Special Article

Cancer Statistics in Korea: Incidence, Mortality, Survival, and Prevalence in 2014

Kyu-Won Jung, MS[1,2]
Young-Joo Won, PhD[1,2,3]
Chang-Mo Oh, MD, PhD[1,2]
Hyun-Joo Kong, MS[1,2]
Duk Hyoung Lee, MD, PhD[2,3]
Kang Hyun Lee, MD, PhD[1]
The Community of Population-Based Regional Cancer Registries*

[1]*The Korea Central Cancer Registry, National Cancer Center, Goyang,* [2]*National Cancer Control Institute, National Cancer Center, Goyang,* [3]*Department of Cancer Control and Population Health, National Cancer Center Graduate School of Cancer Science and Policy, Goyang, Korea*

+ + + + + + + + + + + + + + +
Correspondence: Young-Joo Won, PhD
The Korea Central Cancer Registry,
National Cancer Center, 323 Ilsan-ro,
Ilsandong-gu, Goyang 10408, Korea
Tel: 82-31-920-2015
Fax: 82-31-920-2179
E-mail: astra67@ncc.re.kr
+ + + + + + + + + + + + + + +
Received March 6, 2017
Accepted March 6, 2017
Published Online March 9, 2017
+ + + + + + + + + + + + + + +
*The members of the group are listed at the end
of this article.

Purpose
This study presents the 2014 nationwide cancer statistics in Korea, including cancer incidence, survival, prevalence, and mortality.

Materials and Methods
Cancer incidence data from 1999 to 2014 was obtained from the Korea National Cancer Incidence Database and followed until December 31, 2015. Mortality data from 1983 to 2014 were obtained from Statistics Korea. The prevalence was defined as the number of cancer patients alive on January 1, 2015, among all cancer patients diagnosed since 1999. Crude and age-standardized rates (ASRs) for incidence, mortality, prevalence, and 5-year relative survivals were also calculated.

Results
In 2014, 217,057 and 76,611 Koreans were newly diagnosed and died from cancer respectively. The ASRs for cancer incidence and mortality in 2014 were 270.7 and 85.1 per 100,000, respectively. The all-cancer incidence rate has increased significantly by 3.4% annually from 1999 to 2012, and started to decrease after 2012 (2012-2014; annual percent change, –6.6%). However, overall cancer mortality has decreased 2.7% annually since 2002. The 5-year relative survival rate for patients diagnosed with cancer between 2010 and 2014 was 70.3%, an improvement from the 41.2% for patients diagnosed between 1993 and 1995.

Conclusion
Age-standardized cancer incidence rates have decreased since 2012 and mortality rates have also declined since 2002, while 5-year survival rates have improved remarkably from 1993-1995 to 2010-2014 in Korea.

Key words
Incidence, Survival, Prevalence, Mortality, Neoplasms, Korea

Introduction

Cancer is a major life-threatening disease worldwide. Approximately 14.1 million patients were newly diagnosed with cancer and 8.2 million people died from cancer in 2012 worldwide [1]. The global burden of cancer is expected to grow rapidly due to aging population [2].

In Korea, cancer accounts for one in four deaths and more than 200,000 new cancer cases were diagnosed in 2013 [3].

The number of cancer incidences and deaths are expected to increase with an aging population and westernized lifestyles [4]. Additionally, the economic burden of cancer in Korea increased approximately 1.8-fold, from $11,424 to $20,858 million, between 2000 and 2010 [5].

In this context, cancer statistics are the most important indicator to assess the national cancer burden and form cancer prevention and control strategies. This article aims to provide nationwide cancer statistics including incidence, survival, prevalence, and mortality in 2014.

Materials and Methods

1. Data sources

The Korea Central Cancer Registry (KCCR) was established by the Ministry of Health and Welfare in 1980 as a nationwide hospital-based cancer registry. Since 1999, the KCCR has collected cancer incidence data nationwide by integrating a hospital-based KCCR database with data from regional cancer registry programs. The KCCR currently provides the nationwide cancer incidence, survival, and prevalence statistics annually [6].

The KCCR built the Korea National Cancer Incidence Database (KNCI DB) from hospitals, 11 population-based registries, and additional medical chart reviews. The KNCI DB contains information regarding age, sex, region, date of diagnosis, primary cancer site, histological type, most valid diagnostic method, and SEER stage. The completeness of cancer incidence data for 2014 was estimated to be 97.8% based on the method proposed by Ajiki et al. [7]. The mid-year population and cancer mortality data from 1983 to 2014 were obtained from Statistics Korea [8]. To ascertain vital status and to calculate survival and prevalence, the KNCI DB was linked to mortality data and population registration data from Ministry of the Interior.

2. Classification

All incidence cases were registered according to the International Classification of Diseases for Oncology, 3rd edition [9] and converted to the International Classification of Diseases, 10th edition (ICD-10) [10]. The mortality cases were registered according to ICD-10. All cancer cases were reported based on the 24 cancer types.

3. Statistical analyses

Rates were expressed as crude and age-standardized rates (CR and ASR, respectively) per 100,000 individuals. The crude rate was calculated as the total number of incidence/mortality cases divided by the mid-year population of the specified years. The ASR is a weighted average of the age-specific rates, where the weights are the proportions of persons in the corresponding age groups of a standard population [11]. In this report, ASRs were calculated using Segi's world standard population [12]. The cumulative risk of developing cancer from birth to life expectancy was calculated using cumulative rates; that is, the sum of the age-specific rates from birth to life expectancy, as follows [13].

Cumulative risk of developing cancer from birth to life expectancy $= 100 \times (1 - e^{-\frac{cumulative\ rate}{100}})$

Trends in incidence/mortality rates were summarized as an annual percentage change (APC) by using a Joinpoint regression. APC is the average percentage change of rates and is calculated as follows [11]:

$$APC = \frac{R_{y+1} - R_y}{R_y} \times 100 = (e^{b1} - 1) \times 100$$

, where $\log(R_y) = b_0 + b_1 y$,
$\log(R_y)$ is the natural log transformed age standardized rates.
y=year, b_0=intercept, b_1=slope

The survival duration for each cancer case was determined as the interval between the date of initial diagnosis and the date of death, date of loss of follow-up, or closing date for follow-up. The 5-year relative survival rates were calculated as the ratios of the observed survival of the cancer patients to the expected survival of the general population, which was derived from the standard life table provided by Statistics Korea. Trends in 5-year relative survival rates were evaluated as percentage differences in 5-year relative survival rates from 1993-1995 and 2010-2014. Relative survival rates were calculated using the Ederer II method [14] with some minor corrections, based on an algorithm by Paul Dickman [15].

Prevalent cases were defined as the number of cancer patients alive on January 1, 2015 among all cancer patients diagnosed between 1999 and 2014. Limited-duration prevalences were calculated using SEER*Stat software. Any p-values less than 0.05 were considered statistically significant. SEER*Stat 8.2.1 (National Cancer Institute, Bethesda, MD), Joinpoint 4. 1. 1 (National Cancer Institute), and SAS 9.3 (SAS Institute, Cary, NC) were used in this report.

