International Journal of Latest Trends in Engineering and Technology
Vol.(12)Issue(4), pp.009-013
DOI: http://dx.doi.org/10.21172/1.124.03
e-ISSN:2278-621X

ASSESSMENT OF ENVIRONMENTAL POLLUTION FACTORS IN INDOOR AIR OF DAYCARE CENTERS IN SEOUL BASED ON IOT

Kil Yong Choi[1], Seong min Han[2]

Abstract- Background: Indoor air pollutants have been regulated since 1980 and the importance of indoor pollutants is increasing. Asthma and atopy are known to be infant and childhood diseases. According to the data of National Health Insurance Corporation, 43.2% of asthmatic patients are children under 12 years of age, and atopic dermatitis is high as half of patients and it is more necessary to study asthma in children. Methods: The subjects were (1) home environment measurement of allergic patients and (2) indoor air quality according to interior decoration. In this study, IoT indoor air quality equipment was installed at 3 years of national public nursing homes, 1 day nursery, 3 day nurseries and 2 years old (4 years old). From May 2018 to April 2019, we will carry out measurements for ultra-fine dust, ultrafine dust, fine dust, CO2, VOCs, and temperature and humidity. The data of the measurement is confirmed in real time, and it is downloaded from the central center for analysis. Results: A total of 63,928 data were collected for 5 months, 32,019 in the experimental group and 31,909 in the control group In VOCs, the average concentration of experimental group was 145.80 ㎍/㎥ and the average concentration of control group was 145.20 ㎍/㎥. In CO2, the average concentration value of the experimental group was 681.00 ppm and the average concentration value of the control group was 782.40 ppm. In HCHO, the average concentration value of experimental group was 81.87 ㎍/㎥ and the mean concentration value of control group was 65.85 ㎍/㎥. Conclusions: It is known that fine dusts and chemical harmful substances in the indoor air have a high correlation with allergies such as asthma and aggravation of symptoms of asthmatic patients. As a part of the project to create a dust free environment, IoT-based real-time indoor air quality measurement system was used to collect data. There was a difference in the average concentration value between the experimental group and the control group, and the concentration was higher in the nursery built within the last 1 year. According to recent data, KT recently released open IoT platform collects and analyzes air quality data in 1 minute increments.

Key words: Asthma, Atopy, Indoor air pollutants, IoT(Internet of Things), Childhood

1. INTRODUCTION

There are more than 80 ~ 90% of indoor living in modern residential environment, and various diseases such as asthma and atopic dermatitis occur due to exposure of various chemical and environmental factors (1). Indoor air pollutants have been regulated since 1980 and the importance of indoor pollutants is increasing. Korea has established indoor air quality management law for multi - use facilities in 2004 and has been managing indoor air quality for multi - use facilities. Indoor air pollutants (PM2.5, PM10, VOCs, NOx) have been reported as one of the causes (2-3). Asthma and atopy are known to be infant and childhood diseases. According to the data of National Health Insurance Corporation, 43.2% of asthmatic patients are children under 12 years of age, and atopic dermatitis is high as half of patients and it is more necessary to study asthma in children (4-5). After moving to a new home, the occurrence of patients suffering from allergic diseases, coughing, and asthma was reported. In particular, children and elderly people are more likely to have health effects due to exposure because their residence time in the room is lower than adults. Studies on indoor pollution and health effects including residential space in Korea and abroad have been reported (6-7). It is known that asthma is the first place in the disease burden of boys in Korea. In previous studies, many studies on the exposure of indoor harmful substances and asthma have been reported. Most of them are assessed through indoor harmful substances or health effects. However, there is a lack of research into the relationship between outdoor exposure to pollutants, indoor air pollution, and living conditions (patterns) and asthma. Previous studies have used disease prevalence as a basis for predicting disease.

