



## Special Article

# Cancer Statistics in Korea: Incidence, Mortality, Survival, and Prevalence in 2018

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**Purpose** The current study provides national cancer statistics and their secular trends in Korea, including incidence, mortality, survival, and prevalence in 2018.

**Materials and Methods** Incidence, survival, and prevalence rates of cancer were calculated using the Korea National Cancer Incidence Database, from 1999 to 2018, with survival follow-up until December 31, 2019. Deaths from cancer were assessed using causes-of-death data obtained from Statistics Korea. Crude and age-standardized rates (ASRs) for incidence, mortality, prevalence, and 5-year relative survival rates were calculated, and temporal trends for incidence and mortality rates were evaluated, with annual percentage changes.

**Results** In 2018, newly diagnosed cancer cases and deaths from cancer were reported as 243,837 (ASR, 270.4 per 100,000) and 79,153 (ASR, 73.3 per 100,000), respectively. The overall cancer incidence rates increased by 3.3% annually from 1999 to 2012, and decreased by 5.4% annually from 2012 to 2015, thereafter, followed by nonsignificant changes. Cancer mortality rates have been decreasing since 2002, with more rapid decline in recent years (annual decrease of 2.7% from 2007 to 2014; 3.7% from 2014 to 2018). The 5-year relative survival between 2014 and 2018 was 70.3%, which contributed to prevalent cases reaching over 2 million by the end of 2018.

**Conclusion** Cancer statistics have improved significantly during the past two decades. However, there remain important challenges to be solved, such as controlling cancers with low survival rates. Cancer statistics can be used to discover blind spots in cancer control, and as evidence for developing and implementing future cancer control strategies.

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

## Introduction

It is estimated that cancer affects one in five men or women, and causes one in six deaths worldwide, according to the recent reports on global cancer statistics [1,2]. To address the overwhelming disease burden of cancer, collecting data and producing cancer statistics are the initial and fundamental steps indispensable to each nation's cancer control plan. In this regard, Korea has been compiling the national cancer registry data and publishing its statistics for more than 20 years. The current study reports the most recent nationwide statistics on cancer incidence, survival, prevalence, and mortality, and their temporal trends.

## Materials and Methods

### 1. Data sources

Annual cancer statistics in Korea are calculated using a national and population-based database of cancer occurrence, the Korea National Cancer Incidence Database (KNCI DB). Every year, the Korea Central Cancer Registry (KCCR) collects information on patients diagnosed with cancer, in any hospital across the country during the past year, and backs up the data from the year before the last, with data compiled by central and 11 regional cancer registries that also include information regarding missing cancer patients. Hence, it takes two years to complete and calculate the year's KNCI DB and cancer statistics. The KCCR has reported such nationwide statistics from 1999 onward; other detailed information on the KCCR and KNCI DB is provided elsewhere [3]. Completeness is an important indicator of data quality, and the 2018 KNCI DB was estimated to be 98.2% complete

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using the method proposed by Ajiki et al. [4].

Annual mid-year population data and recently updated mortality data including causes of death from 1983 were obtained from Statistics Korea [5]. To confirm the validity of individual vital statuses used in survival and prevalence calculation, the KNCI DB was linked to both mortality and population resident registration data, which were obtained from the Ministry of the Interior and Safety.

## 2. Cancer classification

All cancer cases had been registered in accordance with the *International Classification of Diseases for Oncology, 3rd edition* (ICD-O-3) [6]. The range of cancers to be registered and used for the national statistics calculation was limited to records with a behavior code of “/2 (carcinoma *in situ*)” or “/3 (malignant),” from the morphology (i.e., histology) codes of ICD-

O-3, by which a patient was initially enrolled in the KNCI DB. Similar to previous reports, malignant cancer cases and their statistics were mainly assessed in this article. In addition, the supplementary incidence statistics for carcinoma *in situ* cases were also calculated separately, using 2018 KNCI DB.

For the convenience of classification and reporting, the ICD-O-3 codes were converted to the classification of the *International Classification of Diseases, 10th edition* (ICD-10) [7]. Exceptionally, some hematopoietic diseases (myeloproliferative disorders/myelodysplastic syndromes) are not classified as malignant cancer in ICD-10 classification, therefore their ICD-O-3 codes were used without any conversion. For mortality data, causes of death were coded according to the ICD-10.

We adopted cancer classifications with 24 and 61 types; the

**Table 1.** Cancer incidence, mortality, and prevalence by sex in Korea, 2018

Site/Type	New cases			Deaths			Prevalent cases <sup>a)</sup>		
	Both sexes	Men	Women	Both sexes	Men	Women	Both sexes	Men	Women
All sites	243,837	128,757	115,080	79,153	48,898	30,255	2,005,520	881,057	1,124,463
Lip, oral cavity, and pharynx	3,806	2,740	1,066	1,137	841	296	27,533	18,422	9,111
Esophagus	2,698	2,449	249	1,435	1,314	121	11,238	10,055	1,183
Stomach	29,279	19,865	9,414	7,746	5,083	2,663	304,265	201,278	102,987
Colon and rectum	27,909	16,686	11,223	8,715	4,900	3,815	265,291	157,777	107,514
Liver <sup>b)</sup>	15,736	11,728	4,008	10,611	7,790	2,821	71,774	53,903	17,871
Gallbladder <sup>c)</sup>	7,179	3,840	3,339	4,871	2,504	2,367	24,013	12,408	11,605
Pancreas	7,611	4,020	3,591	6,036	3,193	2,843	13,321	6,926	6,395
Larynx	1,143	1,081	62	295	271	24	11,461	10,787	674
Lung <sup>d)</sup>	28,628	19,524	9,104	17,852	13,188	4,664	93,600	56,954	36,646
Breast	23,647	100	23,547	2,473	13	2,460	237,771	867	236,904
Cervix uteri	3,500	-	3,500	845	-	845	57,104	-	57,104
Corpus uteri	3,182	-	3,182	327	-	327	28,249	-	28,249
Ovary	2,898	-	2,898	1,243	-	1,243	22,641	-	22,641
Prostate	14,857	14,857	-	1,995	1,995	-	96,852	96,852	-
Testis	335	335	-	17	17	-	3,747	3,747	-
Kidney	5,456	3,806	1,650	989	672	317	46,358	31,302	15,056
Bladder	4,577	3,650	927	1,400	1,055	345	37,722	30,734	6,988
Brain and CNS	2,024	1,088	936	1,355	727	628	12,356	6,332	6,024
Thyroid	28,651	6,727	21,924	372	109	263	432,932	77,440	355,492
Hodgkin lymphoma	299	181	118	62	39	23	3,215	1,988	1,227
Non-Hodgkin lymphoma	5,216	3,001	2,215	1,876	1,075	801	35,224	19,993	15,231
Multiple myeloma	1,719	927	792	953	508	445	7,008	3,677	3,331
Leukemia	3,494	2,037	1,457	1,848	1,081	767	23,782	13,250	10,532
Other and ill-defined	19,993	10,115	9,878	4,700	2,523	2,177	138,063	66,365	71,698

CNS, central nervous system. <sup>a)</sup>Limited-duration prevalent cases on January 1, 2018. These are patients who were diagnosed between January 1, 1999 and December 31, 2018, and who were alive on January 1, 2019. Multiple primary cancer cases were counted multiple times,

<sup>b)</sup>Includes the liver and intrahepatic bile duct, <sup>c)</sup>Includes the gallbladder and other/unspecified parts of the biliary tract, <sup>d)</sup>Includes the lung and bronchus.

