



Special Article

Prediction of Cancer Incidence and Mortality in Korea, 2021

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Purpose This study aimed to report the projected cancer incidence and mortality for the year 2021 to estimate Korea's current cancer burden.

Materials and Methods Cancer incidence data from 1999 to 2018 were obtained from the Korea National Cancer Incidence Database, and cancer mortality data from 1993 to 2019 were acquired from Statistics Korea. Cancer incidence and mortality were projected by fitting a linear regression model to observed age-specific cancer rates against their respective years and then by multiplying the projected age-specific rates by the anticipated age-specific population for 2021. A joinpoint regression model was used to determine the year in which the linear trend changed significantly; we only used the data of the latest trend.

Results In total, 259,999 new cancer cases and 81,567 cancer deaths are expected to occur in Korea in 2021. The most common cancer site is expected to be the lung, followed by the thyroid, colon and rectum, breast, and stomach. These five cancers are expected to represent half of the overall burden of cancer in Korea. The most common type of cancer leading to death is expected to be lung cancer, followed by liver, colorectal, pancreatic, and stomach cancers.

Conclusion The incidence rates for all types of cancer in Korea are estimated to gradually decrease. These up-to-date estimates of the cancer burden in Korea could be an important resource for planning and evaluating cancer-control programs.

Key words Incidence, Mortality, Neoplasms, Forecasting, Korea, 2021

Introduction

As the leading cause of death in Korea [1], cancer has been a major public health concern in the country since 1983. More than 230,000 patients were newly diagnosed with cancer in Korea, and one-fourth of deaths were due to cancer in 2017 [2]. Although the cancer registration system in Korea is highly efficient and can provide nationwide cancer statistics within a relatively short period, a lag time of at least 2 years is required to collect and analyze data for a specific year. For planning and implementing comprehensive cancer-control programs, it is important to assess the number of new cases and deaths that are expected to occur during the current year. In this study, we report the projected cancer incidence and mortality for the year 2021 based on data from the 1990s to 2018.

Materials and Methods

The Korean Ministry of Health and Welfare initiated a nationwide, hospital-based cancer registry, known as the Korea Central Cancer Registry (KCCR), in 1980. The histo-

ry, objectives, and activities of the KCCR have been documented in detail elsewhere [3]. Cancer incidence data from 1999 to 2018 were obtained from the Korea National Cancer Incidence Database (KNCI DB). Cancer cases were classified according to the International Classification of Diseases for Oncology, 3rd edition [4] and converted according to the International Classification of Diseases, 10th edition (ICD-10) [5]. Mortality data from 1993 to 2019 were acquired from Statistics Korea [1]. The cause of death was coded and classified according to the ICD-10 [5].

The cancer sites included in this study were (1) all cancer sites combined and (2) the 24 cancer sites as follows: lips, oral cavity, and pharynx (C00-C14), esophagus (C15), stomach (C16), colon and rectum (C18-C20), liver (C22), gallbladder etc. (C23-C24), pancreas (C25), larynx (C32), lung (C33-C34), breast (C50), cervix uteri (C53), corpus uteri (C54), ovary (C56), prostate (C61), testis (C62), kidney (C64), bladder (C67), brain and central nervous system (C70-C72), thyroid (C73), Hodgkin lymphoma (C81), non-Hodgkin lymphoma (C82-C86, C96), multiple myeloma (C90), leukemia (C91-C95), and other and ill-defined sites (remainder of C00-C96).

The population data were obtained from the resident reg-

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Table 1. Estimated new cancer cases and deaths by sex during 2021 in Korea