Selected Findings

1. Incidence

A total of 217,057 cases were newly diagnosed with cancer during the study period (Table 1). Of these cases, 112,882 (52.0%) were men and 104,175 (48.0%) were women. Thyroid cancer was the most commonly diagnosed cancer in 2014, followed by stomach, colorectal, lung, and breast cancer in 2014. The overall cumulative risk of developing cancer from birth to life expectancy was 36.2%. However, the cumulative risk of developing cancer from birth to life expectancy was

Table 1. Cancer incidence, deaths, and prevalence by sex in Korea, 2014

Site/Type	New cases			Deaths			Prevalent cases[a]		
	Both sexes	Men	Women	Both sexes	Men	Women	Both sexes	Men	Women
All sites	217,057	112,882	104,175	76,611	47,869	28,742	1,464,935	645,332	819,603
Lip, oral cavity, and pharynx	3,191	2,261	930	1,097	824	273	19,687	13,253	6,434
Esophagus	2,344	2,131	213	1,540	1,407	133	8,496	7,666	830
Stomach	29,854	20,087	9,767	8,917	5,767	3,150	235,172	156,264	78,908
Colon and rectum	26,978	16,182	10,796	8,338	4,760	3,578	202,295	121,057	81,238
Liver	16,178	12,058	4,120	11,566	8,616	2,950	57,691	43,192	14,499
Gallbladder[b]	5,576	2,838	2,738	3,931	1,966	1,965	17,061	8,749	8,312
Pancreas	5,948	3,191	2,757	5,116	2,752	2,364	8,472	4,539	3,933
Larynx	1,111	1,048	63	410	371	39	9,262	8,714	548
Lung	24,027	16,750	7,277	17,440	12,785	4,655	63,460	40,098	23,362
Breast	18,381	77	18,304	2,271	17	2,254	158,916	622	158,294
Cervix uteri	3,500	-	3,500	960	-	960	45,189	-	45,189
Corpus uteri	2,214	-	2,214	264	-	264	18,381	-	18,381
Ovary	2,413	-	2,413	1,021	-	1,021	16,161	-	16,161
Prostate	9,785	9,785	-	1,667	1,667	-	62,256	62,256	-
Testis	259	259	-	14	14	-	2,570	2,570	-
Kidney	4,471	3,108	1,363	944	665	279	31,610	21,404	10,206
Bladder	3,949	3,182	767	1,354	1,016	338	28,559	23,293	5,266
Brain and CNS	1,725	917	808	1,285	716	569	9,500	4,898	4,602
Thyroid	30,806	6,174	24,632	346	84	262	328,072	54,696	273,376
Hodgkin lymphoma	278	167	111	70	38	32	2,318	1,471	847
Non-Hodgkin lymphoma	4,948	2,766	2,182	1,574	910	664	31,553	16,984	14,569
Multiple myeloma	1,396	758	638	864	473	391	4,811	2,513	2,298
Leukemia	3,080	1,771	1,309	1,671	921	750	17,151	9,534	7,617
Other and ill-defined	14,645	7,372	7,273	3,951	2,100	1,851	86,292	41,559	44,733

CNS, central nervous system. [a]Limited-duration prevalent cases on January 1, 2015. These are patients who were diagnosed between January 1, 1999 and December 31, 2014 and who were alive on January 1, 2015. Multiple primary cancer cases were counted multiple times, [b]Includes the gallbladder and other/unspecified parts of the biliary tract.

higher in men (38.7%) than in women (33.1%) (data not shown).

The total CR and ASR for overall cancer incidences in 2014 were 427.6 and 270.7 per 100,000, respectively (Table 2). According to sex, CRs for all sites combined were 444.9 per 100,000 in men and 410.3 per 100,000 in women. The ASRs were 302.2 and 255.5 per 100,000 in men and women, respectively. Stomach cancer (CR, 79.2 per 100,000) was the most common cancer in men, followed by lung (CR, 66.0 per 100,000), colorectal (CR, 63.8 per 100,000), liver (CR, 47.5 per 100,000), and prostate cancer (CR, 38.6 per 100,000). These five cancers accounted for 66.3% of newly diagnosed cases in men during the study period. In contrast, thyroid cancer (CR, 97.0 per 100,000) was the most common cancer among women, followed by breast (CR, 72.1 per 100,000), colorectal

(CR, 42.5 per 100,000), stomach (CR, 38.5 per 100,000), and lung cancer (CR, 28.7 per 100,000). These five cancers accounted for 67.9% of cases in women.

2. Mortality

In 2014, the total number of deaths from cancer was 76,611, accounting for 28.6% of all deaths (Table 3). Expressed based on sex, 62.5% and 37.5% of cancer deaths occurred in men and women, respectively (Table 1).

The total CR and ASR for cancer deaths were 150.9 and 85.1 per 100,000, respectively, in 2014 (Table 4). The total CR and ASR for cancer deaths per 100,000 were higher among men (CR, 188.7; ASR, 125.8) than in women (CR, 113.2; ASR, 55.6).

Table 2. Crude and age-standardized cancer incidence rates by sex in Korea, 2014

Site/Type	Crude incidence rate per 100,000			Age-standardized incidence rate per 100,000[a]		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	427.6	444.9	410.3	270.7	302.2	255.5
Lip, oral cavity, and pharynx	6.3	8.9	3.7	4.0	6.1	2.3
Esophagus	4.6	8.4	0.8	2.8	5.5	0.4
Stomach	58.8	79.2	38.5	35.8	52.7	21.4
Colon and rectum	53.1	63.8	42.5	31.9	42.6	23.0
Liver	31.9	47.5	16.2	19.4	31.4	8.6
Gallbladder[b]	11.0	11.2	10.8	6.2	7.4	5.2
Pancreas	11.7	12.6	10.9	6.7	8.4	5.4
Larynx	2.2	4.1	0.2	1.3	2.7	0.1
Lung	47.3	66.0	28.7	27.2	43.7	14.9
Breast	36.2	0.3	72.1	24.0	0.2	47.7
Cervix uteri	6.9	-	13.8	4.6	-	9.0
Corpus uteri	4.4	-	8.7	2.9	-	5.7
Ovary	4.8	-	9.5	3.3	-	6.4
Prostate	19.3	38.6	-	11.2	25.6	-
Testis	0.5	1.0	-	0.5	1.0	-
Kidney	8.8	12.2	5.4	5.7	8.4	3.3
Bladder	7.8	12.5	3.0	4.5	8.4	1.5
Brain and CNS	3.4	3.6	3.2	2.7	3.0	2.4
Thyroid	60.7	24.3	97.0	43.3	17.3	69.8
Hodgkin lymphoma	0.5	0.7	0.4	0.5	0.5	0.4
Non-Hodgkin lymphoma	9.7	10.9	8.6	6.8	8.1	5.7
Multiple myeloma	2.8	3.0	2.5	1.6	2.0	1.3
Leukemia	6.1	7.0	5.2	5.2	6.1	4.3
Other and ill-defined	28.8	29.1	28.6	18.6	21.0	16.6

CNS, central nervous system. [a]Age-adjusted using the Segi's world standard population, [b]Includes the gallbladder and other/unspecified parts of the biliary tract.

Table 3. The top 10 leading causes of death in Korea, 2014

Rank	Cause of death	No. of deaths	Percentage of all deaths	Age-standardized death rate per 100,000[a]
	All causes	267,692	100.0	295.7
1	Cancer	76,611	28.6	85.1
2	Heart disease	26,588	9.9	27.7
3	Cerebrovascular disease	24,486	9.1	24.8
4	Intentional self-harm (suicide)	13,836	5.2	19.3
5	Pneumonia	12,021	4.5	11.6
6	Diabetes mellitus	10,526	3.9	10.7
7	Chronic lower respiratory diseases	7,171	2.7	6.9
8	Disease of liver	6,635	2.5	8.0
9	Transport accidents	5,700	2.1	8.0
10	Hypertensive diseases	5,061	1.9	4.9
	Others	79,057	29.5	88.8

Source: Mortality Data, 2014, Statistics Korea [8]. [a]Age-adjusted using the Segi's world standard population.