**Table 2.** Crude and age-standardized cancer incidence rates by sex in Korea, 2018

Site/Type	Crude incidence rates per 100,000			Age-standardized incidence rates per 100,000 <sup>a)</sup>		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	475.3	502.9	447.8	270.4	295.2	259.4
Lip, oral cavity, and pharynx	7.4	10.7	4.1	4.3	6.3	2.4
Esophagus	5.3	9.6	1.0	2.7	5.4	0.5
Stomach	57.1	77.6	36.6	30.4	44.3	18.3
Colon and rectum	54.4	65.2	43.7	28.4	37.4	20.6
Liver <sup>b)</sup>	30.7	45.8	15.6	16.2	26.3	7.2
Gallbladder <sup>c)</sup>	14.0	15.0	13.0	6.6	8.2	5.2
Pancreas	14.8	15.7	14.0	7.4	8.8	6.3
Larynx	2.2	4.2	0.2	1.2	2.4	0.1
Lung <sup>d)</sup>	55.8	76.3	35.4	27.6	41.9	16.4
Breast	46.1	0.4	91.6	29.1	0.2	57.9
Cervix uteri	6.8	-	13.6	4.4	-	8.8
Corpus uteri	6.2	-	12.4	3.9	-	7.7
Ovary	5.6	-	11.3	3.6	-	7.1
Prostate	29.0	58.0	-	14.3	31.9	-
Testis	0.7	1.3	-	0.7	1.3	-
Kidney	10.6	14.9	6.4	6.3	9.2	3.6
Bladder	8.9	14.3	3.6	4.3	7.9	1.5
Brain and CNS	3.9	4.2	3.6	3.0	3.3	2.7
Thyroid	55.8	26.3	85.3	40.2	18.8	62.2
Hodgkin lymphoma	0.6	0.7	0.5	0.5	0.6	0.4
Non-Hodgkin lymphoma	10.2	11.7	8.6	6.5	8.0	5.0
Multiple myeloma	3.4	3.6	3.1	1.7	2.0	1.4
Leukemia	6.8	8.0	5.7	5.3	6.4	4.4
Other and ill-defined	39.0	39.5	38.4	21.9	24.5	19.7

CNS, central nervous system. <sup>a)</sup>Age-adjusted using Segi's world standard population, <sup>b)</sup>Includes the liver and intrahepatic bile duct, <sup>c)</sup>Includes the gallbladder and other/unspecified parts of the biliary tract, <sup>d)</sup>Includes the lung and bronchus.

former was a modified classification based on the GLOBOCAN cancer dictionary [8], and the latter was the taxonomy used in "Cancer Incidence in Five Continents" [9], and both of them were provided by the International Association of Cancer Registries. In this article, cancer classification with 24 types of cancer was used for description. The summary staging system developed under the Surveillance, Epidemiology, and End Results (SEER) program (i.e., SEER summary staging) [10] was used to categorize the extent of tumor invasion or metastasis.

### 3. Statistical analyses

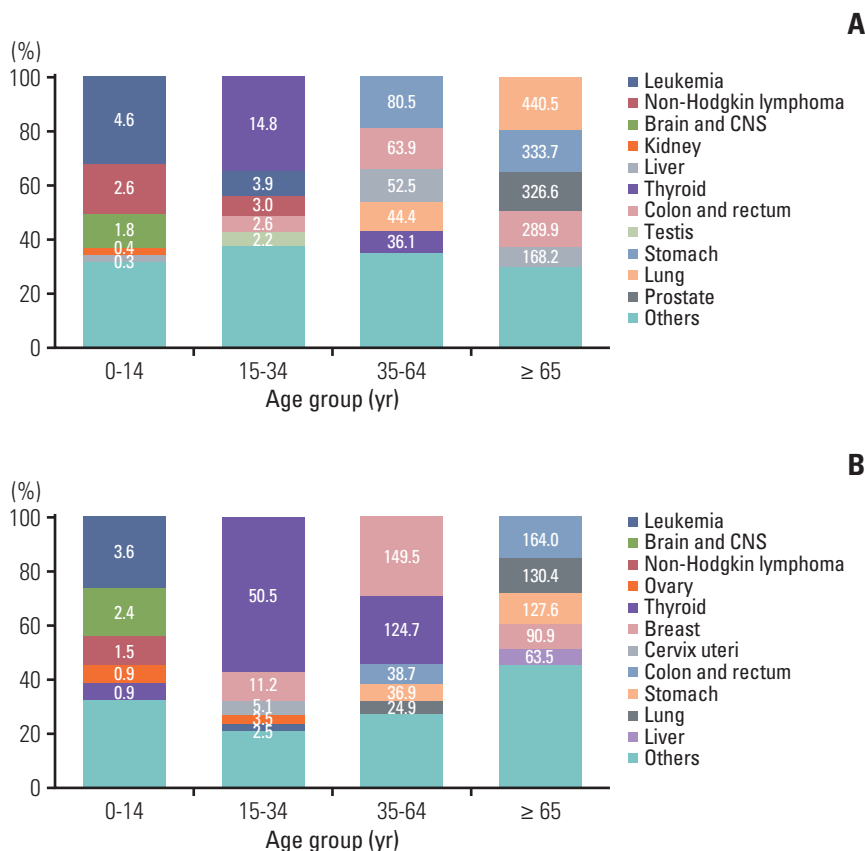
Incidence, mortality, and prevalence rates were expressed as crude rates (CRs) or age-standardized rates (ASRs) per 100,000 people. The CR was defined as the total number of newly diagnosed (for incidence) or deceased (for mortality) cases in a year divided by the mid-year population. The ASR was defined as the weighted average of the age-specific rates

in which the weights represent the proportions of people in the corresponding age groups in a standard population [11]. ASRs were standardized using Segi's world standard population [12]. The cumulative risk of developing cancer from birth to life expectancy during 2018 in Korea were also assessed, assuming no other cause of death (i.e., by simply calculating the sum of the age-specific cancer rates from birth to life expectancy), as follows [11]:

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

Trends in ASRs were estimated using Joinpoint regression [13], with a maximum number of two joinpoints. The results were summarized as annual percentage changes with the best model fit, based on a linear model for the natural log-transformed ASRs.

The survival rate of cancer patients, diagnosed between



**Fig. 1.** The five common sites of cancer incidence by age group and sex in Korea, 2018. (A) Men. (B) Women. Numbers in the graph are age-specific incidence rates per 100,000. CNS, central nervous system.

1993 and 2018, was calculated based on the results of follow-up until December 31, 2019. The 5-year relative survival rate was defined as the ratio of observed survival of cancer patients to expected survival in the general population, adjusting the effects of other causes of death using the standard population life table provided by Statistics Korea [5]. Relative survival rates were estimated using the Ederer II method [14] with some minor corrections, based on an algorithm devised by Paul Dickman [15]. Trends in 5-year relative survival rates were evaluated as percent differences in survival rates between 1993-1995 and 2014-2018.

Prevalent cases were defined as the number of cancer patients alive on January 1, 2019 among all the patients diagnosed with cancer between 1999 and 2018. Limited-duration prevalence was calculated using SEER\*Stat 8.3.8 software (National Cancer Institute, Bethesda, MD).  $p < 0.05$  was considered statistically significant. SEER\*Stat, Joinpoint 4.8.0 (National Cancer Institute), and SAS ver. 9.4 (SAS Institute, Cary, NC) were used for statistical analyses.