Site	Estimated new cases			Estimated deaths		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	259,999	135,577	124,422	81,567	49,630	31,937
Lip, oral cavity, and pharynx	4,077	2,926	1,151	1,257	913	344
Esophagus	2,622	2,379	243	1,260	1,125	135
Stomach	26,768	17,899	8,869	5,808	3,842	1,966
Colon and rectum	28,177	17,110	11,067	8,865	4,907	3,958
Liver ^{a)}	14,707	10,991	3,716	9,856	7,033	2,823
Gallbladder ^{b)}	8,338	4,460	3,878	5,387	2,890	2,497
Pancreas	8,812	4,569	4,243	7,031	3,634	3,397
Larynx	1,066	1,005	61	250	231	19
Lung ^{c)}	32,149	21,206	10,943	18,379	13,611	4,768
Breast	26,926	102	26,824	2,840	18	2,822
Cervix uteri	3,105	-	3,105	794	-	794
Corpus uteri	3,467	-	3,467	403	-	403
Ovary	3,080	-	3,080	1,344	-	1,344
Prostate	16,749	16,749	-	2,140	2,140	-
Testis	326	326	-	18	18	-
Kidney	6,244	4,290	1,954	1,174	814	360
Bladder	5,067	4,020	1,047	1,564	1,157	407
Brain and CNS	2,170	1,165	1,005	1,387	719	668
Thyroid	31,144	7,938	23,206	344	98	246
Hodgkin lymphoma	350	216	134	64	39	25
Non-Hodgkin lymphoma	5,791	3,333	2,458	2,247	1,288	959
Multiple myeloma	2,012	1,046	966	1,171	639	532
Leukemia	3,865	2,237	1,628	2,102	1,231	871
Other and ill defined	22,987	11,610	11,377	5,882	3,283	2,599

CNS, central nervous system. ^{a)}Includes the liver and intrahepatic bile duct, ^{b)}Includes the gallbladder and other/unspecified parts of the biliary tract, ^{c)}Includes the lung and bronchus.

istration population data, reported by Statistics Korea. Data of the mid-year population (July 1 of the respective year) were used as the denominator to obtain the annual incidence and mortality rates. However, for the year 2021, we used the population data on December 31, 2020, as the mid-2021 resident registration population data were not yet available at the time of the analysis.

Linear regression models [6] were used to assess time trends and create projections. We first performed a joinpoint regression analysis on the data available to detect the year when significant changes occurred in cancer trends according to sex and cancer site. A joinpoint regression describes changes in data trends by connecting several different line segments on a log scale at "joinpoints." This analysis was performed using *Joinpoint* software (version 4.7.0.0; <http://surveillance.cancer.gov/joinpoint>) from the Surveillance Research Program of the US National Cancer Institute [7]. For the analysis, we arranged to have at least four data points between consecutive joinpoints. Secondly, to predict age-

specific cancer rates, a linear regression model was fitted to age-specific rates by 5-year age groups against their respective years, based on the observed cancer incidence data of the latest trends. Finally, we multiplied the projected age-specific rates by the age-specific population to get the projected number of cancer cases and deaths for the year 2021.

We summarized the results using crude rates (CRs) and age-standardized rates (ASRs) of cancer incidence and mortality. ASRs were standardized using the world standard population [8] and expressed per 100,000 persons.

Results

1. Incidence

In total, 259,999 new cancer cases are expected to occur in 2021 (Table 1, Fig. 1); more men (n=135,577) than women (n=124,422) are expected to be affected.