2. MATERIALS AND METHODS

2.1 Subjects and study design

The subjects were (1) home environment measurement of allergic patients and (2) indoor air quality according to interior decoration. First, the degree of severity of allergic diseases (asthma, rhinitis) visited the hospital and the indoor air quality in the home was investigated. Second, as a part of the pilot project to create a micro dust free environment, we monitored real -

1 Department of Chemical and Biological Engineering, SeoKyeong University
2 Department of Social Welfare, Kyungwoon university, Gyeongsangbuk-do Province, Korea

time indoor air quality in the day care facilities where the interior construction work was carried out and the day care facilities that did not, and the indoor air quality concentration (Figure 1).

3. RESEARCH METHOD OVERVIEW

3.1 Indoor air quality measurement at home

This study was conducted to investigate indoor air pollutants in children by using asthma and allergic rhinitis by using light scattering, nondispersive infrared method and solid adsorption heating method. The indoor air quality of asthma and rhinitis patients was measured and the difference of indoor air quality between asthma and rhinitis home was compared. Results of measurement were sent to asthmatic and rhinitis patients.

3.2 Creating a fine dust-free environment, child care pilot project

In this study, IoT (Internet of Things) indoor air quality equipment was installed at 3 years of national public nursing homes, 1 day nursery, 3 day nurseries and 2 years old (4 years old). The criteria for selection were selected from 3 kindergartens (experimental group) that performed the interior work within the last 1 year among the nursery schools received through the Nursing General Support Center in Seoul, and 4 kindergartens (control group) that did not perform the interior work within the last 3 years Respectively.

Figure 1. Target Nurseries Indoor Air Quality Measurement Equipment (IAQ Monitor EM200I)

4. METRICS

From May 2018 to April 2019, we will carry out measurements for ultra-fine dust, ultrafine dust, fine dust, CO2, VOCs, and temperature and humidity (Table 2). The data of the measurement is confirmed in real time, and it is downloaded from the central center for analysis.

5. STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS 23.0 program. T-test was performed to compare indoor air concentrations of asthma and rhinitis. SPSS 23.0 was used for the data of making the nursery environment without fine dust. The concentration of indoor air quality in the experimental group (day care center) and the control group (day care center without interior construction) were measured. We compared indoor air quality of experimental group and control group only for the period from May to October.

6. RESULTS

6.1 Comparison of average concentration of indoor air materials in classroom

From June to October, 2018, 7 out of 12 children's houses were selected and 6 indoor air substances in the classrooms were measured. The experiment group (n = 3) in the 7 day care centers was the daycare center that constructed the interior work within 1 year, and the control group (n = 4) was the daycare center that had more than 3 years since the construction of the interior work. A total of 63,928 data were collected for 5 months, 32,019 in the experimental group and 31,909 in the control group In VOCs, the average concentration of experimental group was 145.80 ㎍ / ㎥ and the average concentration of control group was 145.20 ㎍ / ㎥. In CO2, the average concentration value of the experimental group was 681.00 ppm and the average concentration value of the control group was 782.40 ppm. In HCHO, the average concentration value of experimental group was 81.87 ㎍ / ㎥ and the mean concentration value of control group was 65.85 ㎍ / ㎥.

Table 1. Comparison of average concentration of indoor air materials in classroom

		N	Median	Min	Max	p-value
Radon	case*	28754	-0.96	-2.30	1.50	0.191

	contro**	4258	0.39	-2.30	2.07	
PM2.5	case	7992	1.75	-2.30	5.61	0.915
	control	9438	1.41	-2.30	6.91	
PM10	case	7992	2.14	-2.30	6.17	0.859
	control	9438	1.77	-2.30	6.91	
VOCs	case	7992	4.96	4.83	6.40	<0.001
	control	9325	5.00	4.83	6.40	
CO2	case	7992	6.44	5.99	8.24	<0.001
	control	9581	6.54	5.99	8.21	
HCHO	case	6568	3.53	0.00	7.07	0.007
	control	8169	3.85	0.00	7.15	

Case: Interior construction within one year a child care center(+)
Control: Interior construction within one year a child care center(-)