Table 4. Crude and age-standardized cancer mortality rates by sex in Korea, 2014

Site/Type	Crude mortality rate per 100,000			Age-standardized mortality rate per 100,000[a]		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	150.9	188.7	113.2	85.1	125.8	55.6
Lip, oral cavity, and pharynx	2.2	3.2	1.1	1.3	2.1	0.5
Esophagus	3.0	5.5	0.5	1.7	3.6	0.2
Stomach	17.6	22.7	12.4	9.7	15.1	5.7
Colon and rectum	16.4	18.8	14.1	9.0	12.6	6.3
Liver	22.8	34.0	11.6	13.4	22.4	5.6
Gallbladder[b]	7.7	7.7	7.7	4.1	5.1	3.4
Pancreas	10.1	10.8	9.3	5.6	7.1	4.4
Larynx	0.8	1.5	0.2	0.4	1.0	0.1
Lung	34.4	50.4	18.3	18.8	33.2	8.5
Breast	4.5	0.1	8.9	2.8	0.0	5.4
Cervix uteri	1.9	-	3.8	1.1	-	2.1
Corpus uteri	0.5	-	1.0	0.3	-	0.6
Ovary	2.0	-	4.0	1.2	-	2.3
Prostate	3.3	6.6	-	1.6	4.5	-
Testis	0.0	0.1	-	0.0	0.0	-
Kidney	1.9	2.6	1.1	1.0	1.8	0.5
Bladder	2.7	4.0	1.3	1.4	2.7	0.5
Brain and CNS	2.5	2.8	2.2	1.7	2.1	1.4
Thyroid	0.7	0.3	1.0	0.4	0.2	0.4
Hodgkin lymphoma	0.1	0.1	0.1	0.1	0.1	0.1
Non-Hodgkin lymphoma	3.1	3.6	2.6	1.8	2.4	1.3
Multiple myeloma	1.7	1.9	1.5	1.0	1.2	0.8
Leukemia	3.3	3.6	3.0	2.2	2.7	1.8
Other and ill-defined	7.8	8.3	7.3	4.5	5.8	3.6

CNS, central nervous system. [a]Age-adjusted using the world standard population, [b]Includes the gallbladder and other/unspecified parts of the biliary tract.

According to the cancer sites, lung cancer (CR, 50.4 per 100,000) was the leading cause of death in men, followed by liver (CR, 34.0 per 100,000), stomach (CR, 22.7 per 100,000), colorectal (CR, 18.8 per 100,000), and pancreatic cancer (CR, 10.8 per 100,000). The top five causes of deaths from cancer in women included lung (CR, 18.3 per 100,000), colorectal (CR, 14.1 per 100,000), stomach (CR, 12.4 per 100,000), liver (CR, 11.6 per 100,000), and pancreatic cancer (CR, 9.3 per 100,000).

3. Trends in cancer incidence and mortality

Fig. 1 shows trends in cancer incidence and mortality from 1983 to 2014. The ASR for all-cancer incidence increased by 3.4% annually from 1999 to 2012, and then began to decrease from 2012 to 2014 (APC, –6.6%) (Table 5, Fig. 1). Cancers in stomach, colorectum, lung and thyroid started to decrease
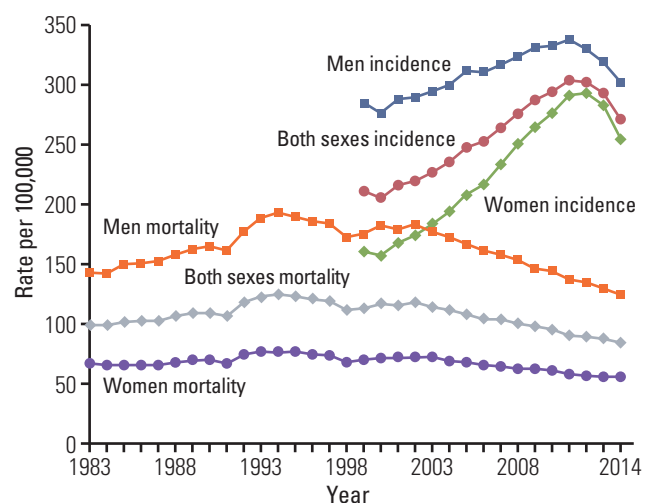
Fig. 1. Annual age-standardized cancer incidence and death rates by sex for all sites from 1983 to 2014 in Korea. Age standardization was based on the Segi's world standard population.

**Table 5.** Trends in cancer incidence rates from 1999 to 2014 in Korea

Site/Type	Both sexes						Men						Women					
			Trend 1		Trend 2				Trend 1		Trend 2				Trend 1		Trend 2	
	1999	2014	Year	APC	Year	APC	1999	2014	Year	APC	Year	APC	1999	2014	Year	APC	Year	APC
All sites	210.5	270.7	1999-2012	3.4[a]	2012-2014	-6.6[a]	285.0	302.2	1999-2011	1.7[a]	2011-2014	-3.6[a]	161.1	255.5	1999-2012	5.5[a]	2012-2014	-7.9[a]
Lip, oral cavity, and pharynx	3.6	4.0	1999-2014	0.5	-	-	6.1	6.1	1999-2014	-0.3	-	-	1.6	2.3	1999-2014	1.3[a]	-	-
Esophagus	4.1	2.8	1999-2014	-2.2[a]	-	-	8.8	5.5	1999-2014	-2.7[a]	-	-	0.6	0.4	1999-2014	-2.0[a]	-	-
Stomach	43.6	35.8	1999-2011	-0.1	2011-2014	-5.8[a]	66.2	52.7	1999-2011	-0.3[a]	2011-2014	-6.3[a]	26.7	21.4	1999-2011	-0.3	2011-2014	-5.4[a]
Colon and rectum	20.4	31.9	1999-2010	6.0[a]	2010-2014	-4.6[a]	26.2	42.6	1999-2010	6.5[a]	2010-2014	-5.1[a]	16.4	23.0	1999-2009	5.3[a]	2009-2014	-2.5[a]
Liver	27.9	19.4	1999-2011	-1.7[a]	2011-2014	-5.2[a]	46.8	31.4	1999-2009	-1.8[a]	2009-2014	-3.8[a]	12.3	8.6	1999-2011	-1.4[a]	2011-2014	-6.1[a]
Gallbladder[b]	6.5	6.2	1999-2005	1.1	2005-2014	-1.2[a]	8.1	7.4	1999-2014	-0.6[a]	-	-	5.3	5.2	1999-2003	2.7	2003-2014	-1.2[a]
Pancreas	5.6	6.7	1999-2014	1.4[a]	-	-	7.8	8.4	1999-2014	0.7[a]	-	-	4.0	5.4	1999-2014	2.1[a]	-	-
Larynx	2.3	1.3	1999-2014	-3.6[a]	-	-	4.9	2.7	1999-2014	-3.8[a]	-	-	0.4	0.1	1999-2014	-7.1[a]	-	-
Lung	28.5	27.2	1999-2011	0.1	2011-2014	-1.7[a]	51.4	43.7	1999-2005	-0.1	2005-2014	-1.5[a]	12.4	14.9	1999-2011	1.9[a]	2011-2014	-0.4
Breast	10.7	24.0	1999-2005	7.6[a]	2005-2014	4.5[a]	0.2	0.2	1999-2014	-1.2	-	-	20.9	47.7	1999-2007	7.0[a]	2007-2014	4.2[a]
Cervix uteri	8.5	4.6	1999-2014	-4.1[a]	-	-	-	-	-	-	-	-	16.3	9.0	1999-2014	-3.9[a]	-	-
Corpus uteri	1.4	2.9	1999-2009	6.2[a]	2009-2014	3.0[a]	-	-	-	-	-	-	2.8	5.7	1999-2009	6.4[a]	2009-2014	3.1[a]
Ovary	2.7	3.3	1999-2014	1.5[a]	-	-	-	-	-	-	-	-	5.0	6.4	1999-2014	1.8[a]	-	-
Prostate	3.1	11.2	1999-2009	15.1[a]	2009-2014	0.6	8.4	25.6	1999-2009	13.6[a]	2009-2014	-0.2	-	-	-	-	-	-
Testis	0.3	0.5	1999-2014	4.8[a]	-	-	0.6	1.0	1999-2014	4.7[a]	-	-	-	-	-	-	-	-
Kidney	3.0	5.7	1999-2009	6.6[a]	2009-2014	1.6[a]	4.5	8.4	1999-2010	6.0[a]	2010-2014	0.7	1.7	3.3	1999-2009	6.6[a]	2009-2014	0.9
Bladder	4.6	4.5	1999-2004	2.4[a]	2004-2014	-1.5[a]	9.0	8.4	1999-2005	1.5[a]	2005-2014	-1.9[a]	1.6	1.5	1999-2003	2.9	2003-2014	-2.0[a]
Brain and CNS	2.9	2.7	1999-2009	1.1[a]	2009-2014	-2.4	3.2	3.0	1999-2009	1.3[a]	2009-2014	-2.5	2.6	2.4	1999-2007	1.5[a]	2007-2014	-1.7
Thyroid	6.3	43.3	1999-2011	22.4[a]	2011-2014	-10.8[a]	2.1	17.3	1999-2012	22.8[a]	2012-2014	-16.7[a]	10.4	69.8	1999-2011	22.1[a]	2011-2014	-11.9[a]
Hodgkin lymphoma	0.2	0.5	1999-2014	4.4[a]	-	-	0.4	0.5	1999-2014	3.5[a]	-	-	0.1	0.4	1999-2014	5.5[a]	-	-
Non-Hodgkin lymphoma	4.5	6.8	1999-2014	3.4[a]	-	-	5.8	8.1	1999-2014	2.7[a]	-	-	3.4	5.7	1999-2011	4.7[a]	2011-2014	1.0
Multiple myeloma	1.0	1.6	1999-2014	3.5[a]	-	-	1.2	2.0	1999-2014	3.2[a]	-	-	0.8	1.3	1999-2014	3.7[a]	-	-
Leukemia	4.7	5.2	1999-2014	0.9[a]	-	-	5.5	6.1	1999-2014	0.9[a]	-	-	3.9	4.3	1999-2014	0.6[a]	-	-
Other and ill-defined	14.3	18.6	1999-2014	2.2[a]	-	-	17.9	21.0	1999-2014	1.6[a]	-	-	11.8	16.6	1999-2010	3.2[a]	2010-2014	0.7

