



Special Article

Cancer Statistics in Korea: Incidence, Mortality, Survival, and Prevalence in 2021

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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 2021.

Materials and Methods Incidence, survival, and prevalence rates of cancer were calculated using the Korea National Cancer Incidence Database, from 1999 to 2021, with survival follow-up until December 31, 2022. Deaths from cancer were assessed using causes-of-death data obtained from Statistics Korea.

Results The number of new cancer diagnoses in 2021 increased by 27,002 cases (10.8%) compared to 2020. In 2021, newly diagnosed cancer cases and deaths from cancer were reported as 277,523 (age-standardized rate [ASR], 289.3 per 100,000) and 82,688 (ASR, 67.6 per 100,000), respectively. The overall cancer incidence rates increased by 3.3% annually from 1999 to 2012, and decreased by 5.3% from 2012 to 2015, thereafter, followed by non-significant changes. Cancer mortality rates have been decreasing since 2002, with more rapid decline in recent years (annual decrease of 2.8% from 2002 to 2013; 3.2% from 2013 to 2021). The 5-year relative survival between 2017 and 2021 was 72.1%, which contributed to prevalent cases reaching over 2.4 million in 2021.

Conclusion In 2021, the number of newly diagnosed cancer patients increased as healthcare utilization recovered from the coronavirus disease 2019–related declines of 2020. Revised cancer registration guidelines expanded the registration scope, particularly for stomach and colorectal cancer. Survival rates have improved over the years, leading to a growing population of cancer survivors, necessitating a comprehensive cancer control strategy. The long-term impact of the pandemic on cancer statistics requires future investigation.

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

Introduction

Cancer is one of the leading causes of death worldwide, with an estimated 19.9 million new cancer cases and 9 million deaths worldwide in 2022 [1]. In Korea, cancer has been the leading cause of death since 1983 [2]. In response to this public health threat, the National Plan for Cancer Control was implemented in 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. In contrast to 2020, when the number of cancer cases decreased due to the coronavirus disease 2019 (COVID-19) pandemic, the number of cancer cases increased in 2021 as access to healthcare recovered [3,4]. The impact of reduced healthcare utilization, not only in Korea but worldwide due to COVID-19, on cancer diagnosis and treatment needs to be examined more closely in the coming years [3,5]. In this study, we report 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 the 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

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1999; other detailed information on the KCCR and KNCI DB is provided in our previous report [6]. Completeness is an important indicator of data quality, and the 2021 KNCI DB was estimated to be 98.2% complete using the method proposed by Ajiki et al. [7].

Annual mid-year population data and recently updated mortality data including causes of death from 1983 were obtained from Statistics Korea [2]. 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) [8]. 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. Since 2021, neuroendocrine tumors (ICD-O-3: 8152 and 8240) of colorectal cancer and gastrointestinal stromal tumors (ICD-O-3: 8936) of stomach cancer have been classified as malignant cancers. 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 2021 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) [9]. Exceptionally, some hematopoietic diseases (myeloproliferative disorders/myelodysplastic syndromes) are not

Table 1. Cancer incidence, deaths and prevalence by sex in Korea, 2021

Site/Type	New cases			Deaths			Prevalent cases ^{a)}		
	Both sexes	Men	Women	Both sexes	Men	Women	Both sexes	Men	Women
All sites	277,523	143,723	133,800	82,688	50,922	31,766	2,434,089	1,066,228	1,367,861
Lip, oral cavity, and pharynx	4,371	3,159	1,212	1,226	941	285	33,749	22,507	11,242
Esophagus	2,954	2,615	339	1,569	1,408	161	13,510	11,953	1,557
Stomach	29,361	19,533	9,828	7,249	4,769	2,480	343,895	226,327	117,568
Colon and rectum	32,751	19,142	13,609	8,902	4,981	3,921	309,761	182,877	126,884
Liver	15,131	11,207	3,924	10,255	7,524	2,731	81,042	60,491	20,551
Gallbladder ^{b)}	7,617	4,085	3,532	5,277	2,724	2,553	28,061	14,586	13,475
Pancreas	8,872	4,592	4,280	6,931	3,600	3,331	18,178	9,134	9,044
Larynx	1,302	1,226	76	340	316	24	12,697	11,931	766
Lung	31,616	21,176	10,440	18,902	13,953	4,949	121,747	71,731	50,016
Breast	28,861	141	28,720	2,744	19	2,725	304,905	1,101	303,804
Cervix uteri	3,173	-	3,173	853	-	853	62,204	-	62,204
Corpus uteri	3,749	-	3,749	429	-	429	36,809	-	36,809
Ovary	3,221	-	3,221	1,376	-	1,376	27,510	-	27,510
Prostate	18,697	18,697	-	2,360	2,360	-	133,160	133,160	-
Testis	347	347	-	16	16	-	4,699	4,699	-
Kidney	6,883	4,775	2,108	1,029	725	304	59,583	40,363	19,220
Bladder	5,169	4,201	968	1,534	1,159	375	44,163	36,018	8,145
Brain and CNS	2,055	1,116	939	1,399	782	617	14,052	7,210	6,842
Thyroid	35,303	8,771	26,532	395	131	264	523,409	99,877	423,532
Hodgkin lymphoma	356	244	112	55	37	18	3,926	2,442	1,484
Non-Hodgkin lymphoma	5,726	3,292	2,434	1,913	1,104	809	43,765	24,793	18,972
Multiple myeloma	2,018	1,095	923	1,044	548	496	9,079	4,809	4,270
Leukemia	3,983	2,297	1,686	2,038	1,167	871	28,969	16,100	12,869
Other and ill-defined	24,007	12,012	11,995	4,852	2,658	2,194	175,216	84,119	91,097

CNS, central nervous system. ^{a)}Limited-duration prevalent cases on January 1, 2021. These are patients who were diagnosed between January 1, 1999 and December 31, 2021 and who were alive on January 1, 2022. 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, 2021

