〈論　文〉

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A Study of the Effects of Air Pollution on Health

Emphasizing on the Aspects of Respiratory Diseases in Medical Insurance Recipients

대기오염이 건강에 미치는 영향에 관한 조사연구

- 의료보험환자에서의 호흡기질환 발생양상 분석을 중심으로 -

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국 문 초 록

대기오염이 건강에 미치는 영향의 유무를 알아보고 그 영향의 정도를 반영해 줄 수 있는 지표의 개발을 목적으로 우리나라 전역을 서울, 대도시, 중소도시, 농어촌 등 4개 지역으로 구분하고 의료보험대상자 3,922,027명에 대한 호흡기질환 외래수진률을 지역별로 비교해 보았다. 조사대상 질환군으로서는 다음 7가지의 호흡기질환을 채택하기로 하였다.

(1) 결핵성 질환
(2) 호흡기 및 흉곽내장기의 악성신생물
(3) 급성호흡기 감염
(4) 폐염 및 인플루엔자
(5) 만성폐색성 폐질환 및 유사증
(6) 진폐증 및 외인성의 기타 폐질환
(7) 상기도의 기타질환

상기 질환으로 인한 외래수진에 관한 정보는 1983년 1월 1일 부터 12월31일 사이에 제출된 보험의료비 청구서에 나타난 자료를 이용하여 수집하였으며, 그 분석을 통해 다음과 같은 결론을 얻었다.

1) 지역별 연간종합외래수진률을 비교해 본 결과 농촌지역에서 가장 낮은 수준을 나타내고 있는 질환은 조사대상 7개 호흡기질환군중 다음 4개 질환군이 해당되고 있다.

(1) 결핵질환
(2) 호흡기 및 흉곽내장기의 악성 신생물
(3) 상기도의 기타질환
(4) 진폐증 및 외인성의 기타 폐질환

한편 이 종합외래수진률이 가장 높은 지역은 대도시 지역으로서 5가지 호흡기질환군의 수진률이 다른 지역에 비해 훨씬 높게 나타나 있다. 이와같은 결과는 의료보험환자들의 "외래수진률"을 이용하여 대기오염과 건강과의 관련도를 측정할 수 있는 "대기오염-건강" 지표의 개발이 가능할 것임을 뒷받침해 주고 있다. 그러나 가장 오염도가 높다고 예상되는 서울지역에서의 외래수진률이 대도시 지역보다 높지 않다는

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것은 오염도와 외래수진률과의 관계에서 일관성있는 결과를 보여주지 못하고 있음을 뜻하는데 과거의 자료로서는 외래수진률만 가지고 대기오염과 건강과의 관계를 표시해주는 지표로 삼기에는 미흡함을 알 수 있다.

2) 월별 외래수진률의 경향을 보면 거의 모든 호흡기질환군에서 계절적인 특이성을 나타내지 못하고 있다. 단 이 경우도 농촌지역이 연중 계속 최하위를 유지하고 있는 질환군이 7개 대상질환군 중에 4개군에 달하고 있다.

3) 보험환자들의 "외래수진률"은 아직은 미흡한 점이 있으나 앞으로 "대기오염-건강" 지표로서 개발 활용할 가치는 있다고 볼 수 있으며 서울, 대도시, 중소도시, 농어촌 등 4개 지역에 대한 월별 외래수진률을 다음 4가지 질환군에 대하여 계속 관측하여 그 경향을 분석할 것을 권장한다.

(1) 호흡기 및 흉곽내장기의 악성 신생물 (ICD. 160-165)

(2) 급성호흡기 감염 (ICD. 460 ~ 466)

(3) 폐염 및 인플루엔자 (ICD. 480 ~ 487)

(4) 만성폐색성 폐질환 및 유사증 (ICD. 490 ~ 496)

4) 외래수진률은 진료방식 즉, 투약기간의 장단등으로 인한 통원 (通院) 빈도 차이의 영향을 받게 되므로 지역별 병·의원의 보험환자 진료방식에 대한 비교검토가 요구된다.

INTRODUCTION

Man's interest in environmental pollution has increased much more in the modern era than in any other times of human history. It goes without saying that enormous amounts of money and effort for purification and preventive measures against pollution have been spent in the world. This recent trend is no exception for Korea. The recent socio-economical development in Korea such as industrial development, the drastic increase of fuel consumption, concentrated industrialization in special areas, urbanization, and modernization of living condition have caused environmental pollution problems.[1)]

As far as environmental pollution is concerned, we are talking of two kinds of pollution; air pollution and water pollution. Air pollution, especially, causes more serious acute or chronic effects to the human body, animals and plants than any other kinds of pollution. The reason is that man, animals and plants are widely exposed to air in very wide range of areas, so that they are in contact with pollutants through their respiratory organs, skin or mucous membranes.

The effects of air pollution on human body can be explained as follows, in the case that the degree of pollution goes beyond a maximum permissible limits for pollution: First, there occurs some diseases caused by pollutants which affect skin, eyes, mucous membrane and upper respiratory tract; second, there are some acute or chronic diseases, which are caused by pollutants in the air that are taken in the human body through respiratory or digestive organs. Furthermore, if pollutants are absorbed into blood stream, there is a possibility of general toxic symptoms in the human body.