APC was calculated using age-standardized incidence data based on the Segi's world standard population. APC, annual percentage change; CNS, central nervous system. [a]Significantly different from zero (p < 0.05), [b]Includes the gallbladder and other/unspecified parts of the biliary tract.

Table 6. Trends in cancer mortality rates from 1999 to 2014 in Korea

Site/Type	Both sexes						Men						Women					
	1999	2014	Trend 1		Trend 2		1999	2014	Trend 1		Trend 2		1999	2014	Trend 1		Trend 2	
			Year	APC	Year	APC			Year	APC	Year	APC			Year	APC	Year	APC
All sites	114.3	85.1	1999-2002	1.0	2002-2014	-2.7[a]	176.6	125.8	1999-2002	1.1	2002-2014	-3.1[a]	70.6	55.6	1999-2002	1.0	2002-2014	-2.2[a]
Lip, oral cavity, and pharynx	1.1	1.3	1999-2014	-2.0[a]	-	-	2.0	2.1	1999-2014	-2.2[a]	-	-	0.4	0.5	1999-2014	-3.1[a]	-	-
Esophagus	3.1	1.7	1999-2014	-4.5[a]	-	-	6.8	3.6	1999-2014	-4.7[a]	-	-	0.5	0.2	1999-2014	-5.2[a]	-	-
Stomach	23.8	9.7	1999-2003	-3.3[a]	2003-2014	-6.6[a]	36.9	15.1	1999-2002	-1.3	2002-2014	-6.7[a]	14.6	5.7	1999-2003	-4.4[a]	2003-2014	-6.6[a]
Colon and rectum	7.7	9.0	1999-2004	5.2[a]	2004-2014	-1.0[a]	10.5	12.6	1999-2004	5.6[a]	2004-2014	-0.7[a]	6.0	6.3	1999-2004	4.7[a]	2004-2014	-1.7[a]
Liver	20.4	13.4	1999-2002	0.7	2002-2014	-3.6[a]	35.3	22.4	1999-2002	-0.2	2002-2014	-3.7[a]	8.3	5.6	1999-2002	2.9[a]	2002-2014	-3.7[a]
Gallbladder[b]	5.2	4.1	1999-2001	7.7	2001-2014	-2.8[a]	6.8	5.1	1999-2001	6.7	2001-2014	-3.0[a]	4.1	3.4	1999-2001	9.3	2001-2014	-2.7[a]
Pancreas	5.4	5.6	1999-2014	0.3[a]	-	-	7.6	7.1	1999-2014	-0.4[a]	-	-	3.9	4.4	1999-2014	0.8[a]	-	-
Larynx	1.6	0.4	1999-2014	-9.6[a]	-	-	3.4	1.0	1999-2014	-9.1[a]	-	-	0.4	0.1	1999-2012	-15.3[a]	2012-2014	16.4
Lung	22.4	18.8	1999-2001	3.7[a]	2001-2014	-1.9[a]	41.5	33.2	1999-2001	4.0	2001-2014	-2.4[a]	9.4	8.5	1999-2001	4.2	2001-2014	-1.4[a]
Breast	2.2	2.8	1999-2014	1.4[a]	-	-	0.1	0.0	1999-2014	-4.6[a]	-	-	4.2	5.4	1999-2014	1.7[a]	-	-
Cervix uteri	1.4	1.1	1999-2003	8.8[a]	2003-2014	-5.5[a]	-	-	-	-	-	-	2.6	2.1	1999-2003	8.2[a]	2003-2014	-5.2[a]
Corpus uteri	0.1	0.3	1999-2003	35.7[a]	2003-2014	2.4[a]	-	-	-	-	-	-	0.1	0.6	1999-2003	35.7[a]	2003-2014	2.8[a]
Ovary	0.9	1.2	1999-2001	10.6	2001-2014	0.3	-	-	-	-	-	-	1.7	2.3	1999-2014	1.1[a]	-	-
Prostate	0.9	1.6	1999-2002	16.1[a]	2002-2014	1.2[a]	2.6	4.5	1999-2002	16.7[a]	2002-2014	0.7[a]	-	-	-	-	-	-
Testis	0.0	0.0	1999-2014	-2.3	-	-	0.1	0.0	1999-2014	-2.5	-	-	-	-	-	-	-	-
Kidney	1.1	1.0	1999-2014	0.0	-	-	1.8	1.8	1999-2014	0.2	-	-	0.5	0.5	1999-2014	-0.8	-	-
Bladder	1.3	1.4	1999-2014	-1.2[a]	-	-	2.6	2.7	1999-2014	-1.4[a]	-	-	0.5	0.5	1999-2001	11.1	2001-2014	-2.0[a]
Brain and CNS	1.9	1.7	1999-2002	4.6	2002-2014	-2.1[a]	2.2	2.1	1999-2014	-1.5[a]	-	-	1.6	1.4	1999-2014	-1.5[a]	-	-
Thyroid	0.4	0.4	1999-2003	6.7	2003-2014	-3.9[a]	0.3	0.2	1999-2002	15.4	2002-2014	-3.7[a]	0.5	0.4	1999-2004	4.1	2004-2014	-4.5[a]
Hodgkin lymphoma	0.0	0.1	1999-2003	27.8[a]	2003-2014	0.8	0.0	0.1	1999-2004	18.2[a]	2004-2014	-1.2[a]	0.0	0.1	1999-2002	56.3	2002-2014	3.5[a]
Non-Hodgkin lymphoma	2.1	1.8	1999-2014	-0.9[a]	-	-	3.0	2.4	1999-2014	-1.2	-	-	1.4	1.3	1999-2014	-0.5	-	-
Multiple myeloma	0.6	1.0	1999-2003	12.6[a]	2003-2014	1.0	0.8	1.2	1999-2002	14.3[a]	2002-2014	1.4[a]	0.4	0.8	1999-2007	7.6[a]	2007-2014	-1.6
Leukemia	2.9	2.2	1999-2001	1.4	2001-2014	-2.0[a]	3.5	2.7	1999-2014	-1.7[a]	-	-	2.4	1.8	1999-2014	-2.0[a]	-	-
Other and ill-defined	7.8	4.5	1999-2014	-3.0[a]	-	-	9.0	5.8	1999-2009	-0.5	2009-2014	-7.2[a]	7.0	3.6	1999-2005	-7.1[a]	2005-2014	-1.9[a]