The projected CRs per 100,000 for all of the sites combined

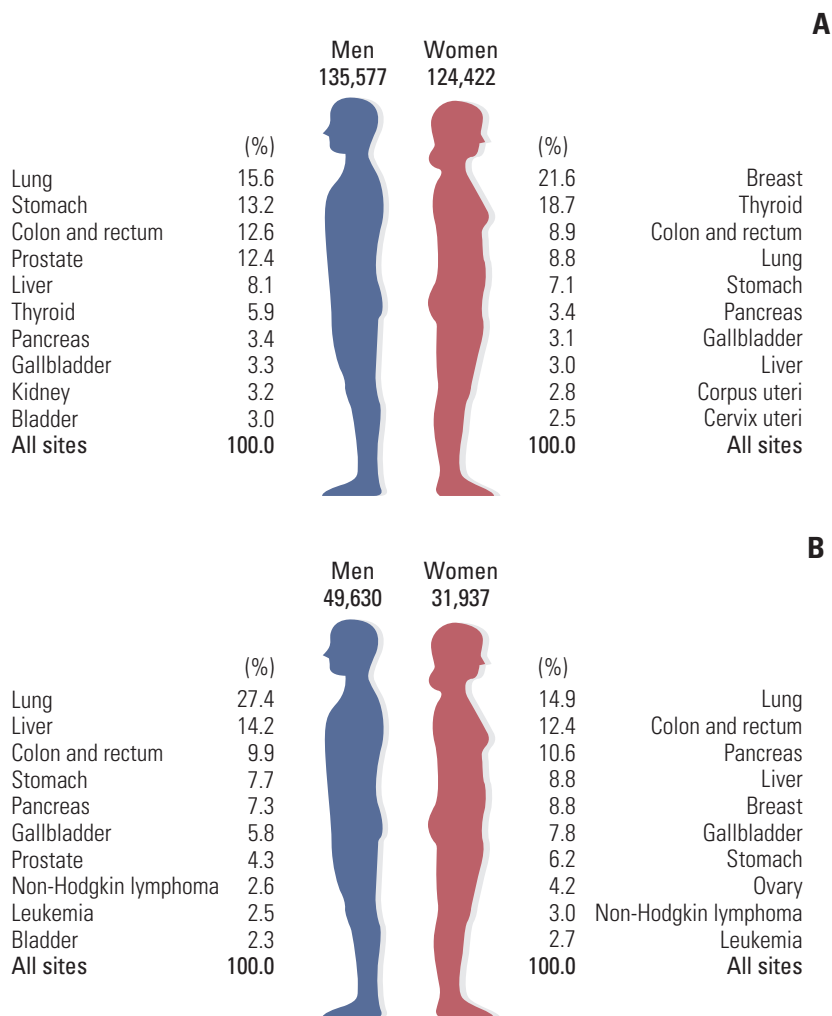


Fig. 1. The 10 leading types of estimated new cancer cases and deaths by sex in 2021. (A) Estimated new cases. (B) Estimated deaths.

in 2021 are 524.7 cases and 478.8 cases for men and women, respectively (Table 2). The projected ASRs per 100,000 for all of the sites combined are 280.0 cases and 265.2 cases for men and women, respectively. In men, the five leading primary sites of cancer are expected to be the lung (CR, 82.1; ASR, 39.7), stomach (CR, 69.3; ASR, 35.8), colon and rectum (CR, 66.2; ASR, 34.4), prostate (CR, 64.8; ASR, 31.5), and liver (CR, 42.5; ASR, 22.0), accounting for 61.9% of all new cancer cases in 2021. In women, the five leading primary sites are expected to be the breast (CR, 103.2; ASR, 63.6), thyroid (CR, 89.3; ASR, 66.3), colon and rectum (CR, 42.6; ASR, 17.7), lung (CR, 42.1; ASR, 18.1), and stomach (CR, 34.1; ASR, 15.7), accounting for 65.0% of all new cancer cases in 2021 (Fig. 1).

The five most common cancer sites expected in 2021 according to sex and age group are shown in Table 3. Leukemia and thyroid cancer are expected to be the most common forms of cancer in both sexes for those aged 0-14 years and

15-34 years, respectively. Stomach cancer is predicted to be the most prevalent cancer in men aged 35-64 years, while lung cancer is expected to be more frequent in men aged 65 years and above. Breast cancer is predicted to be the most common cancer in women aged 35-64 years, whereas colorectal cancer is expected to be the most common form in women aged 65 years and above. According to the projection, the incidences of stomach, lung, liver, colorectal, and prostate cancers will increase gradually with age for men (Fig. 2A). In women, the age-specific incidence rates for stomach, colorectal, liver, lung, and cervical cancers denote an increasing trend with age; however, the incidences of breast and thyroid cancers in women are expected to level off after the age of 45 and 50 years, respectively (Fig. 2B).

Table 2. Estimated crude and age-standardized cancer incidences by sex during 2021 in Korea

