

Cancer Statistics in Korea: Incidence, Mortality, Survival, and Prevalence in 2008

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Purpose

This paper overviews the nationwide cancer statistics including incidence, mortality, survival and prevalence, and their trends in Korea based on the year 2008 cancer incidence data.

Materials and Methods

Incidence data from 1993 to 2008 were obtained from the Korea National Cancer Incidence Database, and the vital status was followed through December 31, 2009. Mortality data from 1983 to 2008 were obtained from the Korea National Statistics Office. Crude rates and age-standardized rates for incidence, mortality, prevalence and relative survival were calculated.

Results

There were 178,816 cancer cases and 68,912 cancer deaths observed during year 2008 and 724,663 10-year cancer prevalent cases as of January 1, 2009 in Korea. The incidence rate for all cancer combined showed an annual increase of 3.1% from 1999 to 2008.

Conclusion

With significantly increasing cancer incidence, Korea faces a large cancer burden and efficient cancer control programs are essential.

Key words

Incidence, Mortality, Survival, Prevalence, Neoplasms, Korea

Introduction

Cancer has been the leading cause of death in Korea since 1983 [1] and has drawn much attention in public health. Over 170,000 new cancer cases are diagnosed annually in Korea and one out of four deaths results from cancer [2,3]. This paper gives an overview of the nationwide cancer statistics, including the incidence, mortality,

prevalence, survival rates and their trends in Korea.

1 Data sources

The Ministry of Health and Welfare, Korea had initiated a nationwide hospital-based cancer registry as early as 1980 called the Korea Central Cancer Registry (KCCR). The registry collected approximately 80-90% cancer cases from more than 150 training hospitals

across the country every year. From 1999, the KCCR expanded cancer registration to cover the whole population under the Population-Based Regional Cancer Registry (PB-RCR) program. Details of the history, objectives, and activities of the KCCR have been documented [4]. Incidence data from 1999 to 2008 were obtained from the Korea National Cancer Incidence Database (KNCI DB). Cancer cases were classified according to the International Classification of Diseases for Oncology 3rd edition [5] and converted according to the International Classification of Diseases 10th edition (ICD-10) [6]. The survival analysis used 1,623,046 cancer cases first diagnosed during 1993-2008 from the KNCI DB, and followed the vital status through 31 December 2009.

Mortality data from 1983 to 2008 were obtained from the Korea National Statistics Office (KNSO) [1]. Cause of death was coded and classified according to the ICD-10. The population data were also obtained from KNSO using the resident registration population on July 1st of specified years.

Analysis

Crude rates (CRs) and age-specific rates of cancer incidence and mortality were calculated. Age-standardized rates (ASRs) were determined using the World Health Organization (WHO) world standard population [7]. The cumulative risks of cancer incidence, which represent the probability of developing cancer to life expectancy, were also calculated. Changes in the annual age-standardized cancer incidence rates were examined by calculating the annual percentage change over a time period as $(\exp(b)-1) \times 100$, where b is the slope of the regression of log ASR on a calendar year [8].

In order to assess the level of cancer burden, prevalence was also estimated which represents new and pre-existing cancer cases diagnosed during a given period of time and still alive on an index date. Using the cancer incidence database from 1999 to 2008, we calculated the limited-duration prevalence, such as 1, 5, and 10-year prevalence. In this study, for example, 10-year prevalence was calculated from the number of people alive on January 1, 2009 who were diagnosed with cancer within the previous 10 years. We applied the counting method

Table 1. Number of cancer incidence cases, deaths, and prevalent cases by sex during 2008 in Korea

Sites	New cases			Deaths			10-yr prevalent cases ^{a)}		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All sites	178,816	93,017	85,799	68,912	43,785	25,127	724,663	334,329	390,334
Lip, oral cavity, and pharynx	2,557	1,899	658	969	761	208	11,304	7,728	3,576
Esophagus	2,181	1,986	195	1,385	1,244	141	5,216	4,717	499
Stomach	28,078	18,898	9,180	10,312	6,712	3,600	134,722	89,616	45,106
Colon and rectum	22,623	13,536	9,087	6,802	3,809	2,993	103,033	60,448	42,585
Liver	15,663	11,776	3,887	11,292	8,512	2,780	36,036	27,085	8,951
Gallbladder ^{b)}	4,378	2,149	2,229	3,459	1,698	1,761	9,935	5,076	4,859
Pancreas	4,320	2,404	1,916	3,767	2,135	1,632	4,780	2,663	2,117
Larynx	1,073	998	75	409	364	45	6,385	5,977	408
Lung	18,774	13,384	5,390	14,791	10,899	3,892	34,926	23,465	11,461
Breast	12,659	75	12,584	1,731	13	1,718	79,468	381	79,087
Cervix uteri	3,888	-	3,888	954	-	954	33,102	-	33,102
Corpus uteri	1,562	-	1,562	210	-	210	9,084	-	9,084
Ovary	1,816	-	1,816	834	-	834	9,732	-	9,732
Prostate	6,471	6,471	-	1,168	1,168	-	23,940	23,940	-
Testis	176	176	-	14	14	-	1,408	1,408	-
Kidney	3,228	2,220	1,008	655	461	194	15,243	10,265	4,978
Bladder	3,230	2,582	648	1,007	752	255	18,260	14,845	3,415
Brain and CNS	1,620	876	744	1,040	568	472	6,273	3,289	2,984
Thyroid	26,923	4,275	22,648	347	108	239	107,693	15,252	92,441
Hodgkin lymphoma	210	127	83	46	31	15	1,253	796	457
Non-Hodgkin lymphoma	3,475	1,936	1,539	1,343	814	529	16,142	8,873	7,269
Multiple myeloma	893	480	413	615	316	299	2,464	1,295	1,169
Leukemia	2,561	1,432	1,129	1,507	867	640	9,936	5,442	4,494
Other and ill-defined	10,457	5,337	5,120	4,255	2,539	1,716	44,328	21,768	22,560

CNS, central nervous system. ^{a)}10-yr prevalent cases: limited-duration prevalent cases on January 1, 2009. These are patients that were diagnosed between January 1, 1999 and December 31, 2008 and were alive on January 1, 2009. Multiple primary cancer cases were counted multiple times. ^{b)}Includes gallbladder and other/unspecified parts of biliary tract.

using SEER*Stat software [9] to calculate the number of prevalent cases while adjusting for the patients lost in follow-up [8].