APC was calculated using age-standardized incidence data based on the Segi's world standard population. APC, annual percentage change; CNS, central nervous system. [a]Significantly different from zero (p < 0.05). [b]Includes the gallbladder and other/unspecified parts of the biliary tract.
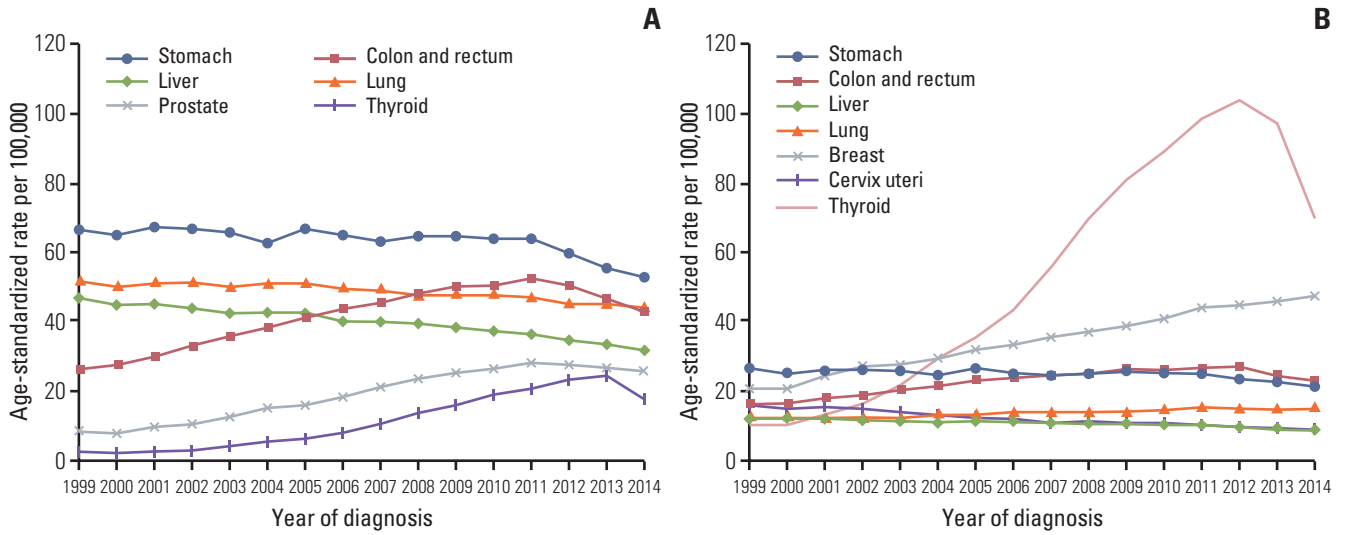
Fig. 2. Trends in age-standardized incidences of selected cancers by sex from 1999 to 2014 in Korea. (A) Men. (B) Women. Age standardization was based on the Segi's world standard population.
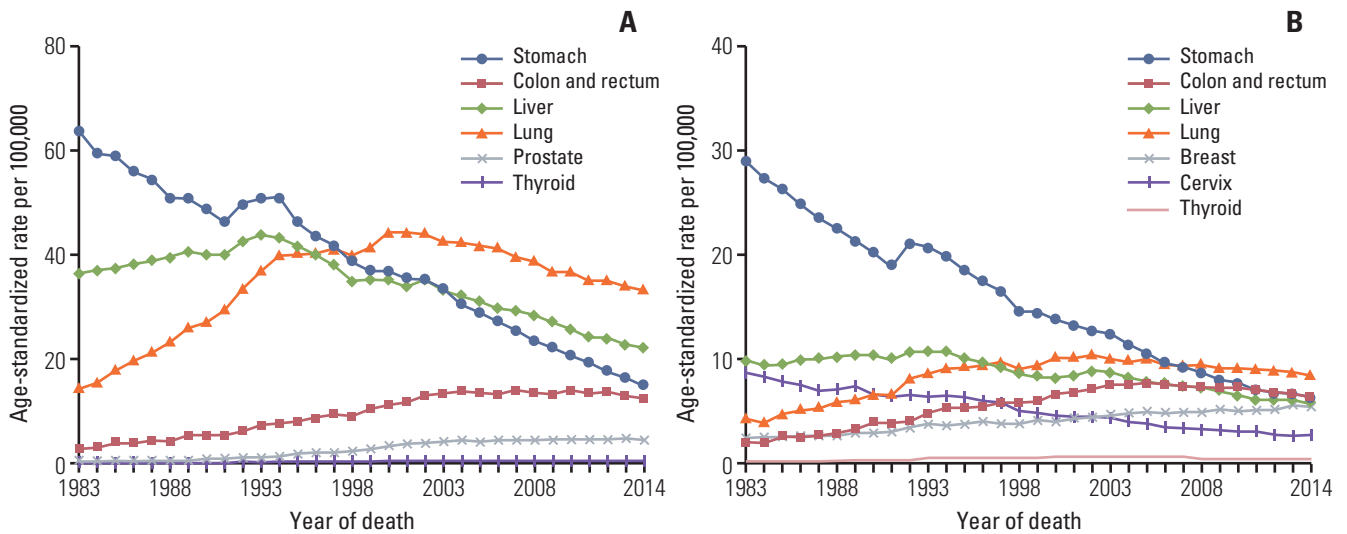
Fig. 3. Annual age-standardized cancer mortalities of selected cancers by sex from 1983 to 2014 in Korea. (A) Men. (B) Women. Age standardization was based on the Segi's world standard population.

around 2011 (Table 5, Fig. 2). Especially, ASR for thyroid cancer has increased rapidly 22.4% from 1999 to 2011, but then decreased swiftly 10.8% annually starting in 2011. Incidence of breast cancer has increased constantly throughout the period, but APC was slowed from 2005. Conversely, the incidence rates of cervix and liver showed constant decrease for the whole period. The incidence rate for liver cancer has

started to decrease since 1999. After 2011, decreasing rate for liver cancer was more steepen.

The ASR for all-cancer mortality rate has been increased until 2002 (Table 6, Fig. 1). After that year, it began to decrease (2002-2014; APC, −2.7%). Same patterns were shown in men and women. Most cancer sites, including lung, liver, colorectum, gallbladder, leukemia, brain and central

Table 7. The five common sites of cancer incidence by age group and sex in Korea, 2014

Rank	Age (yr)			
	0-14	15-34	35-64	≥ 65
Men				
1	Leukemia (4.4)	Thyroid (13.5)	Stomach (86.7)	Lung (445.7)
2	Non-Hodgkin lymphoma (2.8)	Non-Hodgkin lymphoma (3.2)	Colon and rectum (66.0)	Stomach (373.6)
3	Brain and CNS (1.8)	Colon and rectum (3.1)	Liver (59.1)	Colon and rectum (313.5)
4	Liver (0.4)	Leukemia (3.1)	Lung (42.8)	Prostate (284.2)
5	Testis (0.3)	Testis (2.1)	Thyroid (38.8)	Liver (192.4)
Women				
1	Leukemia (4.1)	Thyroid (54.7)	Thyroid (161.4)	Colon and rectum (168.5)
2	Non-Hodgkin lymphoma (2.0)	Breast (11.4)	Breast (129.0)	Stomach (142.2)
3	Brain and CNS (1.7)	Cervix uteri (5.3)	Colon and rectum (38.7)	Lung (126.8)
4	Ovary (0.8)	Ovary (3.3)	Stomach (37.6)	Breast (73.5)
5	Thyroid (0.6)	Stomach (3.3)	Lung (22.2)	Liver (71.7)