Recently, by measuring the density of pollutants in the air, some of the problems of air pollution have been raised and the degree of air pollution have examined. But concerning the problem of pollution in reference to public health, the following matters have yet to be examined: to what degree does air pollution affect the human body? What diseases are caused by pollution, if any, what disease, to whom, where? The immediate obstacle to the effects of environmental pollution on the human body is that we cannot experiment on the human body. Therefore, we can do nothing but examine the effects of air pollution on health by observing only the situation and the state of things in nature. However, obviously there arise

following some difficulties in analyzing and interpreting the effects.[2)]

1) The difficulty to determine the criteria for classifying the effects of air pollution on health into two diseases progresses chronologically; acute and chronic diseases.

2) The difficulty in the allocation of pollutant variables and health variables.

3) The analytical difficulty due to the latent periods of diseases caused by pollution. (Latent period: the gap between the time of stimulation by pollutants and one of response in the form of disease of the human body.)

4) The difficulty by other confounding variables (aside from air pollution) which can have an effect on health variables (i.e.; smoking, occupational environment, individual resistancy to disease). In order to eliminate these difficulties entirely, even in part, every adequate research method which lead to a somewhat more correct analysis should be adopted. For example, in the case that elementary school children are selected as a subject of research, it will be possible to analyze the relation between health variables (frequency of absense, number of respiratory disease occurrences) and the degree of air pollution measured to time.[3)4)] As for college students or inhabitants of a certain village, it is also possible to find a relation between respiratory diseases and the degree of air pollution.[5)6)] In addition, there are some research examples which use the frequency of coughing, or the period of hospitalization as health variables.[6)7)8)]

This study, to examine the effects of air pollution on health, analyzes some aspects of health variables according to the degree of air pollution. And we know that the authors mentioned above select rather acute aspects of diseases as health variables. But our matter of concern lies not only in the acute response of human body to the unsuccessive short-term change of the degree of air pollution, but also in the effects on inhabitants' health in the aspect of chronic and long-term response. Of course, in Korea there are research which analyze comparatively the relations between health variables, both acute and chronic effects, and the number of disease occurrences calculated directly or indirectly in a certain area or in an area selected by the degree of air pollution.[9)10)]

In Korea, there has been established a system of observation which can check up the degree of air pollution at regular intervals, but an index for evaluation which regularly indicates what effects of air pollution has on inhabitants' health has not been established.

This study will show a relation between the degree of air pollution measured to the progress of time and health variables in a special area (i.e.; Seoul). In a more comprehensive sense, the study area will be divided into four areas corresponding to the degree of air pollution: 1) Seoul 2) Cities 3) Towns 4) Rural and, respiratory diseases occurring in the four areas during a year will be compared. Then we will reconsider whether relationships between air pollution and health in Korea can be drawn by the above-mentioned health variables, and decide whether what they call an "Air Pollution-Health" index made from inter-area, health variables can be used as an evaluation index to check up the relation between air pollution and health at regular intervals.

MATERIAL AND METHOD

To find relations between air pollution and health, the incidence of disease (suspected to be highly related to air pollution) corresponding to the degrees of air pollution in areas was analyzed. The target areas and subject of research were selected as follows: First of all, the target areas were divided into four areas which were thought to show the differences of the degree of air pollution; 1) Seoul 2) Cities (Busan, Daegu, Gwangju, Daejeon, Incheon) 3) Towns (city municipal areas except for 1) & 2)) 4) Rural area (all administrative

areas of Gun, Eup, Myeon). Secondly, 3,924,027 medical insurance receipients under the control of the Public Cooperation for Medical Care Insurance were selected as a base population, regardless of sex and age. The distribution of the population in the four areas are as follows: As in Table 1, the

Table 1. Base population by sex, age, and areas.