The survival duration of each case was determined as the time difference between the date of initial diagnosis and the date of death, date of loss to follow-up, or closing date for follow-up. Observed survival rates were calculated using a life table method and relative survival rates were examined with the Ederer II method [10] using an algorithm written in SAS by Dickman [11], with some minor modifications.

Selected Findings

1 Incidence

Table 1 presents the overall number of cancer incident cases, deaths and prevalent cases during 2008 in Korea by sex and cancer site. In 2008, 178,816 cancer incident cases and 68,912 deaths were observed in Korea. As of January 1, 2009, there were 724,663 10-year cancer prevalent cases observed in Korea. The cumulative risks for develop-

ping cancer to the life expectancy were 37.2% for men and 30.5 for women in 2008.

Table 2 shows the cancer incidence rates by sex in 2008. The CRs of all sites combined in 2008 were 375.7 and 348.1 per 100,000 in men and women, respectively. The ASRs of all sites combined were 318.5 and 245.3 per 100,000 in men and women, respectively. In males, the five leading primary sites of cancer were the stomach (CR, 76.3; ASR, 63.8), colon and rectum (CR, 54.7; ASR, 45.9), lung (CR, 54.1; ASR, 46.9), liver (CR, 47.6; ASR, 38.9), and prostate (CR, 26.1; ASR, 23.0), accounting for 68.9% of all newly diagnosed cancers in 2008. In females, the most common cancer sites were the thyroid (CR, 91.9; ASR, 68.6), breast (CR, 51.1; ASR, 36.8), stomach (CR, 37.2; ASR, 24.9), colon and rectum (CR, 36.9; ASR, 24.7), lung (CR, 21.9; ASR, 13.9), and cervix uteri (CR, 15.8; ASR, 11.2), accounting for 73.2% of all newly diagnosed cancers. Thyroid cancer alone accounted for 26.4% (22,648) of incident cases in women in 2008.

2 Mortality

There were 68,912 cancer deaths reported in Korea during 2008, accounting for 28.0% of all deaths (Table 3). In 2008, The CRs of all

Table 2. Crude and age-standardized cancer mortality rates by sex during 2008 in Korea

Sites	Crude incidence rates/100,000			Age-standardized incidence rates/100,000 ^{a)}		
	Both sexes	Male	Female	Both sexes	Male	Female
All sites	361.9	375.7	348.1	271.1	318.5	245.3
Lip, oral cavity, and pharynx	5.2	7.7	2.7	3.9	6.4	1.9
Esophagus	4.4	8.0	0.8	3.3	6.9	0.5
Stomach	56.8	76.3	37.2	42.2	63.8	24.9
Colon and rectum	45.8	54.7	36.9	34.1	45.9	24.7
Liver	31.7	47.6	15.8	23.7	38.9	10.5
Gallbladder ^{b)}	8.9	8.7	9.0	6.4	7.5	5.5
Pancreas	8.7	9.7	7.8	6.3	8.3	4.8
Larynx	2.2	4.0	0.3	1.6	3.4	0.2
Lung	38.0	54.1	21.9	27.7	46.9	13.9
Breast	25.6	0.3	51.1	18.7	0.3	36.8
Cervix uteri	7.9	-	15.8	5.8	-	11.2
Corpus uteri	3.2	-	6.3	2.4	-	4.6
Ovary	3.7	-	7.4	2.8	-	5.5
Prostate	13.1	26.1	-	9.6	23.0	-
Testis	0.4	0.7	-	0.4	0.7	-
Kidney	6.5	9.0	4.1	5.0	7.4	3.0
Bladder	6.5	10.4	2.6	4.7	9.0	1.6
Brain and CNS	3.3	3.5	3.0	2.9	3.3	2.6
Thyroid	54.5	17.3	91.9	40.8	13.1	68.6
Hodgkin lymphoma	0.4	0.5	0.3	0.4	0.5	0.3
Non-Hodgkin lymphoma	7.0	7.8	6.2	5.5	6.7	4.6
Multiple myeloma	1.8	1.9	1.7	1.4	1.6	1.2
Leukemia	5.2	5.8	4.6	5.0	5.7	4.3
Other and ill-defined	21.2	21.6	20.8	16.5	19.1	4.3

CNS, central nervous system. ^{a)}Age adjusted to the World Health Organization (WHO) world standard population, ^{b)}Includes gallbladder and other/unspecified parts of biliary tract.

Table 3. Ten leading causes of death during 2008 in Korea

Rank	Cause of death	No. of deaths	Percent of all deaths	Age-standardized death rate ^{a)}
	All causes	246,113	100.0	365.3
1	Cancer	68,912	28.0	101.0
2	Cerebrovascular disease	27,932	11.3	39.1
3	Heart disease	21,429	8.7	30.6
4	Intentional self harm (suicide)	12,858	5.2	20.3
5	Diabetes mellitus	10,234	4.2	14.5
6	Chronic lower respiratory diseases	7,338	3.0	10.1
7	Transport accidents	7,287	3.0	12.1
8	Disease of liver	7,164	2.9	10.7
9	Pneumonia	5,461	2.2	7.7
10	Hypertensive diseases	4,724	1.9	6.6
	Others	72,774	29.6	112.6

Source: Mortality Data, 2008, Korea National Statistical Office. ^{a)}Age adjusted to the World Health Organization (WHO) world standard population.

sites combined were 176.9 and 101.9 per 100,000 for men and women, respectively. The ASRs of all sites combined were 154.1 and 63.5 per 100,000 for men and women, respectively. Cancers of the lung, liver, stomach and colon and rectum were the most common fatal cancers, which accounted for about 62.7% of all cancer deaths in 2008 (Table 4).