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	540.6	561.7	519.7	289.3	298.2	292.5
Lip, oral cavity, and pharynx	8.5	12.3	4.7	4.6	6.8	2.5
Esophagus	5.8	10.2	1.3	2.7	5.1	0.6
Stomach	57.2	76.3	38.2	27.5	38.9	17.5
Colon and rectum	63.8	74.8	52.9	31.9	40.0	24.5
Liver	29.5	43.8	15.2	14.1	22.7	6.4
Gallbladder ^{b)}	14.8	16.0	13.7	6.1	7.6	4.8
Pancreas	17.3	17.9	16.6	7.8	8.9	6.9
Larynx	2.5	4.8	0.3	1.2	2.4	0.1
Lung	61.6	82.8	40.6	27.3	39.6	17.5
Breast	56.2	0.6	111.6	34.4	0.3	68.6
Cervix uteri	6.2	-	12.3	3.9	-	7.8
Corpus uteri	7.3	-	14.6	4.4	-	8.8
Ovary	6.3	-	12.5	3.9	-	7.7
Prostate	36.4	73.1	-	15.7	34.5	-
Testis	0.7	1.4	-	0.7	1.3	-
Kidney	13.4	18.7	8.2	7.5	10.7	4.4
Bladder	10.1	16.4	3.8	4.3	7.9	1.4
Brain and CNS	4.0	4.4	3.6	2.9	3.2	2.6
Thyroid	68.8	34.3	103.1	50.1	24.6	76.5
Hodgkin lymphoma	0.7	1.0	0.4	0.6	0.7	0.4
Non-Hodgkin lymphoma	11.2	12.9	9.5	6.3	7.7	5.0
Multiple myeloma	3.9	4.3	3.6	1.8	2.1	1.5
Leukemia	7.8	9.0	6.5	5.9	7.0	4.9
Other and ill-defined	46.8	46.9	46.6	23.9	26.1	22.1

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.

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 [10], and the latter was the taxonomy used in "Cancer Incidence in Five Continents" [11], 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) [12] 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 [13]. ASRs were standardized using Segi's world standard population [14]. The cumulative risk of developing cancer from birth to life expectancy during 2021 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 [13]:

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

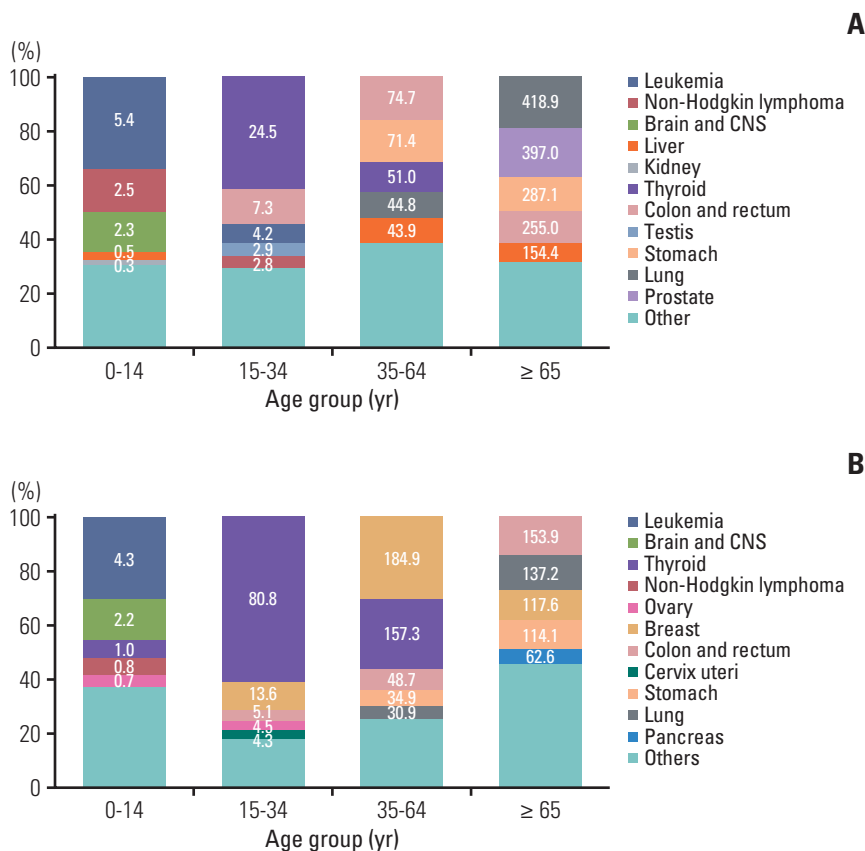


Fig. 1. The five common sites of cancer incidence by age group and sex in Korea, 2021. (A) Men. (B) Women. Numbers in the graph are age-specific incidence rates per 100,000. CNS, central nervous system.

Trends in ASRs were estimated using Joinpoint regression, 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 2021, was calculated based on the results of follow-up until December 31, 2022. 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 [2]. Relative survival rates were estimated using the Ederer II method [15] with some minor corrections, based on an algorithm devised by Paul Dickman [16]. Trends in 5-year relative survival rates were evaluated as percent differences in survival rates between 1993-1995 and 2017-2021.

Prevalent cases were defined as the number of cancer patients alive on January 1, 2022, among all the patients diagnosed with cancer between 1999 and 2021. $p < 0.05$ was considered statistically significant. Joinpoint 5.0.2.0 (National

Cancer Institute, Bethesda, MD) and SAS ver. 9.4 (SAS Institute Inc., Cary, NC) were used for statistical analyses.

Results

1. Incidence

The number of new cancer diagnoses in 2021 increased by 27,002 cases (10.8%) compared to 2020. In 2021, a total of 277,523 people were newly diagnosed with cancer in Korea, of which 51.8% (143,723 cases) were men and 48.2% (133,800 cases) were women (Table 1). The five most diagnosed cancers in Korea were thyroid, colorectal, lung, stomach, 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, lung, and stomach cancers in women. These top five cancers in each sex accounted for 62.4% and 66.6% of all cancer cases in men and women, respectively. Among the five most diagnosed cancers, the increase in new cancer diagnoses in 2021 compared to 2020 was the largest for thyroid cancer (5,667

