

Nationwide Incidence Estimation of Lung Cancer in Korea

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The aim of this paper is to estimate the nationwide incidence rate of lung cancer in Korea. The potential incident cases were identified by hospital visiting and mailing, based on the ICD-9 diagnostic codes on the claims as one of the following: ICD-9 162-165 (malignant neoplasms of the respiratory system), 212 (benign neoplasm), 231 (carcinoma in situ), 511 (pleurisy), or 195-199 (malignant neoplasms with uncoded sites) in beneficiaries data of the Korea Medical Insurance Corporation from January, 1988 to December, 1989. Thereafter, the identified cases were confirmed by an oncologist (Dr. DS Heo). When adjusted with age distribution of the Korean population based on the 1985 Population Census, the incidence rate was 22.3 per 100,000 in males (95% CI: 21.70-23.01) and 8.37 (95% CI: 7.97-8.78) in females in 1989. And the age-adjusted rate for the world population was 39.63 in males and 9.95 in females.

Key Words: Lung cancer, Incidence, Korea

INTRODUCTION

In 1992, cancer was the primary cause of death in Korea (National Statistical Office, 1993). The death rate from lung cancer was 24.5 per 100,000 in males, 9.0 in females, and 17.0 in the whole Korean population, which ranked third in the causes of death by cancer. This index was 2.98 times that of 1983, which showed a more rapidly increasing trend than other

major cancers (Fig. 1). In order to interpret this trend and to provide useful information for making hypotheses on lung cancer, estimating the incidence level is necessary.

There has been only one incidence survey on the estimation of lung cancer in Korea, which was conducted at Kwangwha island in 1983 - 1987 (Kim et al., 1990). The estimated incidence rate of the Kwangwha Cohort Study were 29.0 per 100,000 in men and 4.0 in women, which could not be a representative one for Koreans as a whole, since the data were obtained from a geographically restricted area and a relatively small population.

Therefore, the representative incidence rate of lung cancer has not been available for Koreans as a whole yet, which made a nationwide survey necessary.

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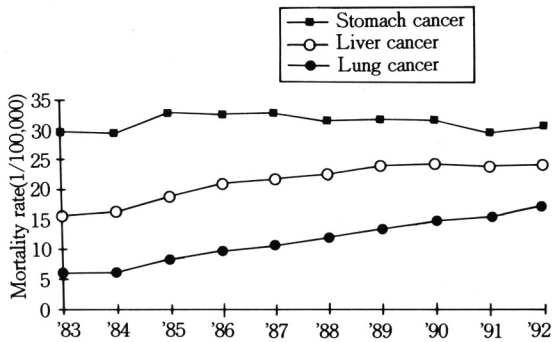


Fig. 1. Mortality trends of 3 major cancers among Koreans, 1983-1992.

MATERIALS AND METHODS

This study was conducted as a series of incidence estimation surveys of several major cancers among Koreans using claims data of the beneficiaries of the Korea Medical Insurance Corporation (KMIC) from 1988 to 1989 (Ahn *et al.*, 1989; Ahn *et al.*, 1991a; 1991b; 1991c; Ahn *et al.*, 1994).

In order to estimate the valid incidence rate of a disease, information on several conditions are needed. For instance, incident cases during a defined period as a numerator, and the age and sex distribution of the study population as a denominator should be known. For these conditions, the database of the beneficiaries in KMIC can be considered as a study population for a nationwide incidence survey on lung cancer. The rationale is that all the incident cases of

lung cancer during a specified period can be found through reviewing a computerized morbidity database which contains information on the medical utilization of the beneficiaries of KMIC, who make up about 10 percent of the Korean population and show similar ages and sex structure to the whole Korean population (Ahn *et al.*, 1989). The database on the beneficiaries of KMIC includes the first 2 diagnostic ICD-9 codes in the claims sent by medical care institutions throughout the country to the KMIC, which could be used as the information source for incident cases. However, an additional survey for confirming the final diagnoses of the claimed incident cases should be conducted.

