

Special Article

Cancer Statistics in Korea: Incidence, Mortality, Survival, and Prevalence in 2019

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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 2019.

Materials and Methods Incidence, survival, and prevalence rates of cancer were calculated using the Korea National Cancer Incidence Database, from 1999 to 2019, with survival follow-up until December 31, 2020. Deaths from cancer were assessed using causes-of-death data obtained from Statistics Korea.

Results In 2019, newly diagnosed cancer cases and deaths from cancer were reported as 254,718 (age-standardized rate [ASR], 275.4 per 100,000) and 81,203 (ASR, 72.2 per 100,000), respectively. For the first time, lung cancer (n=29,960) became the most frequent cancer in Korea, excluding thyroid cancer. The overall cancer incidence rates increased by 3.3% annually from 1999 to 2012, and decreased by 5.3% annually from 2012 to 2015, thereafter, followed by nonsignificant changes. The incidence of thyroid cancer increased again from 2016 (annual percentage change, 6.2%). Cancer mortality rates have been decreasing since 2002, with more rapid decline in recent years (annual decrease of 2.7% from 2002 to 2013; 3.3% from 2013 to 2019). The 5-year relative survival between 2015 and 2019 was 70.7%, which contributed to prevalent cases reaching over 2 million in 2019.

Conclusion Cancer survival rates have improved over the past decades, but the number of newly diagnosed cancers is still increasing, with some cancers showing only marginal improvement in survival outcomes. As the number of cancer survivors increases, a comprehensive cancer control strategy should be implemented in line with the changing aspects of cancer statistics.

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

Introduction

It is estimated that there were approximately 19.3 million new cancer cases and 10 million deaths from cancer worldwide in 2020 [1]. During this century, cancer is expected to surpass cardiovascular disease as the leading cause of premature death in most countries [2]. Cancer is the leading cause of death in Korea [3]. In order to reduce the pain and social burden caused by cancer and to promote public health, the National Plan for Cancer Control has been implemented since 1996, and the 4th stage is in effect from 2021. As a fundamental part of the Plan, the Korea Central Cancer Registry (KCCR) publishes cancer registration statistics every year. 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 KCCR collects information on patients diagnosed with cancer at hospitals across the country during the past year. The data from previous year is backed up with information compiled by central and 11 regional cancer registries, including information on cancer patients missed in hospital-based registrations. Hence, it takes two years to complete and calculate the year's KNCI DB and cancer statistics. The KCCR has reported nationwide statistics since 1999; other detailed information on the KCCR and KNCI DB is provided in our previous report [4]. Completeness is an important indicator of data quality, and the 2019 KNCI DB was estimated to be 98.3% complete using the method proposed by Ajiki et al. [5].

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Annual mid-year population data and recently updated mortality data including causes of death from 1983 were obtained from Statistics Korea [3]. 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 2019 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 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

Table 1. Cancer incidence, deaths and prevalence by sex in Korea, 2019

Site/Type	New cases			Deaths			Prevalent cases ^{a)}		
	Both sexes	Men	Women	Both sexes	Men	Women	Both sexes	Men	Women
All sites	254,718	134,180	120,538	81,203	50,281	30,922	2,147,503	943,518	1,203,985
Lip, oral cavity, and pharynx	3,969	2,863	1,106	1,298	997	301	29,516	19,723	9,793
Esophagus	2,870	2,573	297	1,554	1,425	129	12,086	10,769	1,317
Stomach	29,493	19,761	9,732	7,624	4,956	2,668	318,948	210,689	108,259
Colon and rectum	29,030	17,119	11,911	8,880	5,016	3,864	279,717	165,962	113,755
Liver	15,605	11,541	4,064	10,586	7,784	2,802	75,261	56,420	18,841
Gallbladder ^{b)}	7,383	3,896	3,487	4,988	2,568	2,420	25,505	13,185	12,320
Pancreas	8,099	4,150	3,949	6,396	3,424	2,972	14,964	7,562	7,402
Larynx	1,222	1,154	68	318	289	29	11,902	11,205	697
Lung	29,960	20,331	9,629	18,574	13,698	4,876	103,108	62,105	41,003
Breast	24,933	113	24,820	2,643	21	2,622	259,116	944	258,172
Cervix uteri	3,273	-	3,273	898	-	898	58,983	-	58,983
Corpus uteri	3,287	-	3,287	358	-	358	30,946	-	30,946
Ovary	2,888	-	2,888	1,234	-	1,234	24,259	-	24,259
Prostate	16,803	16,803	-	2,047	2,047	-	108,870	108,870	-
Testis	325	325	-	19	19	-	4,046	4,046	-
Kidney	6,026	4,155	1,871	983	666	317	50,674	34,270	16,404
Bladder	4,895	3,984	911	1,550	1,167	383	39,963	32,592	7,371
Brain and CNS	1,981	1,070	911	1,416	756	660	12,934	6,650	6,284
Thyroid	30,676	7,516	23,160	373	109	264	462,151	84,565	377,586
Hodgkin lymphoma	308	181	127	57	33	24	3,436	2,115	1,321
Non-Hodgkin lymphoma	5,388	3,117	2,271	1,856	1,081	775	37,971	21,544	16,427
Multiple myeloma	1,831	997	834	961	527	434	7,741	4,064	3,677
Leukemia	3,738	2,108	1,630	1,911	1,143	768	25,538	14,178	11,360
Other and ill-defined	20,735	10,423	10,312	4,679	2,555	2,124	149,868	72,060	77,808

CNS, central nervous system. ^{a)}Limited-duration prevalent cases on January 1, 2019. These are patients who were diagnosed between January 1, 1999 and December 31, 2019 and who were alive on January 1, 2020. Multiple primary cancer cases were counted multiple times,

^{b)}Includes the gallbladder and other/unspecified parts of the biliary tract.

Table 2. Crude and age-standardized cancer incidence rates by sex in Korea, 2019

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	496.2	523.9	468.5	275.4	296.6	267.4
Lip, oral cavity, and pharynx	7.7	11.2	4.3	4.3	6.5	2.4
Esophagus	5.6	10.0	1.2	2.8	5.3	0.6
Stomach	57.4	77.2	37.8	29.6	42.4	18.4
Colon and rectum	56.5	66.8	46.3	28.7	37.0	21.4
Liver	30.4	45.1	15.8	15.6	25.0	7.1
Gallbladder ^{b)}	14.4	15.2	13.6	6.5	8.0	5.3
Pancreas	15.8	16.2	15.3	7.6	8.8	6.6
Larynx	2.4	4.5	0.3	1.2	2.4	0.1
Lung	58.4	79.4	37.4	27.7	41.7	16.9
Breast	48.6	0.4	96.5	30.4	0.3	60.5
Cervix uteri	6.4	-	12.7	4.0	-	8.0
Corpus uteri	6.4	-	12.8	4.0	-	7.9
Ovary	5.6	-	11.2	3.5	-	7.0
Prostate	32.7	65.6	-	15.5	34.3	-
Testis	0.6	1.3	-	0.6	1.2	-
Kidney	11.7	16.2	7.3	6.8	9.8	4.1
Bladder	9.5	15.6	3.5	4.4	8.2	1.4
Brain and CNS	3.9	4.2	3.5	2.9	3.2	2.6
Thyroid	59.8	29.3	90.0	42.9	21.0	65.6
Hodgkin lymphoma	0.6	0.7	0.5	0.5	0.6	0.4
Non-Hodgkin lymphoma	10.5	12.2	8.8	6.3	7.8	5.0
Multiple myeloma	3.6	3.9	3.2	1.8	2.1	1.5
Leukemia	7.3	8.2	6.3	5.6	6.7	4.7
Other and ill-defined	40.4	40.7	40.1	21.9	24.3	20.0

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.