## Results

### 1. Incidence

In 2018, a total of 243,837 people were newly diagnosed with cancer in Korea, of which 52.8% (128,757 cases) were men and 47.2% (115,080 cases) were women (Table 1). Five most diagnosed cancers in Korea were stomach, thyroid, lung, colorectal, and breast cancers; in men, stomach and lung cancers were followed by colorectal, prostate, and liver cancers, whereas breast and thyroid cancers were followed by colorectal, stomach, and lung cancers in women. These top five cancers in each sex accounted for 64.2% and 65.4% of all cancer cases in men and women, respectively. Table 2 provides the CRs and ASRs of cancer incidence in 2018. The CR and ASR of all cancer incidence were 475.3 per 100,000 (502.9 for men and 447.8 for women) and 270.4 per 100,000 (295.2 for men and 259.4 for women), respectively. Such differences between CR and ASR, revealed in values and their relative ranks, imply that majority of cancer patients in Korea belong to the old age group (because the world's standard population consists of a higher proportion of young people)

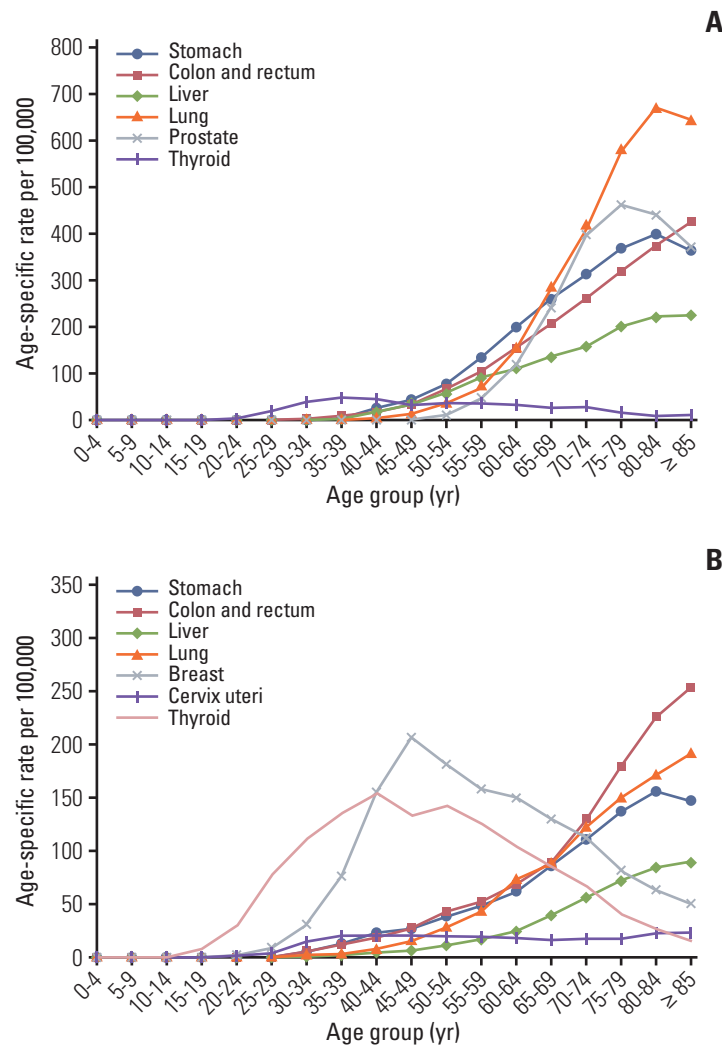


Fig. 2. Age-specific incidence rates of common cancers for 2018 in Korea. (A) Men. (B) Women.

Table 3. The top 10 leading causes of death in Korea, 2018

Rank	Cause of death	No. of deaths	Percentage of all deaths	Age-standardized death rate per 100,000 <sup>a)</sup>
	All causes	298,777	100.0	268.3
1	Cancer	79,153	26.5	73.3
2	Heart disease	32,004	10.7	26.5
3	Cerebrovascular disease	22,940	7.7	18.7
4	Pneumonia	23,280	7.8	17.5
5	Intentional self-harm (suicide)	13,670	4.6	18.2
6	Diabetes mellitus	8,789	2.9	7.3
7	Disease of liver	6,858	2.3	7.4
8	Chronic lower respiratory diseases	6,608	2.2	5.0
9	Hypertensive diseases	6,065	2.0	4.5
10	Transport accidents	4,671	1.6	5.7
	Others	94,782	31.7	84.3

Source: Mortality data, 2018, Statistics Korea [5]. <sup>a)</sup>Age-adjusted using Segi's world standard population.

**Table 4.** Crude and age-standardized cancer mortality rates by sex in Korea, 2018

Site/Type	Crude mortality rates per 100,000			Age-standardized mortality rates per 100,000 <sup>a)</sup>		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	154.3	191.0	117.7	73.3	105.3	49.5
Lip, oral cavity, and pharynx	2.2	3.3	1.2	1.1	1.8	0.5
Esophagus	2.8	5.1	0.5	1.3	2.8	0.2
Stomach	15.1	19.9	10.4	7.1	11.0	4.1
Colon and rectum	17.0	19.1	14.8	7.7	10.6	5.5
Liver <sup>b)</sup>	20.7	30.4	11.0	10.2	17.0	4.4
Gallbladder <sup>c)</sup>	9.5	9.8	9.2	4.2	5.2	3.4
Pancreas	11.8	12.5	11.1	5.5	6.9	4.3
Larynx	0.6	1.1	0.1	0.3	0.6	0.0
Lung <sup>d)</sup>	34.8	51.5	18.1	15.7	27.5	7.0
Breast	4.8	0.1	9.6	2.7	0.0	5.3
Cervix uteri	1.6	-	3.3	0.9	-	1.7
Corpus uteri	0.6	-	1.3	0.3	-	0.6
Ovary	2.4	-	4.8	1.3	-	2.4
Prostate	3.9	7.8	-	1.5	4.2	-
Testis	0.0	0.1	-	0.0	0.1	-
Kidney	1.9	2.6	1.2	0.9	1.5	0.5
Bladder	2.7	4.1	1.3	1.1	2.2	0.4
Brain and CNS	2.6	2.8	2.4	1.7	1.9	1.5
Thyroid	0.7	0.4	1.0	0.3	0.2	0.4
Hodgkin lymphoma	0.1	0.2	0.1	0.1	0.1	0.0
Non-Hodgkin lymphoma	3.7	4.2	3.1	1.8	2.4	1.3
Multiple myeloma	1.9	2.0	1.7	0.8	1.1	0.7
Leukemia	3.6	4.2	3.0	2.1	2.7	1.7
Other and ill-defined	9.2	9.9	8.5	4.5	5.7	3.6

CNS, central nervous system. <sup>a)</sup>Age-adjusted using Segi's world standard population, <sup>b)</sup>Includes the liver and intrahepatic bile duct, <sup>c)</sup>Includes the gallbladder and other/unspecified parts of the biliary tract, <sup>d)</sup>Includes the lung and bronchus.

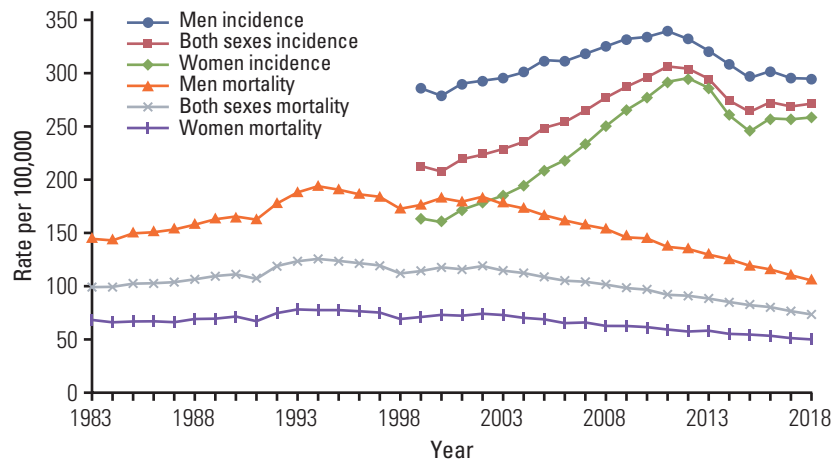
and there are differences in the age composition of patients according to the site of cancer. The overall lifetime probability of being diagnosed with any cancer was 37.4%, under the condition that one survives to the age that matches the life expectancy of the Korean population. That probability was higher in men (39.8%) than in women (34.2%) (data not shown).