Site	Crude incidence rates per 100,000			Age-standardized incidence rates per 100,000 ^{a)}		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	501.7	524.7	478.8	266.5	280.0	265.2
Lip, oral cavity, and pharynx	7.9	11.3	4.4	4.3	6.3	2.5
Esophagus	5.1	9.2	0.9	2.3	4.5	0.4
Stomach	51.7	69.3	34.1	25.0	35.8	15.7
Colon and rectum	54.4	66.2	42.6	25.6	34.4	17.7
Liver ^{b)}	28.4	42.5	14.3	13.5	22.0	5.8
Gallbladder ^{c)}	16.1	17.3	14.9	6.7	8.3	5.4
Pancreas	17.0	17.7	16.3	7.6	8.9	6.5
Larynx	2.1	3.9	0.2	0.9	1.9	0.1
Lung ^{d)}	62.0	82.1	42.1	27.5	39.7	18.1
Breast	52.0	0.4	103.2	31.9	0.2	63.6
Cervix uteri	6.0	-	12.0	3.9	-	7.8
Corpus uteri	6.7	-	13.3	4.0	-	8.0
Ovary	5.9	-	11.9	3.6	-	7.2
Prostate	32.3	64.8	-	14.3	31.5	-
Testis	0.6	1.3	-	0.7	1.3	-
Kidney	12.1	16.6	7.5	6.7	9.6	3.9
Bladder	9.8	15.6	4.0	4.2	7.6	1.6
Brain and CNS	4.2	4.5	3.9	3.0	3.4	2.7
Thyroid	60.1	30.7	89.3	43.8	22.1	66.3
Hodgkin lymphoma	0.7	0.8	0.5	0.6	0.7	0.5
Non-Hodgkin lymphoma	11.2	12.9	9.5	6.6	8.1	5.3
Multiple myeloma	3.9	4.1	3.7	1.8	2.0	1.6
Leukemia	7.5	8.7	6.3	5.6	6.6	4.6
Other and ill defined	44.4	44.9	43.8	22.7	25.4	20.3

CNS, central nervous system. ^{a)}Age adjusted to the world standard population, ^{b)}Includes the liver and intrahepatic bile duct, ^{c)}Includes the gallbladder and other/unspecified parts of the biliary tract, ^{d)}Includes the lung and bronchus.

Table 3. Estimated cancer incidence by age group and sex during 2021 in Korea

Rank	Age group (yr)			
	0-14	15-34	35-64	≥ 65
Men				
1	Leukemia (4.8)	Thyroid (22.9)	Stomach (65.3)	Lung ^{a)} (426.0)
2	Non-Hodgkin lymphoma (3.3)	Leukemia (3.9)	Colon and rectum (61.7)	Prostate (351.5)
3	Brain and CNS (2.3)	Non-Hodgkin lymphoma (3.3)	Thyroid (44.4)	Stomach (264.8)
4	Kidney (0.4)	Testis (3.0)	Lung ^{a)} (44.0)	Colon and rectum (251.3)
5	Testis (0.3)	Colon and rectum (2.9)	Liver ^{b)} (42.3)	Liver ^{b)} (154.5)
Women				
1	Leukemia (4.0)	Thyroid (69.3)	Breast (171.6)	Colon and rectum (150.0)
2	Brain and CNS (2.1)	Breast (12.1)	Thyroid (135.1)	Lung ^{a)} (142.8)
3	Non-Hodgkin lymphoma (1.7)	Cervix uteri (5.6)	Lung ^{a)} (33.0)	Breast (108.0)
4	Ovary (0.8)	Ovary (3.5)	Stomach (30.9)	Stomach (104.3)
5	Thyroid (0.6)	Corpus uteri (2.7)	Colon and rectum (30.5)	Pancreas (65.1)

CNS, central nervous system. ^{a)}Includes the lung and bronchus, ^{b)}Includes the liver and intrahepatic bile duct.