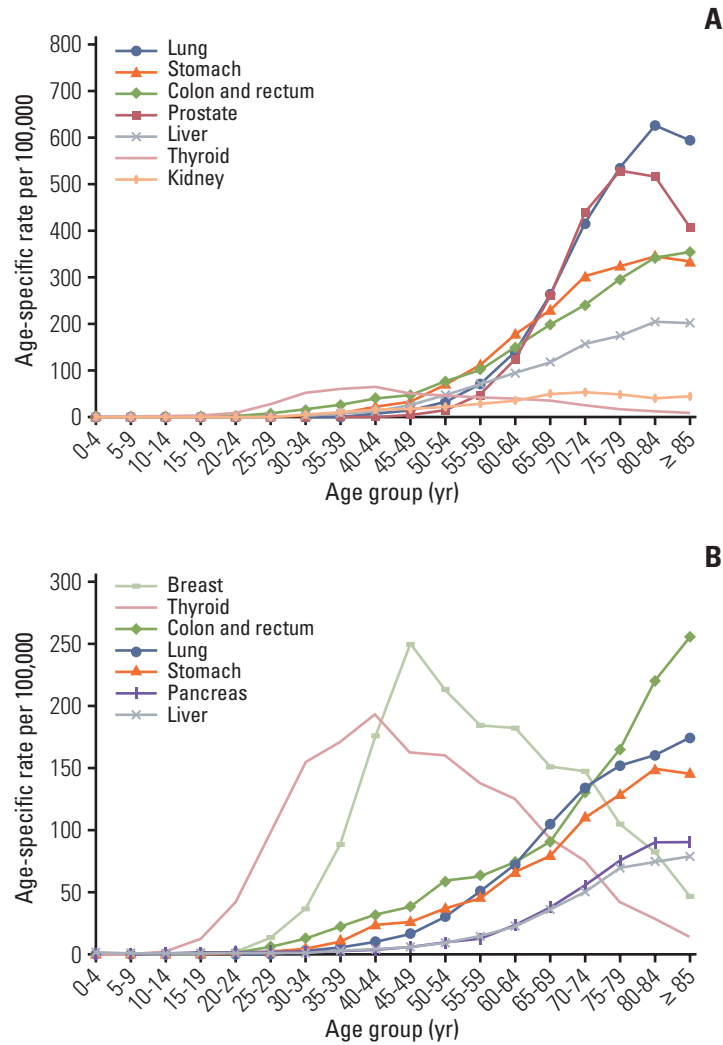


Fig. 2. Age-specific incidence rates of common cancers for 2021 in Korea. (A) Men. (B) Women.

Table 3. The top 10 leading causes of death in Korea, 2021

Rank	Cause of death	No. of deaths	Percentage of all deaths	Age-standardized death rate per 100,000 ^{a)}
	All causes	317,655	100.0	248.3
1	Cancer	82,688	26.0	67.6
2	Heart disease	31,569	9.9	22.4
3	Cerebrovascular disease	22,607	7.1	16.2
4	Pneumonia	22,812	7.2	14.3
5	Intentional self-harm (suicide)	13,352	4.2	18.2
6	Diabetes mellitus	8,961	2.8	6.5
7	Disease of liver	7,129	2.2	7.1
8	Chronic lower respiratory diseases	5,357	1.7	3.4
9	Hypertensive diseases	6,223	2.0	3.8
10	Transport accidents	3,624	1.1	4.3
	Others	113,358	35.7	84.6

Source: Mortality Data, 2021, 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, 2021

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	161.1	199.0	123.4	67.6	95.2	46.6
Lip, oral cavity, and pharynx	2.4	3.7	1.1	1.1	1.8	0.4
Esophagus	3.1	5.5	0.6	1.3	2.6	0.2
Stomach	14.1	18.6	9.6	5.9	8.9	3.5
Colon and rectum	17.3	19.5	15.2	7.0	9.3	5.1
Liver	20.0	29.4	10.6	8.8	14.5	3.7
Gallbladder ^{b)}	10.3	10.6	9.9	3.9	4.9	3.1
Pancreas	13.5	14.1	12.9	5.6	6.7	4.5
Larynx	0.7	1.2	0.1	0.3	0.6	-
Lung	36.8	54.5	19.2	14.5	25.0	6.5
Breast	5.3	0.1	10.6	2.8	-	5.5
Cervix uteri	1.7	-	3.3	0.8	-	1.6
Corpus uteri	0.8	-	1.7	0.4	-	0.8
Ovary	2.7	-	5.3	1.3	-	2.4
Prostate	4.6	9.2	-	1.6	4.0	-
Testis	-	0.1	-	-	-	-
Kidney	2.0	2.8	1.2	0.9	1.4	0.4
Bladder	3.0	4.5	1.5	1.0	2.0	0.4
Brain and CNS	2.7	3.1	2.4	1.6	1.9	1.3
Thyroid	0.8	0.5	1.0	0.3	0.2	0.3
Hodgkin lymphoma	0.1	0.1	0.1	-	0.1	-
Non-Hodgkin lymphoma	3.7	4.3	3.1	1.6	2.1	1.1
Multiple myeloma	2.0	2.1	1.9	0.8	1.0	0.7
Leukemia	4.0	4.6	3.4	2.1	2.6	1.6
Other and ill-defined	9.5	10.4	8.5	4.1	5.3	3.2

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

cases, 19.1%), followed by colorectal cancer (4,471 cases, 15.8%), and lung cancer (2,397 cases, 8.2%). 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 since 2019. Table 2 provides the CRs and ASRs of cancer incidence in 2021. The CR and ASR of all cancer incidence were 540.6 per 100,000 (561.7 for men and 519.7 for women) and 289.3 per 100,000 (298.2 for men and 292.5 for women), respectively. The difference between CR and ASR implies that the 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 38.1%, under the condition that one survives to the age that matches the life expectancy of the Korean population. That probability was higher in men (39.1%) than in women (36.0%) (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 32.2%, 14.8%, and 11.3% 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 54.7% of all cancers diagnosed. The most common cancers in that age group, excluding thyroid cancer, were colorectal cancer and leukemia in men, and breast and colorectal cancer in women. In the 35-64-year age group, men were most commonly diagnosed with colorectal, stomach, thyroid, and lung cancers (collectively accounting for 52.0%), while breast and thyroid cancers were the most common in women (collectively accounting for 56.0%). 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

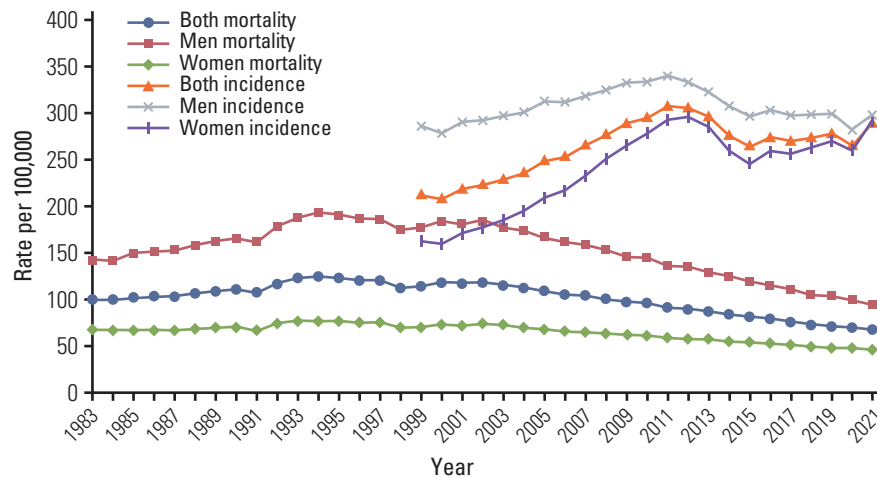


Fig. 3. Annual age-standardized cancer incidence and mortality rates by sex for all sites from 1983 to 2021 in Korea. Age standardization was based on Segi's world standard population.

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).

