A Study on the field survey of the IAQ

in the childcare center

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Abstract

Child care center, one of the public facilities, has recently been increased. It is because of the government's childbirth policy. In particular, infants and children who use this place are frequently exposed in danger because of their biological characteristics. They stay in child care center over 7 hours a day in average. Therefore, the importance of the child care center's indoor air has been increased. Thus, survey and investigation of the child care center's indoor air are conducted in this study. Moreover, preliminary data will be suggested for management of the child care center's indoor air quality. The measurement items are PM_{10}, Asbestos, CO, CO_2, NO_2, VOCs, HCHO, Rn and Ozone. And fact finding was conducted in 30 child care centers. Moreover, the survey about the consciousness and administration of satisfaction and interest in indoor air quality targeting 161 teachers who worked in child care centers.

Keywords: Indoor air quality, childcare center, survey

Introduction

1.1 Purpose of Study

Modern men spend 80~90% of their days inside and the matter regarding indoor air pollution is becoming a big social issue due to increment of building airtightness according to energy saving, despite the recent increasing use of construction materials using complex chemicals. The number of patients with environmental disease such as Sick House Syndrome (SHS) has increased from 5.52 million in 2002 up to 7.14 million in 2007. Due to increasing concerns for Well-being, along with the recognition of social issue, the importance of managing building indoor air quality is becoming greater.

Childcare center is a facility expending according to the government’s childbirth policy. The importance of indoor air of childcare centers will especially be important, since there is a high possibility for infants at childcare centers to suffer fatal diseases from very little germs, for they are in the stage of full physical growth and their immunity is inferior to that of ordinary grown-ups.

Hence this study carried out research on the actual condition as well as survey centering 5 items of indoor air quality maintenance standard, targeting childcare centers, and attempted to apply such as the foundation for preparing system and policy to protect environment and health of future childcare centers.

1.2 Method and Procedure of Study

The study is to investigate the indoor air condition of childcare centers and suggest basic data for indoor air condition of childcare centers based on such. The following is the summary of the study's procedure.

1) Research on the actual indoor air condition of childcare centers

To investigate the indoor air condition of childcare centers through investigation of actual childcare centers, temperature, humidity and 5 matters of indoor air quality maintenance standard according to the "Law Of Indoor Air Quality Control In Crowd Facilities" were measured on the spot at 30 childcare centers in Dongjak-gu, Seoul.

2) Survey targeting childminders

Targeting 161 childminders of the relevant childcare centers, 26-question survey questioning degree of satisfaction, awareness, detectable symptoms regarding indoor air quality as well as childcare center management and awareness of indoor air quality improvement was carried out.

3) Study on current indoor air condition of childcare centers

Based on the result of survey targeting childminders and indoor air quality measurement of childcare center, characteristics of current indoor air quality condition of the childcare centers were analyzed.

Measurement of air quality of interior facility

2.1 Outline of measurement

The study simultaneously carried out survey and field measurement on indoor air pollutant to inspect the actual condition of indoor air condition of childcare centers. Items to measure for indoor air quality are classified into thermal environmental factor and contaminating factor; temperature, humidity and 5 matters of indoor air quality maintenance standard of crowd facilities were measured. When collecting samples, it measured in nursing rooms where the most facility users are with the same general environmental condition as the relevant in nursing rooms, in daytime. The outline of field measurement of indoor air quality and its measurement items and instruments are shown in Table 1.

Table 1 Outline of intdoor air quality measurement

Classification	Contents
Measurement subject	30 childcare centers in Dongjak-gu (15 Public childcare centers, 15 Private childcare centers)
Measurement period	4. 3. 2009. ~ 6. 5. 2009.
Measurement items	maintenance standard of indoor air quality of crowd facility for 5 contaminants (PM_{10}, CO_2, HCHO, TBC, CO)
Measurement method	Ministry of Environment Notification No. 2004-80 Based on the official test method of indoor air quality

Measurement items	Measurement instrument	Sample collection method and time
Formaldehyde (HCHO)		Flow velocity of 700mL/min, DNPH In DNPH cartridge for 30minutes Collect and analyze with HPLC analysis

Total Bacteria Colony (TBC)		Measure 2 times for 30 minutes with total collection amount of 450L using Air Sampler
Carbon dioxide (CO_2)		Measure for 1 hour using AIRBOXX
Particle Matter (PM_{10})		Microvolt 1100 Low Measure for 8 hours using Flow-Rate Air Sampler with velocity of 3mL/min
Carbon monoxide (CO)		Measure for 1 hour using carbon monoxide measuring instrument
Temperature and Humidity		Measure the average in time zone of 9~11

2.2 Measurement result

The condition of temperature and humidity of each measured childcare center is shown in Table 2. And the result of 5 matters of indoor air quality maintenance standard of crowd facilities is shown in Table 3, Table 4, Table 5, Table 6 and Table 7.