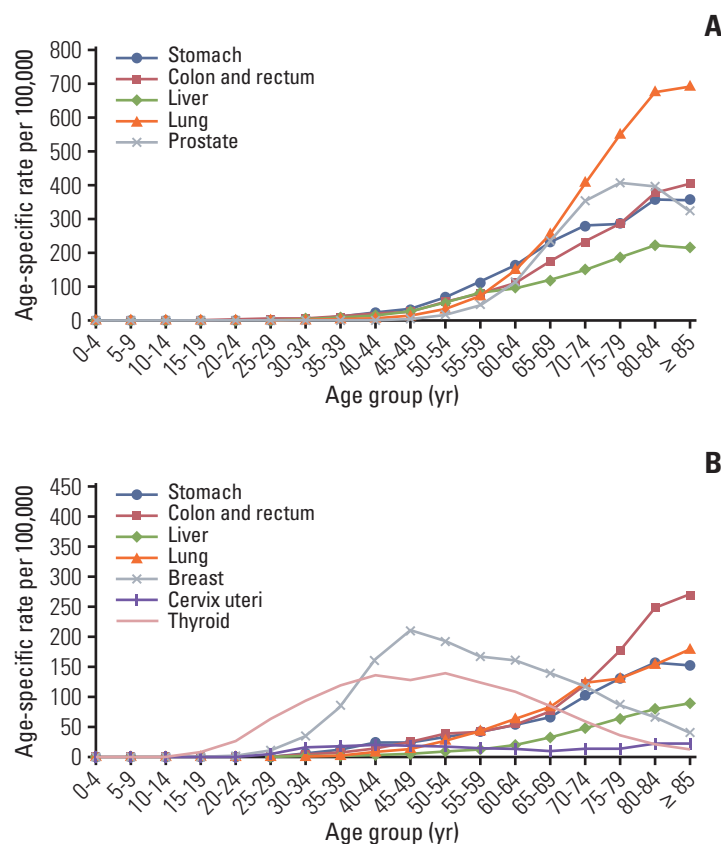


Fig. 2. Projected age-specific incidences of major cancers during 2021 in Korea. (A) Men. (B) Women.

2. Mortality

It is estimated that 81,567 cancer deaths will occur in Korea during 2021 (Table 1, Fig. 1). The projected CRs per 100,000 for all of the sites combined in 2021 for men and women are 192.1 cases and 122.9 cases, respectively, whereas the projected ASRs per 100,000 for all sites combined for men and women are expected to be 92.6 cases and 45.5 cases, respectively (Table 4). The predicted five leading cancer sites causing mortality in men are the lung (CR, 52.7; ASR, 24.4), liver (CR, 27.2; ASR, 13.5), colon and rectum (CR, 19.0; ASR, 9.2), stomach (CR, 14.9; ASR, 7.2), and pancreas (CR, 14.1; ASR, 6.9). During the same period, lung cancer (CR, 18.4; ASR, 6.2) is projected to be the leading cause of cancer death in women, followed by colon and rectal (CR, 15.2; ASR, 4.9), pancreatic (CR, 13.1; ASR, 4.6), liver (CR, 10.9; ASR, 3.6), and breast (CR, 10.9; ASR, 5.7) cancers.

The predicted age-specific mortality rates of the leading causes of cancer-associated death in men and women in 2021 are shown in detail in Fig. 3. According to age, Korean men and women aged at least 60 years are expected to have the highest mortality rates due to lung cancer.

Conclusion

A total of 259,999 new cancer cases and 81,567 cancer deaths are expected to occur in Korea during 2021. Lung cancer is predicted to be the most common type of cancer among men, followed by stomach, colorectal, prostate, and liver cancers. Lung, liver, colorectal, stomach, and pancreatic cancers are expected to be the most common causes of cancer deaths among men. In women, the five leading primary cancer sites are expected to be the breast, thyroid, colon and rectum, lung, and stomach, while lung, colorectal, pancreatic, liver, and breast cancers are projected to be the most common causes of cancer deaths.

Cancer is currently one of the foremost public health concerns in Korea. Although cancer incidence rates are anticipated to slightly decrease, the burden of most types of cancers will continue to grow with the increasing age of the population. The current projections of cancer incidence and mortality for 2021 represent an important resource for planning and evaluating cancer-control programs. As the estimates in this study are model-based, these results should be interpreted with caution.

Table 4. Estimated crude and age-standardized cancer mortality rates by sex during 2021 in Korea