There were marked differences in major cancers of each age-specific group (Fig. 1). In the childhood population (0-14 years), leukemia, non-Hodgkin lymphoma, and brain and central nervous system (CNS) cancer were the top three cancers in both sexes, accounting for 30.5%, 16.1%, and 14.2% of all cancer cases diagnosed in this age group, respectively. Thyroid cancer was the most common cancer in both sexes among the adolescent and young adult population (15-34 years), with a proportion of 50.8% of all cancers diagnosed. Leukemia and non-Hodgkin lymphoma were ranked next in men, while breast and cervix cancers were the next high-

est in women among that age group. In the 35-64-year age group population, men were most commonly diagnosed with stomach, colorectal, liver, and lung cancers (collectively accounting for 54.1%), while breast and thyroid cancers were most common in women (collectively accounting for 54.4%). For those aged 65 years and above, lung and prostate cancers were most common in men, while colorectal and lung cancers were most common in women. Most cancers demonstrated higher incidence rates in older age groups (i.e., incidence rates increased with age); the only exceptions were thyroid cancer in both sexes and breast cancer in women, which showed the highest incidences among the 30-40s and 40-50s age groups, respectively (Fig. 2).

## 2. Mortality

Since the causes-of-death statistics began to be reported in 1983, cancer has been the first cause of death in Korea. In 2018, a total of 79,153 people (61.8% men and 38.2% women)



**Fig. 3.** Annual age-standardized cancer incidence and mortality rates by sex for all sites from 1983 to 2018 in Korea. Age standardization was based on Segi's world standard population.

died of cancer, accounting for 26.5% of all deaths occurring in Korea (Tables 1 and 3). The overall CR for cancer deaths was 154.3 per 100,000, and the rate in men was approximately 1.6 times higher than in women (Table 4). Lung cancer was the leading cause of cancer death in both sexes (CR, 51.5 per 100,000 in men and 18.1 per 100,000 in women), followed by liver and stomach cancers in men, and colorectal and pancreatic cancers in women. When stratified according to the age at the time of death, the most common causes of cancer mortality were as follows: leukemia at ages 10 and 20 years, stomach cancer at 30 years, liver cancer at 40 and 50 years, and lung cancer at 60 years or more (data not shown).

### 3. Trends in cancer incidence and mortality

Changes in cancer incidence rates from 1999 to 2018 and mortality rates from 1983 to 2018 are depicted in Fig. 3. Compared to 1999, cancer incidence rates increased about 27.5% and mortality rates decreased about 35.9%, in 2018 (Table 5). The overall cancer incidence rates increased by approximately 3.3% per year until 2012, followed by a decline until 2015 with an annual decrease of 5.4%, and thereafter showed nonsignificant changes. In contrast, cancer mortality rates demonstrated nonsignificant changes until 2002, and decreased thereafter with an annual decrease of 2.7% until 2014, and a further decrease of 3.7% per year until 2018. These trends were observed similarly in both men and women, although the slopes of change were much more pronounced in women for incidence, and in men for mortality rates (S1 and S2 Tables).

Since 1999, breast, pancreas, kidney, and hematologic (leukemia and lymphoma) cancers, and that of some male or female reproductive organs (ovary, corpus uteri, prostate, and testis) have been continuously increasing. In both

sexes combined, breast (especially for women) and kidney cancers displayed initial rapid increases and then lessened increases after 2007 and 2009, respectively. Prostate cancer demonstrated distinguished increase until 2009, followed by nonsignificant trend until 2015, and regained increasing trend thereafter. The remaining cancers with increasing trend revealed steady increases throughout the entire period. On the other hand, the incidences of colorectal, thyroid, and bladder cancers demonstrated increasing trends that have recently reversed significantly, with decreases starting in 2011, 2011, and 2004, respectively. Finally, in contrast, stomach and liver cancers demonstrated initial moderate decreasing trends until 2011 and 2010, respectively, followed by more rapid decreases thereafter; and cervical cancer showed initial nonsignificant trend until 2001, followed by marked decrease until 2007, however it showed lessened decrease thereafter until now (Table 5). These trends were observed similarly in both men and women, except for breast and thyroid cancer incidences in men and colorectal and bladder cancer incidences in women that revealed partially different results of trends from those described above (Fig. 4, S1 and S2 Tables).

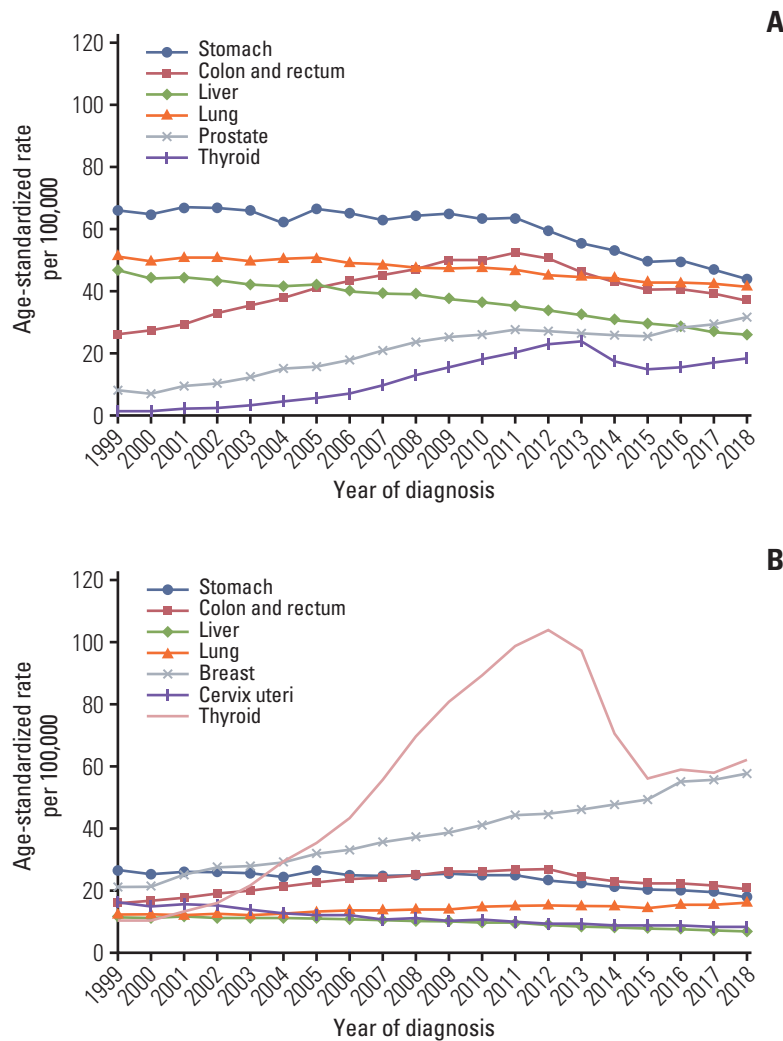
Recently, the ASRs for mortality in most cancers have shown decreasing trends in Korea. Stomach cancer revealed continuous decreasing trends throughout the entire observed period for mortality, with more pronounced decreasing slopes in more recent periods. On the other hand, the mortality rates of colorectal, cervical, and thyroid cancers initially increased (significantly, for colorectal and cervical cancers; nonsignificantly, for thyroid cancer) until 2003, and began to decline thereafter (for cervical and thyroid cancers) or after a nonsignificant period of 10 years from 2003 had passed (i.e., from 2012, for colorectal cancer). Liver and lung cancer mor-