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 2019 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 1993 and 2019, was calculated based on the results of follow-up until December 31, 2020. The 5-year relative survival rate was defined as the ratio of observed survival of cancer

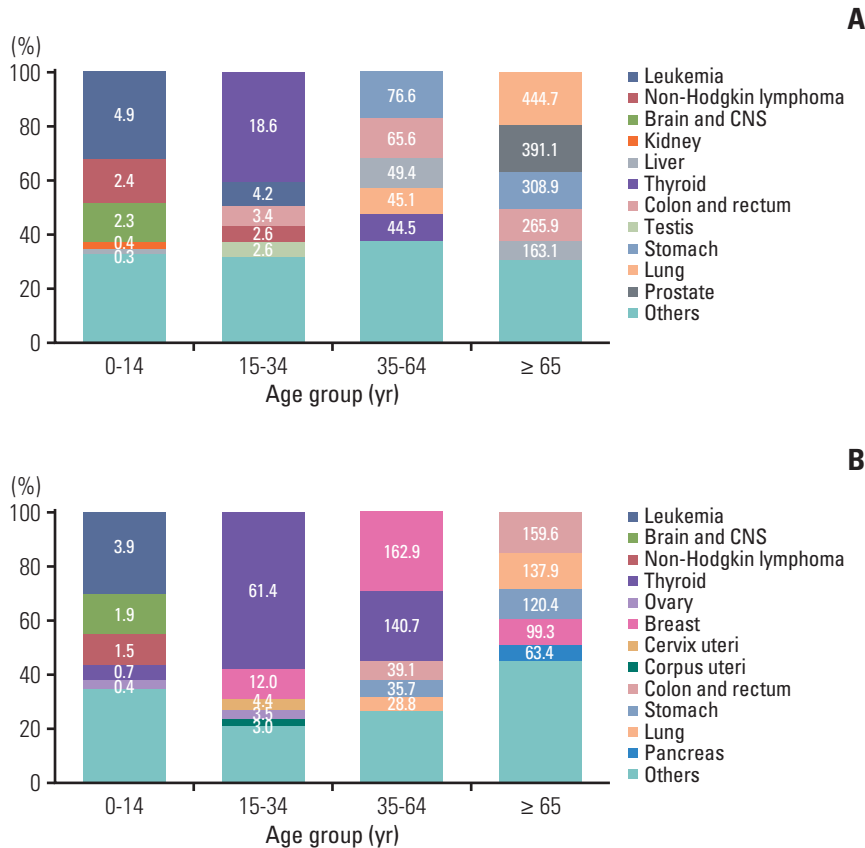


Fig. 1. The five common sites of cancer incidence by age group and sex for 2019 in Korea. (A) Men. (B) Women. Numbers in parentheses are age-specific incidence rates per 100,000. CNS, central nervous system.

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 [3]. 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 2015-2019.

Prevalent cases were defined as the number of cancer patients alive on January 1, 2020 among all the patients diagnosed with cancer between 1999 and 2019. 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 2019, a total of 254,718 people were newly diagnosed with cancer in Korea, of which 52.7% (134,180 cases) were men and 47.3% (120,538 cases) were women (Table 1). The five most diagnosed cancers in Korea were thyroid, lung, stomach, colorectal, and breast cancers; in men, lung and stomach 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 63.8% and 65.7% of all cancer cases in men and women, respectively. Thyroid cancer was the most frequent cancer from 2010 to 2014: its ranking fell after the debate on overdiagnosis in 2014, but recently rose again and regained the first rank in 2019. Excluding thyroid cancer, it is the first time in 2019 that lung cancer has surpassed stomach cancer to rank first in the incidence rate in Korea. Table 2 provides the CRs and ASRs of cancer incidence in 2019. The CR and ASR of all cancer incidence were 496.2 per 100,000 (523.9 for men and 468.5 for

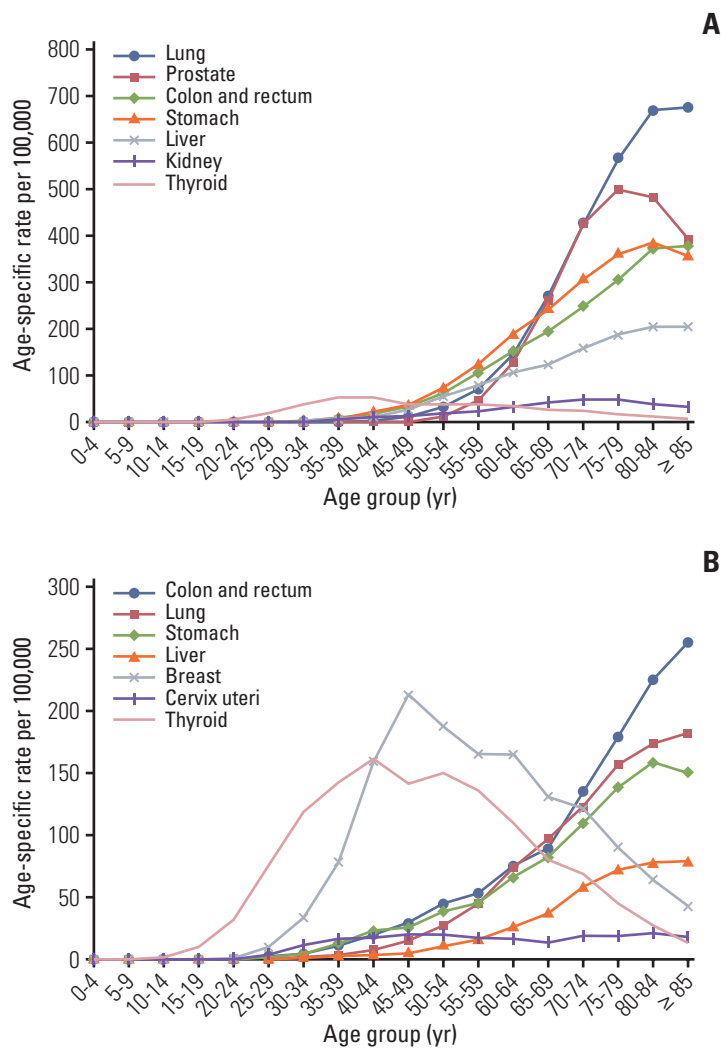


Fig. 2. Age-specific incidence rates of common cancers for 2019 in Korea. (A) Men. (B) Women.