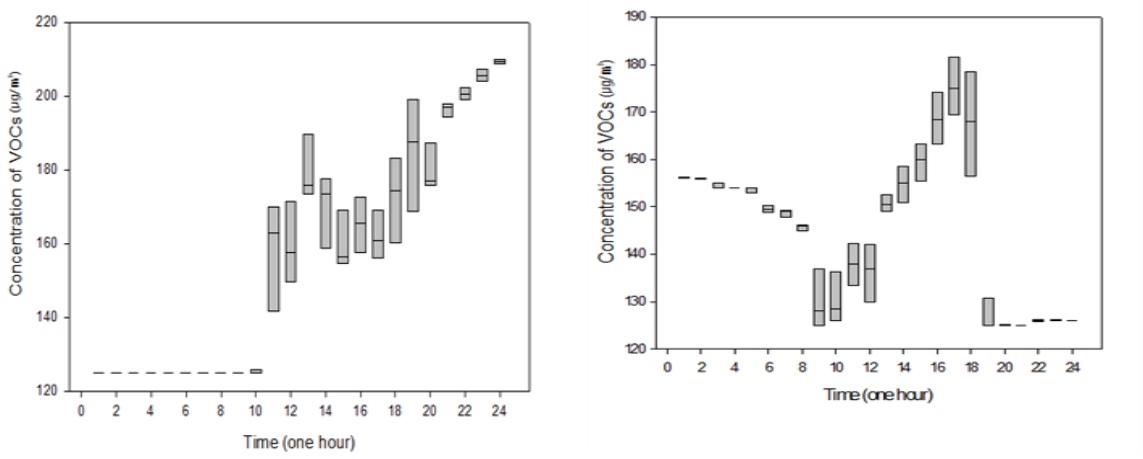

Figure 2. Day care 24 hours VOCs concentration Case (left), Control (right)

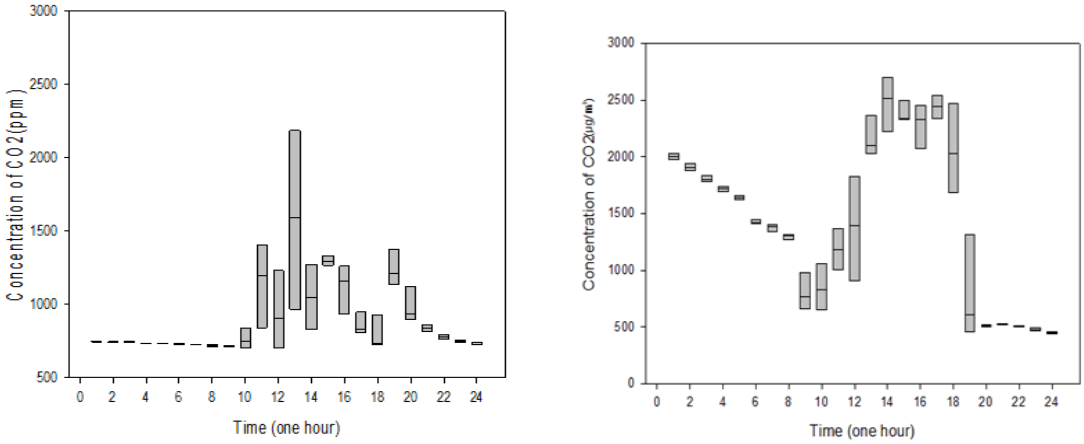

Figure 3. Day care 24 hours CO2 concentration Case (left), Control (right)