**Table 5.** Trends in cancer incidence and mortality rates from 1999 to 2018 in Korea, both sexes

Site/Type	Incidence						Mortality								
	1999		Trend 1		Trend 2		1999		Trend 1		Trend 2		Trend 3		
	2018	Years	APC	Years	APC	Years	2018	Years	APC	Years	APC	Years	APC	Years	
All sites	212.0	1999-2012	3.3 <sup>a)</sup>	2012-2015	-5.4 <sup>b)</sup>	2015-2018	1.0	114.3	73.3	1999-2002	1.0	2002-2014	-2.7 <sup>a)</sup>	2014-2018	-3.7 <sup>b)</sup>
Lip, oral cavity, and pharynx	3.6	1999-2018	0.7 <sup>a)</sup>	-	-	-	1.1	1.1	1999-2018	-1.9 <sup>a)</sup>	-	-	-	-	-
Esophagus	4.1	1999-2018	-2.2 <sup>b)</sup>	-	-	-	3.1	1.3	1999-2018	-4.4 <sup>a)</sup>	-	-	-	-	-
Stomach	43.6	1999-2011	-0.2	2011-2018	-4.6 <sup>b)</sup>	-	23.8	7.1	1999-2002	-2.6 <sup>a)</sup>	2002-2010	-6.2 <sup>a)</sup>	2010-2018	-7.4 <sup>b)</sup>	-
Colon and rectum	20.6	1999-2006	7.2 <sup>a)</sup>	2006-2011	3.1 <sup>a)</sup>	2011-2018	-4.4 <sup>a)</sup>	7.7	7.7	1999-2003	6.4 <sup>a)</sup>	2003-2012	-0.4	2012-2018	-3.8 <sup>b)</sup>
Liver <sup>b)</sup>	27.9	1999-2010	-1.7 <sup>a)</sup>	2010-2018	-4.3 <sup>b)</sup>	-	20.4	10.2	1999-2002	0.7	2002-2014	-3.6 <sup>a)</sup>	2014-2018	-6.4 <sup>b)</sup>	-
Gallbladder <sup>c)</sup>	6.5	1999-2004	1.4	2004-2018	-0.3 <sup>b)</sup>	-	5.2	4.2	1999-2001	7.6	2001-2014	-2.8 <sup>a)</sup>	2014-2018	0.5	-
Pancreas	5.6	1999-2018	1.5 <sup>a)</sup>	-	-	-	5.4	5.5	1999-2018	0.2	-	-	-	-	-
Larynx	2.4	1999-2018	-3.6 <sup>b)</sup>	-	-	-	1.6	0.3	1999-2005	-8.0 <sup>b)</sup>	2005-2008	-15.4 <sup>a)</sup>	2008-2018	-7.1 <sup>a)</sup>	-
Lung <sup>d)</sup>	28.5	1999-2011	0.1	2011-2015	-1.4 <sup>b)</sup>	2015-2018	0.7	22.4	15.7	1999-2001	3.7	2001-2014	-1.9 <sup>a)</sup>	2014-2018	-4.3 <sup>b)</sup>
Breast	11.0	1999-2007	6.4 <sup>a)</sup>	2007-2018	4.4 <sup>a)</sup>	-	2.2	2.7	1999-2016	1.4 <sup>a)</sup>	2016-2018	-2.7	-	-	-
Cervix uteri	8.6	1999-2001	-1.0	2001-2007	-5.4 <sup>b)</sup>	2007-2018	-2.8 <sup>a)</sup>	1.4	0.9	1999-2003	10.0 <sup>a)</sup>	2003-2008	-7.0 <sup>a)</sup>	2008-2018	-4.2 <sup>b)</sup>
Corpus uteri	1.4	1999-2018	5.1 <sup>a)</sup>	-	-	-	0.1	0.3	1999-2003	35.9 <sup>a)</sup>	2003-2018	2.4 <sup>a)</sup>	-	-	-
Ovary	2.7	1999-2018	1.7 <sup>a)</sup>	-	-	-	0.9	1.3	1999-2018	0.7 <sup>a)</sup>	-	-	-	-	-
Prostate	3.1	1999-2009	14.9 <sup>a)</sup>	2009-2015	0.6	2015-2018	6.8 <sup>a)</sup>	0.9	1.5	1999-2002	15.0 <sup>a)</sup>	2002-2011	1.7 <sup>a)</sup>	2011-2018	-1.5 <sup>b)</sup>
Testis	0.3	1999-2018	4.8 <sup>a)</sup>	-	-	-	0.0	0.0	1999-2018	-2.4 <sup>a)</sup>	-	-	-	-	-
Kidney	3.0	1999-2009	6.4 <sup>a)</sup>	2009-2018	2.0 <sup>b)</sup>	-	1.1	0.9	1999-2018	-0.4	-	-	-	-	-
Bladder	4.7	1999-2004	1.9 <sup>a)</sup>	2004-2018	-1.1 <sup>a)</sup>	-	1.3	1.1	1999-2001	10.5	2001-2018	-1.9 <sup>a)</sup>	-	-	-
Brain and CNS	2.9	1999-2018	0.2	-	-	-	1.9	1.7	1999-2002	6.3 <sup>a)</sup>	2002-2008	-3.5 <sup>a)</sup>	2008-2018	-0.9 <sup>b)</sup>	-
Thyroid	6.5	1999-2011	21.7 <sup>a)</sup>	2011-2018	-9.3 <sup>b)</sup>	-	0.4	0.3	1999-2003	7.5 <sup>a)</sup>	2003-2018	-4.5 <sup>a)</sup>	-	-	-
Hodgkin lymphoma	0.3	1999-2018	3.6 <sup>a)</sup>	-	-	-	0.0	0.1	1999-2004	23.0 <sup>b)</sup>	2004-2018	-1.7	-	-	-
Non-Hodgkin lymphoma	4.3	1999-2018	2.3 <sup>a)</sup>	-	-	-	2.1	1.8	1999-2018	-1.0 <sup>a)</sup>	-	-	-	-	-
Multiple myeloma	1.0	1999-2012	3.7 <sup>a)</sup>	2012-2018	1.0	-	0.6	0.8	1999-2003	12.6 <sup>a)</sup>	2003-2016	1.0	2016-2018	-7.6	-
Leukemia	4.7	1999-2018	0.9 <sup>a)</sup>	-	-	-	2.9	2.1	1999-2018	-1.8 <sup>a)</sup>	-	-	-	-	-
Other and ill-defined	15.0	1999-2001	-0.9	2001-2007	3.6 <sup>b)</sup>	2007-2018	1.8 <sup>a)</sup>	7.8	4.5	1999-2018	-2.8 <sup>a)</sup>	-	-	-	-

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





**Fig. 4.** Trends in age-standardized incidences of selected cancers by sex from 1999 to 2018 in Korea. (A) Men. (B) Women. Age standardization was based on Segi's world standard population.

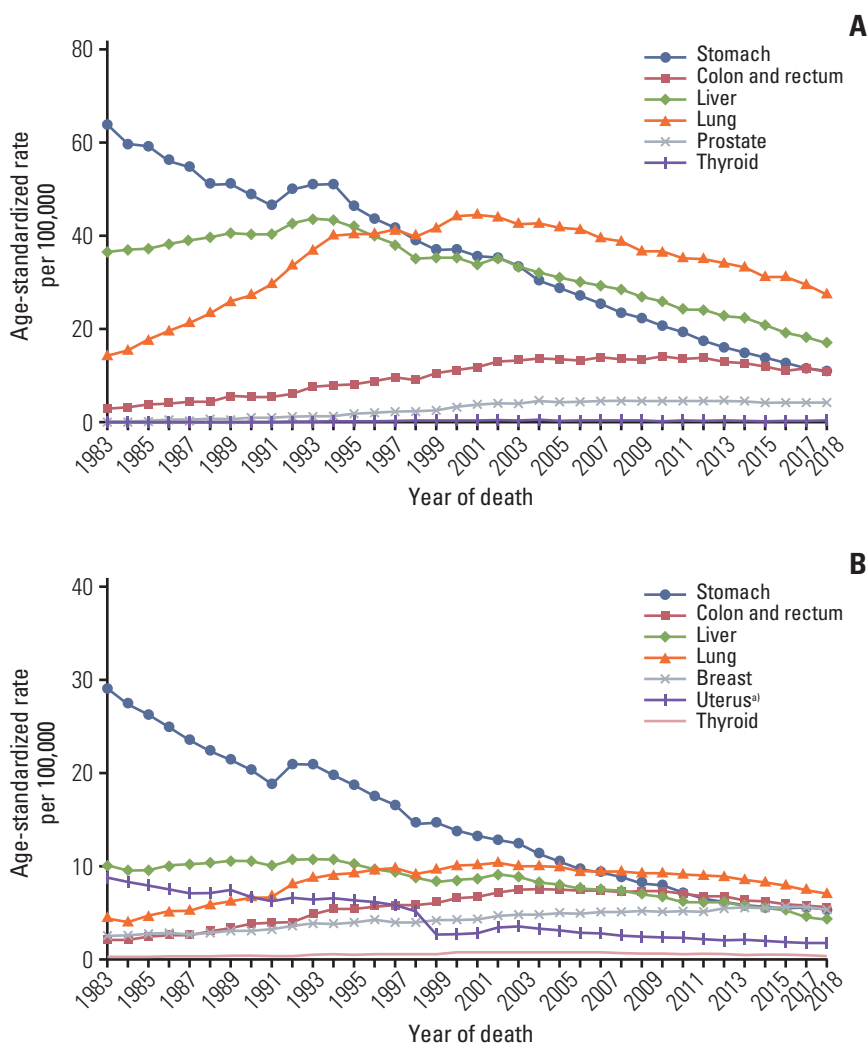
tality rates began to decrease in 2002 and 2001, respectively, after nonsignificant trends until those years, followed by further rapid decreases starting in 2014 (Table 5). These trends were observed similarly in both sexes. In contrast, breast cancer (women) displayed significantly increasing mortality trends until 2016, followed by nonsignificant changes thereafter (Fig. 5, S1 and S2 Tables).