In men, the five leading primary cancer sites for mortality in 2008 were the lung (CR, 44.0; ASR, 38.7), liver (CR, 34.4; ASR, 28.5), stomach (CR, 27.1; ASR, 23.5), colon and rectum (CR, 15.4; ASR, 13.5), and pancreas (CR, 8.6; ASR, 7.5). In women, lung cancer mortality (CR, 15.8; ASR, 9.4) increased gradually being the first cancer site for mortality in 2008, followed by stomach (CR, 14.6; ASR, 8.7), colon and rectum (CR, 12.1; ASR, 7.3), liver (CR, 11.3; ASR, 7.2), and gallbladder (CR, 7.1; ASR, 4.1).

3 Trends in cancer incidence

Tables 5-7 present the cancer incidence rates during 1999-2008 in Korea for all sites combined and for selected cancer sites. The incidence rate for all sites combined increased by 3.1% annually from 1999 to 2008. The incidence rate for all sites combined increased by

Table 4. Crude and age-standardized cancer mortality rates by sex during 2008 in Korea

Sites	Crude mortality rates/100,000			Age-standardized mortality rates/100,000 ^{a)}		
	Both sexes	Male	Female	Both sexes	Male	Female
All sites	139.5	176.9	101.9	101.0	154.1	63.5
Lip, oral cavity, and pharynx	2.0	3.1	0.8	1.4	2.6	0.5
Esophagus	2.8	5.0	0.6	2.1	4.4	0.3
Stomach	20.9	27.1	14.6	14.8	23.5	8.7
Colon and rectum	13.8	15.4	12.1	9.8	13.5	7.3
Liver	22.9	34.4	11.3	16.9	28.5	7.2
Gallbladder ^{b)}	7.0	6.9	7.1	4.9	6.1	4.1
Pancreas	7.6	8.6	6.6	5.5	7.5	4.0
Larynx	0.8	1.5	0.2	0.6	1.3	0.1
Lung	29.9	44.0	15.8	21.3	38.7	9.4
Breast	3.5	0.1	7.0	2.6	0.0	4.9
Cervix uteri	1.9	-	3.9	1.4	-	2.5
Corpus uteri	0.4	-	0.9	0.3	-	0.6
Ovary	1.7	-	3.4	1.2	-	2.3
Prostate	2.4	4.7	-	1.6	4.6	-
Testis	0.0	0.1	-	0.0	0.1	-
Kidney	1.3	1.9	0.8	1.0	1.6	0.5
Bladder	2.0	3.0	1.0	1.4	2.8	0.5
Brain and CNS	2.1	2.3	1.9	1.7	2.0	1.4
Thyroid	0.7	0.4	1.0	0.5	0.4	0.5
Hodgkin lymphoma	0.1	0.1	0.1	0.1	0.1	0.0
Non-Hodgkin lymphoma	2.7	3.3	2.1	2.0	2.8	1.4
Multiple myeloma	1.2	1.3	1.2	0.9	1.1	0.8
Leukemia	3.1	3.5	2.6	2.6	3.2	2.0
Other and ill-defined	8.6	10.3	7.0	6.3	9.1	4.4

CNS, central nervous system. ^{a)}Age adjusted to the World Health Organization (WHO) world standard population, ^{b)}Includes gallbladder and other/unspecified parts of biliary tract.

Table 5. Trends in cancer incidence rates in both sexes during 1999-2008 in Korea

Sites	Year										APC ^{a)}
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
All sites	210.5	205.1	216.7	220.1	227.1	234.1	246.7	250.5	260.8	271.1	3.1 ^{b)}
Lip, oral cavity, and pharynx	3.6	4.4	3.6	3.7	3.8	3.8	3.8	3.7	3.8	3.9	0.1
Esophagus	4.1	3.7	3.9	3.8	3.6	3.5	3.5	3.4	3.3	3.3	-2.1 ^{b)}
Stomach	43.6	42.3	44.0	43.6	43.2	41.1	44.3	42.7	41.6	42.2	-0.3
Colon and rectum	20.4	21.0	22.9	24.7	26.8	28.5	30.8	32.2	33.3	34.1	6.4 ^{b)}
Liver	27.9	26.7	27.3	26.5	25.7	25.5	25.8	24.5	24.2	23.7	-1.7 ^{b)}
Gallbladder ^{c)}	6.5	6.4	6.7	6.7	6.7	6.9	7.1	6.6	6.5	6.4	0.1
Pancreas	5.6	5.5	5.5	5.8	5.8	6.0	6.3	6.1	6.3	6.3	1.7
Larynx	2.3	2.2	2.4	2.2	2.1	1.9	2.0	1.8	1.8	1.6	-3.9 ^{b)}
Lung	28.5	27.7	28.3	28.5	27.8	28.7	28.9	28.6	28.2	27.7	0.0
Breast	10.7	10.8	12.7	13.9	14.2	14.9	16.1	16.8	17.9	18.7	6.5 ^{b)}
Cervix uteri	8.5	7.9	8.3	7.7	7.4	6.8	6.5	6.3	5.7	5.8	-4.6 ^{b)}
Corpus uteri	1.4	1.3	1.5	1.7	1.9	1.9	2.0	2.1	2.1	2.4	6.0 ^{b)}
Ovary	2.7	2.5	2.5	2.6	2.7	2.7	2.8	2.8	3.0	2.8	1.6 ^{b)}
Prostate	3.1	2.7	3.6	3.9	4.8	5.9	6.3	7.2	8.5	9.6	15.2 ^{b)}
Testis	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	3.5 ^{b)}
Kidney	3.0	2.9	3.3	3.4	3.5	3.7	4.1	4.4	4.7	5.0	6.4 ^{b)}
Bladder	4.6	4.6	4.9	4.7	5.1	5.1	5.1	4.9	4.9	4.7	0.5
Brain and CNS	2.9	2.8	2.8	2.6	2.9	2.9	3.1	2.9	3.1	2.9	1.0 ^{b)}
Thyroid	6.3	6.1	7.9	9.5	12.7	17.2	20.6	25.3	32.6	40.8	25.1 ^{b)}
Hodgkin lymphoma	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.4	4.5 ^{b)}
Non-Hodgkin lymphoma	4.5	4.2	4.5	4.6	4.9	5.2	5.3	5.5	5.5	5.5	3.3 ^{b)}
Multiple myeloma	1.0	1.0	1.1	1.1	1.1	1.2	1.3	1.3	1.4	1.4	4.0 ^{b)}
Leukemia	4.7	4.3	4.7	4.8	4.7	4.8	4.7	4.9	4.8	5.0	0.9 ^{b)}
Other and ill-defined	14.3	13.5	13.9	13.5	15.1	15.1	16.0	15.9	16.8	16.5	-

CNS, central nervous system. ^{a)}Annual percent change (APC) using age-standardized incidence based on the World Health Organization (WHO) world standard population, ^{b)}The APC is significantly different from zero ($p < 0.05$), ^{c)}Includes gallbladder and other/unspecified parts of biliary tract.

