

RESEARCH COMMUNICATION

Long-term Survival of Cancer Patients in Korea, 1993-2007: National Cancer Registry Study

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Abstract

Although survival rates are very useful for monitoring the effects of early cancer detection and treatment, at present there are only limited population-based estimates of long-term survival rates in Korea. Furthermore, published data are only available for 5-year survival; 10-year survival rates have hitherto not been reported. We therefore analysed data from the Korean National Cancer Incidence Database between 1993 and 2007 and followed through into 2008 to estimate long-term survival rates and trends at 5 and 10 years after diagnosis of all cancers combined. Further analysis was conducted on the 19 most common cancers in Korea. From 1993 to 2007, the 10-year relative survival rates (RSRs) for all cancer types combined were 36.3% and 56.4% in Korean men and women, respectively. The 10-year RSRs for all cancers combined improved from 29.5% and 50.5% during 1993-1998 to 39.2% and 58.9% during 1999-2007 in Korean men and women, respectively. From 1993 to 2007, the 5-year and 10-year RSRs thus improved in both sexes for the most common cancers. In the 75 years and older group, increases of the 5-year and 10-year RSR for all combined, and for most of the major cancers were lower than all other age groups. This study provides population-based estimates of long-term survival and confirms improvements of long-term survivals for all cancer sites and for most of the major cancer sites. Improvements of survival for young patients are more significant than for older patients. The results may help clinicians and patients assess long-term prognosis.

Keywords: Neoplasms - long-term survival - Korea

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Introduction

Cancer has been the leading cause of death in Korea since 1983. Over 160,000 new cancer cases are diagnosed annually in Korea, and one in four deaths are caused by cancer (Jung et al., 2010).

Survival of five years after successful cancer treatment is considered to be a cure despite there being no biological basis for this perspective. While for some cancers five year survival may be regarded as almost equivalent to a cure, for others, such as breast and prostate cancer, there is an appreciable risk of death for many years after diagnosis (Stiller and Bunch, 1990; Wingo et al., 1998).

Survival rates are useful for monitoring effects of early detection and treatment of cancer. Short- and long-term survival rates differ by cancer site, age, gender, stage at diagnosis, and treatment protocol. In Korea, the five year survival rates of cancer have been published (Jung et al., 2007) but data relating to longer time frames are limited.

The Korea Central Cancer Registry (KCCR) began as a nationwide hospital-based program in 1980. The KCCR constructed the Korea National Cancer Incidence DataBases (KNCIDB) by merging the KCCR and eight

population-based regional cancer registry databases, the site-specific cancer registry databases (breast, ovary, uterus, and liver cancer), and additional data from medical records. Using the KNCIDB and other sources, such as mortality data from the National Statistical Office, it is possible to produce national survival rates.

In this study, we report relative survival and its trends at five and 10 years after diagnosis for all cancers combined and the 19 most common cancers in Korea.

Materials and Methods

Database

The Korean Ministry of Health and Welfare started a nationwide, hospital-based cancer registry called the KCCR in 1980. Details of the history, objectives, and activities of the KCCR have been documented (Shin et al., 2005). Initially, the diagnosis of cancer was classified according to the International Classification of Diseases for Oncology 3rd edition and converted to the International Classification of Diseases 10th edition. The analysis was restricted to the first primary diagnosis of cancer. The survival analysis used 1,302,353 cancer cases first

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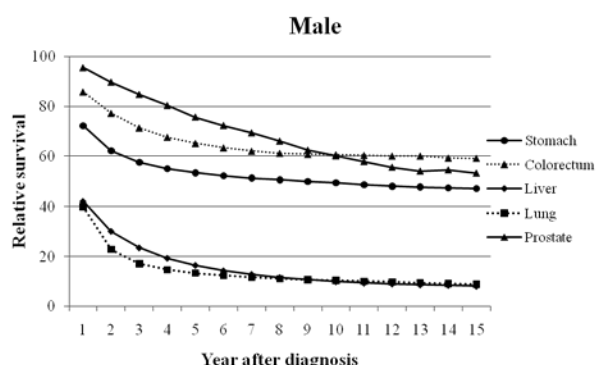


Figure 1. Trends in Relative Survival of Cancer Patients According to the Year of Diagnosis in Korean Men

diagnosed during 1993-2007 from the KNCIDB, and followed vital status until the 31st December 2008.