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 2021, a total of 82,688 people (61.6% men and 38.4% women) died of cancer, accounting for 26.0% of all deaths in Korea (Tables 1 and 3). The overall CR for cancer deaths was 161.1 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, 54.5 per 100,000 in men and 19.2 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 2021 and mortality rates from 1983 to 2021 are depicted in Fig. 3. Compared to 1999, cancer incidence rates increased about 36.4% and mortality rates decreased about 41.3%, in 2021 (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 dem-

onstrated nonsignificant changes until 2002, and decreased thereafter with an annual decrease of 2.8% until 2013, and a further decrease of 3.2% per year until 2021. 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 2008, 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 2010 and 2004, respectively. 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 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

Table 5. Trends in cancer incidence and mortality rates from 1999 to 2021 in Korea, both sexes

Site/Type	Incidence						Mortality									
	1999	2021	Trend 1		Trend 2		1999	2021	Trend 1		Trend 2		Trend 3			
			Years	APC	Years	APC			Years	APC	Years	APC				
All sites	212.1	289.3	1999-2012	3.3 ^{a)}	2012-2015	-5.3	2015-2021	1.0 ^{a)}	115.1	67.6	1999-2002	0.9	2002-2013	-2.8 ^{a)}	2013-2021	-3.2 ^{a)}
Lip, oral cavity, and pharynx	3.6	4.6	1999-2021	0.8 ^{a)}	-	-	-	-	1.1	1.1	1999-2021	-1.8 ^{a)}	-	-	-	-
Esophagus	4.1	2.7	1999-2016	-2.2 ^{a)}	2016-2021	-0.6	-	-	3.1	1.3	1999-2021	-4.2 ^{a)}	-	-	-	-
Stomach	43.7	27.5	1999-2011	-0.2	2011-2021	-4.6 ^{b)}	-	-	23.9	5.9	1999-2002	-2.5 ^{a)}	2002-2010	-6.4 ^{a)}	2010-2021	-7.1 ^{a)}
Colon and rectum	20.6	31.9	1999-2010	5.8 ^{a)}	2010-2019	-3.8 ^{a)}	2019-2021	5.5	7.8	7.0	1999-2003	6.5 ^{a)}	2003-2012	-0.5 ^{a)}	2012-2021	-3.5 ^{a)}
Liver	27.9	14.1	1999-2010	-1.7 ^{a)}	2010-2021	-4.3 ^{b)}	-	-	20.6	8.8	1999-2002	0.7	2002-2014	-3.7 ^{a)}	2014-2021	-5.8 ^{b)}
Gallbladder ^{b)}	6.5	6.1	1999-2004	1.4	2004-2018	-0.3	2018-2021	-3.2 ^{a)}	5.2	3.9	1999-2001	7.6	2001-2013	-2.8 ^{a)}	2013-2021	-0.9 ^{a)}
Pancreas	5.6	7.8	1999-2021	1.6 ^{a)}	-	-	-	-	5.5	5.6	1999-2021	0.1	-	-	-	-
Larynx	2.4	1.2	1999-2021	-3.4 ^{a)}	-	-	-	-	1.6	0.3	1999-2005	-8.1 ^{a)}	2005-2008	-15.8 ^{a)}	2008-2021	-6.9 ^{a)}
Lung	28.5	27.3	1999-2021	-0.3 ^{a)}	-	-	-	-	22.5	14.5	1999-2001	3.6	2001-2013	-1.9 ^{a)}	2013-2021	-3.6 ^{b)}
Breast	11.0	34.4	1999-2007	6.4 ^{a)}	2007-2021	4.3 ^{a)}	-	-	2.3	2.8	1999-2004	3.0 ^{a)}	2004-2021	0.7 ^{a)}	-	-
Cervix uteri	8.6	3.9	1999-2007	-4.6 ^{a)}	2007-2021	-3.1 ^{a)}	-	-	1.4	0.8	1999-2003	10.1 ^{a)}	2003-2008	-7.2 ^{a)}	2008-2021	-4.0 ^{a)}
Corpus uteri	1.4	4.4	1999-2021	5.1 ^{a)}	-	-	-	-	0.1	0.4	1999-2003	35.5 ^{a)}	2003-2021	2.5 ^{a)}	-	-
Ovary	2.7	3.9	1999-2021	1.8 ^{a)}	-	-	-	-	0.9	1.3	1999-2021	0.6 ^{a)}	-	-	-	-
Prostate	3.1	15.7	1999-2009	14.8 ^{a)}	2009-2015	1.2	2015-2021	5.0 ^{a)}	0.9	1.6	1999-2002	15.1 ^{a)}	2002-2010	1.7 ^{a)}	2010-2021	-0.9 ^{a)}
Testis	0.3	0.7	1999-2021	4.7 ^{a)}	-	-	-	-	0.0	0.0	1999-2021	-2.5 ^{a)}	-	-	-	-
Kidney	3.0	7.5	1999-2008	6.6 ^{a)}	2008-2021	2.7 ^{a)}	-	-	1.1	0.9	1999-2015	-0.1	2015-2021	-3.7 ^{a)}	-	-
Bladder	4.7	4.3	1999-2004	1.9	2004-2021	-1.0 ^{a)}	-	-	1.3	1.0	1999-2001	10.9	2001-2021	-2.0 ^{a)}	-	-
Brain and CNS	2.9	2.9	1999-2021	0.1	-	-	-	-	1.9	1.6	1999-2002	6.4 ^{a)}	2002-2008	-3.5 ^{a)}	2008-2021	-0.9 ^{a)}
Thyroid	6.5	50.1	1999-2011	22.5 ^{a)}	2011-2016	-12.3 ^{a)}	2016-2021	6.0 ^{a)}	0.4	0.3	1999-2003	7.2 ^{a)}	2003-2021	-4.4 ^{a)}	-	-
Hodgkin lymphoma	0.3	0.6	1999-2011	4.8 ^{a)}	2011-2021	1.9 ^{a)}	-	-	0.0	0.0	1999-2004	25.0 ^{a)}	2004-2021	-2.8 ^{a)}	-	-
Non-Hodgkin lymphoma	4.3	6.3	1999-2019	2.3 ^{a)}	2019-2021	-1.1	-	-	2.1	1.6	1999-2021	-1.2 ^{a)}	-	-	-	-
Multiple myeloma	1.0	1.8	1999-2013	3.6 ^{a)}	2013-2021	0.6	-	-	0.6	0.8	1999-2003	13.0 ^{a)}	2003-2016	0.7	2016-2021	-4.6 ^{b)}
Leukemia	4.7	5.9	1999-2021	1.0 ^{a)}	-	-	-	-	2.9	2.1	1999-2021	-1.8 ^{a)}	-	-	-	-
Other and ill-defined	15.0	23.9	1999-2021	2.2 ^{a)}	-	-	-	-	7.8	4.1	1999-2021	-2.7 ^{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.