Age \ Area		Seoul		Cities		Towns		Rural		Total	
		N	Percent	N	Percent	N	Percent	N	Percent	N	Percen
0	M	13150	1.9	5950	1.6	7232	1.7	8348	1.7	34680	1.8
	F	11935	1.8	5294	1.4	6518	1.5	7630	1.5	31377	1.6
	T	25085	1.9	11244	1.5	13750	1.6	15978	1.6	66057	1.7
1-4	M	59583	8.8	27727	7.7	33933	7.9	38522	8.0	159765	8.2
	F	55470	8.3	25473	6.9	31567	7.2	36083	7.3	148593	7.5
	T	115053	8.6	53200	7.3	65500	7.5	74605	7.6	308358	7.9
5-14	M	133652	19.8	79710	22.0	95692	22.2	100516	20.8	409570	21.0
	F	124060	18.6	73432	19.8	89371	20.3	94731	19.2	381594	19.4
	T	257712	19.2	153142	20.9	185063	21.2	195247	20.0	791164	20.1
15-24	M	101399	15.0	62815	17.3	77621	18.0	91081	18.8	332916	17.0
	F	107678	16.2	68921	18.6	82921	18.8	98496	20.0	358016	18.2
	T	209077	15.6	131736	18.0	160542	18.4	189577	19.4	690932	17.6
25-34	M	136745	20.2	57350	15.8	66744	15.5	79827	16.5	340666	17.4
	F	126265	19.0	59234	16.0	68222	15.5	76062	15.5	329783	16.8
	T	263010	19.6	116584	15.9	134966	15.5	155889	16.0	670449	17.1
35-44	M	91224	13.5	48270	13.3	55510	12.9	55296	11.4	250300	12.8
	F	83233	12.5	47733	12.9	53915	12.3	53426	10.9	238307	12.1
	T	174457	13.0	96003	13.1	109425	12.6	108722	11.1	488607	12.5
45-54	M	71752	10.6	426541	11.8	49586	11.5	55150	11.4	219142	11.2
	F	74757	11.2	41189	11.1	47644	10.8	57033	11.6	220623	11.2
	T	146509	10.9	83843	11.4	97230	11.2	112183	11.5	439765	11.2
55-64	M	42580	6.3	22283	6.2	25797	6.0	32111	6.6	122771	6.3
	F	43495	6.5	24235	6.5	28870	6.6	33382	6.8	129982	6.6
	T	86075	6.4	46518	6.3	54667	6.3	65493	6.7	252753	6.4
65 ↑	M	26366	3.9	15492	4.3	19217	4.5	22599	4.7	83674	4.3
	F	38766	5.8	25034	6.8	31009	7.0	35459	7.2	130268	6.6
	T	65132	4.9	40526	5.5	50226	5.8	58058	6.0	213942	5.5
TOTAL	M	676451	100.0	362251	100.0	431332	100.2	483450	99.9	1953484	100.0
	F	665659	99.9	370545	100.0	440037	100.0	492302	100.0	1968543	100.0
	T	1342110	100.1	732796	99.9	871369	100.1	975752	99.9	3922027	100.0

Note) M: Male, F: Female, T: Total

Table 2. Disease categories selected for analysis of health effect of air pollution

A. Tuberculosis (010-018)*
   (010) Primary tuberculous infection
   (011) Pulmonary tuberculosis
   (012) Other respiratory tuberculosis
   (013) Tuberculosis of meninges and central nervous system
   (014) Tuberculosis of intestines, peritoneum and mesenteric glands
   (015) Tuberculosis of bones and joints
   (016) Tuberculosis of genitourinary system
   (017) Tuberculosis of other organs
   (018) Miliary tuberculosis

   *The numbers stand for Codes of International Classification of Diseases.

B. Malignant neoplasm of respiratory and intrathoracic organs (160-165)
   (160) Malignant neoplasm of nasal cavities, middle ear and accessory sinuses
   (161) Malignant neoplasm of larynx
   (162) Malignant neoplasm of trachea, bronchus and lung
   (163) Malignant neoplasm of pleura
   (164) Malignant neoplasm of thymus, heart and mediastinum
   (165) Malignant neoplasm of other and ill-defined sites within the respiratory system and intrathoracic organs

C. Acute respiratory infections (460-466)
   (460) Acute nasopharyngitis (common cold)
   (461) Acute sinusitis
   (462) Acute pharyngitis
   (463) Acute tonsillitis
   (464) Acute laryngitis and trachitis
   (465) Acute upper respiratory infections of multiple or unspecified sites
   (466) Acute bronchitis and bronchiolitis

D. Other diseases of upper respiratory tract (470-478)
   (470) Deflected nasal septum
   (471) Nasal polyps
   (472) Chronic pharyngitis and nasopharyngitis
   (473) Chronic sinusitis
   (474) Chronic disease of tonsils and adenoids
   (475) Peritonsillar abscess
   (476) Chronic laryngitis and laryngotracheitis
   (477) Allergic rhinitis
   (478) Other diseases of upper respiratory tract

E. Pneumonia and influenza (480-487)
   (480) Viral pneumonia
   (481) Pneumococcal pneumonia
   (482) Other bacterial penumonia
   (483) Pneumonia due to other specified organism
   (484) Pneumonia in infectious diseases classified elsewhere
   (485) Bronchopneumonia, organism unspecified
   (486) Pneumonia, organism unspecified
   (487) Influenza

F. Chronic obstructive pulmonary disease and allied conditions (490-496)
   (490) Bronchitis, not specified as acute or chronic
   (491) Chronic bronchitis
   (492) Emphysema
   (493) Asthna
   (494) Bronchiectasis
   (495) Extrinsic allergic alveolitis
   (496) Chronic airways obstruction, not elsewhere classified

G. Pneumoconioses and other lung diseases due to external agents (500-508)
   (500) Coalworkers' pneumoconiosis
   (501) Asbestosis
   (502) Pneumoconiosis due to other silica or silicates
   (503) Pneumoconiosis due to other inorganic dust
   (504) Pneumopathy due to inhalation of other dust
   (505) Pneumoconiosis, unspecified
   (506) Respiratory conditions due to chemical fumes and vapours
   (507) Pneumonitis due to solids and liquids
   (508) Respiratory conditions due to other and unspecified external agents

numbers of the base population are: about 1,340,000 in Seoul; 730,000 in cities; 870,000 in towns; 970,000 in rural areas. There is no wide difference in the distribution of ages among areas. The analysis of diseases occurrences was based on the data from the clinical records of medical insurance members who had been treated in a hospital or a clinic during the year of 1982. The kinds of respiratory diseases were selected among the other diseases analyzed, because they are thought to be highly related to air pollution. The disease categories selected for analysis are as Table 2.