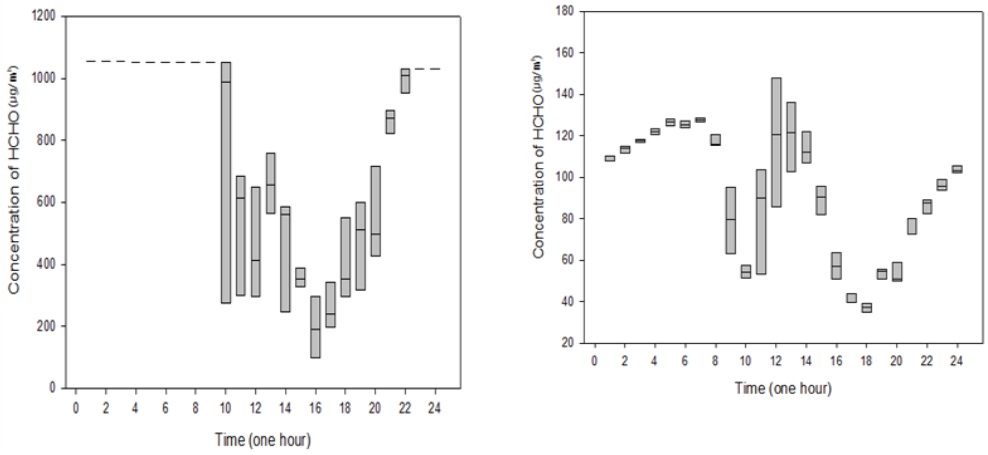

Figure 4. Day care 24 hours HCHO concentration Case (left), Control (right)

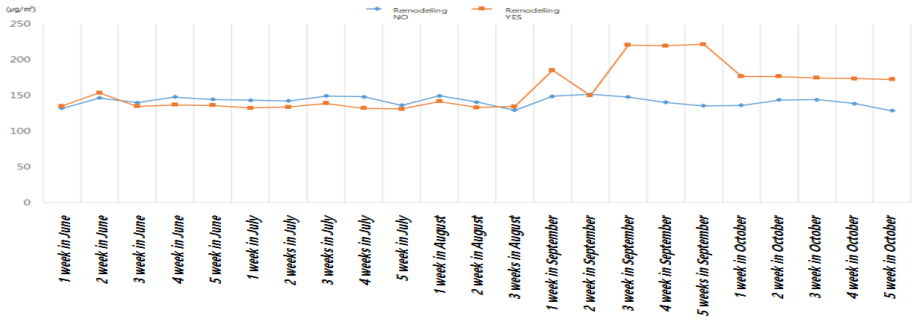

Figure 5. Remodeling day care 24 hour VOC concentration

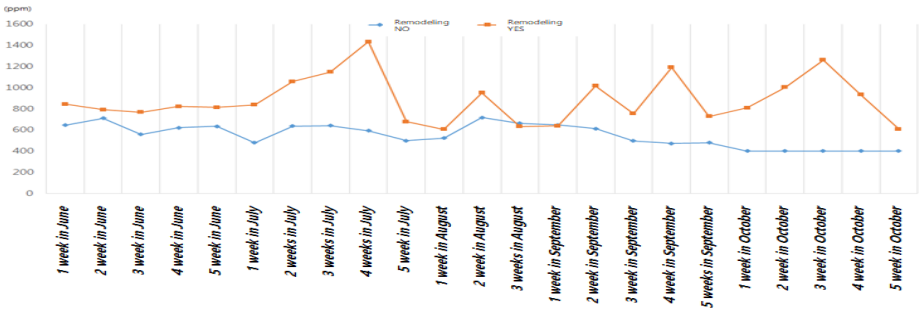

Figure 6. Remodeling day care 24 hour CO2 concentration

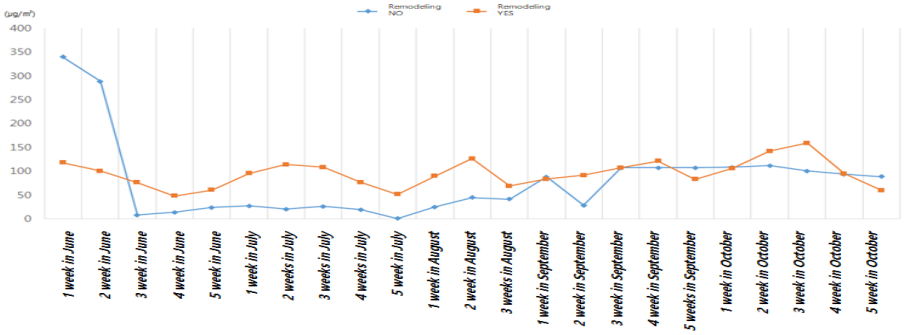

Figure 7. Remodeling day care 24 hour HCHO concentration

7. DISCUSSION

It is known that fine dusts and chemical harmful substances in the indoor air have a high correlation with allergies such as asthma and aggravation of symptoms of asthmatic patients. Therefore, systematic and continuous monitoring of