Table 2 Measurement result of temperature and humidity of childcare center (℃,%)

Classification	Heukseok H		Heukseok K		Daebang B	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	24.8	32.9	24.6	26.7	22.2	31.1
Outdoor	15.7	38.7	14.8	34.8	20.6	35.4
Classification	Daebang E		Noryangjin N		Sangdo B	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	25.1	28.5	25.9	27.4	25.2	61.7
Outdoor	22.9	25.3	28.6	25.3	23.3	60.2
Classification	Sadang Y		Sadang M		Daebang S	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	26.5	33.2	20.9	47.2	21.4	49.9
Outdoor	24.9	31.6	15.5	48.5	24.6	46.3
Classification	Dongjak C		Sangdo R		Sangdo G	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	24.9	44.7	23.5	53.2	24.8	44.8
Outdoor	27.6	41.5	25.3	43.3	26.8	42.3
Classification	Sadang D		Sadang K		Sadang C	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	20.5	45.0	26.8	24.9	24.9	24.9
Outdoor	15.4	50.2	16.8	37.8	17.9	32.5
Classification	Sangdo H		Sadang H		Sangdo J	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	24.0	45.3	28.1	28.4	27.7	24.0
Outdoor	25.6	38.5	30.6	23.2	31.2	22.5

Classification	Sindaebang G		Sindaebang B		Sangdo L	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	22.3	37.2	27.6	24.3	26.0	51.7
Outdoor	21.7	30.7	23.6	28.5	25.6	52.6
Classification	Sangdo N		Daebang K		Sindaebang L	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	27.5	33.4	21.3	42.1	23.2	35.8
Outdoor	28.1	26.4	24.6	38.3	22.9	25.3
Classification	Sadang O		Sindaebang Y		Sangdo S	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	29.7	32.5	27.5	32.8	29.4	32.6
Outdoor	31.2	28.6	28.3	28.5	31.3	23.4
Classification	Sadang M2		Noryangjin D		Sangdo N2	
	Temperature	Humidity	Temperature	Humidity	Temperature	Humidity
Indoor	27.4	42.8	26.2	36.3	26.2	49.8
Outdoor	27.8	32.3	30.4	32.0	29.2	26.3
Classification	Temperature		Humidity			
Indoor	25.2		37.5			
Outdoor	24.4		35.0			

Table 3 Measurement result of particle matter of childcare center (㎍/㎥)

Childcare centers	Heukseok H	Heukseok K	Daebang B	Sindaebang G	Sindaebang B	Sadang D	Sadang K	Sadang C
Indoor 1	27.8	25.9	41.7	26.3	44.4	55.6	41.7	40.7
Childcare centers	Daebang E	Noryangjin N	Sangdo B	Sangdo L	Sangdo N	Sangdo S	Sadang M2	Sangdo H
Indoor 1	76.2	67.8	45.5	55.6	38.5	46.3	43.3	41.7
Childcare centers	Sadang Y	Sadang M	Daebang S	Daebang K	Sindaebang L	Sadang H	Sangdo J	Noryangjin D
Indoor 1	18.5	37.8	64.2	80.6	47.2	36.3	112.4	34
Childcare centers	Dongjak C	Sangdo R	Sangdo G	Sadang O	Sindaebang Y	Sangdo N2	Average	
Indoor 1	37.6	46.4	75	52	39.2	41	48.04	

Table 4 Measurement result of carbon dioxide of childcare center (ppm)