Statistical Analyses

The 1-year, 5-year, and 10-year relative survival rates (RSRs) were calculated during the whole period and by the periods of diagnosis; 1993-1998, 1999-2007. Analysis by age groups was restricted to adult Korean cancers due to the small numbers of childhood cancers. The age groups were classified as 20-44, 45-54, 55-64, 65-74, and 75 years or older. The RSRs were calculated among the seven most common cancers and represented the proportion of patients surviving for a specified length of time after cancer diagnosis (Figures 1 and 2).

The duration of survival for each case was determined as the time difference between the date of initial diagnosis and the date of death, date of loss to follow-up, or closing date for follow-up. Relative survival was defined as the ratio of the observed survival rate to the expected rate; this was based on a group of people in the general population similar to the patient group with respect to sex, age and calendar period of observation (Brenner and Gefeller, 1996). The RSRs were calculated using the Ederer II method (Ederer and Heise, 1959). All analysis was conducted using SAS version 9.1.

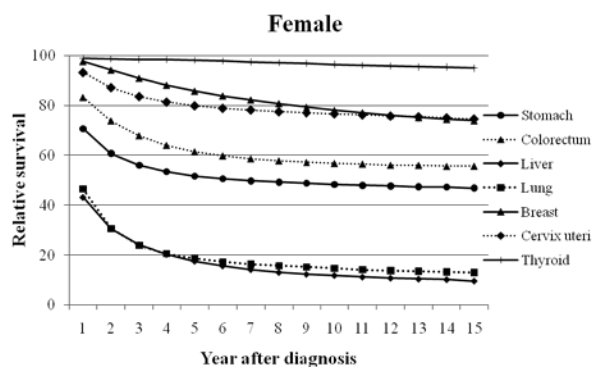


Figure 2. Trends in Relative Survival of Cancer Patients According to the Year of Diagnosis in Korean Women

Results

Tables 1 and 2 show the 1-year, 5-year, and 10-year RSRs by cancer site and period of diagnosis for men and women, respectively. At 1-year, 5-years, and 10-years after diagnosis, survival rates of all sites combined during 1993-2007 were 63.0%, 41.2%, and 36.3% in males, and 77.6%, 61.0%, and 56.4% in females. Overall the survival of females is better than that of males, but there are clear improvements in survival from the period 1993-1998 to the period 1999-2007 in both sexes.

In males, the 15 most common cancer sites were oral cavity and pharynx, esophagus, stomach, colon and rectum, liver, gallbladder, pancreas, lung, prostate, kidney, bladder, brain and central nervous system (CNS), thyroid, non-Hodgkin lymphoma (NHL), and leukemia (not in order). The 1-year, 5-year, and 10-year RSRs for these cancer sites increased from the period 1993-1998 to the period 1999-2007. The 5-year RSR for prostate cancer substantially increased from 62.5% during 1993-1998 to 78.9% during 1999-2007. Also, the 10-year RSR for prostate cancer substantially increased from 48.5% during 1993-1998 to 63.7% during 1999-2007. The 5-year RSRs for leukemia, oral cavity and pharyngeal, stomach and colorectal cancers increased more than 10% from the

Table 1. Trends in the 1- Year, 5-Year and 10-Year Relative Survival for Korean Men during 1993-2007 by Site

Site	Overall (1993-2007)				1993-1998				1999-2007			
	N	1-year	5-year	10-year	N	1-year	5-year	10-year	N	1-year	5-year	10-year
All sites	801,519	63.0	41.2	36.3	224,093	55.7	33.6	29.5	577,426	65.8	44.5	39.2
Oral cavity & pharynx	17,878	73.8	44.5	36.5	5,683	70.9	37.8	31.1	12,195	75.1	48.2	39.3
Esophagus	21,284	45.8	17.4	12.5	7,059	39.5	12.6	8.7	14,225	48.9	19.9	15.3
Stomach	190,436	72.1	53.3	49.3	57,610	65.3	44.5	41.1	132,826	75.1	57.6	53.4
Colon & Rectum	89,381	85.8	65.2	60.6	18,328	81.2	57.4	52.9	71,053	87.0	67.5	63.4
Liver	124,117	42.1	16.5	10.0	37,295	33.5	11.3	6.8	86,822	45.8	19.0	11.4
Gallbladder	20,568	47.2	21.8	18.3	6,108	42.5	19.0	16.0	14,460	49.2	23.0	19.3
Pancreas	19,781	23.7	7.8	6.2	5,134	20.3	7.6	6.0	14,647	24.9	7.8	6.1
Lung	126,167	40.0	13.3	10.4	36,127	35.4	11.0	8.6	90,040	41.8	14.2	10.8
Prostate	28,486	95.5	75.6	60.0	4,373	91.5	62.5	48.5	24,113	96.2	78.9	63.7
Kidney	14,688	83.2	69.8	64.0	3,424	78.7	63.8	58.3	11,264	84.6	71.8	66.0
Bladder	24,923	90.1	75.9	70.6	7,035	89.1	72.7	67.8	17,888	90.6	77.5	70.7
Brain & CNS	9,090	64.6	39.0	31.8	2,925	62.8	37.9	30.7	6,165	65.5	39.4	32.6
Thyroid	13,206	97.0	94.4	91.4	1,877	93.3	88.5	85.7	11,329	97.6	95.7	94.0
NHL	18,078	71.0	53.5	48.6	5,150	66.7	47.8	43.0	12,928	72.8	56.0	50.8
Leukemia	15,688	59.0	35.8	31.0	5,197	54.2	28.7	24.2	10,491	61.4	39.9	35.2
All other cancers	67,748	71.0	51.6	46.3	20,768	65.8	45.9	41.1	46,980	73.3	54.2	49.1