Site	Crude mortality rates per 100,000			Age-standardized mortality rates per 100,000 ^{a)}		
	Both sexes	Men	Women	Both sexes	Men	Women
All sites	157.4	192.1	122.9	65.6	92.6	45.5
Lip, oral cavity, and pharynx	2.4	3.5	1.3	1.1	1.8	0.5
Esophagus	2.4	4.4	0.5	1.0	2.0	0.2
Stomach	11.2	14.9	7.6	4.5	7.2	2.4
Colon and rectum	17.1	19.0	15.2	6.8	9.2	4.9
Liver ^{b)}	19.0	27.2	10.9	8.3	13.5	3.6
Gallbladder ^{c)}	10.4	11.2	9.6	4.0	5.2	2.9
Pancreas	13.6	14.1	13.1	5.6	6.9	4.6
Larynx	0.5	0.9	0.1	0.2	0.4	0.0
Lung ^{d)}	35.5	52.7	18.4	14.0	24.4	6.2
Breast	5.5	0.1	10.9	2.9	0.0	5.7
Cervix uteri	1.5	-	3.1	0.8	-	1.5
Corpus uteri	0.8	-	1.6	0.4	-	0.7
Ovary	2.6	-	5.2	1.3	-	2.4
Prostate	4.1	8.3	-	1.4	3.7	-
Testis	0.0	0.1	-	0.0	0.1	-
Kidney	2.3	3.2	1.4	1.0	1.6	0.5
Bladder	3.0	4.5	1.6	1.1	2.1	0.4
Brain and CNS	2.7	2.8	2.6	1.6	1.7	1.4
Thyroid	0.7	0.4	1.0	0.2	0.2	0.3
Hodgkin lymphoma	0.1	0.2	0.1	0.1	0.1	0.0
Non-Hodgkin lymphoma	4.3	5.0	3.7	1.8	2.4	1.3
Multiple myeloma	2.3	2.5	2.1	0.9	1.2	0.7
Leukemia	4.1	4.8	3.4	2.0	2.6	1.5
Other and ill defined	11.4	12.7	10.0	4.9	6.5	3.7

CNS, central nervous system. ^{a)}Age adjusted to the world standard population, ^{b)}Includes the liver and intrahepatic bile duct, ^{c)}Includes the gallbladder and other/unspecified parts of the biliary tract, ^{d)}Includes the lung and bronchus.

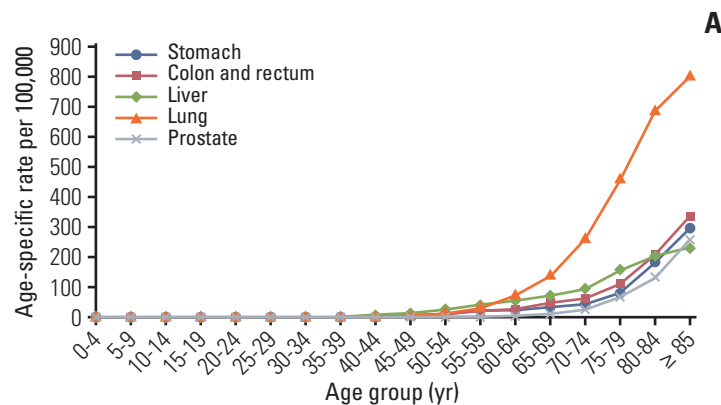


Fig. 3. Projected age-specific mortality rates of major cancers during 2021 in Korea. (A) Men. (B). Women. (Continued to the next page)

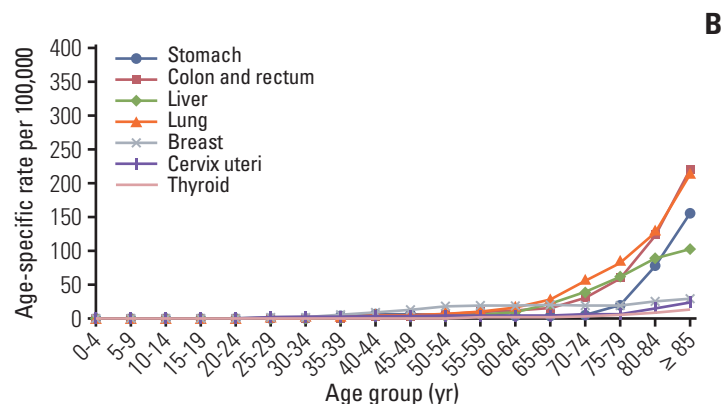


Fig. 3. (Continued from the previous page)

Author Contributions

Conceived and designed the analysis: Won YJ.
 Contributed data or analysis tools: Jung KW, Won YJ, Kong HJ.
 Performed the analysis: Jung KW.
 Wrote the paper: Jung KW, Won YJ.
 Interpretation and review: Hong S.
 Review and comment: Im JS, Seo HG.

Conflicts of Interest

Conflict of interest relevant to this article was not reported.

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