Table 6. Trends in cancer incidence rates in males during 1999-2008 in Korea

Sites	Year										APC ^{a)}
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
All sites	285.0	276.7	288.3	290.0	294.2	298.6	310.4	308.6	314.3	318.5	1.5 ^{b)}
Lip, oral cavity, and pharynx	6.1	7.1	6.0	6.2	6.5	6.1	6.0	6.1	6.2	6.4	-0.4
Esophagus	8.8	8.0	8.3	8.2	7.7	7.7	7.6	7.2	6.9	6.9	-2.5 ^{b)}
Stomach	66.2	65.0	67.2	66.6	65.9	62.2	66.7	65.2	62.8	63.8	-0.5
Colon and rectum	26.2	27.2	29.6	32.9	35.2	37.8	40.9	43.0	44.8	45.9	7.0 ^{b)}
Liver	46.8	44.7	45.1	43.9	42.3	42.1	42.6	40.1	39.5	38.9	-1.9 ^{b)}
Gallbladder ^{c)}	8.1	7.8	8.2	8.1	7.8	8.4	8.7	8.1	7.9	7.5	-0.2
Pancreas	7.8	7.6	7.6	7.9	7.7	8.0	8.3	8.0	8.2	8.3	0.9 ^{b)}
Larynx	4.9	4.5	5.1	4.7	4.4	4.1	4.3	3.7	3.7	3.4	-3.8 ^{b)}
Lung	51.4	49.8	51.1	51.0	49.9	50.8	50.8	49.1	48.5	46.9	-0.7 ^{b)}
Breast	0.2	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.3	-2.2
Prostate	8.4	7.2	9.5	10.1	12.3	15.0	15.7	17.8	20.7	23.0	13.7 ^{b)}
Testis	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	3.4 ^{b)}
Kidney	4.5	4.4	4.9	5.0	5.2	5.5	6.0	6.5	7.0	7.4	6.0 ^{b)}
Bladder	9.0	9.0	9.4	9.0	9.7	9.8	9.7	9.5	9.3	9.0	0.3
Brain and CNS	3.2	3.1	3.1	2.9	3.3	3.3	3.4	3.2	3.4	3.3	0.9
Thyroid	2.1	1.9	2.4	2.7	3.7	4.8	5.9	7.5	9.9	13.1	24.5 ^{b)}
Hodgkin lymphoma	0.4	0.4	0.4	0.3	0.4	0.5	0.4	0.4	0.5	0.5	2.8
Non-Hodgkin lymphoma	5.8	5.5	5.8	5.8	6.2	6.6	6.4	6.8	6.9	6.7	2.5 ^{b)}
Multiple myeloma	1.2	1.3	1.4	1.4	1.4	1.4	1.6	1.4	1.6	1.6	3.1 ^{b)}
Leukemia	5.5	5.0	5.4	5.8	5.4	5.7	5.5	5.6	5.6	5.7	0.8
Other and ill-defined	17.9	16.5	16.8	16.5	18.4	18.1	19.1	18.6	19.9	19.1	-

CNS, central nervous system. ^{a)}Annual percent change (APC) using age-standardized incidence based on the World Health Organization (WHO) world standard population, ^{b)}The APC is significantly different from zero ($p < 0.05$), ^{c)}Includes gallbladder and other/unspecified parts of biliary tract.

Table 7. Trends in cancer incidence rates in females during 1999-2008 in Korea

Sites	Year										APC ^{a)}
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
All sites	161.1	157.4	169.0	174.6	183.8	192.8	206.7	215.0	229.7	245.3	5.1 ^{b)}
Lip, oral cavity, and pharynx	1.6	2.4	1.7	1.7	1.7	1.8	1.9	1.8	1.9	1.9	0.5
Esophagus	0.6	0.6	0.6	0.5	0.6	0.5	0.4	0.5	0.5	0.5	-2.2 ^{b)}
Stomach	26.7	25.2	26.2	26.3	25.9	24.7	26.8	25.0	24.7	24.9	-0.6
Colon and rectum	16.4	16.4	17.9	18.8	20.4	21.4	22.8	23.9	24.2	24.7	5.3 ^{b)}
Liver	12.3	11.8	12.2	11.8	11.5	11.3	11.3	11.1	11.0	10.5	-1.5 ^{b)}
Gallbladder ^{c)}	5.3	5.5	5.7	5.8	5.8	5.9	6.0	5.5	5.6	5.5	0.2
Pancreas	4.0	4.0	4.0	4.2	4.4	4.4	4.7	4.7	4.7	4.8	2.5 ^{b)}
Larynx	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	-9.0 ^{b)}
Lung	12.4	12.5	12.3	12.6	12.4	13.0	13.5	13.9	13.8	13.9	1.5 ^{b)}
Breast	20.9	20.9	24.7	27.2	27.8	29.1	31.7	33.1	35.4	36.8	6.7 ^{b)}
Cervix uteri	16.3	15.1	15.8	14.8	14.2	13.1	12.4	12.2	11.0	11.2	-4.5 ^{b)}
Corpus uteri	2.8	2.6	3.0	3.3	3.8	3.7	3.9	4.0	4.2	4.6	6.2 ^{b)}
Ovary	5.0	4.8	4.8	5.0	5.1	5.2	5.4	5.4	5.8	5.5	1.8 ^{b)}
Kidney	1.7	1.8	1.9	2.0	2.1	2.2	2.5	2.7	2.8	3.0	6.5 ^{b)}
Bladder	1.6	1.6	1.7	1.7	1.8	1.7	1.7	1.6	1.7	1.6	-0.1
Brain and CNS	2.6	2.5	2.5	2.4	2.5	2.7	2.8	2.7	2.8	2.6	1.0
Thyroid	10.4	10.1	13.2	16.2	21.7	29.5	35.2	43.0	55.2	68.6	25.4 ^{b)}
Hodgkin lymphoma	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	7.1 ^{b)}
Non-Hodgkin lymphoma	3.4	3.2	3.4	3.5	3.9	4.1	4.4	4.3	4.3	4.6	4.2 ^{b)}
Multiple myeloma	0.8	0.8	0.9	0.8	1.0	1.0	1.2	1.1	1.2	1.2	5.3 ^{b)}
Leukemia	3.9	3.8	4.1	4.0	4.1	4.1	4.0	4.3	4.1	4.3	1.1 ^{b)}
Other and ill-defined	11.8	11.5	11.8	11.5	12.6	12.9	13.7	13.9	14.4	14.3	-

