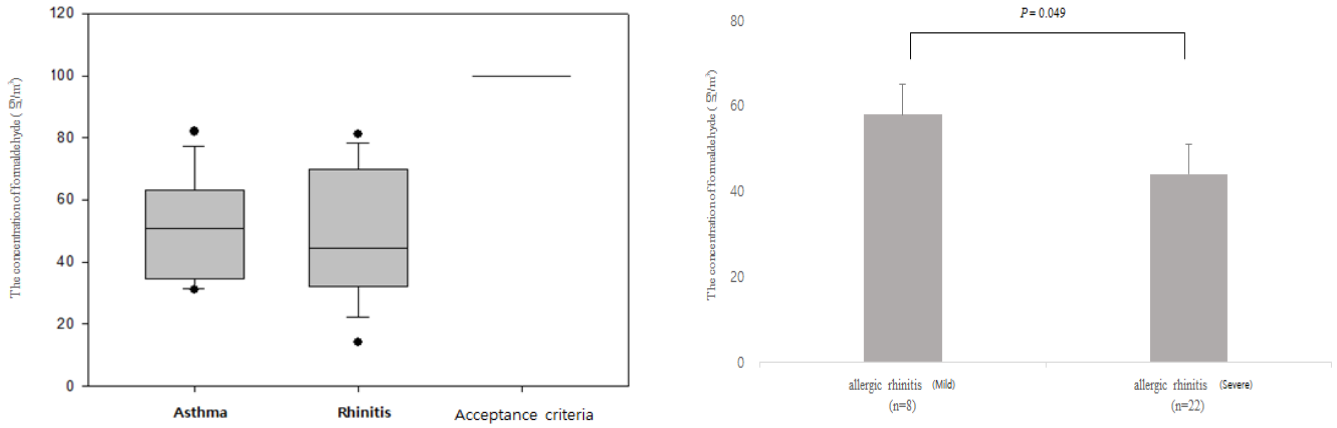


Figure 1. Formaldehyde exposure levels according to statutory limits (left), Statistical significance of rhinitis and rhinitis + asthma (right)

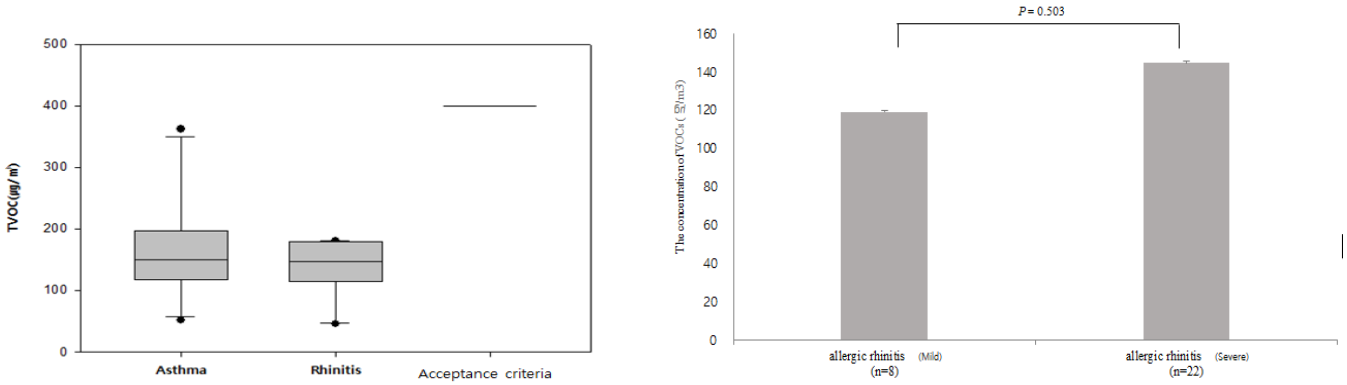


Figure 2. VOCs exposure levels according to statutory limits (left), Statistical significance of rhinitis and rhinitis + asthma (right)