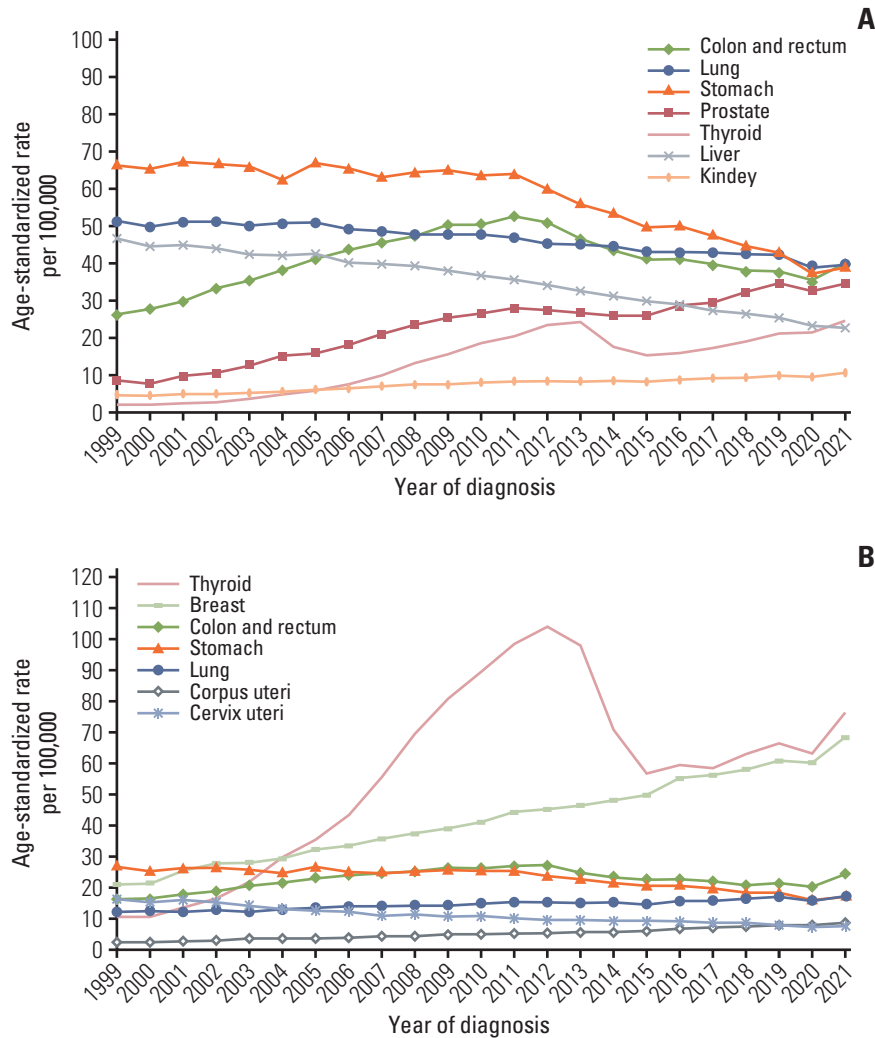


Fig. 4. Trends in age-standardized incidences of selected cancers by sex from 1999 to 2021 in Korea. (A) Men. (B) Women. Age standardization was based on Segi's world standard population.

from those described above. In men, decreasing trend of stomach, lung, and liver cancer throughout the period and colorectal cancer since 2010 were significant while prostate and kidney cancer had an increasing trend. In women, stomach, colorectal, liver, and cervix cancer had decreasing trend 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 and 2013, respectively. On the other hand, the mortality rates of colorectal, cervical, and thyroid cancers initially increased significantly until 2003; since then, the mortality rate from these cancers significantly decreased (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 can-

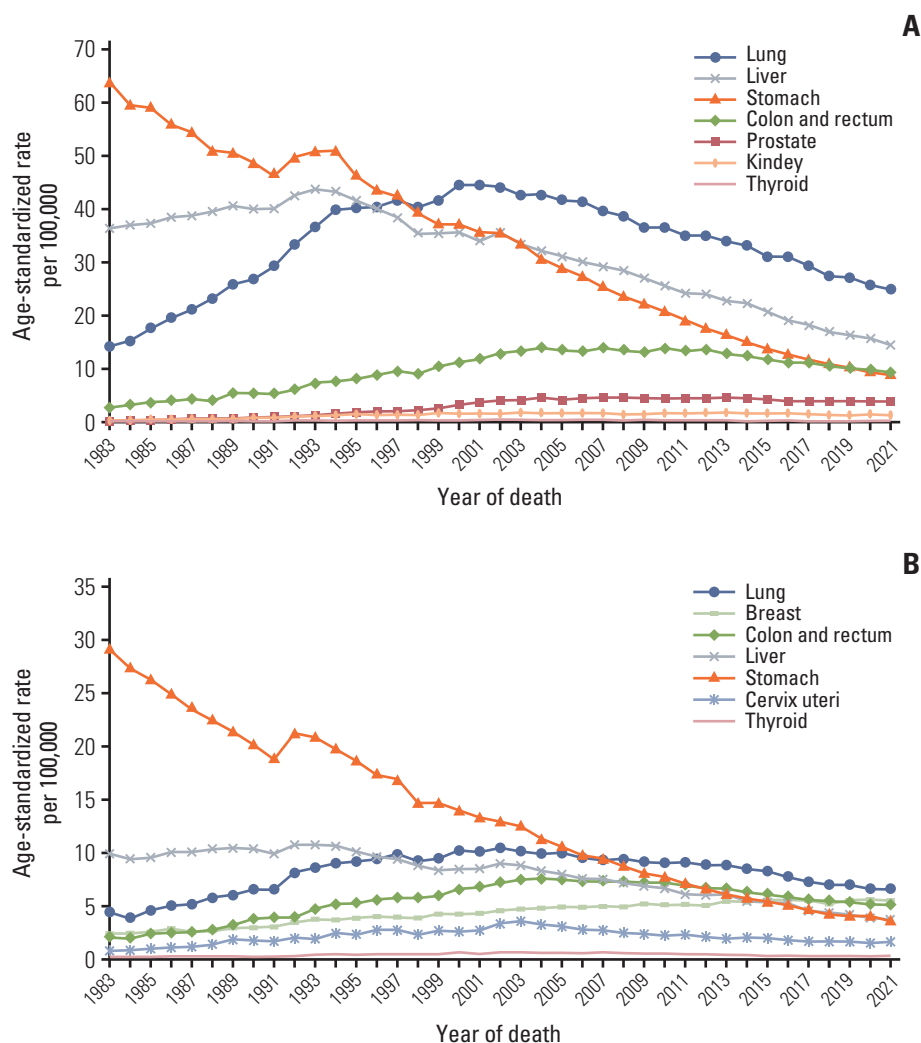


Fig. 5. Trends in age-standardized mortalities of selected cancers by sex from 1983 to 2021 in Korea. (A) Men. (B) Women. Age standardization was based on Segi's world standard population.

cer in the recent five years, from 2017 to 2021 were 72.1% in both sexes; 66.1% in men and 78.2% in women (Table 6). The temporal increasing trends in survival rates, from 42.9% in 1993-1995 to 72.1% in 2017-2021, were maintained even after excluding thyroid cancer (from 41.2% in 1993-1995 to 67.8% in 2017-2021), which has an excellent prognosis with a 5-year relative survival rate of 100%.