Childcare centers	Heukseok H	Heukseok K	Daebang B	Sindaebang G	Sindaebang B	Sadang D	Sadang K	Sadang C
Indoor 1	851	518	568	568	682	780	507	437
Indoor2	985	678	342	560	615	352	440	764
Outdoor	335	336	347	342	336	342	339	352
Childcare centers	Daebang E	Noryangjin N	Sangdo B	Sangdo L	Sangdo N	Sangdo S	Sadang M2	Sangdo H
Indoor 1	1348	611	647	501	623	773	690	690

Indoor2	1498	1548	586	640	704	887	622	890
Outdoor	345	339	346	337	341	329	340	336
Childcare centers	Sadang Y	Sadang M	Daebang S	Daebang K	Sindaebang L	Sadang H	Sangdo J	Noryangjin D
Indoor 1	934	844	786	936	801	870	848	1345
Indoor2	947	424	737	1137	909	862	548	847
Outdoor	346	332	326	332	341	326	335	329
Childcare centers	Dongjak C	Sangdo R	Sangdo G	Sadang O	Sindaebang Y	Sangdo N2	Average	
Indoor 1	535	902	1001	1504	755	1710	818.8	
Indoor2	815	964	1118	972	632	1162	806.2	
Outdoor	323	331	327	345	323	335	336.4	

Table 5 Measurement result of formaldehyde of childcare center (㎍/㎥)

Childcare centers	Heukseok H	Heukseok K	Daebang B	Sindaebang G	Sindaebang B	Sadang D	Sadang K	Sadang C
Indoor 1	35.8	20.55	20.77	26.57	17.65	42.4	22	23.6
Indoor2	37.26	25.19	23.15	21.25	13.53	47.5	27.8	26.2
Childcare centers	8.84	12.25	9.36	15.85	14.5	11.85	11.5	10.8
Childcare centers	Daebang E	Noryangjin N	Sangdo B	Sangdo L	Sangdo N	Sangdo S	Sadang M2	Sangdo H
Indoor 1	26.65	20.48	41.91	23.51	43.19	53.37	36.6	76
Indoor2	25.39	44.98	24.73	19.34	48.78	31.22	42.3	79.51
Childcare centers	8.25	15.3	14.3	12.8	11.5	12.3	8.3	13.9
Childcare centers	Sadang Y	Sadang M	Daebang S	Daebang K	Sindaebang L	Sadang H	Sangdo J	Noryangjin D
Indoor 1	49.15	80.13	20.84	43.25	67.72	69.26	83.5	53.2
Indoor2	53.39	23.68	27.38	70.33	20.93	57.58	60.7	67.5
Childcare centers	13.34	12.26	13.7	11.5	12.62	15.84	16.52	22.48
Childcare centers	Dongjak C	Sangdo R	Sangdo G	Sadang O	Sindaebang Y	Sangdo N2	Average	
Indoor 1	81.42	45.4	25.9	42.3	35.93	61.7	43.0	
Indoor2	78.53	78.18	19.64	56.3	46.58	59.3	41.9	
Childcare centers	15.76	16.72	14.67	12.3	10.9	26.3	13.5	

Table 6 Measurement result of total bacteria colony of childcare center (CFU/㎥)

Childcare centers	Heukseok H	Heukseok K	Daebang B	Sindaebang G	Sindaebang B	Sadang D	Sadang K	Sadang C
Indoor 1	88	29	238	32	28	34	70	289
Indoor2	8	5	230	33	18	19	174	58
Childcare centers	Daebang E	Noryangjin N	Sangdo B	Sangdo L	Sangdo N	Sangdo S	Sadang M2	Sangdo H
Indoor 1	134	119	153	96	78	106	720	215
Indoor2	113	85	85	80	57	64	500	148
Childcare centers	Sadang Y	Sadang M	Daebang S	Daebang K	Sindaebang L	Sadang H	Sangdo J	Noryangjin D

Indoor 1	179	150	210	139	121	100	236	594
Indoor2	97	22	131	129	101	218	379	566
Childcare centers	Dongjak C	Sangdo R	Sangdo G	Sadang O	Sindaebang Y	Sangdo N2	Average	
Indoor 1	260	153	44	290	220	553	189.2	
Indoor2	120	147	54	494	330	347	160.4	

Table 7 Measurement result of carbon monoxide of childcare center (ppm)