RESULTS

1. The yearly outpatient visiting rates by areas: An outpatient visiting rate is the number of outpatients' visiting a hospital or a clinic divided by the pertinent base population (per 1,000 persons). As in Table 3, there are certain differences between males and females as expected in outpatient visiting rates in respect to respiratory diseases. But differ-

Table 3. Outpatient visiting rates by respiratory diseases and by areas during Jan. 1 – Dec. 31, 1982. (Rate per 1000)

	Diseases	Seoul			Cities			Towns			Rural		
		M	F	T	M	F	T	M	F	T	M	F	T
1.	Tuberculosis	31.7	26.7	29.2	75.5	48.3	61.8	42.8	26.0	34.3	8.4	5.3	6.8
2.	Malignant Neoplasm of Respiratory and in Trathoracic Organs	1.5	0.6	1.0	2.1	0.6	1.4	1.8	1.5	1.7	0.2	0.0	0.2
3.	Acute Resp. Infection	577	553	565	1132	1028	1079	1030	913	971	629	571	600
4.	Other Diseases of Upper Resp. Tract	52.7	46.5	49.6	90.6	76.3	83.4	83.5	72.2	77.8	26.4	24.3	25.3
5.	Pneumonia and Influnza	14.4	14.4	14.4	40.8	35.9	38.3	31.9	28.6	30.3	35.2	33.5	34.4
6.	Chronic Obstructive Pulmonary Disease and allied Conditions	38.0	37.1	37.6	84.9	77.7	81.2	74.7	65.6	70.1	44.3	38.8	41.5
7.	Pneumoconioses and other Lung Diseases due to external agents	5.8	5.1	5.5	4.1	3.7	3.9	8.6	7.4	8.0	1.7	1.6	1.7

ences among the four areas, which are classified by the degree of air pollution, did not meet up to our expectation. In other words, Seoul which is a highly polluted area did not show the highest outpatient visiting rate as expected. But the rural, as expected, showed the lowest outpatient visiting rate. The areas which shows the lowest and the highest outpatient visiting rates in respect to respiratory diseases are shown in Table 4. Table 4 shows that the rural area has the lowest outpatient visiting rates in four diseases during the year because the differences among areas which are divided corresponding to the degree of air pollution do not show a obvious, consistant trend. We assume that this was due to the followings:

1) It is possible that the outpatient visiting rates which are statistically compiled per year do not show seasonal variations.

2) It is possible that the rates of visiting a hospital or a clinic are influenced by some regional traits.

3) It is possible that the trend of courteously refusing the benefit of medical insurance for a slight illness be differs among the areas.

2. The monthly trend of outpatient visiting rates:

The monthly trend of outpatient visiting rates in respect to respiratory diseases is influenced by the following factors:

1) Monthly change of the degree of air pollution
2) Changes of the occurrence rates of acute respiratory diseases by seasons

It is generally known that the degree of air pollution is higher in the winter than in any other seasons, and that occurrences of respiratory diseases and their worsenings are frequent in winter. In following, it is expected that the trend of outpatient visiting rates by respiratory diseases from January to December will be in a form of a "U". But the trend in this report didn't show the expected results; excluding the rural area which had the lowest outpatient visiting rates in tuberculosis,

Table 4. The areas which showed the lowest and the highest outpatient visiting rate by respiratory disease groups during Jan. 1 – Dec. 31, 1982.

Disease	Lowest Area (Rate per 1,000)	Highest Area (Rate per 1,000)
1. Tuberculosis	Rural (6.8)	Cities (61.8)
2. Malignant Neoplasm of Respiratory and Intrathoracic Organs	Rural (0.15)	Towns (1.7)
3. Acute Respiratory Infection	Seoul (564.9)	Cities (1,078.9)
4. Other Diseases of Upper Respiratory Tract	Rural (25.3)	Cities (83.4)
5. Pneumonia and Influenza	Seoul (14.4)	Cities (38.3)
6. Chronic Obstructive Pulmonary Disease and allied conditions	Seoul (37.6)	Cities (81.2)
7. Pneumoconioses and other Lung Diseases due to external agents	Rural (1.7)	Towns (8.0)

malignant neoplasm of respiratory tract, other diseases of upper respiratory tract and pneumoconiosis; and excluding Seoul and rural area, both of which areas have lower rates than cities and towns, and show a similar trend in the categories of acute respiratory disease, pneumonia and influenza chronic respiratory disease (chronic bronchitis, asthma, etc.). The detailed monthly trends of outpatient visiting rates with respect to respiratory diseases are as follows:

1) Tuberculosis (ICD Code 010-018)

This disease category includes "tuberculosis" in the internal organs (intestine, peritoneum, joint, etc.) as well as pulmonary tuberculosis. As this disease is caused by mycobacterium tuberculosis, it has no direct relation to air pollution. Instead, the pattern of living and nutritive conditions is closely connected with it, so that it is thought that tuberculosis may be used an "Air Pollution-Health" index. However, as acute or chronic inflammation of upper respiratory tract, bronchus, and lung tissue, or pneumoconiosis which are greatly influenced by air pollution, lower the resistance to tuberculosis and worsen the disease. It can be said that tuberculosis is indirectly influenced by air pollution. Figure 1 shows the monthly trend of outpatient visiting rates for "tuberculosis" by areas to indicate the relation between the degree of air pollution by areas and tuberculosis.