After thyroid cancer, survival rates were the highest for prostate and testis cancers in men (96.0% and 95.6%, respectively) and breast cancer in women (93.8%). On the contrary, the survival rates were the lowest for cancers of the pancreas (15.9%), and gallbladder plus other and unspecified parts of the biliary tract (28.9%) in both sexes. Prostate cancer (men), lung cancer (women), stomach cancer (both sexes), and lip, oral cavity, and pharynx (men) were associated with out-

standing improvements in survival rates over the observed period. In contrast, brain and CNS cancer showed a decline in both sexes.

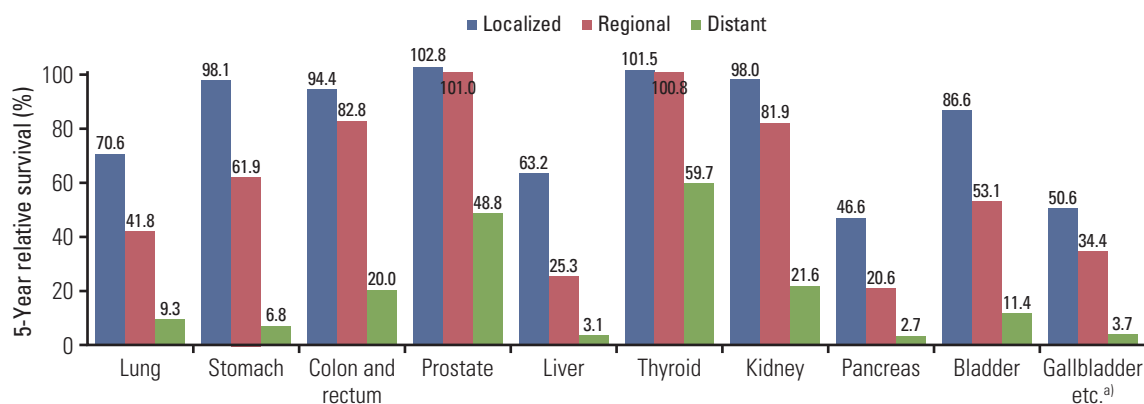
In terms of stage distribution at diagnosis and recent survival rates according to the SEER summary stage in each cancer, Fig. 6 shows the top 10 most common cancers for each sex in 2021. In men, kidney, bladder and stomach cancers revealed the highest proportions of patients who were diagnosed at the localized stage (73.2%, 72.3%, and 64.8%, respectively), accompanied by the 5-year survival rates of 98.0%, 86.6%, and 98.1%, respectively. In contrast, pancreatic and lung cancers demonstrated the highest proportions of patients diagnosed at the distant metastatic stage, which approximated to 50%, with corresponding 5-year survival rates of 2.7% and 9.3%, respectively. In women, 72.1%, 63.5%,

Table 6. Trends in the 5-year relative survival rates (%) by sex and year of diagnosis from 1993 to 2021 in Korea