CNS, central nervous system. ^{a)}Annual percent change (APC) using age-standardized incidence based on the World Health Organization (WHO) world standard population, ^{b)}The APC is significantly different from zero ($p < 0.05$), ^{c)}Includes gallbladder and other/unspecified parts of biliary tract.

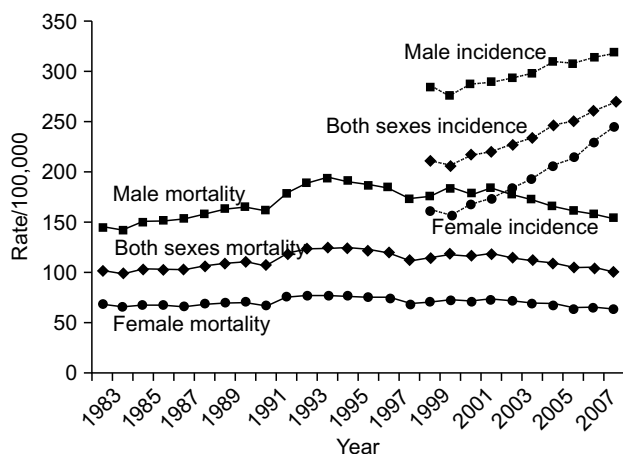


Fig. 1. Annual age-standardized cancer incidence and death rates for all sites by sex during 1983-2008 in Korea. Age-standardization was based on the World Health Organization (WHO) world standard population.

1.5% annually in men and by 5.1% in women from 1999 to 2008. The rapid increase in cancer incidence is also illustrated in Fig. 1.

As shown in Fig. 2, the incidence rates have continued to increase for colon and rectum and thyroid cancer in both sexes, along with

breast cancer in females and prostate cancer in males. On the contrary, the incidences of liver cancer in both sexes and cervix cancer in women have decreased. Stomach cancer incidence rates remained the same in men and women. One notable aspect was the sharp increase (25.4% annually) in the incidence of female thyroid cancer. As diagnostic techniques for thyroid cancer have become more sensitive, such as with the advent of ultrasound and fine-needle aspiration, the detection of subclinical disease has become possible. Therefore, the increased incidence of thyroid cancer may reflect improved diagnostic techniques for previously undetected disease, rather than a true increase in the occurrence of thyroid cancer [12,13]. Furthermore, from the construction of a KNCI DB for 1999 onward to 2008, the completeness of the Korea cancer registry data has improved gradually. This might have contributed in part to the gradual overall increase in cancer incidence, especially among the elderly.

4 Age-specific incidence rates for selected cancer sites

Table 8 presents the most common cancer sites by sex and age group in 2008. Leukemia and thyroid were the most common forms in both sexes, for ages 0-14 and 15-34 years, respectively. For males,

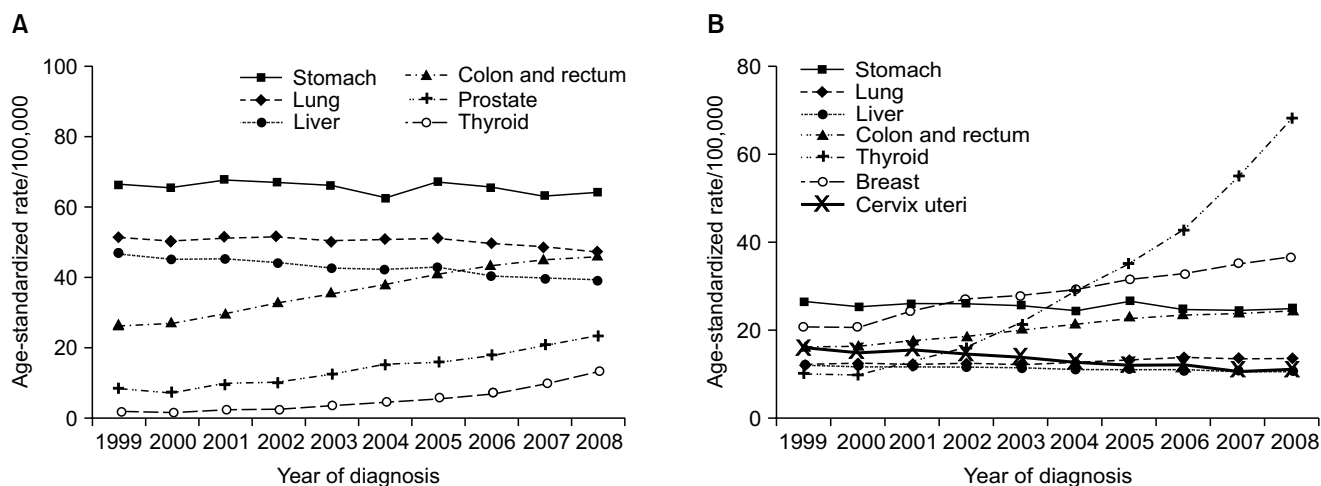


Fig. 2. Trend of age-standardized cancer incidence for selected cancers by sex during 1999-2008 in Korea. Age-standardization was based on the World Health Organization (WHO) world standard population. (A) Male. (B) Female.