Table 3. The top 10 leading causes of death in Korea, 2019

Rank	Cause of death	No. of deaths	Percentage of all deaths	Age-standardized death rate per 100,000 ^{a)}
	All causes	295,039	100.0	254.4
1	Cancer	81,203	27.5	72.2
2	Heart disease	31,030	10.5	24.6
3	Cerebrovascular disease	21,586	7.3	16.9
4	Pneumonia	23,168	7.9	16.4
5	Intentional self-harm (suicide)	13,799	4.7	18.4
6	Diabetes mellitus	8,102	2.7	6.4
7	Disease of liver	6,496	2.2	6.8
8	Chronic lower respiratory diseases	6,176	2.1	4.4
9	Hypertensive diseases	5,631	1.9	3.9
10	Transport accidents	4,221	1.4	5.0
	Others	93,698	31.8	79.5

Source: Mortality Data, 2019, Statistics Korea [1]. ^{a)}Age-adjusted using the Segi's world standard population.

Table 4. Crude and age-standardized cancer mortality rates by sex in Korea, 2019

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	158.2	196.3	120.2	72.2	103.6	48.7
Lip, oral cavity, and pharynx	2.5	3.9	1.2	1.2	2.1	0.5
Esophagus	3.0	5.6	0.5	1.4	2.9	0.2
Stomach	14.9	19.4	10.4	6.7	10.3	4.0
Colon and rectum	17.3	19.6	15.0	7.6	10.3	5.4
Liver	20.6	30.4	10.9	9.9	16.4	4.2
Gallbladder ^{b)}	9.7	10.0	9.4	4.1	5.1	3.2
Pancreas	12.5	13.4	11.6	5.6	7.1	4.4
Larynx	0.6	1.1	0.1	0.3	0.6	0.0
Lung	36.2	53.5	19.0	15.6	27.1	7.0
Breast	5.1	0.1	10.2	2.9	0.0	5.5
Cervix uteri	1.7	-	3.5	0.9	-	1.7
Corpus uteri	0.7	-	1.4	0.4	-	0.7
Ovary	2.4	-	4.8	1.2	-	2.4
Prostate	4.0	8.0	-	1.5	4.0	-
Testis	0.0	0.1	-	0.0	0.1	-
Kidney	1.9	2.6	1.2	0.9	1.4	0.4
Bladder	3.0	4.6	1.5	1.2	2.3	0.4
Brain and CNS	2.8	3.0	2.6	1.7	2.0	1.4
Thyroid	0.7	0.4	1.0	0.3	0.2	0.3
Hodgkin lymphoma	0.1	0.1	0.1	0.1	0.1	0.0
Non-Hodgkin lymphoma	3.6	4.2	3.0	1.7	2.3	1.2
Multiple myeloma	1.9	2.1	1.7	0.8	1.0	0.6
Leukemia	3.7	4.5	3.0	2.1	2.8	1.5
Other and ill-defined	9.1	10.0	8.3	4.3	5.6	3.3

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

women) and 275.4 per 100,000 (296.6 for men and 267.4 for women), respectively. The difference between CR and ASR implies that majority of cancer patients in Korea belong to the elderly, as opposed to the world's standard population, which has a higher proportion of young people. The overall lifetime probability of being diagnosed with any cancer was 37.9%, under the condition that one survives to the age that matches the life expectancy of the Korean population. That probability was higher in men (39.9%) than in women (35.8%) (data not shown).

There were marked differences in age-specific incidence rates (Fig. 1). In the childhood population (0-14 years), leukemia, brain and central nervous system (CNS) cancer, and non-Hodgkin lymphoma were the top three cancers in both sexes, accounting for 31.3%, 14.7%, and 13.9% 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 populations (15-34 years),

accounting for 52.1% of all cancers diagnosed. The most common cancers in that age group, excluding thyroid cancer, were leukemia and colorectal cancer in men, and breast and cervical cancer in women. In the 35-64-year age group, men were most commonly diagnosed with stomach, colorectal, liver, and lung cancers (collectively accounting for 52.5%), while breast and thyroid cancers were the most common in women (collectively accounting for 54.8%). For those aged 65 years and above, lung and prostate cancers were the most common in men, while colorectal and lung cancers were the most common in women. Most cancers have shown to increase in incidence with age; the exceptions were thyroid cancer in both sexes and breast cancer in women, which showed the highest incidence in those in their 30-40s and 40-50s age groups, respectively (Fig. 2).

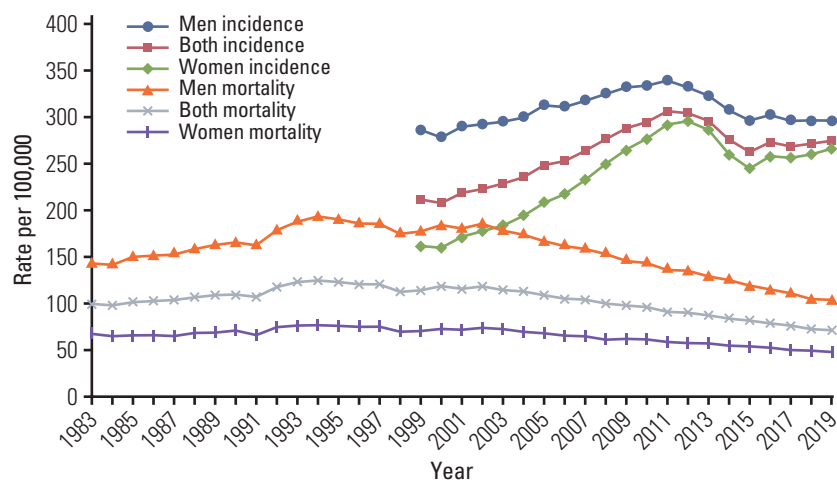


Fig. 3. Annual age-standardized cancer incidence and mortality rates by sex for all sites from 1983 to 2019 in Korea. Age standardization was based on Segi's world standard population.

2. Mortality

Since the causes-of-death statistics were published in 1983, cancer has been the number one cause of death in Korea. As of 2019, a total of 81,203 people (61.9% men and 38.1% women) died of cancer, accounting for 27.5% of all deaths in Korea (Tables 1 and 3). The overall CR for cancer deaths was 158.2 per 100,000, and the rate was approximately 1.6 times higher for men than for women (Table 4). Lung cancer was the leading cause of cancer death in both sexes (CR, 53.5 per 100,000 in men and 19.0 per 100,000 in women), followed by liver and colorectal 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 in both sexes were as follows: leukemia in their 10s and 20s, breast cancer in their 30s, liver cancer in their 40s and 50s, and lung cancer among those 60 years old or older (data not shown).