For identifying the potential cases of lung cancer among all the admitted cases, screening was done by the ICD-9 codes as one of the following: malignant neoplasm of the lung (162-165), benign neoplasm of the lung (212), undefined neoplasm (231), pleurisy (511) from January 1, 1988 to December 31, 1989.

Abstracting the medical records of all the potential cases was conducted through hospital visiting and mailing survey. Thereafter, medical oncologist (Dr. DS Heo) confirmed the final diagnosis and date of onset of the cancer cases by reviewing the collected abstracts, based on the pathologic findings and the date of the first admission to the medical care institution with the diagnosis.

The total number of incident cases was determined based on the date of onset, which was restricted to the middle of the survey period, between July 1, 1988 and June 30, 1989.

Table 1. Age distribution of lung cancer cases occurring among KMIC beneficiaries during one year of 1988-1989

Age Group	Male		Female		Total	
	No	%	No	%	No	%
under 25	1	0.1	5	1.9	6	0.6
25-29	1	0.1	8	3.0	9	0.9
30-34	4	0.5	5	1.9	9	0.9
35-39	5	0.6	9	3.4	14	1.3
40-44	9	1.1	11	4.1	20	1.9
45-49	27	3.4	14	5.3	41	3.9
50-54	81	10.2	21	7.9	102	9.6
55-59	125	15.8	41	15.4	166	15.7
60-64	176	22.2	32	12.0	208	19.7
65-69	163	20.6	35	13.2	198	18.7
70-74	120	15.2	38	14.3	158	14.9
75 and over	80	10.1	47	17.7	127	12.0
Total	792	100.0	266	100.0	1,058	100.0

Table 2. Geographical distribution of lung cancer cases occurring among KMIC beneficiaries during one year of 1988-1989

Area	Male		Female		Total	
	No	%	No	%	No	%
Seoul, Incheon, Kyunggi Province	284	35.9	124	46.6	408	38.6
Kangwon Province	34	4.3	12	4.5	46	4.3
Chungbuk Province	23	2.9	10	3.8	33	3.1
Taejeon, Chungnam Province	76	9.6	13	4.9	89	8.4
Jeonbuk Province	52	6.6	18	6.8	70	6.6
Kwangju, Jeonnam Province	76	9.6	20	7.5	96	9.1
Taegu, Kyungbuk Province	109	13.8	29	10.9	138	13.0
Pusan, Kyungnam Province	126	15.9	40	15.0	166	15.7
Jeju Province	12	1.5	0	0.0	12	1.1
Total	792	100.0	266	100.0	1,058	100.0

RESULTS

Distribution of lung cancer cases by sex, age group, and residential area

From July, 1988 to June, 1989, the total incident cases of lung cancer were 792 in male and 266 in female. The sex ratio was 297.7. The age group between 50 and 69 showed the highest proportion among incident cases, which were 68.8% in male and 48.5% in female (Table 1).

According to the residence, Kyunggi Province including Seoul and Incheon city had 35.9% of the male patients and 46.6% of the female patients. Kyungnam Province including Pusan city was second in the number of incident patients, followed by Kyungbuk Province including Taegu city (Table 2).

Distribution of lung cancer by anatomical subsite and histologic type

Data for 781 cases (73.8%) could be analyzed on the involved lobes, and for 496 cases (46.9%) on anatomical subsites, and for 741 cases (70.0%) on histologic types.

According to the distribution of involved lobes among the classifiable cases, lung cancer occurred more frequently on the right lung, and the ratio of right to left involved lobes was 3:2 (Table 3). When stratified by the anatomical site, the hilar region had a higher occurrence than the peripheral region (Table 4). Squamous cell type took the highest proportion on histological type (Table 5).