Site/Type	Both sexes										Men					Women								
	1993-1996		2001-2006		2011-2016		2017-2021		Change ^{a)}		1993-1996		2001-2006		2011-2016		2017-2021		Change ^{a)}					
	1995	2000	2005	2010	2015	2020	2021	1995	2000	2005	2010	2015	2020	2021	1995	2000	2005	2010	2015	2020	2021			
All sites	42.9	45.2	54.2	65.5	70.8	71.6	72.1	29.2	33.2	36.4	45.6	56.9	63.1	65.6	66.1	33.0	55.2	56.4	64.3	74.5	78.3	77.9	78.2	23.1
All sites excluding thyroid	41.2	43.4	50.9	59.1	64.3	67.4	67.8	26.6	32.7	35.9	44.7	54.6	60.4	63.5	63.9	31.2	52.6	53.5	59.1	65.0	69.4	72.3	72.7	20.1
Lip, oral cavity, and pharynx	42.2	47.4	54.5	61.1	65.5	69.3	69.8	27.6	36.7	41.8	49.7	57.0	61.9	66.5	66.6	29.9	59.4	64.5	68.1	72.1	74.6	76.5	77.7	18.2
Esophagus	14.0	15.7	21.5	30.0	36.6	42.4	42.8	28.8	13.0	14.7	20.8	29.4	36.3	42.0	42.2	29.2	25.0	25.9	29.8	37.3	39.8	46.5	48.2	23.2
Stomach	43.9	47.3	58.0	68.4	75.9	77.9	77.9	34.0	43.9	47.6	58.7	69.1	76.8	78.8	78.6	34.7	43.7	46.8	56.6	67.0	74.0	76.1	76.4	32.7
Colon and rectum	56.2	58.9	66.9	73.9	76.1	74.3	74.3	18.1	56.7	59.8	68.8	75.8	77.8	75.5	75.3	18.7	55.7	57.7	64.4	71.1	73.6	72.5	72.7	17.1
Liver	11.8	14.1	20.6	28.3	34.5	38.8	39.3	27.5	10.8	13.8	20.4	28.3	35.0	39.4	39.8	29.0	15.1	15.1	21.0	28.3	32.9	37.4	37.6	22.5
Gallbladder ^{b)}	18.7	20.7	23.1	26.9	28.8	28.7	28.9	10.2	18.0	21.1	23.5	27.8	29.5	29.7	30.0	12.0	19.3	20.3	22.7	26.0	28.0	27.7	27.7	8.4
Pancreas	10.6	8.7	8.4	8.6	11.0	15.1	15.9	5.3	10.0	8.3	8.4	8.4	10.4	14.1	14.8	4.8	11.5	9.3	8.4	8.9	11.6	16.2	17.2	5.6
Larynx	61.6	63.3	66.6	73.2	75.3	80.2	80.3	18.7	62.2	63.7	67.2	73.5	75.7	80.3	80.3	18.1	56.3	58.9	58.7	68.0	69.4	78.8	80.3	24.0
Lung	12.5	13.7	16.6	20.3	27.6	37.2	38.5	26.0	11.6	12.4	15.3	18.0	23.4	30.8	31.9	20.3	15.8	17.5	20.2	26.0	37.4	50.8	52.4	36.6
Breast	79.2	83.7	88.7	91.2	92.8	93.8	93.8	14.6	77.1	84.3	87.5	89.9	90.7	90.3	90.0	12.9	79.3	83.7	88.7	91.2	92.8	93.8	93.8	14.6
Cervix uteri	78.3	80.3	81.5	80.7	80.4	80.2	79.9	1.6	-	-	-	-	-	-	-	-	78.3	80.3	81.5	80.7	80.4	80.2	79.9	1.6
Corpus uteri	82.9	82.0	84.8	86.5	87.7	89.4	89.6	6.7	-	-	-	-	-	-	-	-	82.9	82.0	84.8	86.5	87.7	89.4	89.6	6.7
Ovary	60.2	59.4	61.8	61.4	64.9	65.1	65.9	5.7	-	-	-	-	-	-	-	-	60.2	59.4	61.8	61.4	64.9	65.1	65.9	5.7
Prostate	59.1	69.4	81.0	92.0	94.2	95.6	96.0	36.9	59.1	69.4	81.0	92.0	94.2	95.6	96.0	36.9	-	-	-	-	-	-	-	-
Testis	87.4	90.4	90.7	93.2	94.9	96.0	95.6	8.1	87.4	90.4	90.7	93.2	94.9	96.0	95.6	8.1	-	-	-	-	-	-	-	-
Kidney	64.2	67.0	73.7	78.6	82.6	85.7	86.4	22.1	63.5	65.4	73.0	78.5	82.2	85.8	86.3	22.8	65.8	70.3	74.9	78.9	83.4	85.4	86.6	20.8
Bladder	70.7	73.6	76.0	77.3	76.6	76.8	77.0	6.3	71.6	75.1	77.8	79.3	78.5	78.7	78.8	7.3	67.2	67.2	69.1	69.2	68.5	69.0	69.5	2.3
Brain and CNS	40.4	40.0	41.2	42.9	42.0	40.4	39.7	-0.7	39.0	38.7	40.5	41.4	40.6	38.3	37.4	-1.6	42.3	41.5	41.9	44.7	43.6	42.8	42.4	0.1
Thyroid	94.5	95.0	98.4	100.0	100.2	100.0	100.1	5.5	87.9	89.7	96.0	100.2	100.6	100.3	100.5	12.6	95.7	96.0	98.7	99.9	100.1	99.9	99.9	4.3
Hodgkin lymphoma	70.2	71.9	76.8	81.1	82.3	87.0	86.4	16.3	69.4	69.3	74.8	80.8	81.8	87.2	86.3	16.9	71.5	77.3	80.7	81.6	83.3	86.7	86.6	15.1
Non-Hodgkin lymphoma	48.3	51.1	56.0	59.4	62.9	65.3	65.4	17.1	46.8	49.6	55.0	59.2	62.9	65.6	65.3	18.4	50.7	53.3	57.5	59.7	62.8	64.8	65.5	14.9
Multiple myeloma	23.7	21.0	29.8	35.0	41.6	50.3	50.1	26.5	23.2	19.1	30.0	35.3	41.2	50.6	50.6	27.3	24.1	23.2	29.7	34.8	42.1	50.0	49.6	25.5
Leukemia	27.5	34.3	41.9	47.7	52.0	55.2	55.4	27.8	27.3	33.3	41.8	46.9	52.3	54.8	55.2	28.0	27.9	35.5	42.1	48.7	51.7	55.6	55.5	27.6
Other and ill-defined	44.5	48.4	57.9	67.7	72.9	76.3	76.5	32.0	39.6	44.7	54.1	63.8	69.4	73.4	73.6	33.9	50.1	52.7	62.0	71.6	76.3	79.3	79.5	29.3

CNS, central nervous system. ^{a)}Absolute percentage change in 5-year relative survival from 1993 to 1995 and 2017 to 2021, ^{b)}Includes the gallbladder and other/ unspecified parts of the biliary tract.

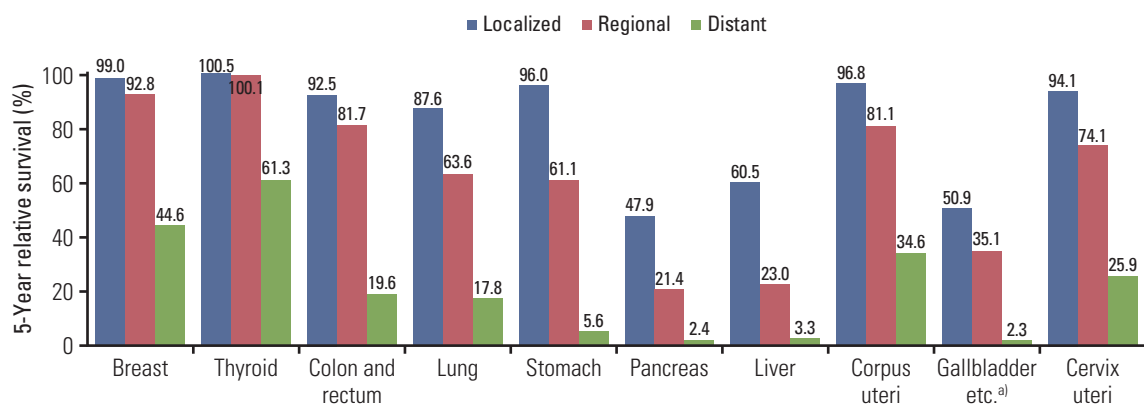
A



Stage distribution at diagnosis (%)

Localized	21.2	64.8	37.1	52.6	45.6	37.4	73.2	11.9	72.3	24.3
Regional	27.7	19.5	41.3	25.6	25.7	55.2	11.3	31.3	11.0	45.4
Distant	44.0	11.0	16.4	10.1	15.5	1.1	11.4	47.2	4.1	20.4

B



Stage distribution at diagnosis (%)

Localized	59.1	44.9	33.6	30.1	63.5	14.0	45.2	72.1	23.5	53.7
Regional	33.0	48.0	42.9	22.9	19.5	30.9	22.1	17.1	40.2	29.8
Distant	4.8	0.7	17.4	40.1	10.9	42.6	16.6	6.6	24.2	9.6

Fig. 6. Five-year relative survival rates by stage at diagnosis and stage distribution of selected cancers by sex in Korea, 2017-2021. (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. ^{a)}Includes the gallbladder and other/unspecified parts of the biliary tract.

and 59.1% of uterine corpus, stomach, and breast cancers, respectively, were diagnosed at the localized stage, with 5-year survival rates of 96.8%, 96.0%, and 99.0%, respectively. However, more than 40% of pancreatic and lung cancers were diagnosed at the distant metastatic stage, with 5-year survival rates of 2.4% and 17.8%, respectively.