3. Trends in cancer incidence and mortality

Changes in cancer incidence rates from 1999 to 2019 and mortality rates from 1983 to 2019 are depicted in Fig. 3. Compared to 1999, cancer incidence rates increased about 29.8% and mortality rates decreased about 37.3%, in 2019 (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 5.3%, and thereafter showed non-significant changes. In contrast, cancer mortality rates demonstrated nonsignificant changes until 2002, and decreased thereafter with an annual decrease of 2.7% until 2013, and a further decrease of 3.3% per year until 2019. These trends were observed similarly in both men and women, although the slopes of change were much more pronounced in wom-

en 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 and bladder cancers demonstrated increasing trends that have recently reversed significantly, with decreases starting in 2011 and 2004, respectively. In contrast, stomach and liver cancers demonstrated initial moderate decreasing trends until 2011 and 2009, respectively, followed by more rapid decreases thereafter; and cervical cancer showed marked decrease until 2007, however it showed lessened decrease thereafter until now. Lastly, the incidence of thyroid cancer increased significantly between 1999 and 2011, decreased significantly between 2011 and 2016, and increased again from 2016 (Table 5). These trends were observed similarly in both men and women, except for breast cancer in men and bladder cancer in women that revealed partially different results of trends from those described above. In men, decreasing trend of stomach, lung, and liver cancer throughout the period and colorectal cancer since 2011 were significant while prostate and kidney cancer had an increasing trend. In women, stomach, colorectal, liver, and cervix cancer had decreasing trend

Table 5. Trends in cancer incidence and mortality rates from 1999 to 2019 in Korea, both sexes

Site/Type	Incidence						Mortality									
	Trend 1		Trend 2		Trend 3		Trend 1		Trend 2		Trend 3					
	1999	2019	Years	APC	Years	APC	Years	APC	Years	APC	Years	APC				
All sites	212.1	275.4	1999-2012	3.3 ^{a)}	2012-2015	-5.3 ^{b)}	2015-2019	1.1	115.1	72.2	1999-2002	0.9	2002-2013	-2.7 ^{a)}	2013-2019	-3.3 ^{b)}
Lip, oral cavity, and pharynx	3.6	4.3	1999-2019	0.7 ^{a)}	-	-	-	-	1.1	1.2	1999-2019	-1.8 ^{a)}	-	-	-	-
Esophagus	4.1	2.8	1999-2017	-2.2 ^{a)}	2017-2019	1.8	-	-	3.1	1.4	1999-2019	-4.43 ^{a)}	-	-	-	-
Stomach	43.6	30.4	1999-2011	-0.2	2011-2018	-4.6 ^{b)}	-	-	23.8	7.1	1999-2002	-2.6 ^{a)}	2002-2010	-6.2 ^{a)}	2010-2018	-7.4 ^{b)}
Colon and rectum	20.5	28.7	1999-2006	7.3 ^{a)}	2006-2011	2.9 ^{a)}	2011-2019	4.0 ^{a)}	7.8	7.6	1999-2003	6.4 ^{a)}	2003-2012	-0.5	2012-2019	-3.6 ^{b)}
Liver	27.9	15.6	1999-2009	-1.6 ^{a)}	2009-2019	-4.1 ^{a)}	-	-	20.6	9.9	1999-2002	0.6	2002-2014	-3.7 ^{a)}	2014-2019	-6.1 ^{a)}
Gallbladder ^{b)}	6.5	6.5	1999-2004	1.5	2004-2019	-0.4 ^{b)}	-	-	5.2	4.1	1999-2001	7.6	2001-2014	-2.8 ^{a)}	2014-2019	0.0
Pancreas	5.6	7.6	1999-2019	1.5 ^{a)}	-	-	-	-	5.5	5.6	1999-2019	0.1	-	-	-	-
Larynx	2.4	1.2	1999-2019	-3.5 ^{a)}	-	-	-	-	1.6	0.3	1999-2005	-8.1 ^{a)}	2005-2008	-15.5 ^{a)}	2008-2019	-7.2 ^{b)}
Lung	28.5	27.7	1999-2011	0.1	2011-2015	-1.4 ^{a)}	2015-2019	0.6	22.5	15.6	1999-2001	3.8	2001-2014	-2.0 ^{a)}	2014-2019	-3.9 ^{b)}
Breast	11.0	30.4	1999-2007	6.4 ^{a)}	2007-2019	4.4 ^{a)}	-	-	2.3	2.9	1999-2004	2.9 ^{a)}	2004-2019	0.8 ^{a)}	-	-
Cervix uteri	8.6	4.0	1999-2007	-4.7 ^{a)}	2007-2019	-3.0 ^{b)}	-	-	1.4	0.9	1999-2003	10.1 ^{a)}	2003-2008	-7.2 ^{a)}	2008-2019	-4.0 ^{b)}
Corpus uteri	1.4	4.0	1999-2019	5.1 ^{a)}	-	-	-	-	0.1	0.4	1999-2003	36.0 ^{a)}	2003-2019	2.4 ^{a)}	-	-
Ovary	2.7	3.5	1999-2019	1.7 ^{a)}	-	-	-	-	0.9	1.2	1999-2019	0.6 ^{a)}	-	-	-	-
Prostate	3.1	15.5	1999-2009	14.9 ^{a)}	2009-2015	0.5	2015-2019	7.3 ^{a)}	0.9	1.5	1999-2002	15.3 ^{a)}	2002-2011	1.6 ^{a)}	2011-2019	-1.4 ^{b)}
Testis	0.3	0.6	1999-2019	4.7 ^{a)}	-	-	-	-	0.0	0.0	1999-2019	-2.1 ^{a)}	-	-	-	-
Kidney	3.0	6.8	1999-2009	6.3 ^{a)}	2009-2019	2.3 ^{a)}	-	-	1.1	0.9	1999-2016	-0.1	2016-2019	-6.6 ^{a)}	-	-
Bladder	4.7	4.4	1999-2004	1.8 ^{a)}	2004-2019	-1.0 ^{b)}	-	-	1.3	1.2	1999-2002	9.3 ^{a)}	2002-2005	-6.1	2005-2019	-1.5 ^{b)}
Brain and CNS	2.9	2.9	1999-2019	0.2	-	-	-	-	1.9	1.7	1999-2003	4.1 ^{a)}	2003-2008	-4.4 ^{a)}	2008-2019	-0.7 ^{b)}
Thyroid	6.5	42.9	1999-2011	22.5 ^{a)}	2011-2016	-12.3 ^{a)}	2016-2019	6.2	0.4	0.3	1999-2003	7.5 ^{a)}	2003-2019	-4.6 ^{a)}	-	-
Hodgkin lymphoma	0.3	0.5	1999-2011	4.9 ^{a)}	2011-2019	1.3	-	-	0.0	0.1	1999-2004	23.7 ^{a)}	2004-2019	-2.1 ^{a)}	-	-
Non-Hodgkin lymphoma	4.3	6.3	1999-2019	2.3 ^{a)}	-	-	-	-	2.1	1.7	1999-2019	-1.1 ^{a)}	-	-	-	-
Multiple myeloma	1.0	1.8	1999-2012	3.7 ^{a)}	2012-2019	1.2 ^{a)}	-	-	0.6	0.8	1999-2003	12.7 ^{a)}	2003-2016	0.9	2016-2019	-7.0 ^{b)}
Leukemia	4.7	5.6	1999-2019	0.9 ^{a)}	-	-	-	-	2.9	2.1	1999-2019	-1.8 ^{a)}	-	-	-	-
Other and ill-defined	15.0	21.9	1999-2001	-0.9	2001-2007	3.7 ^{a)}	2007-2019	1.8 ^{a)}	7.8	4.3	1999-2019	-2.8 ^{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.