Table 8. Five major sites of cancer incidence by age group and sex during 2008 in Korea

Rank	Age (yr)			
	0-14	15-34	35-64	≥ 65
Males				
1	Leukemia (4.5)	Thyroid (8.2)	Stomach (92.1)	Lung (447.5)
2	Brain and CNS (2.3)	Leukemia (3.3)	Liver (69.5)	Stomach (443.6)
3	Non-Hodgkin lymphoma (1.4)	Stomach (2.9)	Colon and rectum (64.5)	Colon and rectum (323.3)
4	Kidney ^{a)} (0.5)	Colon and rectum (2.7)	Lung (41.4)	Prostate (245.3)
5	Testis ^{a)} (0.5)	Non-Hodgkin lymphoma (2.4)	Thyroid (30.0)	Liver (211.6)
Females				
1	Leukemia (3.7)	Thyroid (44.5)	Thyroid (166.0)	Colon and rectum (161.9)
2	Brain and CNS (1.9)	Breast (9.2)	Breast (98.8)	Stomach (154.0)
3	Non-Hodgkin lymphoma (0.9)	Cervix uteri (5.3)	Stomach (40.9)	Lung (117.7)
4	Thyroid (0.7)	Stomach (4.4)	Colon and rectum (39.0)	Liver (74.5)
5	Ovary (0.7)	Ovary (2.7)	Cervix uteri (24.2)	Thyroid (69.3)

CNS, central nervous system. ^{a)}Kidney and testis are same rank.

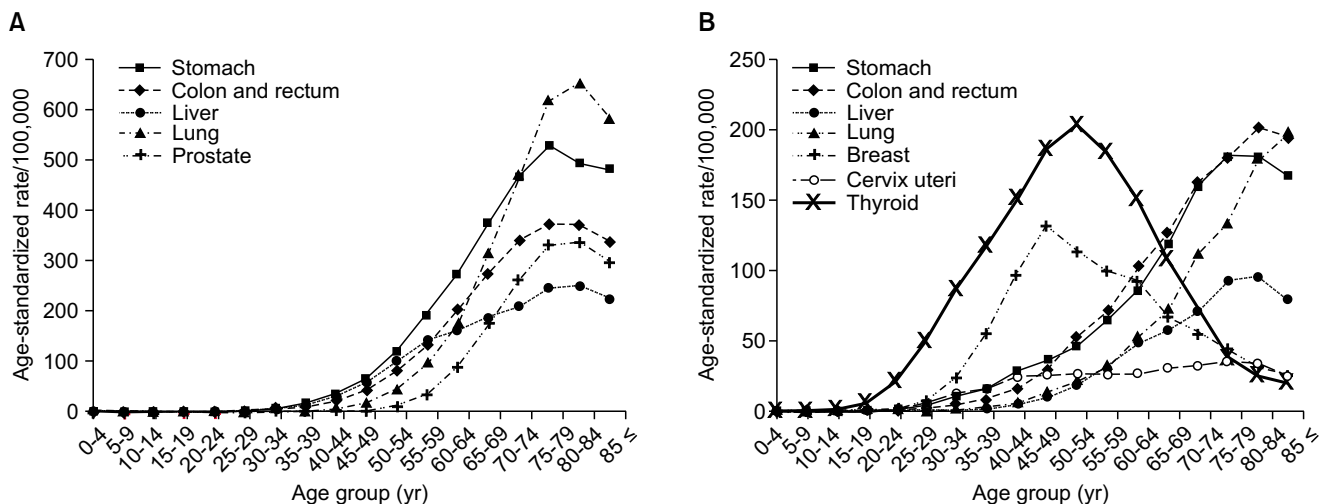


Fig. 3. Age-specific incidence rates of major cancers during 2008 in Korea. (A) Male. (B) Female.

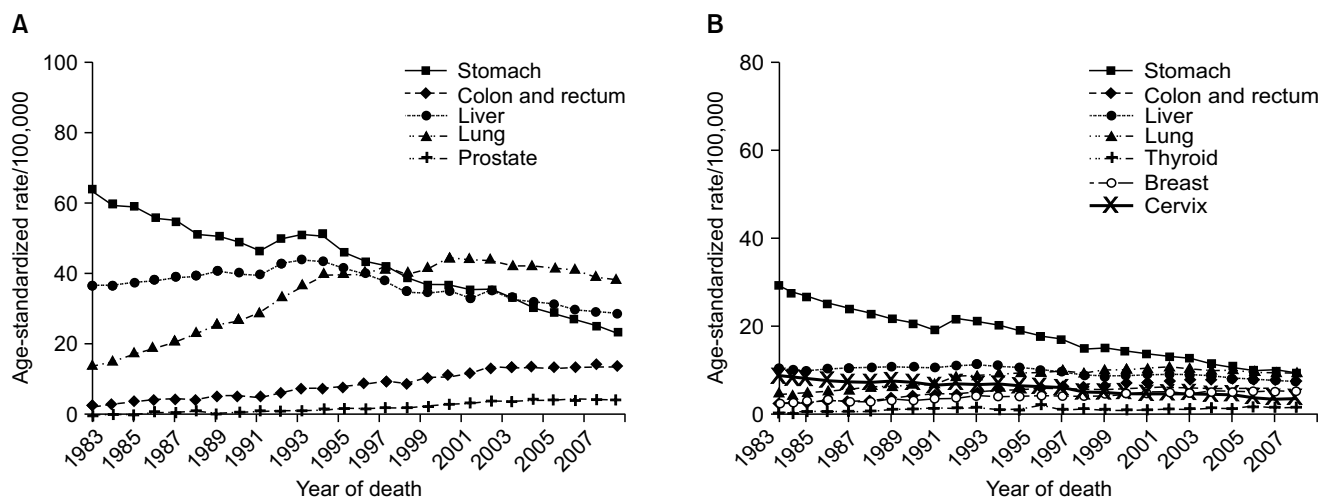


Fig. 4. Annual age-standardized cancer mortality for selected cancers by sex during 1983-2008 in Korea. Age-standardization was based on the World Health Organization (WHO) world standard population. (A) Male. (B) Female.

stomach cancer was the most common in 35-64-year-olds, while lung cancer was more frequent for patients aged 65 and over. Thyroid cancer was the most common site for mid-aged Korean women (35-64-year-olds), and colorectal cancer was the most common among old aged women (≥ 65 year-olds).