When the pathologic types of lung cancer were stratified by age and sex, the most common type was squamous cell carcinoma in both sexes, and small

Table 3. Percentage distribution of lung cancer by subsite(involved lobes)

Site, anatomical	No	%
Right Lung	457	58.5
Upper Lobe(RUL)	199	25.5
Middle Lobe(RML)	72	9.2
Lower Lobe(RLL)	145	18.6
>1 Lobe	41	5.2
Left Lung	311	39.8
Upper Lobe(LUL)	171	21.9
Lower Lobe(LLL)	110	14.1
>1 Lobe	30	3.8
Bilateral	13	1.7
Total	781	100.0

Table 4. Percentage distribution of lung cancer by subsite(hilar or peripheral mass)

Site, anatomical	No	%
Hilar Mass	359	72.4
Peripheral Mass	137	27.6
Total	496	100.0

Table 5. Percentage distribution of lung cancer by histologic type

Histologic type	No	%
Squamous cell carcinoma	334	45.1
Adenocarcinoma	149	20.1
Small cell carcinoma	114	15.4
Others	144	19.4
Total	741	100.0

cell carcinoma was more common in females. Adenocarcinoma was the most common pathologic type in the less than 45 years-old age groups (Fig. 2).

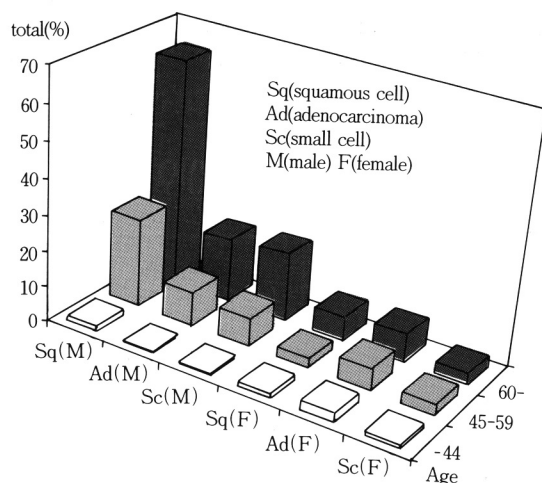


Fig. 2. Distribution of pathologic types in lung cancer according to age and sex.

Age-specific incidence rate of lung cancer among Koreans by sex (Table 6)

The age-specific annual incidence rate of lung cancer among Koreans in 1989 based on the 1985 Population Census was estimated to be 22.33 per 100,000 (95% CI: 21.70 - 23.01) in men and 8.37 (95% CI: 7.97 - 8.78) in women. The cumulative rates for the age spans 0-64 and 0-74 were 2.27%, 5.41% in men, and 0.62%, 1.19% in women, respectively. These estimated rates indicate that the incident cases of lung cancer are about 6,206 (4,517 for men and 1,689 for women) annually in Korea. After age-adjusting for the world population, the incidence rate was 39.63 in men and 9.95 in women; and the truncated rates for those 35-64 years of age were 62.16 and 16.94 in men and women, respectively.

According to this study, incidence rates in men showed an exponential increase pattern with age. The annual incidence rate of lung cancer per 100,000 in men increased from 0.13 in age groups below 25 to 236.72 in that of 60-64, which was a two or threefold increase every five years, then a mild attenuation of the increasing pattern was noted. The peak incidence rate was 328.84 per 100,000 in age 70 - 74, followed by a slight decrease in those over 75 years of age. But the slope of the increasing incidence rate of lung cancer in women was smaller than that in men. The peak incidence rate in women was 66.28 per 100,000 in age 70-74.

Table 6. Age-specific annual incidence rate per 100,000 of lung cancer among Koreans, 1988-1989

Age group	Male	Female
under 25	0.13	0.56
25-29	0.56	3.22
30-34	2.07	2.81
35-39	3.64	6.58
40-44	7.15	9.27
45-49	20.88	10.12
50-54	60.14	15.07
55-59	122.31	36.12
60-64	236.72	37.39
65-69	298.93	47.84
70-74	328.84	66.28
75 and over	229.41	62.12
Total	1) 22.33 (21.70-23.01)	8.37 (7.97-8.78)
	2) 39.63	9.95
	3) 62.16	16.94

1) Crude rate for the Korean population as of 1985 (95% CI). The cumulative rates for 0-64 and 0-74 are 2.27%, 5.41% in males and 0.62%, 1.19% in females, respectively. The estimated number of newly-occurring lung cancer patients per year are about 4,517 for males and 1,689 for females in Korea.