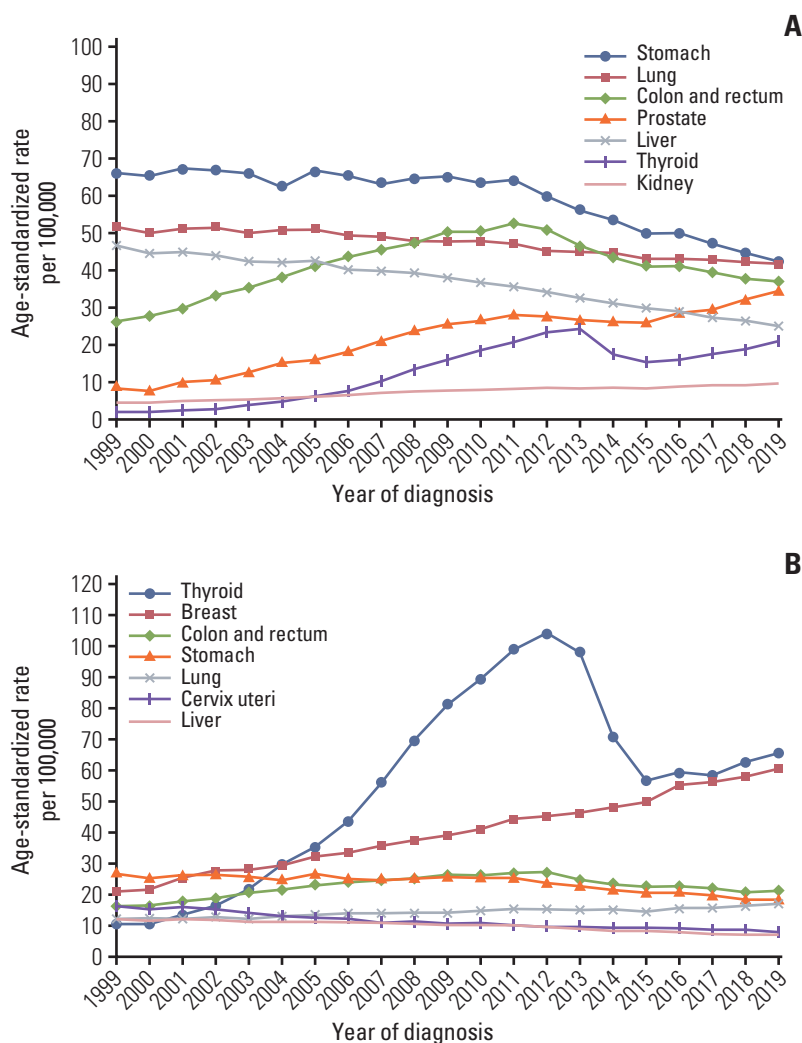


Fig. 4. Trends in age-standardized incidences of selected cancers by sex from 1999 to 2019 in Korea. (A) Men. (B) Women. Age standardization was based on Segi's world standard population.

while breast and lung cancer revealed an increasing trend. The characteristic trend of thyroid cancer which changed rapidly in a short period of time, was more pronounced in women than in men (Fig. 4, S1 and S2 Tables).

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. Liver and lung cancer mortality rates began to decrease in 2002 and 2001, respectively, followed by further rapid decreases starting in 2014. On the other hand, the mortality rates of colorectal, cervical, and thyroid cancers initially increased significantly until 2003; since then, the mortality rate from cervical cancer and thyroid cancer has decreased, and colorectal cancer has shown insignificant changes for 10 years and started to decrease

from 2012 (Table 5). These trends were observed similarly in both sexes. However, breast cancer in women displayed significantly increasing mortality trends throughout the entire observed period, with less increasing trend after 2005 (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 5 years, from 2015 to 2019 were 70.7% in both sexes; 64.5% in men and 77.3% in women (Table 6). The temporal increasing trends in survival rates, from 42.9% in 1993-1995 to 70.7% in 2015-2019, were maintained even after excluding thyroid cancer (from 41.2% in 1993-1995 to 66.5%