CNS, central nervous system.
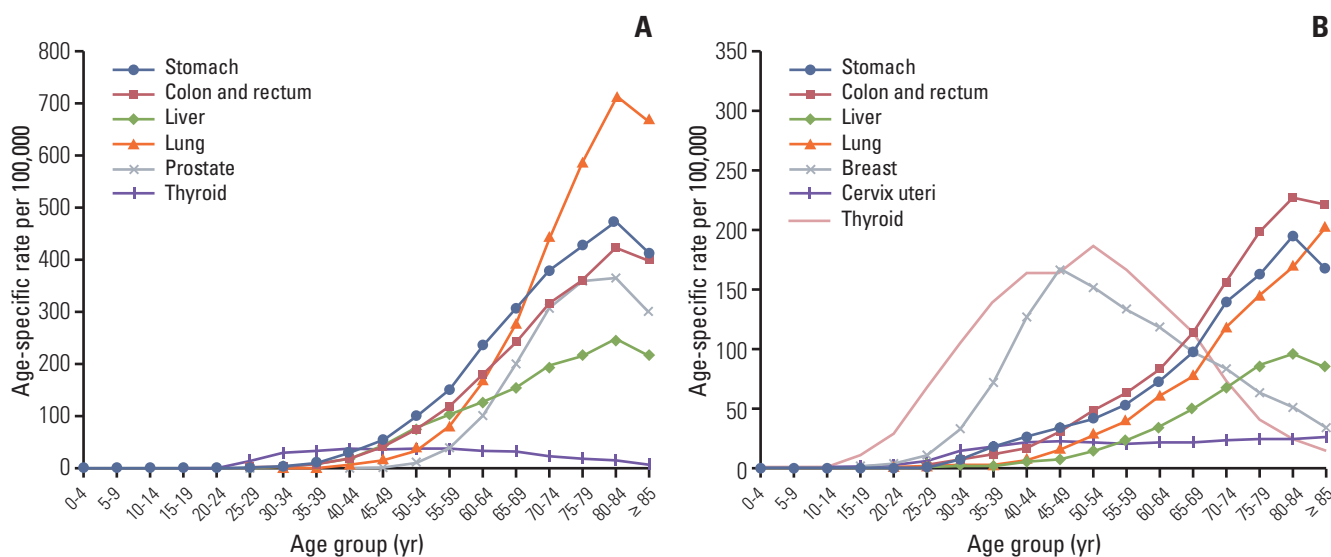
Fig. 4. Age-specific incidence rates of common cancers for 2014 in Korea. (A) Men. (B) Women.

nervous system, cervix uteri, and thyroid started to decrease in the early 2000s. However, cancers in stomach, larynx, testis, bladder, and non-Hodgkin lymphoma decreased starting in 1999 (Table 6, Fig. 3). Cancers in the pancreas, breast, and prostate showed constant increasing trends for the whole period.

4. Age-specific incidence rates

Leukemia was the most commonly diagnosed cancer among children between 0 and 14 years of age. Thyroid cancer was the most common cancer among adolescents and young adults between 15 and 34 years of age (Table 7). For men, the incidence rate of cancer increased until age 70 (Fig. 4A). Stomach cancer was the most commonly diagnosed cancer among men 35 to 64 years old, while lung cancer was

Table 8. Trends in the 5-year relative survival rates (%) by year of diagnosis from 1993 to 2014 in Korea

Site/Type	Both sexes					Men					Women				
	1993-1995	1996-2000	2001-2005	2010-2014	Change[a]	1993-1995	1996-2000	2001-2005	2010-2014	Change[a]	1993-1995	1996-2000	2001-2005	2010-2014	Change[a]
All sites	41.2	44.0	53.9	70.3	29.1	31.7	35.3	45.3	62.2	30.5	53.4	55.3	64.0	78.2	24.8
Lip, oral cavity, and pharynx	41.1	46.7	54.2	63.5	22.4	35.8	41.1	49.4	59.8	24.0	58.1	63.8	67.8	72.4	14.3
Esophagus	12.7	15.2	21.2	35.0	22.3	11.8	14.3	20.5	34.7	22.9	23.7	24.2	29.6	37.3	13.6
Stomach	42.8	46.6	57.7	74.4	31.6	43.0	46.9	58.4	75.3	32.3	42.6	46.0	56.4	72.7	30.1
Colon and rectum	54.8	58.0	66.6	76.3	21.5	55.3	59.0	68.5	78.1	22.8	54.2	56.8	64.2	73.4	19.2
Liver	10.7	13.2	20.2	32.8	22.1	9.9	12.9	20.2	33.1	23.2	13.6	14.2	20.5	31.9	18.3
Gallbladder[b]	17.3	19.7	22.8	29.2	11.9	16.6	20.3	23.4	30.1	13.5	18.0	19.1	22.4	28.4	10.4
Pancreas	9.4	7.6	8.2	10.1	0.7	8.8	7.3	8.2	9.8	1.0	10.1	8.1	8.2	10.5	0.4
Larynx	59.7	62.3	66.2	74.6	14.9	60.2	62.8	66.8	74.9	14.7	55.4	57.8	58.2	70.7	15.3
Lung	11.3	12.7	16.2	25.1	13.8	10.4	11.6	15.0	21.9	11.5	14.2	16.2	19.7	32.4	18.2
Breast	77.9	83.2	88.5	92.0	14.1	75.1	85.6	87.1	86.8	11.7	78.0	83.2	88.5	92.0	14.0
Cervix uteri	77.5	80.0	81.3	79.7	2.2	-	-	-	-	-	77.5	80.0	81.3	79.7	2.2
Corpus uteri	81.5	81.8	84.6	87.9	6.4	-	-	-	-	-	81.5	81.8	84.6	87.9	6.4
Ovary	58.7	58.9	61.5	64.1	5.4	-	-	-	-	-	58.7	58.9	61.5	64.1	5.4
Prostate	55.9	67.2	80.3	93.3	37.4	55.9	67.2	80.3	93.3	37.4	-	-	-	-	-
Testis	85.4	90.4	90.6	96.0	10.6	85.4	90.4	90.6	96.0	10.6	-	-	-	-	-
Kidney	62.0	66.1	73.4	81.3	19.3	60.8	64.4	72.8	80.8	20.0	64.5	69.7	74.5	82.5	18.0
Bladder	69.1	73.1	75.6	75.6	6.5	70.0	74.8	77.4	77.5	7.5	65.5	66.3	68.6	67.9	2.4
Brain and CNS	38.5	39.0	40.8	40.8	2.3	37.2	37.5	40.2	39.4	2.2	40.2	40.7	41.5	42.4	2.2
Thyroid	94.2	94.9	98.3	100.2	6.0	87.2	89.5	95.8	100.5	13.3	95.4	95.9	98.7	100.1	4.7
Hodgkin lymphoma	68.0	71.2	76.7	80.6	12.6	67.6	68.1	74.7	81.6	14.0	68.6	77.4	80.7	78.8	10.2
Non-Hodgkin lymphoma	46.6	50.8	59.9	69.1	22.5	45.3	48.9	58.1	67.4	22.1	48.7	53.5	62.4	71.1	22.4
Multiple myeloma	22.1	19.8	29.3	40.1	18.0	21.1	17.8	29.6	39.7	18.6	23.3	22.1	29.1	40.6	17.3
Leukemia	26.5	33.3	41.8	51.1	24.6	26.2	32.3	41.7	50.9	24.7	26.8	34.6	42.0	51.4	24.6
Other and ill-defined	42.1	45.9	56.0	69.1	27.0	37.4	42.4	52.3	65.7	28.3	47.4	50.0	60.0	72.6	25.2