Fig. 3 shows the age-specific incidence rates of the selected cancers for men and women in 2008. The data show that the incidence of stomach, lung, liver and colorectal cancers increased gradually with age. Female breast and thyroid cancers showed highest incidence rates for women in their late forties and early fifties, respectively, and then leveled off. This pattern is very different from the rates observed in Western countries [14].

5 Trends in cancer mortality

Figs. 1 and 4 show the trends in cancer deaths for all sites combined and for selected cancer sites. Age-standardized mortality rates have decreased for all sites combined in both sexes since 2002. Lung cancer surpassed stomach cancer as the leading cause of cancer death in 1999, and is expected to account for 21.5% of all cancer deaths in 2008. The age-standardized mortality rates of lung have decreased slightly for men since 2001, but increased in women. The age-standardized mortality rates of stomach and cervix uteri cancer have decreased continuously. Along with the significant increases in colorectal, prostate and female breast cancer incidence, the mortality rates of these cancers have also continued to increase.

6 Survival rates

Table 9 shows the 5-year relative survivals for four periods of diagnosis time: 1993-1995, 1996-2000, 2001-2005 and 2004-2008. Cancer patients that were diagnosed in the recent period (2004-2008) had 5-year relative survival rates of 59.5% for all sites combined in

both sexes, 50.8% in males and 69.2% in females. When compared with earlier periods, notable improvements have been observed in the 5-year relative survival rates for all sites combined. Observation of higher female cancer survival rates than male cancer survival rates may be partly explained by common female cancers (e.g., thyroid, breast, and uterine cervix) that are known to have relatively good prognoses.

When examined by the year of diagnosis and cancer site, the 5-year relative survival rates appeared to be higher for most major cancer sites in patients diagnosed during 2004-2008 compared to 1993-1995, except for pancreatic cancer. The greatest improvements were seen in prostate, stomach, leukemia, and non-Hodgkin lymphoma. The improving survival rates could be attributable to early detection, as well as to improved treatments [15,16], but this needs to be evaluated further. Lack of progress in early detection and treatment could explain the observed absence of improvement in the survival rate of pancreatic cancer [17].

7 Prevalence rates

Table 10 shows the 10-year cancer prevalent rates on January 1, 2009 in Korea by sex and cancer site. The 10-year cancer prevalence CRs of all sites combined were 1,350.4 and 1,583.7 per 100,000 in men and women, respectively, and the 10-year cancer prevalence ASRs of all sites combined were 1,145.0 and 1,136.2 per 100,000 in men and women, respectively. In males, the five leading primary sites of cancer for prevalence were the stomach (CR, 362.0; ASR, 302.0), colon and rectum (CR, 244.2; ASR, 206.1), liver (CR, 109.4; ASR, 90.2), prostate (CR, 96.7; ASR, 86.3), and lung (CR, 94.8; ASR, 81.1), accounting for 67.2% of all cancer prevalent cases. In females, the most common cancer sites were the thyroid (CR, 375.1; ASR, 277.7), breast (CR, 320.9; ASR, 232.2), stomach (CR, 183.0; ASR, 123.6), colon and rectum (CR, 172.8; ASR, 115.8), cervix uteri (CR, 134.3; ASR, 95.1), and lung (CR, 46.5; ASR, 31.2), accounting for 77.8% of all cancer prevalent cases.

Table 9. Trends in the 5-yr relative survival rates (%) by year of diagnosis during 1993-2008 in Korea

Sites	Total						Male						Female					
	1993-1995	1996-2000	2001-2005	2004-2008	Change ^{a)}		1993-1995	1996-2000	2001-2005	2004-2008	Change ^{a)}		1993-1995	1996-2000	2001-2005	2004-2008	Change ^{a)}	
All sites	41.2	44.0	53.4	59.5	18.3		31.7	35.3	44.9	50.8	19.1		53.4	55.3	63.5	69.2	15.8	
Lip, oral cavity, and pharynx	41.1	46.7	53.7	57.5	16.4		35.8	41.1	48.9	53.1	17.3		58.1	63.8	67.3	69.3	11.2	
Esophagus	12.7	15.2	20.7	24.7	12.0		11.8	14.3	20.0	24.0	12.2		23.7	24.2	28.4	32.2	8.5	
Stomach	42.8	46.6	57.4	63.1	20.3		43.0	46.9	58.1	63.8	20.8		42.6	46.0	55.9	61.6	19.0	
Colon and rectum	54.8	58.0	66.3	70.1	15.3		55.3	59.0	68.3	72.0	16.7		54.2	56.8	63.8	67.5	13.3	
Liver	10.7	13.2	19.7	23.3	12.6		9.9	12.9	19.7	23.4	13.5		13.6	14.2	19.7	22.9	9.3	
Gallbladder ^{b)}	17.3	19.7	22.3	24.9	7.6		16.6	20.3	22.9	25.9	9.3		18.0	19.1	21.7	23.9	5.9	
Pancreas	9.4	7.6	7.5	7.6	-1.8		8.8	7.3	7.5	7.3	-1.5		10.1	8.1	7.5	7.9	-2.2	
Larynx	59.7	62.3	65.9	69.2	9.5		60.2	62.8	66.5	69.9	9.7		55.4	57.8	57.5	59.1	3.7	
Lung	11.3	12.7	15.8	17.5	6.2		10.4	11.6	14.6	15.9	5.5		14.2	16.2	19.1	21.5	7.3	
Breast	77.9	83.2	88.2	89.9	12.0		75.1	85.6	86.0	81.5	6.4		78.0	83.2	88.2	90.0	12.0	
Cervix uteri	77.5	80.0	81.0	80.5	3.0		-	-	-	77.5	80.0		81.0	80.5	3.0			
Corpus uteri	81.5	81.8	84.5	84.6	3.1		-	-	-	-	81.5		81.8	84.5	84.6	3.1		
Ovary	58.7	58.9	61.0	59.9	1.2		-	-	-	-	58.7		58.9	61.0	59.9	1.2		
Prostate	55.9	67.2	79.5	86.2	30.3		55.9	67.2	79.5	86.2	30.3		-	-	-	-	-	
Testis	85.4	90.4	90.4	91.2	5.8		85.4	90.4	90.4	91.2	5.8		-	-	-	-	-	
Kidney	62.0	66.1	73.2	76.4	14.4		60.8	64.4	72.6	76.4	15.6		64.5	69.7	74.3	76.4	11.9	
Bladder	69.1	73.1	75.3	76.1	7.0		70.0	74.8	77.1	77.8	7.8		65.5	66.3	68.1	68.9	3.4	
Brain and CNS	38.5	39.0	40.4	42.0	3.5		37.2	37.5	39.7	41.3	4.1		40.2	40.7	41.1	42.7	2.5	
Thyroid	94.2	94.9	98.1	99.3	5.1		87.2	89.5	95.6	98.3	11.1		95.4	95.9	98.5	99.5	4.1	
Hodgkin lymphoma	68.0	71.2	75.9	80.9	12.9		67.6	68.1	73.9	78.9	11.3		68.6	77.4	80.0	84.7	16.1	
Non-Hodgkin lymphoma	46.6	50.8	59.6	62.8	16.2		45.3	48.9	57.7	61.0	15.7		48.7	53.5	62.1	65.0	16.3	
Multiple myeloma	22.1	19.8	28.9	33.2	11.1		21.1	17.8	29.1	33.7	12.6		23.3	22.1	28.6	32.8	9.5	
Leukemia	26.5	33.3	41.2	44.9	18.4		26.2	32.3	41.1	44.5	18.3		26.8	34.6	41.4	45.4	18.6	
Other and ill-defined	42.1	45.9	55.0	60.4	18.3		37.4	42.4	51.4	56.3	18.9		47.4	50.0	59.1	64.9	17.5	