Childcare centers	Heukseok H	Heukseok K	Daebang B	Sindaebang G	Sindaebang B	Sadang D	Sadang K	Sadang C
Indoor 1	0.35	0.25	0.62	0.64	0.4	0.72	0.4	0.35
Indoor2	0.33	0.22	0.72	0.46	0.35	0.45	0.25	0.34
Outdoor	0.32	0.21	0.33	0.3	0.38	0.4	0.29	0.31
Childcare centers	Daebang E	Noryangjin N	Sangdo B	Sangdo L	Sangdo N	Sangdo S	Sadang M2	Sangdo H
Indoor 1	0.32	0.4	0.63	0.4	3.04	0.59	0.46	0.19
Indoor2	0.31	0.3	0.56	0.6	1.28	0.64	0.43	0.2
Outdoor	0.28	0.32	0.38	0.41	0.45	0.41	0.37	0.17
Childcare centers	Sadang Y	Sadang M	Daebang S	Daebang K	Sindaebang L	Sadang H	Sangdo J	Noryangjin D
Indoor 1	0.63	0.39	0.34	0.75	0.37	0.22	0.54	0.49
Indoor2	0.54	0.31	0.18	0.44	0.47	0.06	0.47	0.52
Outdoor	0.31	0.28	0.17	0.32	0.28	0.19	0.25	0.34
Childcare centers	Dongjak C	Sangdo R	Sangdo G	Sadang O	Sindaebang Y	Sangdo N2	Average	
Indoor 1	0.13	1.09	0.45	0.35	0.31	0.53	0.55	
Indoor2	0.1	0.75	0.54	0.42	0.28	0.58	0.44	
Outdoor	0.1	0.35	0.37	0.28	0.2	0.4	0.31	

2.3 Discussion

In this chapter, the actual condition of indoor air pollution of childcare centers was to be grasped by analyzing the result of field measurement of 5 pollutants, the indoor air quality maintenance standard of childcare center. The measurement result can be summarized like the following.

1) Among indoor air quality maintenance standard items of childcare center, formaldehyde (HCHO), total bacteria colony (TBC) and carbon monoxide (CO) showed distributions within the limit. Also, as for particle matter (PM_{10}), all facilities, except one with many occupants, were measured to be in less than the limit, showing fair indoor air condition of childcare centers. It is judged to be by the regular cleaning and management of air cleaner use for clean environment maintenance.

2) In case of carbon dioxide (CO_2), the number of relatively many occupants in 6 childcare centers exceeded the limit and it is thought that maintenance of the appropriate number of occupants indoors to be more necessary for childcare center management.

Survey on indoor air quality of childcare facility

3.1 Outline of survey

Unlike other large scale crowd facilities like subway station, hospital and stores, professional indoor air condition management is difficult for childcare center, thus duties of childminders at childcare centers are greater in managing indoor air condition. Hence, survey subjecting 161 childminders of 30 childcare centers in Dongjak-gu was taken place to minutely inspect the actual indoor air condition. Items of the survey were related to general characteristics of childminders and indoor air pollution. The survey subjecting 161 childminders of the relevant childcare centers was carried out along with indoor air pollutant measurement and took the method

of self-responding and withdrawing. The questionnaire was constituted of 26 questions researcher revised and supplemented based on the existing questionnaire regarding indoor air quality and the contents are like the following.

1) General characteristics of childminders such a gender, age, educational background, work experience, physical condition and matter of education: 6 questions
2) Childminders' degree of interest and satisfaction in indoor air quality: 6 questions
3) Physical detectable symptoms of childminders: 3 questions
4) Childminders' awareness of indoor air quality improvement: 3 questions
5) Actual management condition of indoor air quality of childcare facility: 8 questions

3.2 Result of survey

Table 8, Table 9, Table 10, Table 11 and Table 12 show the survey result.