As shown in Figure 1, rural area has the rate for the whole year which corresponds to our expectation, while other areas fail to show the corresponding trend to the degree of air pollution: Seoul which was expected of a highly polluted area had a similar degree to that of towns, whereas cities had the highest degree. In the monthly trend of outpatient visiting rates, there is no significant difference between that of a highly polluted winter and other seasons. These results are more or less in accord with the results in foreign countries which shows that the morbidity of tuberculosis is related to the increase of population, but not to an index for industrialization. As a results, an "Air Pollution-Health" index which use tuberculosis as health variables cannot be regarded as appropriate.

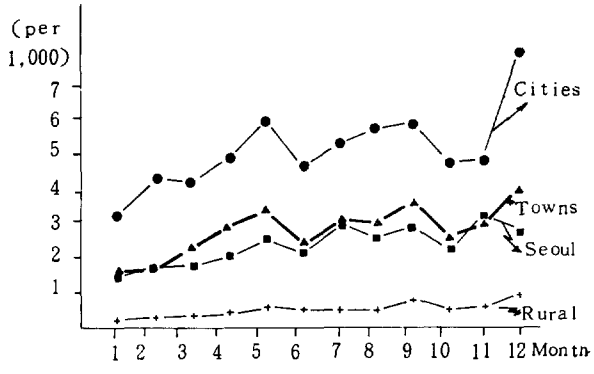

Fig. 1. The monthly trend of outpatient visiting rates for "tuberculosis" by areas.

2) Malignant neoplasm of respiratory and intrathoratic organ (ICD Code 160-165)

This disease category includes malignant neoplasms of thorax shall as upper respiratory tract, pleura or etc., as well as lung cancer. Among the chief factors causing malignant neoplasm of respiratory system, the leading causes are a long history of smoking and air pollution in which our respiratory organs are exposed chronically to pollutants. We are interested especially with

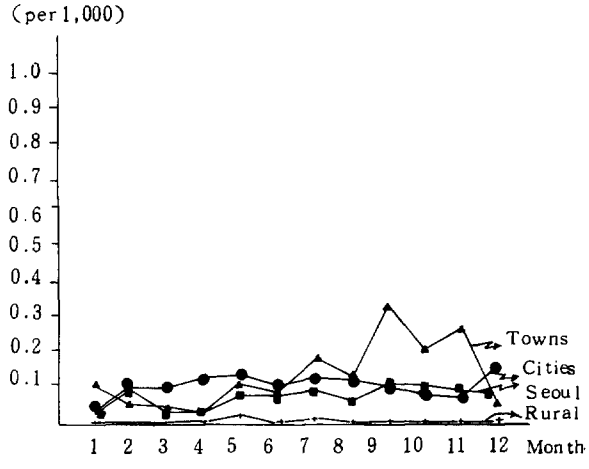

Fig. 2. The monthly trend of outpatient visiting rates for "malignant neoplasm of respiratory and intrathoracic organs" by areas.

lung cancer which is closely related to the density of population, which is suspected to be related to the degree of air pollution of a city. It is also reported in foreign countries[12)13)] that mortality rate of lung cancer is high in big cities than in rural areas. Our study results, as shown in Figure 2, shows that city area has a higher outpatient visiting rate than rural areas, so that the outpatient visiting rate for this disease category has value as a variable for an "Air Pollution-Health" index.

3) Acute respiratory infections (ICD Code 460-466)

This disease category includes acute bronchitis, pharyngitis, laryngitis, etc. and which are known by epidemiologic study both in and out of the country to be closely related to air pollution.[10)12)14)] But Figure 3 shows that there is little differance between Seoul, the highest polluted area and rural area,

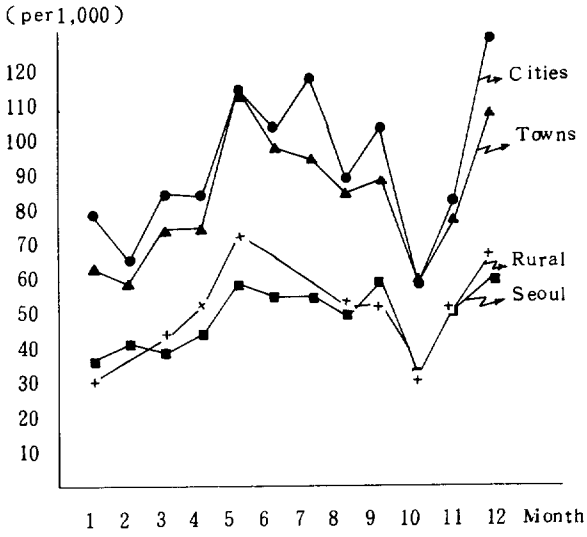

Fig. 3. The monthly trend of outpatient visiting rates for " acute respiratory infections" by areas.

the lowest polluted area. Although this disease category which is much influenced by seasons, usually has the highest incidence rate in the winter and the lowest in the summer, our results fail to show this trend. Therefore, it should be made examine thoroughly whether the result mentioned above is a temporary phenomenum or whether there are any special intervening factors.