5. Prevalence rates

The total prevalent cancer cases in 2021 (identified as survivor at the time of January 1, 2022) were 2,434,089, surpassing 2 million since 2018 (Table 1). It suggested that one in 21 people (4.7% of the entire Korean population; 4.2% of men and 5.3% of women) has a history of being diagnosed with cancer. Of these, 1,194,156 (49.1% of all prevalent cases) were aged ≥ 65 years, indicating that one in seven people in that

Table 7. Crude and age-standardized rates of cancer prevalence by sex on January 1, 2021 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	4,741.7	4,166.7	5,313.3	2,467.3	2,182.1	2,835.3
Lip, oral cavity, and pharynx	65.7	88.0	43.7	34.8	47.6	23.3
Esophagus	26.3	46.7	6.0	11.6	22.3	2.6
Stomach	669.9	884.5	456.7	304.3	434.1	195.9
Colon and rectum	603.4	714.7	492.9	273.9	355.8	206.1
Liver	157.9	236.4	79.8	77.1	122.0	36.1
Gallbladder ^{c)}	54.7	57.0	52.3	23.1	27.2	19.7
Pancreas	35.4	35.7	35.1	17.7	18.5	17.1
Larynx	24.7	46.6	3.0	10.7	22.2	1.2
Lung	237.2	280.3	194.3	106.7	135.4	84.6
Breast	594.0	4.3	1,180.1	327.4	2.2	645.7
Cervix uteri	121.2	-	241.6	65.6	-	128.9
Corpus uteri	71.7	-	143.0	39.4	-	77.8
Ovary	53.6	-	106.9	32.4	-	64.6
Prostate	259.4	520.4	-	101.6	234.7	-
Testis	9.2	18.4	-	8.1	15.7	-
Kidney	116.1	157.7	74.7	61.2	86.7	37.8
Bladder	86.0	140.8	31.6	36.0	66.8	11.7
Brain and CNS	27.4	28.2	26.6	22.1	23.4	20.6
Thyroid	1,019.6	390.3	1,645.2	619.1	244.5	992.7
Hodgkin lymphoma	7.6	9.5	5.8	6.0	7.2	4.8
Non-Hodgkin lymphoma	85.3	96.9	73.7	52.6	62.8	42.8
Multiple myeloma	17.7	18.8	16.6	8.3	9.4	7.3
Leukemia	56.4	62.9	50.0	48.4	54.3	42.5
Other and ill-defined	341.3	328.7	353.9	179.3	189.1	171.3

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, 2021 and who were alive on January 1, 2022. 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.

age group (17.2% of, or one in six, men and 11.4% of, or one in nine, women) would have experienced cancer (data not shown).

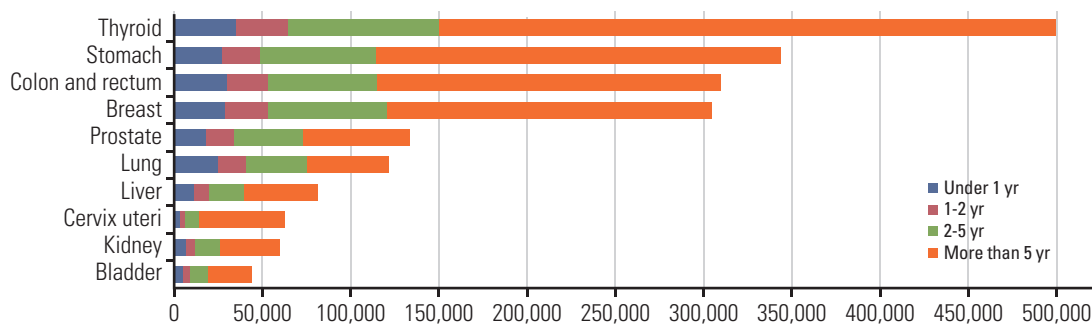
Table 7 provides the CRs and ASRs of prevalence for all cancers combined and for specific cancers. In total, the cancer prevalence rate for 2021 in Korea was 4,741.7 per 100,000 people. Thyroid cancer had the highest prevalence (CR, 1,019.6 per 100,000; 390.3 per 100,000 for men and 1,645.2 per 100,000 for women), followed by stomach cancer (CR, 669.9 per 100,000) and colorectal cancer (CR, 603.4 per 100,000). Prostate cancer in men and breast cancer in women revealed the highest prevalence rates (CR, 520.4 and 1,180.1 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, 1,479,536 (60.8% of all prevalent cases) had

survived > 5 years after cancer diagnosis, majority of them being survivors of thyroid, stomach, colorectal, and breast cancers. Another 510,053 (21.0% 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 444,500 (18.3% 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 2021 is provided as a Supplementary Material (S3-S6 Tables, S7-S9 Figs.).



Time since diagnosis	Thyroid	Stomach	Colon and rectum	Breast	Prostate	Lung	Liver	Cervix uteri	Kidney	Bladder	All cancers
Under 1 yr	35,144	26,760	30,089	28,558	18,275	24,297	11,277	3,035	6,519	4,766	248,448
1-2 yr	29,327	21,708	23,081	24,326	15,848	16,456	8,454	2,671	5,350	3,886	196,052
2-5 yr	85,547	66,176	61,521	67,125	38,720	34,469	19,500	8,316	14,062	9,978	510,053
More than 5 yr	373,391	229,251	195,070	184,896	60,317	46,525	41,811	48,182	33,652	25,533	1,479,536
Total	523,409	343,895	309,761	304,905	133,160	121,747	81,042	62,204	59,583	44,163	2,434,089

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, 2022 among all cancer patients diagnosed between 1999 and 2021.

Conclusion

Compared to 2020, the number of new cancer diagnoses in 2021 increased as healthcare utilization, including cancer screening test, recovered from the declines caused by COVID-19 in 2020. Additionally, revised cancer registration guidelines have expanded the scope of cancer registration, particularly for stomach and colorectal cancer. Since 2015, the number of new cancer patients in Korea has been increasing except for 2020. However, the ASRs of incidence did not show a significant change. During the past decade, the incidence of stomach, liver, and cervical cancer 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 72.1%, which is steadily improving. Since 2018, the number of cancer survivors has exceeded 2 million, of which 60.8% are those who survived over 5 years. As the number of newly diagnosed cancer patients, cancer survival rates, and cancer prevalence continue to increase, national cancer control strategies must be planned and implemented to keep pace with these changing cancer statistics. In addition, the impact of the COVID-19 pandemic on cancer diagnosis and treatment should be evaluated in further studies.

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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: Park EH, Jung KW, Kong HJ, Kang MJ, Yun EH.
 Performed the analysis: Park NJ
 Wrote the paper: Park EH, Jung KW.

Interpretation and review: Jung KW, Kang MJ.
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Conflicts of Interest

Conflict of interest relevant to this article was not reported.

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