Table 8 General characteristics of childminders

(n=161)

Characteristics		n(%)
Gender	Female	161(100.00)
Age	Under 30	104(64.60)
	30 ~ 39	43(26.70)
	Above 40	14(8.70)
Educational background	High school graduate	12(7.45)
	Junior college graduate	77(47.83)
	College student and graduate	65(40.38)
	Masters course enrollment and higher	7(4.35)
Major at final school	Childcare	34(20.86)
	Early Childhood Education	62(38.04)
	Social Welfare	18(11.04)
	Paedology	26(15.95)
	Home Management	4(2.45)
	Education	3(1.84)
	Other	16(9.82)
Work experience	Less than 4 years	79(49.07)
	4 years or more	82(50.93)
Physical condition	Healthy	115(71.43)
	Worse than average	46(28.57)
Does indoor air quality influence education?	Yes	32(19.88)
	No	129(80.12)

※†: Multiple responses

Table 9 Childminders' degree of interest and satisfaction in indoor air quality

(n=161)

Characteristics		n(%)
Satisfaction in indoor air quality	Very unpleasant	0(0.00)
	Unpleasant	3(1.86)
	Average	53(32.92)
	Pleasant	90(55.90)
	Very pleasant	15(9.32)
Total		161(100.00)
Urge to check the actual condition of air quality of the childcare center	Have	122(75.78)
	Don't have	38(23.60)
	No response	1(0.62)
Total		161(100.00)
Influence air pollution of childcare center has on body	No influence at all	1(0.62)
	Not much influence	18(11.181)
	Average	32(19.88)
	Influence in general	79(49.07)

	Great influence	31(19.25)
Total		161(100.00)
Which is worse: outdoor air pollution or indoor air pollution	Outdoor air pollution	93(57.76)
	Indoor air pollution	68(42.24)
Total		161(100.00)
Indoor air pollutants in knowledge †	Particle matter	149(92.55)
	Ozone	38(23.60)
	Carbon monoxide	55(34.16)
	Carbon dioxide	65(40.37)
	Nitrogen dioxide	22(13.66)
	Formaldehyde	46(28.57)
	Asbestos	85(52.80)
	Radon	12(7.45)
	Volatile Organic Compounds	34(21.12)
	Total Bacteria Colony	41(25.47)
	Other	1(0.62)

※†: Multiple responses

Table 10 Physical detectable symptoms of childminders

(n=161)

Characteristics	n(%)				
General symptoms †					
	Always	Often	Average	Sometimes	None
Inflamed eye	6(3.7)	7(4.3)	20(12.4)	30(18.6)	98(60.9)
Itchiness/ sting in eye	4(2.5)	10(6.2)	18(11.2)	42(26.1)	87(54.0)
Headache	1(0.6)	19(11.8)	20(12.4)	42(26.1)	79(49.1)
Dizziness/ vertigo	1(0.6)	12(7.5)	18(11.2)	28(17.4)	102(63.4)
Respiratory disease	2(1.2)	14(8.7)	19(11.8)	25(15.5)	101(62.7)
Vomiting/ nauseous	0(0.0)	4(2.5)	13(8.1)	14(8.7)	130(80.7)
Cough/ sneeze	5(3.1)	12(7.5)	31(19.3)	64(39.8)	49(30.4)
Skin irritation	1(0.6)	8(5.0)	11(6.8)	22(13.7)	119(73.9)
Chilling effect	3(1.9)	7(4.3)	13(8.1)	17(10.6)	121(75.2)
Insomnia	1(0.6)	3(1.9)	8(5.0)	7(4.3)	142(88.2)
Chemical smell	0(0.0)	1(0.6)	6(3.7)	12(7.5)	142(88.2)
The time zone when symptoms occur (relevant responders)					
Morning	9(6.72)				
Afternoon	125(93.28)				
Total	134(100.00)				
Visited doctor with such symptoms (relevant responders)					
Yes	45(30.41)				
No	103(69.59)				
Total	148(100.00)				

※†: Multiple responses

Table 11 Actual management condition of indoor air quality of childcare center

(n=30)

Characteristics	n(%)
Times of ventilation a day	
1~2 times	1(6.67)
3~4 times	11(36.67)
5~10 times	8(26.67)
More	9(30.00)
Equipment in possession†	
Ventilator	19(63.33)