CNS, central nervous system. ^{a)}Change in the 5-yr relative survival between 1993-1995 and 2004-2008 as a percentage, ^{b)}Includes gallbladder and other/unspecified parts of biliary tract.

Table 10. Crude and age-standardized cancer 10-yr prevalent rates on January 1, 2009 by sex during 2008 in Korea

Sites	Crude mortality rates/100,000			Age-standardized mortality rates/100,000 ^{b)}		
	Both sexes	Male	Female	Both sexes	Male	Female
All sites	1,466.8	1,350.4	1,583.7	1,107.4	1,145.0	1,136.2
Lip, oral cavity, and pharynx	22.9	31.2	14.5	17.4	25.8	10.5
Esophagus	10.6	19.1	2.0	8.0	16.4	1.3
Stomach	272.7	362.0	183.0	203.2	302.0	123.6
Colon and rectum	208.5	244.2	172.8	155.1	206.1	115.8
Liver	72.9	109.4	36.3	56.0	90.2	25.9
Gallbladder ^{b)}	20.1	20.5	19.7	14.8	17.5	12.9
Pancreas	9.7	10.8	8.6	7.2	9.0	5.8
Larynx	12.9	24.1	1.7	9.7	20.8	1.0
Lung	70.7	94.8	46.5	52.8	81.1	31.2
Breast	160.9	1.5	320.9	118.5	1.3	232.2
Cervix uteri	67.0	-	134.3	49.1	-	95.1
Corpus uteri	18.4	-	36.9	13.9	-	27.2
Ovary	19.7	-	39.5	15.4	-	30.4
Prostate	48.5	96.7	-	34.6	86.3	-
Testis	2.8	5.7	-	2.6	5.2	-
Kidney	30.9	41.5	20.2	23.9	34.2	15.0
Bladder	37.0	60.0	13.9	26.9	51.8	8.6
Brain and CNS	12.7	13.3	12.1	11.6	12.4	10.8
Thyroid	218.0	61.6	375.1	163.1	47.1	277.7
Hodgkin lymphoma	2.5	3.2	1.9	2.2	2.8	1.7
Non-Hodgkin lymphoma	32.7	35.8	29.5	26.1	30.5	22.3
Multiple myeloma	5.0	5.2	4.7	3.8	4.4	3.3
Leukemia	20.1	22.0	18.2	20.0	22.0	18.1
Other and ill-defined	89.7	87.9	91.5	71.1	78.0	65.7

CNS, central nervous system. ^{a)}Adjusted to the World Health Organization (WHO) world standard population, ^{b)}Includes gallbladder and other/unspecified parts of biliary tract.

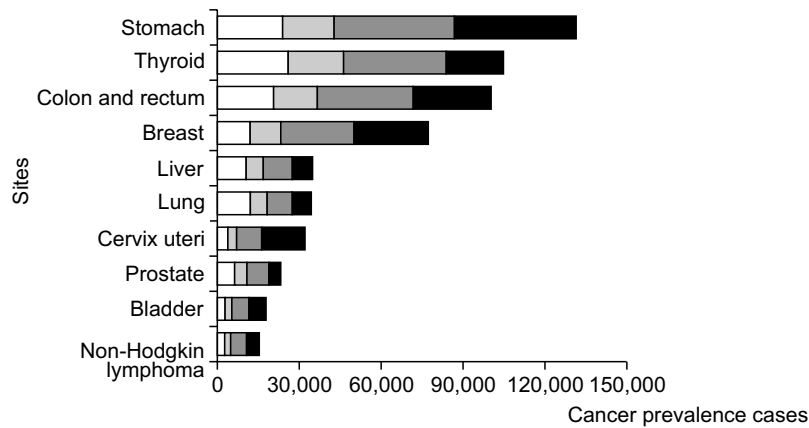


Fig. 5. Number of prevalent cases by time since diagnosis for major cancer sites on January 1, 2009 in Korea.

Fig. 5 shows the prevalence by time since diagnosis. For all cancers combined, the 1- to 2-year prevalence represented 37% of the total prevalent cases. The 1- to 2-year prevalence as a percentage of the total was highest for thyroid cancer (18%) following stomach (16%), and colorectal cancer (14%), which has high incidence rates and a good prognosis. For all cancers combined, the 2- to 5-year prevalence and the 5- to 10-year prevalence constituted 33% and 30% of the total prevalence in both sexes, respectively. The long-term prevalence of lung and liver cancer was relatively low due to lower rates of survival.

Conflicts of Interest

Conflict of interest relevant to this article was not reported.

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