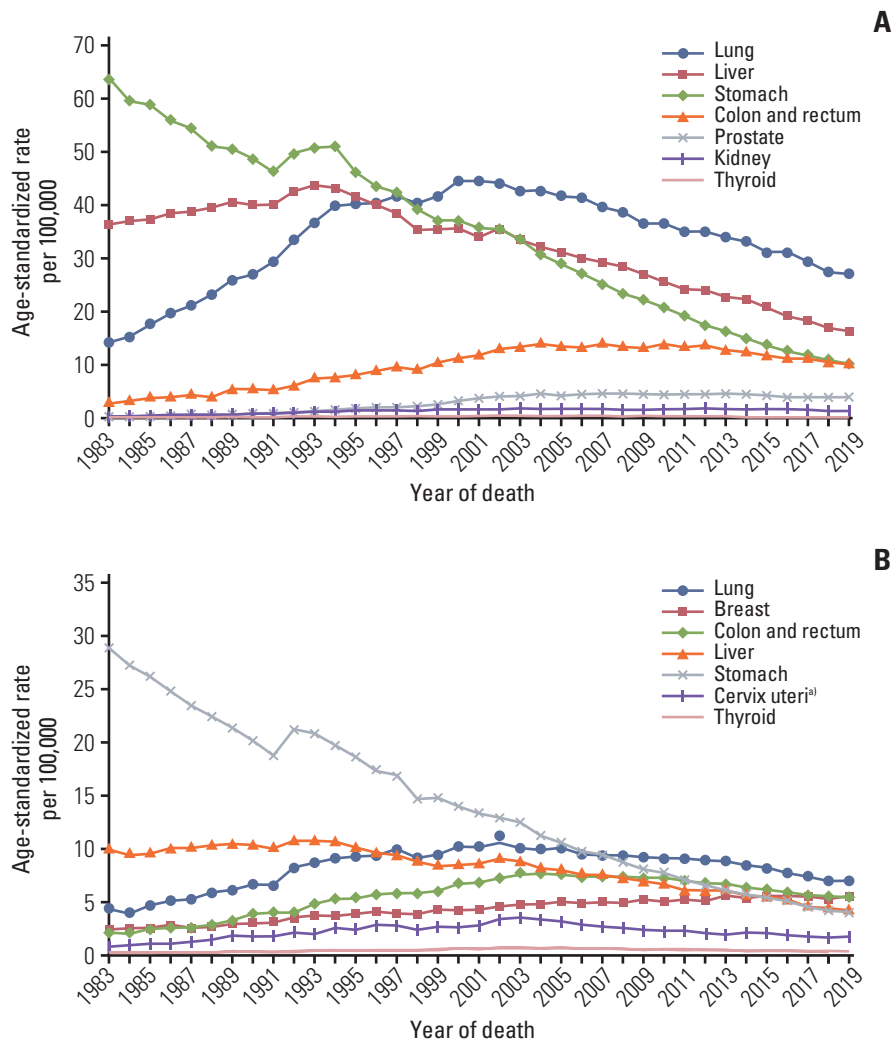


Fig. 5. Trends in age-standardized mortalities of selected cancers by sex from 1983 to 2019 in Korea. (A) Men. (B) Women. Age standardization was based on Segi's world standard population. ^{a)}Cancers of cervix uteri, corpus uteri, and unspecified parts of the uterus were combined (C53-C55), due to their unclear classifications in the past.

in 2015-2019), which has an excellent prognosis with a 5-year relative survival rate of 100%.

After thyroid cancer, survival rates were the highest for testis and prostate cancers in men (95.0% and 94.4%, respectively) and breast cancer in women (93.6%). On the contrary, the survival rates were the lowest for cancers of the pancreas (13.9%), and gallbladder plus other and unspecified parts of the biliary tract (28.5%) in both sexes. Stomach cancer (both sexes), prostate cancer (men), lung cancer, and leukemia (women) were associated with outstanding improvements in survival rates over the observed period. In contrast, advances have been slow for cancers of the brain and CNS, pancreas in both sexes.

In terms of stage distribution at diagnosis and recent sur-

vival rates according to the SEER summary stage in each cancer, Fig. 6 shows the top 10 most common cancers for each sex in 2019. In men, stomach, kidney, and bladder cancers revealed the highest proportions of patients who were diagnosed at the localized stage (64.8%, 72.5%, and 72.2%, respectively), accompanied by the 5-year survival rates of 97.5%, 97.5%, and 86.4%, respectively. In contrast, lung and pancreatic cancers demonstrated the highest proportions of patients diagnosed at the distant metastatic stage, which approximated to 50%, with corresponding 5-year survival rates of 7.6% and 2.2%, respectively. In women, 58.7%, 63.4%, and 72.4% of breast, stomach, and uterine corpus cancers, respectively, were diagnosed at the localized stage, with 5-year survival rates of 98.8%, 95.9%, and 96.6%, respective-

Table 6. Trends in the 5-year relative survival rates (%) by sex and year of diagnosis from 1993 to 2019 in Korea

Site/Type	Both sexes												Men						Women																																
	1993-1995			1996-2000			2001-2010			2011-2019			1993-1995			1996-2000			2001-2010			2011-2019			1993-1995			1996-2000			2001-2010			2011-2019			Change ^{a)}														
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
All sites	42.9	45.2	54.1	54.1	50.8	59.0	64.2	66.5	27.8	33.2	36.3	45.6	56.9	63.1	64.5	31.3	55.2	56.4	64.3	74.4	78.3	77.3	22.1																												
All sites excluding thyroid	41.2	43.4	50.8	59.0	64.2	66.5	25.3	32.7	35.8	44.7	54.6	60.3	62.4	29.7	52.6	53.5	59.1	65.0	69.4	71.5	19.0																														
Lip, oral cavity, and pharynx	42.2	47.4	54.5	61.1	65.4	68.8	26.6	36.6	41.7	49.6	56.9	61.8	65.9	29.3	59.4	64.5	68.1	72.1	74.5	76.2	16.8																														
Esophagus	14.0	15.7	21.6	30.0	36.5	40.9	26.9	13.0	14.8	20.8	29.3	36.2	40.6	27.6	25.0	25.9	29.8	37.3	39.6	43.4	18.4																														
Stomach	43.9	47.3	58.0	68.4	75.9	77.5	33.6	44.0	47.6	58.7	69.1	76.8	78.3	34.3	43.7	46.8	56.6	67.0	74.0	75.8	32.1																														
Colon and rectum	56.2	58.9	66.9	73.9	76.1	74.3	18.1	56.6	59.8	68.8	75.8	77.8	75.5	18.9	55.7	57.7	64.4	71.1	73.6	72.6	16.9																														
Liver	11.8	14.1	20.5	28.3	34.4	37.7	25.9	10.8	13.8	20.4	28.3	34.9	38.3	27.5	15.1	15.1	20.9	28.3	32.8	35.8	20.7																														
Gallbladder ^{b)}	18.7	20.7	23.1	26.9	28.7	28.5	9.8	18.0	21.1	23.5	27.8	29.5	28.8	10.8	19.3	20.3	22.7	26.0	28.0	28.1	8.8																														
Pancreas	10.6	8.7	8.4	8.6	10.8	13.9	3.3	10.0	8.3	8.4	8.3	10.3	13.0	3.0	11.5	9.3	8.4	8.8	11.5	14.9	3.4																														
Larynx	61.6	63.3	66.5	73.2	75.3	80.4	18.8	62.2	63.7	67.1	73.5	75.7	80.5	18.3	56.3	58.9	58.7	68.0	69.1	78.9	22.6																														
Lung	12.5	13.6	16.6	20.3	27.6	34.7	22.2	11.6	12.4	15.3	18.0	23.3	28.9	17.3	15.8	17.5	20.2	26.0	37.4	47.4	31.6																														
Breast	79.2	83.6	88.7	91.2	92.8	93.6	14.4	77.1	84.3	87.5	89.9	90.8	93.3	16.2	79.3	83.6	88.7	91.2	92.8	93.6	14.3																														
Cervix uteri	78.3	80.3	81.5	80.7	80.3	80.5	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2																														
Corpus uteri	82.9	82.0	84.7	86.5	87.7	89.0	6.1	-	-	-	-	-	-	-	-	-	-	-	-	-	6.1																														
Ovary	60.1	59.4	61.7	61.3	64.8	64.5	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4																														
Prostate	59.1	69.4	81.0	92.0	94.2	94.4	35.3	59.1	69.4	81.0	92.0	94.2	94.4	35.3	-	-	-	-	-	-	-																														
Testis	87.4	90.4	90.7	93.2	94.9	95.0	7.6	87.4	90.4	90.7	93.2	94.9	95.0	7.6	-	-	-	-	-	-	-																														
Kidney	64.2	67.0	73.7	78.6	82.5	84.7	20.5	63.4	65.4	73.1	78.5	82.1	84.7	21.3	65.8	70.3	74.9	79.0	83.4	84.8	19.0																														
Bladder	70.7	73.6	76.0	77.3	76.4	76.5	5.8	71.6	75.1	77.8	79.3	78.4	78.1	6.5	67.2	67.2	69.1	69.2	68.5	70.0	2.8																														
Brain and CNS	40.4	39.9	41.0	42.9	41.7	41.4	1.0	39.1	38.7	40.3	41.4	40.4	40.0	0.9	42.3	41.4	41.8	44.6	43.3	43.0	0.7																														
Thyroid	94.5	95.0	98.4	100.0	100.2	100.0	5.5	87.9	89.7	96.0	100.2	100.6	100.3	12.4	95.7	96.0	98.7	99.9	100.1	99.9	4.2																														
Hodgkin lymphoma	70.2	71.9	76.7	81.1	82.3	85.3	15.1	69.4	69.3	74.7	80.8	81.8	84.5	15.1	71.5	77.3	80.7	81.6	83.3	86.5	15.0																														
Non-Hodgkin lymphoma	48.3	51.1	56.0	59.4	62.8	64.5	16.2	46.8	49.6	55.0	59.2	62.9	65.3	18.5	50.6	53.3	57.5	59.7	62.8	63.5	12.9																														
Multiple myeloma	23.7	21.0	29.7	34.9	41.5	49.1	25.4	23.2	19.1	29.9	35.1	41.1	49.7	26.5	24.1	23.3	29.5	34.7	42.1	48.6	24.5																														
Leukemia	27.5	34.3	42.0	47.7	52.0	54.5	27.0	27.3	33.3	41.8	46.9	52.2	54.2	26.9	27.8	35.5	42.2	48.7	51.7	55.0	27.2																														
Other and ill-defined	44.5	48.3	57.9	67.7	72.7	75.4	30.9	39.6	44.7	54.1	63.8	69.3	72.5	32.9	50.1	52.6	62.0	71.6	76.2	78.3	28.2																														