CNS, central nervous system. [a]Percentage change in 5-year relative survival from 1993 to 1995 and 2010 to 2014. [b]Includes the gallbladder and other/unspecified parts of the biliary tract.
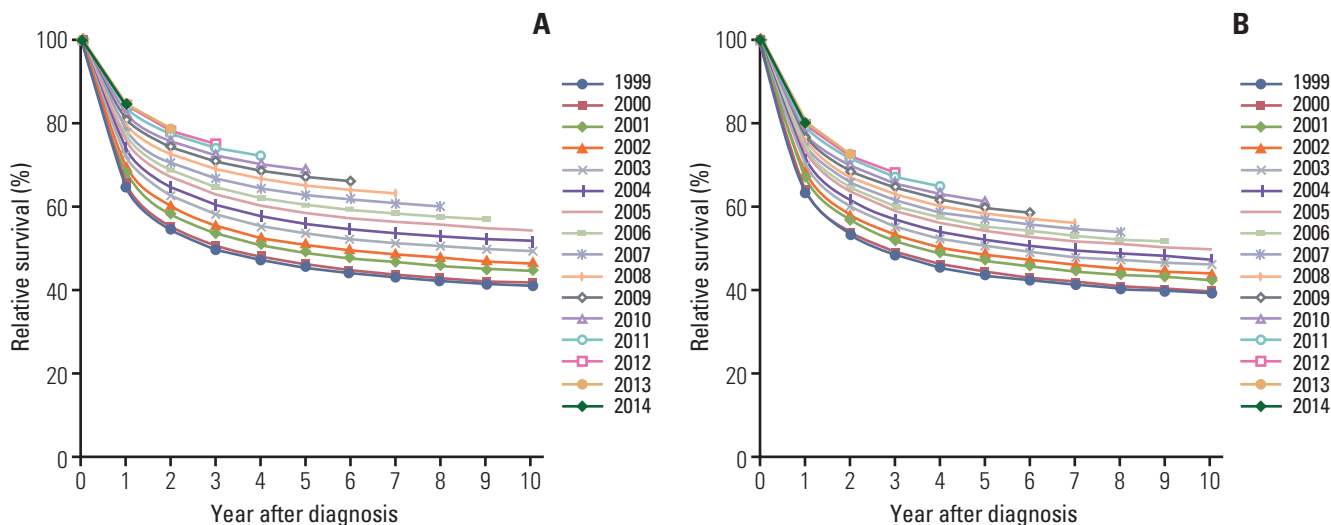
Fig. 5. Trends in relative survival by year of diagnosis from 1999 to 2014. (A) All sites for both sexes. (B) All sites except thyroid cancer for both sexes.
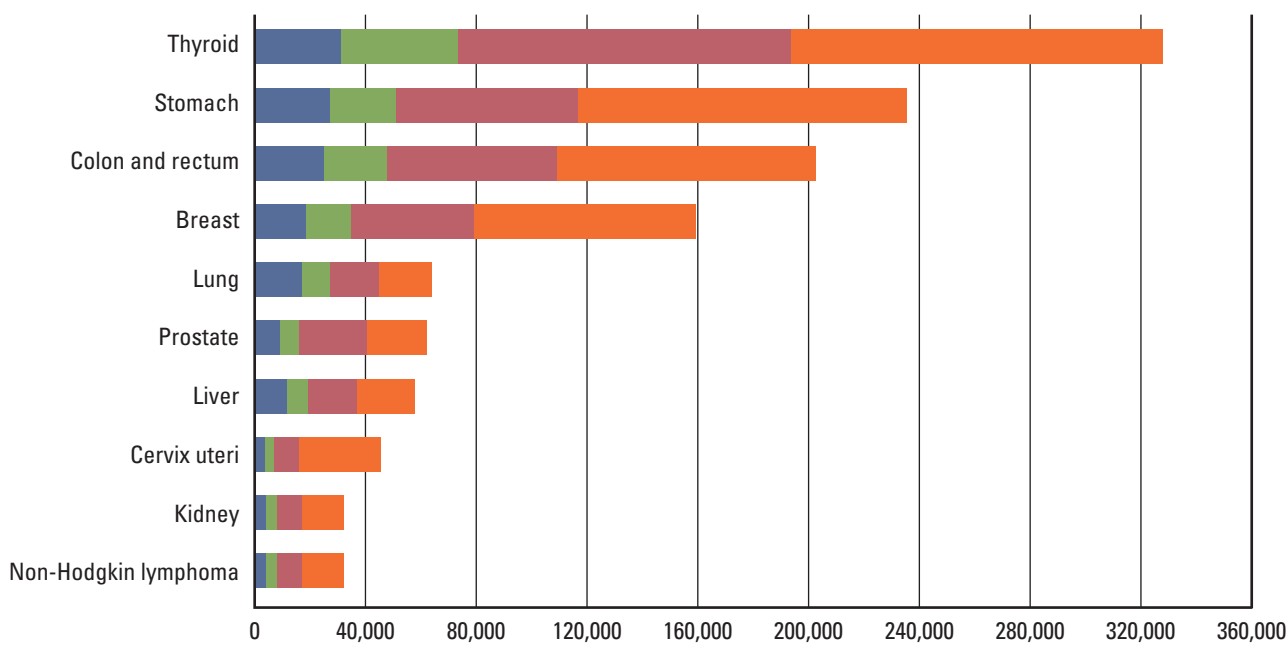
Cancer prevalent cases

	Thyroid	Stomach	Colon and rectum	Breast	Lung	Prostate	Liver	Cervix uteri	Kidney	Non-Hodgkin lymphoma	All cancers
■ Under 1 yr	30,635	26,812	24,674	18,144	16,808	9,526	11,491	3,331	4,141	4,283	189,119
■ 1-2 yr	42,457	24,241	22,870	16,888	10,208	8,858	8,162	3,187	3,713	3,621	174,156
■ 2-5 yr	120,630	65,813	61,623	43,990	17,890	21,992	17,409	9,158	9,307	8,782	443,505
■ More than 5 yr	134,350	118,306	93,128	79,894	18,554	21,880	20,629	29,513	14,449	14,867	658,155
Total	328,072	235,172	202,295	158,916	63,460	62,256	57,691	45,189	31,610	31,553	1,464,935

Fig. 6. Prevalence of common cancer sites by time period after cancer diagnosis. Prevalent cases were defined as the number of cancer patients alive on January 1, 2015 among all cancer patients diagnosed between 1999 and 2014.

Table 9. Crude and age-standardized rates of cancer prevalence by sex on January 1, 2015 in Korea

Site/Type	Crude prevalence rate per 100,000[a]			Age-standardized prevalence rate per 100,000[b]		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	2,885.8	2,543.2	3,228.2	1,837.6	1,730.9	2,027.1
Lip, oral cavity, and pharynx	38.8	52.2	25.3	25.0	35.5	15.8
Esophagus	16.7	30.2	3.3	9.9	20.0	1.7
Stomach	463.3	615.8	310.8	278.1	407.6	171.5
Colon and rectum	398.5	477.1	320.0	237.5	317.6	173.1
Liver	113.6	170.2	57.1	71.8	114.2	33.5
Gallbladder[c]	33.6	34.5	32.7	19.4	22.8	16.8
Pancreas	16.7	17.9	15.5	10.2	12.1	8.7
Larynx	18.2	34.3	2.2	10.8	22.8	1.1
Lung	125.0	158.0	92.0	74.5	105.0	51.0
Breast	313.1	2.5	623.5	201.8	1.6	396.8
Cervix uteri	89.0	-	178.0	56.7	-	110.5
Corpus uteri	36.2	-	72.4	23.7	-	46.5
Ovary	31.8	-	63.7	22.2	-	44.0
Prostate	122.6	245.3	-	67.1	160.7	-
Testis	5.1	10.1	-	4.6	9.0	-
Kidney	62.3	84.4	40.2	40.2	57.5	24.9
Bladder	56.3	91.8	20.7	32.1	61.2	10.1
Brain and CNS	18.7	19.3	18.1	16.1	17.0	15.0
Thyroid	646.3	215.6	1076.8	438.4	148.2	726.7
Hodgkin lymphoma	4.6	5.8	3.3	3.8	4.8	2.9
Non-Hodgkin lymphoma	62.2	66.9	57.4	44.1	50.1	38.7
Multiple myeloma	9.5	9.9	9.1	5.8	6.6	5.1
Leukemia	33.8	37.6	30.0	31.7	35.6	28.0
Other and ill-defined	170.0	163.8	176.2	112.0	120.7	104.7

CNS, central nervous system. [a]Crude prevalence rate: number of prevalent cases divided by the corresponding person-years of observation. Prevalent cases were defined as patients who were diagnosed between January 1, 1999 and December 31, 2014 and who were alive on January 1, 2015. Multiple primary cancer cases were counted multiple times, [b]Age-adjusted using the Segi's world standard population, [c]Includes the gallbladder and other/unspecified parts of the biliary tract.

the most common among men 65 and over. In contrast, thyroid cancer was most commonly diagnosed among women 35 to 64 years old, while colorectal cancer was the most common among women 65 and older. Thyroid and breast cancer showed an inverted U-shaped incidence rates by age (Fig. 4B).