4) Other diseases of the upper respiratory tract (ICD Code 470-478)

This disease category includes chronic nasopharyngitis, chronic diseases of tonsils and adenoids, allergic rhinitis, etc., which are also related to air pollution. Figure 4 shows that the rural area has the lowest outpatient visiting rate for these diseases during the whole survey year, but this case also doesn't show the seasonal traits.

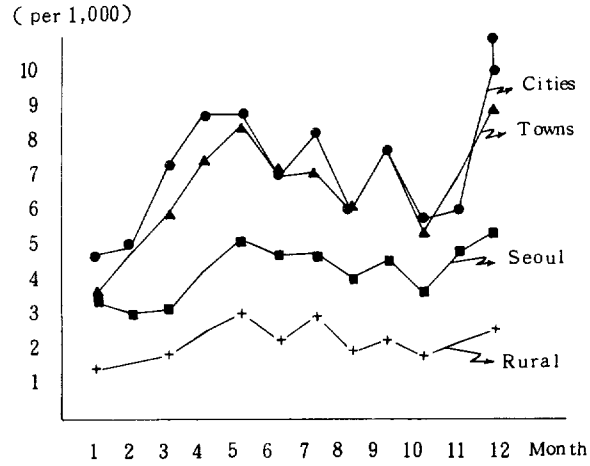

Fig. 4. The monthly trend of outpatient visiting rates for "other diseases of upper respiratory tract" by areas.

5) Pneumonia and influenza (ICD Code 480-487)

It is reported that the diseases in this group are also influenced by air pollution.[15)] But as in Figure 5, we cannot find regional differences according to the degree of air pollution in the outpatient visiting rates: Seoul has the lowest rate and others show similar rate. In this disease category, there is a seasonal change of the rate; the rate is low in summer, high in winter. But Seoul does not follow this seasonal change. This implies that the outpatient visiting rates of Medical Insurance patients do not fully reflect the actual incidences of diseases.

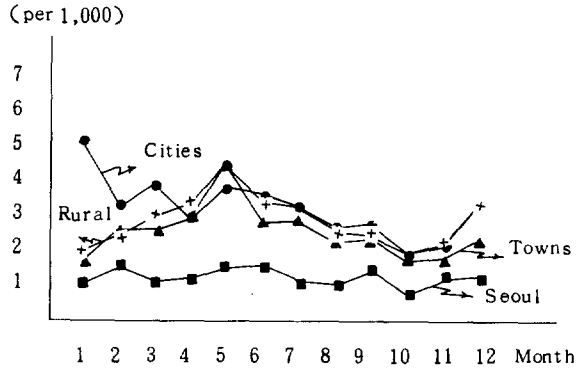

Fig. 5. The monthly trend of outpatient visiting rates for "pneumonia and influenza" by areas.

6) Chronic Obstructive pulmonary disease (ICD Code 490-496)

Chronic bronchitis, emphysema and asthma are included in the this category, and these diseases are mainly caused by smoking and air pollution. Bronchial asthma, in particular, has been reported to be influenced a lot by SO_2 contents in the air.[16] On the other hand, asthma is also caused by peculiar allergens (vegitables, animals, chemicals) or non-peculiar stimuli that cause allergic responses in respiratory organs, therefore the occurrence rate of this diseases is high in seasons which have a lot of vegetable powers like pollen in the air. So, in order to find out a relation between air pollution and asthma it should be discerned whether asthma in a highly polluted area is caused by pollution or vegetable allergens.

According to our study, as shown in Figure 6, the outpatient visiting rate for asthma is high in the spring. But the differences among areas by the degree of air pollution do not meet our expectations; Rural and Seoul have similar rates, and Cities and Towns have higher rates.

7) Pneumoconiosis and other lung diseases due to external agents (ICD Code 500-508). This disease category includes mainly pneumoconiosis and asbestosis and other pneumoconiosis of coalworkers due to silica or silicate salts. In this sense, the diseases in this category are related to special occupational environment. So, it was not expected that there would be great differences of the incidence rate among areas which are grouped by the degree of air pollution. The areas of outpatient visiting rates for these disease in Figure 7 do not show a consistent trend; surprisingly, the rural area has the lowest rate.

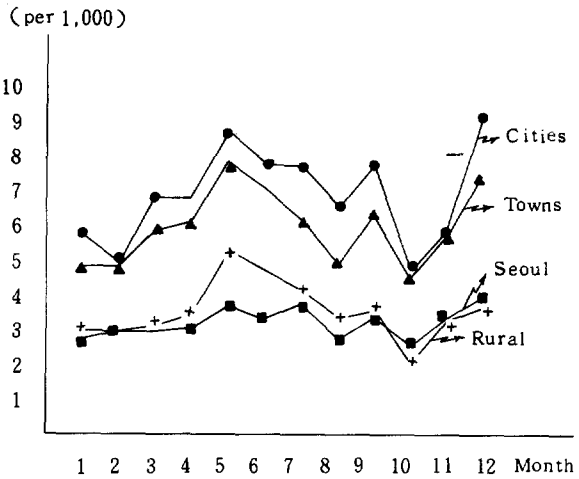

Fig. 6. The monthly trend of outpatient visiting rates for "chronic obstructive pulmonary diseases and allied conditions" by areas.