#### 4. Survival rates

Over the past two decades, when cancer survival statistics have been compiled, the relative survival rates of cancer patients have increased significantly and steadily. The 5-year relative survival rates for all patients diagnosed with cancer in the recent five years, from 2014 to 2018 were 63.8% in men and 77.1% in women, for a combined overall survival rate of

70.3% (Table 6). The temporal increasing trends in survival rates, from 42.9% in 1993-1995 to 70.3% in 2014-2018, were maintained even after excluding thyroid cancer (from 41.2% in 1993-1995 to 65.7% in 2014-2018), which has excellent prognosis and a 5-year relative survival rate of 100%.

After thyroid cancer, survival was the highest for testis and prostate cancers in men (95.1% and 94.4%, respectively) and breast cancer in women (93.3%); survival was lowest for cancers of the pancreas (12.6%), and gallbladder plus other and unspecified parts of the biliary tract (28.8%). Stomach cancer (both sexes), prostate cancer (men), lung cancer, and leukemia (women) were associated with outstanding improvements in survival rates over the time period studied. In contrast, advances have been slow for cancers of the brain and CNS, pancreas (both sexes), and bladder (women).



**Fig. 5.** Trends in age-standardized mortalities of selected cancers by sex from 1983 to 2018 in Korea. (A) Men. (B) Women. Age standardization was based on Segi's world standard population. <sup>a)</sup>Cancers of cervix uteri, corpus uteri, and unspecified parts of the uterus were combined (C53-C55), due to their unclear classifications in the past.

In terms of stage distribution at diagnosis and recent survival rates according to the SEER summary stage in each cancer, Fig. 6 shows the top 10 most common cancers for each sex in 2018. In men, stomach, kidney, and bladder cancers revealed the highest proportions of patients who were diagnosed at the localized stage (64.3%, 71.7%, and 72.5%, respectively), accompanied by the 5-year survival rates of 97.4%, 98.0%, and 87.6%, respectively. In contrast, lung and pancreatic cancers demonstrated the highest proportions of patients diagnosed at the distant metastatic stage (i.e., the lowest proportions of localized stage), which approximated to 50%, with corresponding 5-year survival rates of 7.0% and 1.9%, respectively. In women, 58.4%, 62.9%, and 72.3% of breast,

stomach, and uterine corpus cancers, respectively, were diagnosed at the localized stage, with 5-year survival rates of 98.8%, 95.7%, and 96.1%, respectively. However, more than 40% of lung and pancreatic cancers were diagnosed at the distant metastatic stage, with 5-year survival rates of 13.4% and 1.9%, respectively.

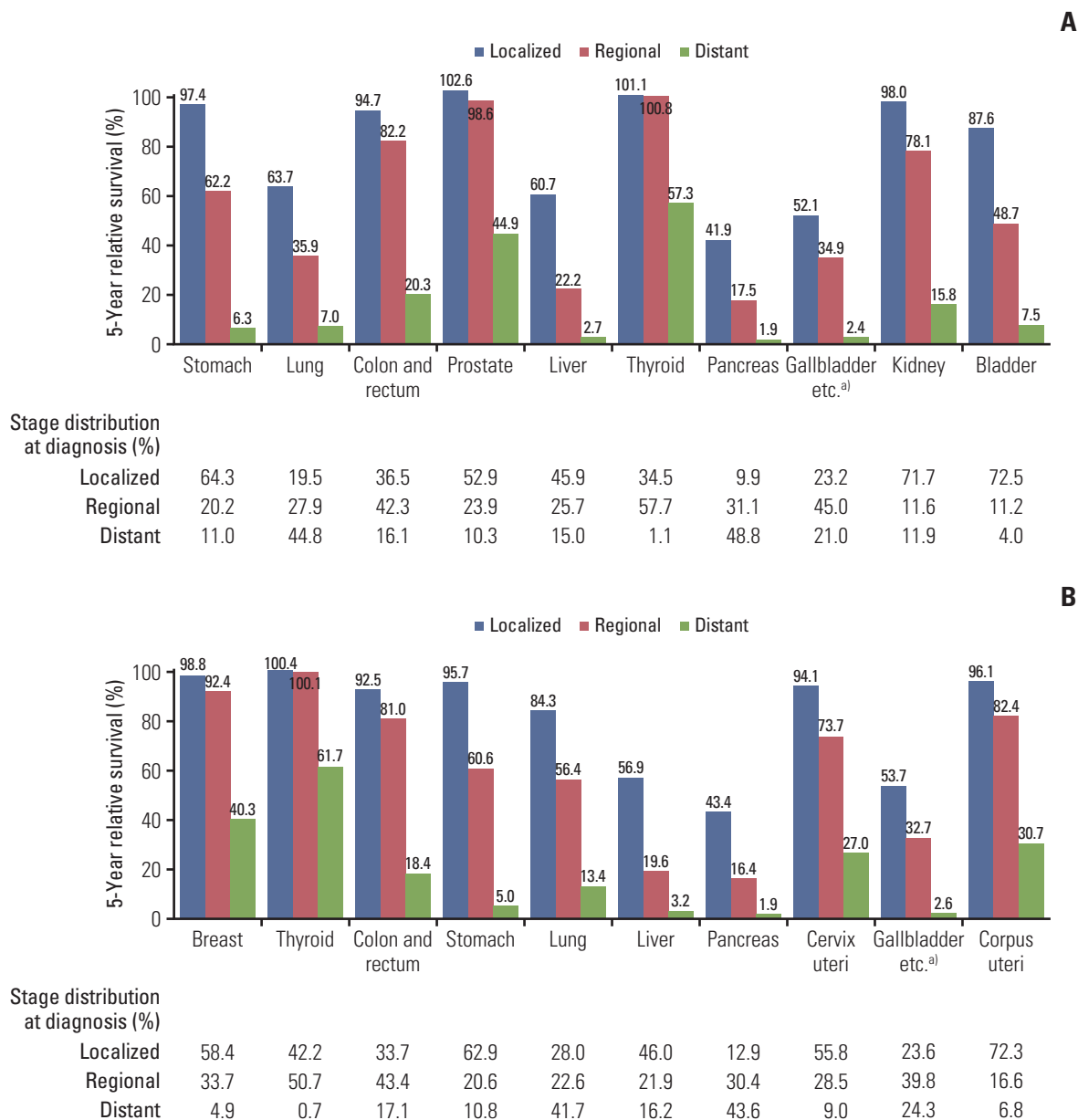
### 5. Prevalence rates

The total prevalent cancer cases in 2018 (identified as survivor at the time of January 1, 2019) were 2,005,520, surpassing 2 million for the first time in Korea (Table 1). It suggested that 1 in 25 people (3.9% of the entire Korean population; 3.4% of men and 4.4% of women) has a history of being diagnosed