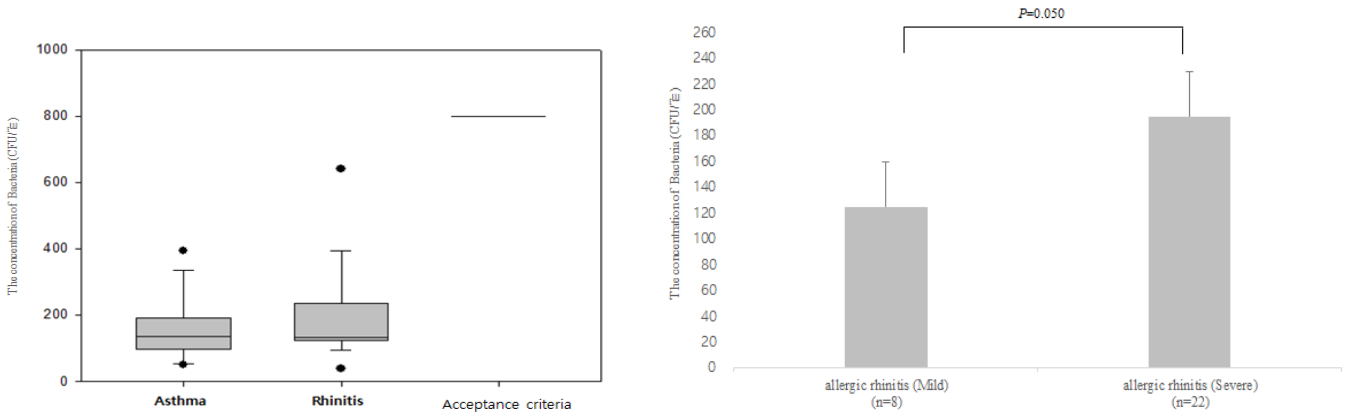


Figure 3. Bacteria exposure levels according to statutory limits (left), Statistical significance of rhinitis and rhinitis + asthma (right)

Comparison of concentration of indoor air materials according to target perfume use

The indoor air quality according to the air purifier is compared. The average concentration of formaldehyde was 51.41 ㎍ / ㎥ and the average concentration of VOCs was 135.72 ㎍ / ㎥. The average concentration of formaldehyde was higher in households using air fresheners in the room.

Table 3. average concentration of indoor air material

| Measured substance (unit) | Use indoor fragrance | N | Mean (95% IC) | p-value |
|---|---|---|---|---|
| Formaldehyde ($\mu$g/m3) | No | 8 | 37.88 (27.54-48.20) | 0.0384 |
| | Yes | 22 | 51.41 (42.5019-60.32) | |
| VOCs ($\mu$g/m3) | No | 8 | 144.24 (56.77-231.61) | 0.8404 |
| | Yes | 22 | 135.72 (96.66-174.65) | |

## 5. DISCUSSION

Modern people are spending a lot of time indoors, and deterioration of indoor air quality due to indoor air pollutants can be chronic exposure even at low concentrations, which can have more serious health effects than outside air pollution. Indoor air pollutants are known to be involved in the development and aggravation of asthma by various mechanisms such as oxidative stress, active oxygen production, and interaction with allergens. Based on this, management of indoor air pollutants to reduce exposure to air quality, and air purifiers are used to control symptoms of asthma through chemical and biological factors. This resulted in clinical results that reduced the deterioration of the results of this study. In addition, although the characteristics of the family and the frequency of individual exposure may be different, some studies have attempted to confirm the effect of reducing the prevalence of asthma as a primary prevention through a consistent multidisciplinary intervention program. However, it is true that there is still no definite basis for the causal relationship between indoor air pollutants and asthma. Further research is needed to determine the effect of indoor air pollutants on asthma.

## 6. CONCLUSION

In this study, we found that exposure to various harmful environments is very serious because of the severity of asthma and living in the indoor environment centered on general patients. Continuous exposure to harmful factors can contribute to an increase in causes and exacerbations of various chronic diseases. Recently, we have demonstrated the improvement effect of asthma and atopic dermatitis symptom through programs such as education of allergic diseases and improvement of living environment in a study on prevention and management of atopic diseases centering on local governments in Korea. This environmental improvement management will have the effect of reducing the disease cost and disease prevalence. In conclusion, it is known that relatively high exposure to biochemical contamination due to exposure to fungi and one chemical substance is observed in Korea. If more research is needed in the future and if the relationship is clarified, more intensive and selective management of children and appropriate environmental improvement management can contribute to the reduction of diseases such as asthma and rhinitis through establishment of environmental health policy.

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