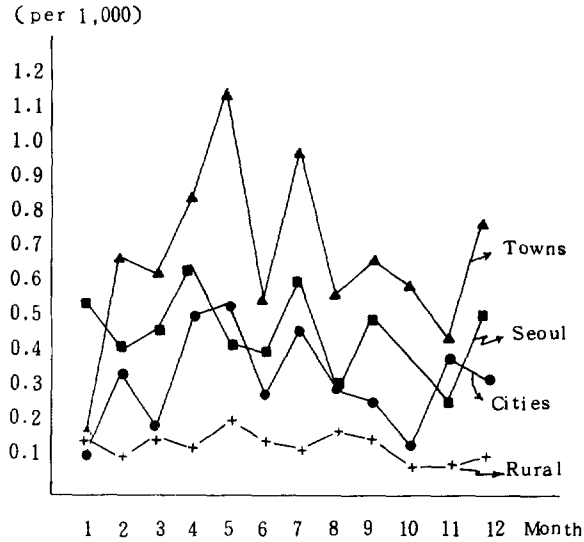

Fig. 7. The monthly trend of outpatient visiting rates for "pneumoconioses and other lung diseases due to external agents" by areas.

DISCUSSION

1) Consideration on methods of the research

This study analyzing the effects of air pollution on health was done under the following assumptions:

Assumption 1) one area's degree of air pollution is different from the others and the other of the degree of air pollution by areas is as follows: (1) Seoul (2) Cities (3) Towns (4) Rural

Assumption 2) the inhabitants' health conditions are influenced by the degree of air pollution of their residential areas. Especially the incidence rates of respiratory diseases are proportionate according to the degree of air pollution.

Assumption 3) the aspect of occurrence on respiratory diseases can be found in the outpatient visiting rate from the data on medical insurance patients.

But in analyzing the effects of air pollution on health, the difficulty we have faced is that the causing factors of the diseases are various: living style, individual susceptability, occupational environment, smoking, etc., as well as air pollution. So, it should not be made a hasty conclusion that respiratory disease are caused only by air pollution. Similarily, it is difficult to decide that air pollution is a direct cause or an indirect one to disease. In addition, the incidence rate of respiratory disease may not be proportionated to the outpatient visiting rate because of the difference in the demands for medical treatment, courteous refusal to use medcal insurance (for a slight illness) and patient-paid treatment, etc. With these difficulties in mind, this study adopted a large population, about 4 millions persons, as subjects to maintain the homogeneity of population (age, sex, smoking, period of residence, individual habit, etc.). The outpatient visiting rate was calculated only from the data on medical insurance patients to reduce the effects of persons not requesting treatment due to medical costs. Respiratory diseases were also grouped according to the international method of classification in order to eliminate the insignificant differences of treatment results.

2) Consideration of Results

According to this research's analysis of the yearly outpatient visiting rate in the four areas grouped by the degree of air pollution, rural has the lowest rate for 4 disease categories of 7 respiratory disease categories. This implies that there is a possibility of developing an "Air Pollution–Health" index by use of the outpatient visiting rate of medical insurance patients. Because Seoul has the lowest outpatient visiting rate for acute respiratory disease which was expected to be influenced a lot by air pollution, it is premature to say that there is a relation between the degree of air pollution and the outpatient visiting rate.

As for the monthly outpatient visiting rate, rural has the lowest rate for 4 disease categories of 7 categories for the whole year, which is similar the result from the yearly outpatient visiting rate. However, the monthly variations of the outpatient visiting rate, did not show the seasonal variations. We can assume from these results that the outpatient visiting rate for respiratory diseases is partially influenced by air pollution, but they don't have obvious, and consistent relations. The possible reasons are as follows:

1) In areas as widely grouped such as Seoul, Cities, Towns and Rural, the difference of the degree of air pollution might not have an influence on the incidence rate of respiratory diseases.

2) The outpatient visiting rate from the data on medical insurance patients does not fully reflect the regional aspects of respiratory diseases. (1) means that as areas are grouped widely, the effects of the degree of air pollution may be diluted. (2) means that the regional outpatient visiting rate may be influenced by the regional tendencies of seeking medical treatments.

At any rate, the monthly trend of the outpatient visiting rate for 1) malignant neoplasm of respiratory and intrathoracic organs 2) acute respiratory infections 3) pneumonia and influenza

4) chronic obstructive pulmonary disease and allied conditions by areas should be further studied as a possible "Air Pollution-Health" index.

CONCLUSION AND SUGGESTION

The purpose of the paper is to study the immediate effects of air pollution on health and to set up an index which indicates the degree of effects. As a part of this purpose, the outpatient visiting rates by respiratory diseases of 3,922,027 medical insurance receipients were compared according to patients' residential district (the whole country was divided into four parts: Seoul, Cities, Towns, Rurals).