Table 6. Trends in the 5-year relative survival rates (%) by sex and year of diagnosis from 1993 to 2018 in Korea

Site/Type	Both sexes												Men						Women					
	1993- 1996- 2001- 2006- 2011- 2014- 1995 2000 2005 2010 2015 2018			1993- 1996- 2001- 2006- 2011- 2014- 1995 2000 2005 2010 2015 2018			1993- 1996- 2001- 2006- 2011- 2014- 1995 2000 2005 2010 2015 2018			1993- 1996- 2001- 2006- 2011- 2014- 1995 2000 2005 2010 2015 2018			1993- 1996- 2001- 2006- 2011- 2014- 1995 2000 2005 2010 2015 2018			1993- 1996- 2001- 2006- 2011- 2014- 1995 2000 2005 2010 2015 2018								
	Change <sup>a)</sup>												Change <sup>a)</sup>						Change <sup>a)</sup>					
All sites	42.9	45.1	54.1	54.1	65.5	70.7	70.3	27.4	33.2	36.3	45.6	56.8	63.1	63.8	30.6	55.1	56.4	64.3	74.4	78.3	77.1	22.0		
All sites excluding thyroid	41.2	43.3	50.8	59.0	64.2	65.7	24.5	32.7	35.8	44.7	54.6	60.3	61.6	28.9	52.6	53.5	59.1	65.0	69.3	70.8	18.2			
Lip, oral cavity, and pharynx	42.2	47.4	54.5	61.1	65.4	68.0	25.8	36.6	41.7	49.6	56.9	61.8	65.0	28.4	59.4	64.5	68.1	72.1	74.5	75.4	16.0			
Esophagus	14.0	15.7	21.5	30.0	36.6	39.5	25.5	13.0	14.8	20.8	29.3	36.2	38.9	25.9	25.0	25.9	29.8	37.2	40.1	44.9	19.9			
Stomach	43.8	47.3	58.0	68.4	75.9	77.0	33.2	43.9	47.6	58.7	69.1	76.8	77.8	33.9	43.7	46.8	56.6	67.0	74.0	75.2	31.5			
Colon and rectum	56.2	58.8	66.9	73.9	76.1	74.3	18.1	56.6	59.8	68.8	75.8	77.8	75.6	19.0	55.7	57.7	64.5	71.1	73.6	72.3	16.6			
Liver <sup>b)</sup>	11.8	14.1	20.5	28.3	34.4	37.0	25.2	10.8	13.8	20.4	28.2	34.9	37.8	27.0	15.0	15.1	20.9	28.3	32.8	34.7	19.7			
Gallbladder <sup>c)</sup>	18.7	20.7	23.1	26.9	28.7	28.8	10.1	18.0	21.1	23.4	27.8	29.4	29.8	11.8	19.3	20.3	22.7	26.0	28.0	27.8	8.5			
Pancreas	10.6	8.7	8.4	8.5	10.8	12.6	2.0	10.0	8.3	8.4	8.3	10.2	11.9	1.9	11.5	9.2	8.4	8.8	11.4	13.2	1.7			
Larynx	61.6	63.3	66.5	73.2	75.1	78.6	17.0	62.1	63.7	67.1	73.5	75.5	78.9	16.8	56.3	58.9	58.7	68.0	68.8	74.1	17.8			
Lung <sup>d)</sup>	12.5	13.6	16.6	20.3	27.5	32.4	19.9	11.6	12.4	15.3	18.0	23.3	27.0	15.4	15.8	17.5	20.2	26.0	37.3	44.3	28.5			
Breast	79.2	83.6	88.7	91.2	92.8	93.3	14.1	77.1	84.3	87.5	89.9	90.5	91.9	14.8	79.3	83.6	88.7	91.2	92.8	93.3	14.0			
Cervix uteri	78.3	80.3	81.5	80.7	80.3	80.5	2.2	-	-	-	-	-	-	-	78.3	80.3	81.5	80.7	80.3	80.5	2.2			
Corpus uteri	82.9	82.0	84.7	86.5	87.8	88.6	5.7	-	-	-	-	-	-	-	82.9	82.0	84.7	86.5	87.8	88.6	5.7			
Ovary	60.1	59.4	61.7	61.2	64.7	65.2	5.1	-	-	-	-	-	-	-	60.1	59.4	61.7	61.2	64.7	65.2	5.1			
Prostate	59.2	69.3	81.0	92.0	94.2	94.4	35.2	59.2	69.3	81.0	92.0	94.2	94.4	35.2	-	-	-	-	-	-	-			
Testis	87.4	90.4	90.7	93.1	94.8	95.1	7.7	87.4	90.4	90.7	93.1	94.8	95.1	7.7	-	-	-	-	-	-	-			
Kidney	64.2	67.0	73.7	78.6	82.6	84.1	19.9	63.4	65.3	73.1	78.5	82.2	84.3	20.9	65.8	70.3	74.9	79.0	83.4	83.7	17.9			
Bladder	70.7	73.6	76.0	77.2	76.4	76.6	5.9	71.6	75.1	77.8	79.2	78.3	78.6	7.0	67.2	67.2	69.1	69.1	68.2	68.2	1.0			
Brain and CNS	40.4	39.9	41.0	42.9	41.6	40.9	0.5	39.1	38.6	40.3	41.3	40.1	39.8	0.7	42.2	41.4	41.8	44.6	43.2	42.2	-			
Thyroid	94.5	95.0	98.4	100.0	100.2	100.0	5.5	87.8	89.7	96.0	100.2	100.6	100.4	12.6	95.7	96.0	98.7	99.9	100.1	99.9	4.2			
Hodgkin lymphoma	70.1	71.9	76.7	81.1	82.3	84.5	14.4	69.2	69.3	74.7	80.8	81.8	81.8	12.6	71.5	77.3	80.7	81.6	83.2	88.8	17.3			
Non-Hodgkin lymphoma	48.3	51.1	56.0	59.4	62.8	64.0	15.7	46.8	49.6	55.0	59.2	62.8	64.8	18.0	50.7	53.3	57.5	59.7	62.8	62.9	12.2			
Multiple myeloma	23.5	21.1	29.7	35.0	41.5	46.6	23.1	23.0	19.2	29.9	35.2	41.0	46.9	23.9	24.1	23.3	29.5	34.7	42.0	46.4	22.3			
Leukemia	27.5	34.3	42.0	47.7	51.9	53.4	25.9	27.3	33.3	41.8	46.9	52.2	53.4	26.1	27.8	35.5	42.2	48.7	51.6	53.6	25.8			
Other and ill-defined	44.5	48.3	57.8	67.6	72.7	74.8	30.3	39.6	44.7	54.0	63.8	69.3	71.7	32.1	50.1	52.6	62.0	71.6	76.1	77.9	27.8			

CNS, central nervous system. <sup>a)</sup>Absolute percentage change in 5-year relative survival from 1993 to 1995 and 2014 to 2018, <sup>b)</sup>Includes the liver and intrahepatic bile duct, <sup>c)</sup>Includes the gallbladder and other/unspecified parts of the biliary tract, <sup>d)</sup>Includes the lung and bronchus.



**Fig. 6.** Five-year relative survival rates by stage at diagnosis and stage distribution of selected cancers by sex in Korea, 2014-2018. (A) Men. (B) Women. Staging according to the Surveillance, Epidemiology, and End Results (SEER) stage categories. For each cancer type, stage categories do not total 100% because sufficient information was not available to stage all cases. <sup>a)</sup>Includes the gallbladder and other/unspecified parts of the biliary tract.

with cancer. Of these, 906,204 (45.2% of all prevalent cases) were aged  $\geq 65$  years, indicating that 1 in 8 people in that age group (15.8% of, or 1 in 6, men and 9.7% of, or 1 in 10, women) would have experienced cancer (data not shown).