2) Age adjusted rate for the world population

3) Truncated(35-64 years of age) rate for the world population

Under the age of 45, the incidence rate of lung cancer in women was higher than that of men. After the age of 45, however, the male incidence rate was higher than that of females, especially showing a sixfold difference in the age group of 60-64.

Geographical variation of the incidence rates of lung cancer within Korea (Table 7)

When the incidence of lung cancer was geographically estimated by the method of indirect standardization, there was little variation in the standardized incidence ratio (SIR) in men. In women, the SIR showed no difference by residence except for the Jeju area.

DISCUSSION

The methodological discussion on this survey could be found in the associated papers (Ahn *et al.*, 1989; Ahn *et al.*, 1991a; 1991b; 1991c; Ahn *et al.*, 1994).

The number of incident cases increased with age, which showed the same pattern as that of previous

Table 7. Geographical comparison of lung cancer incidence within Korea by indirect standardization method using KMIC beneficiaries

Geographical Area	Male			Female		
	Number of		SIR [®]	Number of		SIR [®]
	Observed	Expected		Observed	Expected	
Seoul, Incheon, Kyunggi	284	318	0.89	124	103	1.20
Kangwon	34	46	0.74	12	15	0.80
Chungbuk	23	30	0.77	10	10	1.00
Taejeon, Chungnam	76	60	1.27	13	20	0.65
Jeonbuk	52	46	1.13	18	16	1.13
Kwangju, Jeonnam	76	74	1.03	20	26	0.77
Taegu, Kyungbuk	109	120	0.91	29	33	0.88
Pusan, Kyungnam	126	114	1.11	40	40	1.00
Jeju	12	9	1.33	0	4	0.00*

[®]Standardized incidence ratio (number of observed/number of expected)

* $p < 0.05$ by Poisson distribution

reports (Fleehinger et al., 1984; Frost et al., 1984; Fontana et al., 1984). The most common histologic type of lung cancer was squamous in both sexes and squamous cell type in males, and adenocarcinoma in females, which was consistent with other papers (Yesner et al., 1965; Matthews & Gordon 1977; Fleehinger et al., 1984; Frost et al., 1984; Fontana et al., 1984). Especially adenocarcinoma was the most common pathologic type in females under 45 years old, which could explain the sex-crossing pattern of the age-specific annual incidence rate under 45 years (Table 6) (Fig. 2), which was also consistent with previous papers (Minna et al., 1989; Scoggin, 1992). Such a consistent finding of the pathologic pattern of lung cancer between Koreans and Caucasians suggested that the carcinogenic mechanism of lung cancer in Koreans might be similar to that in Caucasians. So further research to reveal the carcinogenic mechanism will be needed.

The nationwide incidence rate of lung cancer was estimated as 22.33 in males and 8.37 in females in 1989, which was lower in male and higher in female than that of the Kwangwha Cohort Study which was based on the local area of Kwangwha (Kim et al., 1990). This discrepancy could be explained by Table 2 showing almost 40% of lung cancer patients located in the Kyunggi area including Seoul and Incheon, and by Table 7 showing this area had a lower SIR than that of other areas in male and higher in female. So the incidence rate of the Kwangwha Cohort Study seemed to be overestimated in males and underestimated in females as compared to this survey.

The age-adjusted incidence rate for the world population was 39.63 in males and 9.95 in females, which was nearly the same as that of Koreans living in Los Angeles, Japanese in Osaka, Japanese in Hawaii, and Japanese in Los Angeles (IARC, 1992). The truncated rates and cumulative rates of 0-64 years and 0-74 years in male and female, also is nearly the same as that of Koreans living in Los Angeles, Japanese in Osaka, Japanese in Hawaii, and Japanese in Los Angeles (Table 8, 9). When compared with world-population adjusted incidence rates, the rate of this survey is one-third lower than in male and female of Blacks in New Orleans, USA, but much higher than that of a Mali population, which suggests the incidence level of lung cancer among Koreans in Korea is in the middle level in the world.