environmental harmful factors and symptoms is very necessary for prevention of disease outbreak and symptom deterioration. As a part of the project to create a dust free environment, IoT-based real-time indoor air quality measurement system was used to collect data. However, due to problems such as equipment defect, were collected and the abnormal values were summarized. Among the 7 day care centers, the average concentrations of the measured substances (radon, PM10, PM2.5, VOCs, HCHO) except for CO2 were higher than those in the place where the interior was installed within 1 year. There was a difference in the average concentration value between the experimental group and the control group, and the concentration was higher in the nursery built within the last 1 year. According to recent data, KT recently released open IoT platform collects and analyzes air quality data in 1 minute increments. Air purifier, and artificial rain drones. It also collects 24-hour BIG data to measure fine dust and chemical factors to improve the quality of life and reduce pollution. Inform the users of the environment. Comparing and analyzing outdoor data and indoor measurement data installed in Seoul and 1500 cities of 6 metropolitan cities will be useful for establishing a practical air quality response system by linking with various air quality monitoring networks.

8. CONCLUSION

This study investigates the indoor air quality according to the characteristics of living space and remains in the technical statistical analysis. However, it is necessary to analyze the correlations and predictability by presenting the correlation between IoT measurement data and the air pollution index of the relevant area. In conclusion, it has been confirmed that the environmental factors of indoor air quality and asthma disease have a direct effect, and various management such as ventilation according to management time and management time are needed.

9. REFERENCES

[1] Ahn, K., The role of air pollutants in atopic dermatitis, Journal of Allergy and Clinical Immunology, 2014;134(5):993-999.

[2] Kim, H. O., Kim, J. H., Cho, S. I., Chung, B. Y., Ahn, I. S., Lee, C. H., Park, C. W., Improvement of atopic dermatitis severity after reducing indoor air pollutants, Annals of Dermatology, 2013;25(3):292-297.

[3] Moon, K. W., Byeon, S. H., Choi, D. W., Kim, Y. W., Lee, J. H., Lee, E. I., Exposure assessments on biological contaminants in homes of allergy patients-bacteria, fungi, house dust mite allergen and endotoxin, Korean Journal of Environment Health sciences, 2005;31(2):120-126.

[4] Ahn, K., Kim, J., Kwon, H. J., Chae, Y., Hahm, M. I., Lee, K. J., Park, Y. M., Lee, S. Y., Han, M., Kim, W. K., The prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in Korean children: Nationwide cross-sectional survey using complex sampling design, Journal of the Korean Medical Association/Taehan Uisa Hyophoe Chi, 2011;54(7):769-778.

[5] Kim, H. O., Kim, J. H., Cho, S. I., Chung, B. Y., Ahn, I. S., Lee, C. H., Park, C. W., Improvement of atopic dermatitis severity after reducing indoor air pollutants, Annals of Dermatology 2013;25(3):292-297.

[6] Yoon, S. h., Bae, G. N., Lee, B. W., Ji, J. H., Antifungal Characteristics of Metallic Nanoparticles against Indoor Fungi, Journal of Korean Society for Indoor Environment, 2007;4(2):154-162.

[7] Lim, Y. W., Yang, J. Y., Kim, H. H., Lee, Y. G., Kim, Y. S., Jang, S. K., Sohn, J. R., Roh, Y. M., Shin, D. C., Health risk assessment in terms of VOCs at newly-built apartment house, Journal of Korean Society for Indoor Environment, 2006;3(3):211-223.