Table 7 provides the CRs and ASRs of prevalence for all cancers combined and for specific cancers. In total, the cancer prevalence rate for 2018 in Korea was 3,909.3 per 100,000 people. Thyroid cancer had the highest prevalence (CR, 843.9 per

100,000; 302.5 per 100,000 for men and 1,383.3 per 100,000 for women), followed by stomach cancer (CR, 593.1 per 100,000) and colorectal cancer (CR, 517.1 per 100,000). Prostate cancer (men) and breast cancer (women) also revealed high prevalence rates (CR, 378.3 and 921.8 per 100,000, respectively).

The number of prevalent cases for common cancers, according to the time since cancer diagnosis, are described in Fig. 7. In total, 1,160,147 (57.8% of all prevalent cases) had

**Table 7.** Crude and age-standardized rates of cancer prevalence by sex on January 1, 2019 in Korea

Site/Type	Crude prevalence rates per 100,000 <sup>a)</sup>			Age-standardized prevalence rates per 100,000 <sup>b)</sup>		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	3,909.3	3,441.4	4,375.5	2,216.8	2,018.5	2,499.4
Lip, oral cavity, and pharynx	53.7	72.0	35.5	30.9	43.0	20.2
Esophagus	21.9	39.3	4.6	11.0	21.7	2.2
Stomach	593.1	786.2	400.7	304.6	440.6	191.7
Colon and rectum	517.1	616.3	418.4	262.5	347.0	193.7
Liver <sup>c)</sup>	139.9	210.5	69.5	76.7	122.3	35.3
Gallbladder <sup>d)</sup>	46.8	48.5	45.2	22.6	26.7	19.4
Pancreas	26.0	27.1	24.9	14.1	15.7	12.8
Larynx	22.3	42.1	2.6	11.1	23.3	1.2
Lung <sup>e)</sup>	182.5	222.5	142.6	92.8	123.6	68.9
Breast	463.5	3.4	921.8	273.9	1.9	539.4
Cervix uteri	111.3	-	222.2	64.6	-	126.4
Corpus uteri	55.1	-	109.9	32.5	-	64.1
Ovary	44.1	-	88.1	28.4	-	56.4
Prostate	188.8	378.3	-	85.7	200.7	-
Testis	7.3	14.6	-	6.5	12.8	-
Kidney	90.4	122.3	58.6	52.0	73.9	32.2
Bladder	73.5	120.0	27.2	35.2	66.1	11.3
Brain and CNS	24.1	24.7	23.4	19.9	21.1	18.7
Thyroid	843.9	302.5	1,383.3	536.4	196.8	874.0
Hodgkin lymphoma	6.3	7.8	4.8	5.1	6.1	4.0
Non-Hodgkin lymphoma	68.7	78.1	59.3	45.7	54.8	37.2
Multiple myeloma	13.7	14.4	13.0	7.2	8.1	6.3
Leukemia	46.4	51.8	41.0	41.5	46.6	36.4
Other and ill-defined	269.1	259.2	279.0	155.8	165.8	147.6

CNS, central nervous system. <sup>a)</sup>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, 2018, and who were alive on January 1, 2019. Multiple primary cancer cases were counted multiple times, <sup>b)</sup>Age-adjusted using Segi's world standard population, <sup>c)</sup>Includes the liver and intrahepatic bile duct, <sup>d)</sup>Includes the gallbladder and other/unspecified parts of the biliary tract, <sup>e)</sup>Includes the lung and bronchus.

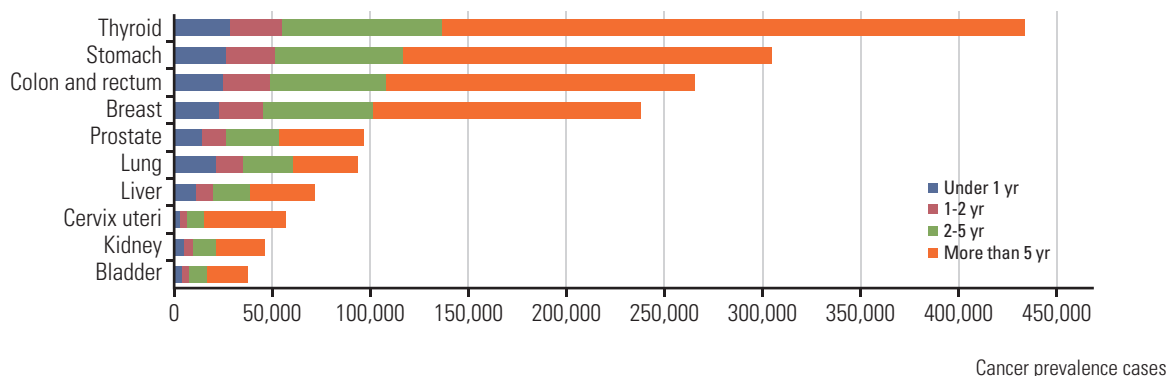
survived > 5 years after cancer diagnosis, including many survivors of thyroid, stomach, colorectal, and breast cancers. Another 448,263 (22.4% of all prevalent cases) have been alive 2-5 years after their cancer diagnosis, in which period they need regular follow-up; and the rest were 397,110 (19.8% of all prevalent cases) for whom it had been < 2 years since their cancer diagnosis, in which period they still need active cancer treatment.

## 6. Carcinoma *in situ* incidence

A summary of carcinoma *in situ* cases in 2018 is provided as a Supplementary Material (S3 Material, S4 and S7 Tables, S5, S6, and S8 Figs.).

## Conclusion

During the past two decades, regardless of the increases in cancer incidence due to changes in biologic, behavioral, and environmental risk factors, overall cancer statistics have improved significantly as a result of national cancer control plans that have been carried out throughout the years. Incidence and mortality rates for major cancers in Korea, i.e., stomach, colorectal, liver, breast, uterine cervix, and lung, have been exhibiting decreasing trends currently, except for increasing incidences in women for breast and lung cancers. The 5-year relative survival rates have continuously improved, reaching over 70% for all patients diagnosed with cancer in recent years. Cancer prevalence in Korea has rapidly increased due to such remarkable improvements in



Time since diagnosis	Thyroid	Stomach	Colon and rectum	Breast	Prostate	Lung	Liver	Cervix uteri	Kidney	Bladder	All cancers
Under 1 yr	28,486	26,633	25,388	23,368	14,501	21,496	11,558	3,350	5,112	4,242	215,757
1-2 yr	26,400	24,531	23,322	21,942	12,104	14,078	8,429	3,107	4,705	3,654	181,353
2-5 yr	81,842	65,482	58,948	55,939	27,121	24,901	18,429	8,691	11,447	8,729	448,263
More than 5 yr	296,204	187,619	157,633	136,522	43,126	33,125	33,358	41,956	25,094	21,097	1,160,147
Total	432,932	304,265	265,291	237,771	96,852	93,600	71,774	57,104	46,358	37,722	2,005,520

**Fig. 7.** Prevalent cases of common cancers by time since cancer diagnosis. Prevalent cases were defined as the number of cancer patients alive on January 1, 2019 among all cancer patients diagnosed between 1999 and 2018.

cancer survival, reaching over 2 million by the end of 2018. Despite those advances, there remain important challenges to be solved, such as the stagnant decreasing trend of cancer incidence rates in recent years, and treatment of cancers with low survival rates, including rare cancers. Cancer statistics can be used to discover blind spots in cancer control, and as evidence for comprehensive and precise cancer control strategies that need to be continuously developed and implemented.

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**Electronic Supplementary Material**

Supplementary materials are available at Cancer Research and Treatment website (<https://www.e-crt.org>).

**Author Contributions**

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 Contributed data or analysis tools: Hong S, Won YJ, Jung KW, Kong HJ.  
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**Conflicts of Interest**

Conflict of interest relevant to this article was not reported.

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