5. Survival rates

The 5-year relative survival rates for all cancer combined improved remarkably in both sexes, from 41.2% in 1993-1995 to 70.3% in 2010-2014 (Table 8, Fig. 5A). After excluding thyroid cancer, the 5-year relative survival rates for all cancer still increased from 1993 to 2014 (Fig. 5B).

The 5-year relative survival rate during 2010-2014 for all cancer combined was 62.2% in men and 78.2% in women, respectively. The 5-year relative survival rate for thyroid cancer was over 100%, while the 5-year relative survival rates for testis, prostate, and breast cancer were over 90% in 2010-2014 for both sexes, respectively. However, the 5-year relative survival rate for pancreatic cancer was only 10.1% in both sexes in 2010-2014.

When compared to the 5-year relative survival rate for men in 1993-1995, prostate cancer diagnosed from 2010 to 2014 showed the most outstanding improvement, followed by stomach cancer, leukemia, lip/oral cavity/pharynx and liver cancer. Among women, stomach cancer diagnosed during 2010-2014 showed the greatest improvement in 5-year rela-

tive survival rates compared to those between 1993 and1995, followed by leukemia, non-Hodgkin lymphoma, colorectal, and liver cancer.

6. Prevalence rates

A total of 1,464,935 cancer prevalent cases were identified on January 1, 2015 (Table 1). Of these cases, 645,332 (44.1%) were men and 819,603 (55.9%) were women. The crude and age-standardized prevalence rates for cancer overall were 2,885.8 per 100,000 individuals and 1,837.6 per 100,000 individuals for both sexes, respectively, in 2014 (Table 9).

The five most common cancers for men were stomach (CR, 615.8 per 100,000), colorectal (CR, 477.1 per 100,000), prostate (CR, 245.3 per 100,000), thyroid (CR, 215.6 per 100,000), and liver cancer (CR, 170.2 per 100,000). In contrast, thyroid cancer was most common in women (CR, 1,076.8 per 100,000), followed by breast (CR, 623.5 per 100,000), colorectal (CR, 320.0 per 100,000), stomach (CR, 310.8 per 100,000), and cervix uteri cancer (CR, 178.0 per 100,000).

Analysis of the period after cancer diagnosis revealed that thyroid (20.1%) cancer was the most prevalent cancer within two years after diagnosis, followed by stomach (14.1%) and colorectal cancer (13.1%) (Fig. 6). Thyroid cancer (27.2%) was most prevalent for 2-5 years, followed by stomach (14.8%) and colorectal cancer (13.9%). After 5 years, thyroid cancer (20.4%) was the most prevalent cancer, followed by stomach (18.0%) and colorectal cancer (14.1%).

*The Community of Population-Based Regional Cancer Registries

Chang-Hoon Kim (Busan Cancer Registry, Pusan National University Hospital), Cheol-In Yoo (Ulsan Caner Registry, Ulsan University Hospital), Heon Kim (Chungbuk Cancer Registry, Chungbuk National University Hospital), Hae-Sung Nam (Daejeon/Chungnam Cancer Registry, Chungnam National University and Hospital), Jung-Sik Huh (Jeju Cancer Registry, Jeju National University and Hospital), Jung-Ho Youm (Chonbuk Cancer Registry, Chonbuk National University Hospital), Moo-Kyung Oh (Kangwon Cancer Registry, Kangwon National University Hospital), Nam-Soo Hong (Deagu/Gyeongbuk Cancer Registry, Kyungpook National University Medical Center), Sun-Seog Kweon (Gwangju/Jeonnam Cancer Registry, Chonnam National University Hwasun Hospital), Woo-Chul Kim (Incheon Cancer Registry, Inha University Hospital), Yune-Sik Kang (Gyeongnam Cancer Registry, Gyeongsang National University and Hospital)

Conflicts of Interest

Conflict of interest relevant to this article was not reported.

Acknowledgments

References

1. Ferlay J, Soerjomataram I, Ervik M, Dikshit R, Eser S, Mathers C, et al. GLOBOCAN 2012 v1.0. Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 11 [Internet]. Lyon: International Agency for Research on Cancer; 2013 [cited 2017 Jan 20]. Available from: http://globocan.iarc.fr.
2. GBD 2013 Mortality and Causes of Death Collaborators. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015;385:117-71.
3. Oh CM, Won YJ, Jung KW, Kong HJ, Cho H, Lee JK, et al. Cancer statistics in Korea: incidence, mortality, survival, and prevalence in 2013. Cancer Res Treat. 2016;48:436-50.
4. Jung KW, Won YJ, Oh CM, Kong HJ, Cho H, Lee DH, et al. Prediction of cancer incidence and mortality in Korea, 2015. Cancer Res Treat. 2015;47:142-8.
5. Lee KS, Chang HS, Lee SM, Park EC. Economic burden of cancer in Korea during 2000-2010. Cancer Res Treat. 2015;47:

387-98.

6. Shin HR, Won YJ, Jung KW, Kong HJ, Yim SH, Lee JK, et al. Nationwide cancer incidence in Korea, 1999~2001; first result using the national cancer incidence database. Cancer Res Treat. 2005;37:325-31.

7. Ajiki W, Tsukuma H, Oshima A. Index for evaluating completeness of registration in population-based cancer registries and estimation of registration rate at the Osaka Cancer Registry between 1966 and 1992 using this index. Nihon Koshu Eisei Zasshi. 1998;45:1011-7.

8. Statistics Korea [Internet]. Daejeon: Statistics Korea; 2016 [cited 2016 Jan 28]. Available from: http://kosis.kr.

9. Fritz A, Percy C, Jack A, Shanmugaratnam K, Sobin L, Parkin DM, et al. International classification of diseases for oncology. 3rd ed. Geneva: World Health Organization; 2000.

10. World Health Organization. International statistical classification of diseases and related health problems. 10th rev. Geneva: World Health Organization; 1994.

11. Howlader N, Noone AM, Krapcho M, Miller D, Bishop K,

Altekruse SF, et al. SEER Cancer Statistics Review, 1975-2013 [Internet]. Bethesda, MD: National Cancer Institute; 2016 [cited 2017 Feb 20]. Available from: http://seer.cancer.gov/csr/1975_2013/.

12. Segi M. Cancer mortality for selected sites in 24 countries (1950-1957). Sendai: Tohoku University School of Medicine; 1960.

13. Day NE. Cumulative rates and cumulative risk. In: Muir C, Waterhouse J, Mack T, Powell J, Whelan S, editors. Cancer incidence in five continents, Vol. V. IARC Scientific Publications No. 88. Lyon: International Agency for Research on Cancer; 1987. p. 787-9.

14. Ederer F, Heise H. Instructions to IBM 650 programmers in processing survival computations. Methodological note No. 10. Bethesda, MD: National Cancer Institute; 1959.

15. Paul Dickman [Internet]. Stockholm: PaulDickman.com; 2016 [cited 2016 Jan 14]. Available from: http//www.pauldickman.com.