CNS, central nervous system. ^{a)}Absolute percentage change in 5-year relative survival from 1993 to 1995 and 2015 to 2019. ^{b)}Includes the gallbladder and other/ unspecified parts of the biliary tract.

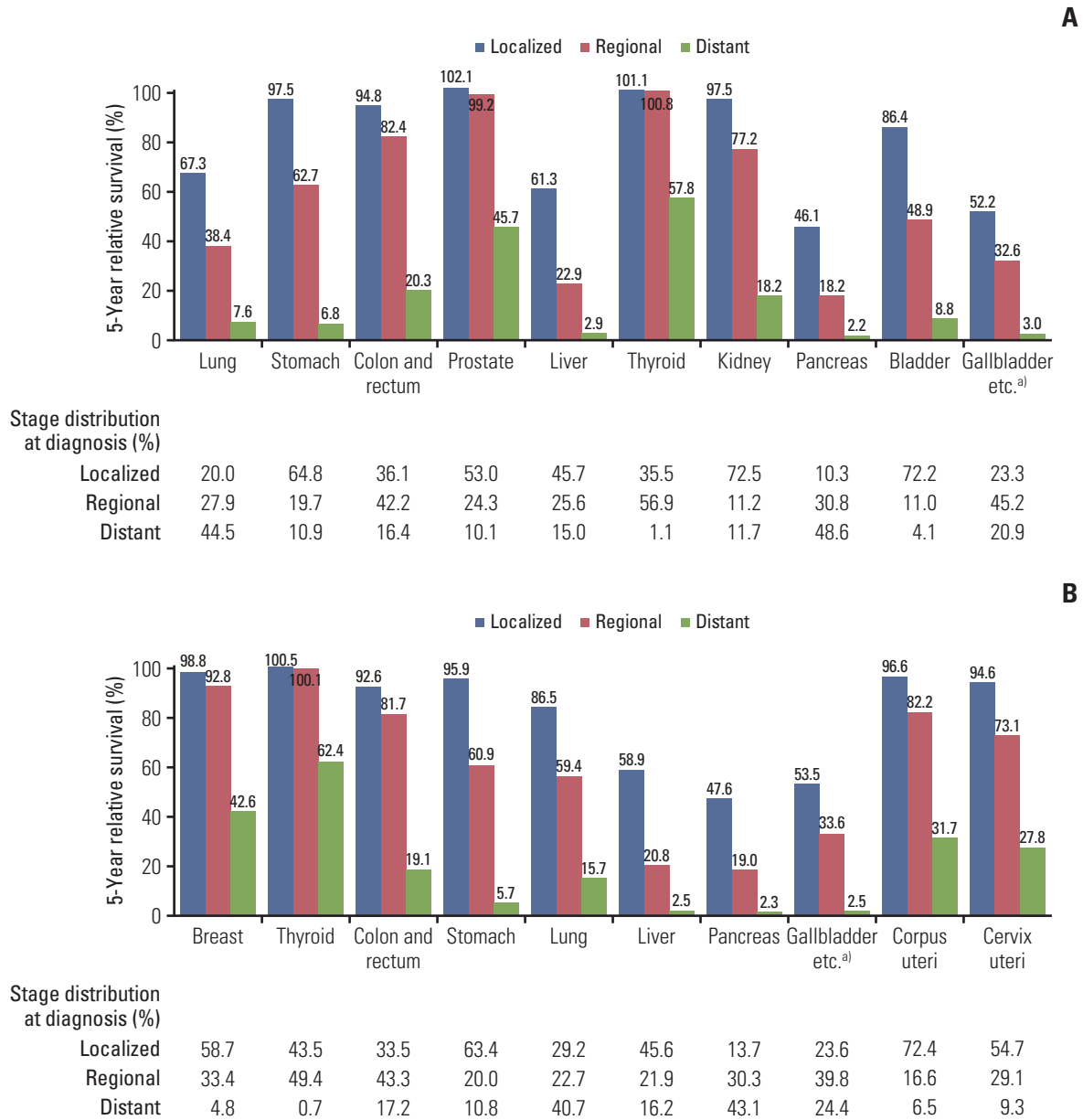


Fig. 6. Five-year relative survival rates by stage at diagnosis and stage distribution of selected cancers by sex in Korea, 2015-2019. (A) Men. (B) Women. Staging according to the Surveillance, Epidemiology, and End Results stage categories. For each cancer type, stage categories do not total 100% because sufficient information was not available to stage all cases. ^{a)}Includes the gallbladder and other/unspecified parts of the biliary tract.

ly. However, more than 40% of lung and pancreatic cancers were diagnosed at the distant metastatic stage, with 5-year survival rates of 5.7% and 2.3%, respectively.