Air cleaner					24(80.00)
Humidifier					16(53.33)
Air conditioner					30(100.00)
Filter cleaning cycle (relevant facilities)	1 time /week	1time /month	1 time /2~3 months	1 time /season	Do not clean
Air cleaner	12(50.0)	8(33.3)	2(8.3)	1(4.2)	1(4.2)
Air conditioner	10(33.3)	8(26.7)	5(16.7)	7(23.3)	0(0.0)
Cook indoors					
Yes					20(66.7)
No					10(33.3)
Cooking hours (relevant facilities)					
Less than 1hour					1(5.0)
1 hour ~ less than 2 hours					2(10.0)
2 hours ~ less than 4 hours					8(40.0)
4 hours or more					9(45.0)
Ventilation time after cooking (relevant facilities)					
Less than 30 minutes					4(20.0)
30 minutes ~less than 1 hour					1(5.0)
1 hour ~ less than 2 hours					4(20.0)
2 hours or more					11(55.0)

※†: Multiple responses

Table 12 Childminders' awareness of indoor air quality improvement

(n=161)

Characteristics		n(%)
Measures to improve air pollution within childcare centers†	Ventilation installation	76(37.44)
	Cleaning system improvement	48(23.65)
	Prohibition of running indoors	25(12.32)
	Plaything improvement	2(0.99)
	Carpet, curtain improvement	34(16.75)
	Other	18(8.86)
Total		203(100.00)
Fields the government ought to manage most urgently for national health†	Air pollution	74(26.81)
	Water pollution	66(23.91)
	Indoor air pollution	54(19.57)
	Ground pollution	22(7.97)
	Waste (garbage)	59(21.38)
	Other	1(0.36)
Total		276(100.00)
Reason why environmental issues of childcare centers are not improved	Lack of parental interest	1(0.62)
	Lack of director's interest	5(3.11)
	Lack of administrative and financial support	116(72.05)
	Lack of teachers' awareness and attempts to improve	17(10.56)
	Other	22(13.66)
Total		161(100.00)

※†: Multiple responses

3.3 Discussion

For subjective judgment on the actual indoor air condition of childcare, survey subjecting 161 childminders of 30 childcare centers regarding awareness and actual management of indoor air pollution, physical detectable symptoms and such was taken place.

As the survey result, more than 60% of the childminders responded they are satisfied with the indoor environment of the childcare centers and more than 75% responded to be interested in indoor air quality of

childcare centers, showing quite a high satisfaction and interest in indoor air quality. Also, it was appeared childcare centers carries on a certain level of management to improve general indoor air quality through a certain level of ventilation, use of air cleaner, cleaning and ventilation after cooking.
Nevertheless, there are only 20% educated about indoor air quality, showing the lack of education regarding indoor air quality, and childminders' awareness of indoor air quality is also caught short. In fact, as the result of research on physical detectable symptoms occurred while working in childcare centers, the usual indoor air pollution in childcare centers seems possible, for more than 90% said to have the symptoms caused by indoor air pollutant in the afternoon as indoor hours accumulates, yet only 30% visited doctors and they seem to not think much of indoor air pollution, for relatively less childminders found indoor air pollution less important then other pollutions to the question regarding awareness of indoor air quality improvement. Hence, it is thought that education on indoor air quality to childminders needs to be increased more.

Conclusions

The study has its purpose on suggesting basic data for improvement and management of indoor air quality of future childcare centers through survey subjecting childcare centers accommodating physically weak children and investigation on the actual indoor air condition. The result of the study can be summarized like the following.
1) As the result of field measurement of pollutants for indoor air maintenance standard of childcare centers, it is thought that they are safe according to the indoor air quality maintenance standard of crowd facility, for items of formaldehyde (HCHO), total bacteria colony (TBC), carbon monoxide (CO) and particle matter (PM_{10}), except for particle matter exceeding the limit, were measured to be in less than the limit, showing indoor air condition of childcare centers is fair by regular cleaning and management of air cleaner use for clean environment maintenance.
2) Among the measured items, carbon dioxide (CO_2) appeared to be exceeding in 6 facilities out of 30 and it is judged that more effort should be made to maintain the appropriate capacity and ventilation in managing indoor air quality in future childcare centers.
3) As the result of survey subjecting 161 childminders of 30 childcare centers, 76% responded to be interested in indoor air quality of childcare centers and 64% responded they are satisfied with the current environment. However, teachers who received education on indoor air condition were only 19.8% and it was grasped only 30% visited doctors due to physical detectable symptoms when exposed in pollution level. This is judged that indoor air quality of childcare centers has potential danger due to insufficient management of childminders and the education on indoor air condition which only 19.8% has completed should be promoted.

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