The groups of respiratory diseases which were the object of this survey were as follows; 1) tuberculosis 2) malignant neoplasm of respiratory and intrathoracic organs 3) acute respiratory infection 4) pneumonia and influenza 5) chronic obstructive pulmonary disease and allied conditions 6) pneumoconiosis and other lung diseases due to external agents 7) other diseases of upper respiratory tract

Information on outpatient visiting to treat the above-mentioned diseases was obtained from the data of medical insurance bill which was introduced to the Public Cooperation for Medical Insurance from Jan. 1, 1983 to Dec. 31, 1983. Through analyzing the information, the results were obtained as follows:

1. As a result of comparing the overall outpatient visiting rate during the survey year, 4 disease groups described below among 7 surveyed groups of respiratory diseases showed the lowest outpatient visiting rate in rural areas; 1) tuberculosis 2) malignant neoplasm of respiratory and intrathoracic organs 3) other diseases of upper respiratory tract 4) pneumoconiosis and other lung diseases due to external agents. On the contrary, the city has the highest outpatient visiting rate on 5 groups of respiratory disease.

These results showed the possibility of setting up an "Air pollution-Health" index to measure the relevance between air pollution and health through analysis of outpatient visiting rate of medical insurance receipients.

But the fact that in Seoul, which city is expected of a seriously air polluted area, outpatient visiting rate is lower than that of other areas do not tell a consistent relevance between the degree of air pollution and outpatient visiting rate. Therefore, it is insufficient to make an index, which indicates the relevance between air pollution and health, only from the past data.

2. According to the tendency of monthly outpatient visiting rate, most groups of respiratory diseases did not show a seasonal characteristics. In this case, rural areas has the whole-year-lowest outpatient visiting rate on 4 disease groups among 7 ones.

3. Outpatient visiting rate of medical insurance patients seems to be worth as an "Air Pollution-Health" index though it is insufficient yet. It is recommended that the monthly outpatient visiting rate in the 4 areas mentioned above are worthy of observing and analyzing with an emphasis on the following 4 disease groups:

1) Malignant neoplasm of respiratory and intrathoracic organs (ICD. 160-165).
2) Acute respiratory infection (ICD. 460-466)
3) Pneumonia and influenza (ICD. 480-487)
4) Chronic obstructive pulmonary disease and allied conditions (ICD. 490-496)

4. As outpatient visiting such as long-term or short-term prescription, frequency of visiting hospitals or clinics, the regional treatment methods for Medical Insurance patients are required to be examined.

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REFERENCE

1. Cha C. W., (1974), Pollution and Disease, 1st ed.,146-161, New Medical Company, Seoul.
2. Ko U. R., (1981), A Review on the Methodological Problems in Measuring the Effects of Air Pollution to Community Health, Bulletin

of Environmental Sciences, Vol. 2, Hanyang University, 106-115.

3. Paccagnella B., et al, (1969), Immediate Effects of Air Pollution on Health of School Children in Some Districts of Ferrara, Archives of Environmental Health, Vol. 18, No.4, 495-502.
4. Kagawa Im., et al, (1975), Photochemical Air Pollution, Its Effects on Respiratory Function of Elementary School Children, Archives of Environmental Health, Vol. 30, No.3, 117-122.
5. Durham W. H., (1974), Air Pollution and Student Health, Archieves Environmental Health, Vol. 28, No.5, 241-254.
6. Cassell E. J., et al, (1969), Air Pollution, Weather and Illness in a New York Population, Archives of Environmental Health, Vol. 18, No.4, 523-530.
7. London R. G., et al., (1964), Cough Frequency in a Group of Male, Archives of Environmental Health, Vol. 11, No.3, 372-374.
8. London R. G., et al, (1969), Air Pollution, Weather, and Cough, Archives of Environmental Health, Vol. 18, No. 4, 641-645.
9. Sterling, T.D., (1969), Measuring the Effect of Air Pollution on Urban Morbidity, Archives of Environmental Health, Vol. 18, No.4, 485-494.
10. Shin Y. S., et al, (1972), Studies of Effects on Human Health by Air Pollution compared with Seoul City (Large city) and Suwon city (Small city), Journal of Korean Medical Association, Vol. 15, No.4, 339-350.
11. Cha C. W., et al, (1981), An analysis of air pollution effect on morbidity pattern of respiratory disease, Korea University Medical Journal, Vol. 18, No.2, 377-388.
12. Yamamoto J. I., (1970), Epidemiology, 177-224, Bun Ko Dou, Tokyo.
13. Ashley D. J. B., (1967), The Distribution of Lung Cancer and Bronchitis in England and Wales, British Journal of Cancer, Vol. 21, No.2, 243-259.
14. Shigemastu K. H., (1964) The Size of Cities and Mortality Rates of Malignant Neoplasms, Health Indices (Japan) 11, 26-39.
15. Tsunetane Y. M., (1967), Epidemiological Study on Chronic Bronchitis (3), Japan Journal of Hygiene, Vol. 14, No.2, 223-231.
16. Takahashi H. O., (1967), Epidimiological Study on the Chronic Effects of Air Pollution, The Japan Medical Association 17th National Symposium, 706-712.