5. Prevalence rates

The total prevalent cancer cases in 2019 (identified as survivor at the time of January 1, 2020) were 2,147,503, surpassing 2 million since 2018 (Table 1). It suggested that one in 25

people (4.2% of the entire Korean population; 3.7% of men and 4.7% of women) has a history of being diagnosed with cancer. Of these, 996,051 (46.4% of all prevalent cases) were aged ≥ 65 years, indicating that one in eight people in that age group (16.4% of, or one in six, men and 10.3% of, or one in ten, women) would have experienced cancer (data not shown).

Table 7 provides the CRs and ASRs of prevalence for all

Table 7. Crude and age-standardized rates of cancer prevalence by sex on January 1, 2020 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	4,183.1	3,684.3	4,679.7	2,305.1	2,081.4	2,612.8
Lip, oral cavity, and pharynx	57.5	77.0	38.1	32.2	44.6	21.2
Esophagus	23.5	42.1	5.1	11.4	22.2	2.4
Stomach	621.3	822.7	420.8	306.6	441.6	194.2
Colon and rectum	544.9	648.1	442.1	266.0	349.9	197.2
Liver	146.6	220.3	73.2	77.5	123.3	35.8
Gallbladder ^{c)}	49.7	51.5	47.9	23.0	27.1	19.7
Pancreas	29.1	29.5	28.8	15.3	16.5	14.4
Larynx	23.2	43.8	2.7	11.0	23.0	1.2
Lung	200.8	242.5	159.4	98.0	128.6	74.4
Breast	504.7	3.7	1,003.5	291.5	2.0	574.2
Cervix uteri	114.9	0.0	229.3	65.1	-	127.6
Corpus uteri	60.3	0.0	120.3	34.8	-	68.6
Ovary	47.3	0.0	94.3	29.7	-	59.2
Prostate	212.1	425.1	0.0	91.8	213.8	-
Testis	7.9	15.8	0.0	7.0	13.7	-
Kidney	98.7	133.8	63.8	55.3	78.5	34.2
Bladder	77.8	127.3	28.6	35.7	66.8	11.5
Brain and CNS	25.2	26.0	24.4	20.7	21.9	19.4
Thyroid	900.2	330.2	1,467.6	563.7	212.3	913.4
Hodgkin lymphoma	6.7	8.3	5.1	5.4	6.4	4.3
Non-Hodgkin lymphoma	74.0	84.1	63.8	48.1	57.6	39.1
Multiple myeloma	15.1	15.9	14.3	7.6	8.7	6.7
Leukemia	49.7	55.4	44.2	44.0	49.3	38.6
Other and ill-defined	291.9	281.4	302.4	163.7	173.7	155.4

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, 2019 and who were alive on January 1, 2020. 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.

cancers combined and for specific cancers. In total, the cancer prevalence rate for 2019 in Korea was 4,183.1 per 100,000 people. Thyroid cancer had the highest prevalence (CR, 900.2 per 100,000; 330.2 per 100,000 for men and 1,467.6 per 100,000 for women), followed by stomach cancer (CR, 621.3 per 100,000) and colorectal cancer (CR, 544.9 per 100,000). Prostate cancer in men and breast cancer in women revealed the highest prevalence rates (CR, 425.1 and 1,003.5 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, 1,268,265 (59.1% of all prevalent cases) had survived > 5 years after cancer diagnosis, majority of them being survivors of thyroid, stomach, colorectal, and breast cancers. Another 462,265 (21.5% 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 416,973

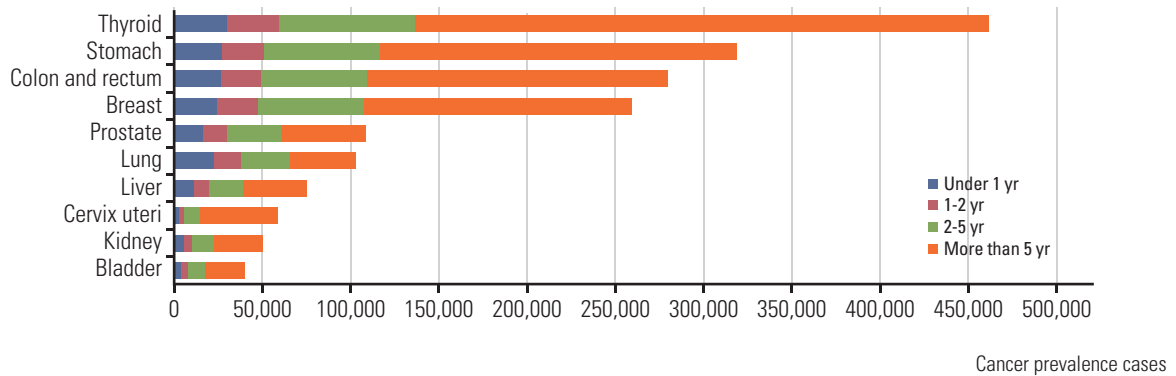
(19.4% of all prevalent cases) for whom it had been < 2 years since their cancer diagnosis, in which period they still need active cancer treatment.

6. Carcinoma *in situ* incidence

A summary of carcinoma *in situ* cases in 2019 is provided as a Supplementary Material (S3-S6 Tables, S7-S9 Figs.).

Conclusion

Since 2015, the number of new cancer patients in Korea has been increasing, but the ASRs of incidence did not reveal a significant change. In 2019, lung cancer has surpassed stomach cancer to rank first in the incidence rate for the first time, excluding thyroid cancer. During the past decade, the incidence of stomach, colorectal, liver, and cervical cancer



Time since diagnosis	Thyroid	Stomach	Colon and rectum	Breast	Prostate	Lung	Liver	Cervix uteri	Kidney	Bladder	All cancers
Under 1 yr	30,508	26,878	26,483	24,677	16,459	22,827	11,605	3,116	5,693	4,501	226,440
1-2 yr	28,645	23,933	22,920	23,045	14,016	15,429	8,605	3,131	4,832	3,823	190,533
2-5 yr	77,420	66,181	59,810	59,841	29,872	27,678	18,859	8,654	12,292	9,052	462,265
More than 5 yr	325,578	201,956	170,504	151,553	48,523	37,174	36,192	44,082	27,857	22,587	1,268,265
Total	462,151	318,948	279,717	259,116	108,870	103,108	75,261	58,983	50,674	39,963	2,147,503

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, 2020 among all cancer patients diagnosed between 1999 and 2019.

has been declining while that of prostate and breast cancer have been on the rise since 1999. Thyroid cancer, which has decreased since 2012, has shown an increasing trend since 2015. The 5-year relative survival rate of cancer patients diagnosed in the past 5 years was 70.7%, which is steadily improving. Since 2018, the number of cancer survivors has exceeded 2 million, of which 59.1% are those who survived over 5 years. Cancer survival rates are increasing, but the number of newly diagnosed cancers and the prevalence of cancer continue to rise. National cancer control strategies should adapt to the changing aspects of cancer statistics.



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Conflicts of Interest

Conflict of interest relevant to this article was not reported.

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