Since Doll and Hill (1954) reported an association between use of tobacco and mortality rates from lung cancer, many epidemiological studies have proven the causal relationship between smoking and lung cancer (Hammond and Horn, 1958; Doll and Peto, 1976; Doll and Peto 1978; Doll and Peto 1981). To explain the difference in lung cancer incidence rates between Koreans and Blacks in the US, information on smoking rates is needed. However, information on smoking rates of both sexes in Korea is not available, a national comparison of incidence rates according to smoking amounts cannot be done and furthermore the prediction of the future incidence trend in Korea is not yet possible.

The incidence level of lung cancer in Koreans and Japanese shows similarity between native country residents and U.S. migrants, and the incidence rate in

Table 8. Comparison of the age-standardized and cumulative rates of male lung cancer among some selected races and areas

Race/Area	Year	World*	Truncated [®]	0-64 [§]	0-74 [§]
Koreans/South Korea	'88-'89	39.6	62.2	2.2	5.4
/L.A.	'83-'87	38.3	53.0	1.8	4.5
Japanese/Osaka	'83-'87	41.5	42.8	1.5	5.0
/Hawaii	'83-'87	37.1	50.4	1.7	4.5
/L.A.	'83-'87	34.9	42.6	1.5	4.7
Chinese/Shanghai	'83-'87	53.0	68.6	2.5	6.9
/Singapore	'83-'87	69.7	94.0	3.3	8.6
/Hawaii	'83-'87	29.7	40.1	1.3	3.8
/L.A.	'83-'87	42.6	57.6	2.0	4.4
White/New Orleans	'83-'87	92.0	139.8	4.9	11.8
Black/New Orleans	'83-'87	115.9	200.1	6.9	14.7
Mali, Bamako	'87-'89	4.8	9.1	0.3	0.5

*World-population adjusted incidence rates

[®]Truncated rates(35-64 years of age)[§]Cumulative rates**Table 9.** Comparison of the age-standardized and cumulative rates of female lung cancer among some selected races and areas

Race/Area	Year	World*	Truncated [®]	0-64 [§]	0-74 [§]
Koreans/South Korea	'88-'89	9.9	16.9	0.6	1.2
/L.A.	'83-'87	12.4	12.3	0.4	1.4
Japanese/Osaka	'83-'87	11.7	13.3	0.4	1.3
/Hawaii	'83-'87	9.3	13.1	0.4	1.1
/L.A.	'83-'87	17.5	18.6	0.6	2.4
Chinese/Shanghai	'83-'87	18.1	24.9	0.8	2.3
/Singapore	'83-'87	21.9	28.1	1.0	2.7
/Hawaii	'83-'87	18.4	30.3	1.1	2.1
/L.A.	'83-'87	18.2	20.1	0.6	2.0
White/New Orleans	'83-'87	35.3	60.9	2.1	4.5
Black/New Orleans	'83-'87	33.2	60.9	2.1	4.1
Mali/Bamako	'87-'89	2.6	4.7	0.1	0.1

*World-population adjusted incidence rates

[®]Truncated rates(35-64 years of age)[§]Cumulative rates

Koreans is one-third lower than in Blacks in New Orleans, U.S., which suggests that genetic susceptibility may play a more important role in lung cancer incidence than life style difference. Further study for confirming this suggestion will be needed.

ACKNOWLEDGMENTS

The authors wish to express their gratitude to the doctors, medical recorders and other related persons of the corresponding hospitals, who helped in abstracting the medical records of the study population. We are also appreciative to the seventy-four junior

and senior students of Seoul National University College of Medicine who did their best to abstract the information from the medical records.

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