CNS, central nervous system; NHL, non-Hodgkin lymphoma

Table 2. Trends in the 1-Year, 5-Year and 10-Year Relative Survival for Korean Women during 1993-2007 by Site

Site	Overall (1993-2007)				1993-1998				1999-2007			
	N	1-year	5-year	10-year	N	1-year	5-year	10-year	N	1-year	5-year	10-year
All sites	647,963	77.6	61.0	56.4	170,706	73.0	54.6	50.5	477,257	79.2	63.5	58.9
Oral cavity & pharynx	6,018	84.9	65.2	58.3	1,744	83.9	61.8	55.3	4,274	85.3	66.7	60.0
Esophagus	1,906	49.6	27.1	20.7	646	46.9	22.6	17.1	1,260	51.0	29.4	20.6
Stomach	95,961	70.7	51.6	48.3	28,964	64.7	43.7	40.7	66,997	73.2	55.3	52.1
Colon & Rectum	68,156	83.2	61.5	56.8	15,617	79.5	55.4	50.9	52,539	84.3	63.6	58.9
Liver	38,801	43.2	17.6	11.9	10,805	36.1	13.5	9.2	27,996	46.0	19.2	13.1
Gallbladder	20,454	43.2	20.6	17.5	5,757	40.0	18.3	15.7	14,697	44.4	21.5	17.7
Pancreas	14,838	24.0	8.1	7.1	3,662	21.8	9.1	8.2	11,176	24.7	7.6	6.3
Lung	42,404	46.4	18.6	14.7	10,750	39.9	14.5	11.6	31,654	48.6	20.0	15.6
Breast	97,218	97.6	85.8	78.1	22,594	96.4	80.9	73.2	74,624	98.0	87.6	80.4
Cervix uteri	62,018	93.3	79.9	76.7	25,856	93.4	79.0	75.7	36,162	93.2	80.6	77.6
Corpus uteri	10,676	93.8	83.8	80.5	2,320	92.0	80.6	77.9	8,356	94.3	84.7	81.7
Ovary	17,646	84.1	60.2	53.5	5,323	82.4	59.0	52.8	12,323	84.8	60.6	52.7
Kidney	6,967	83.6	72.4	67.7	1,678	80.4	66.2	60.5	5,289	84.6	74.6	71.4
Bladder	6,085	83.3	67.6	62.3	1,648	83.3	66.4	60.9	4,437	83.3	68.0	63.6
Brain & CNS	7,640	65.9	41.2	34.4	2,304	63.4	39.4	33.0	5,336	67.0	42.2	35.2
Thyroid	79,239	98.8	98.1	96.4	10,336	97.2	95.4	93.6	68,903	99.1	98.6	97.6
NHL	12,807	74.4	58.5	53.6	3,378	70.7	51.4	46.5	9,429	75.8	61.5	57.1
Leukemia	12,343	58.1	37.1	33.4	4,031	53.2	30.1	26.7	8,312	60.4	41.1	37.9
All other cancers	46,786	72.9	54.1	48.5	13,293	68.1	48.1	43.2	33,493	74.9	56.7	50.6

CNS, central nervous system; NHL, non-Hodgkin lymphoma

period 1993-1998 to the period 1999-2007 and the 10-year RSRs for leukemia, stomach and colorectal cancers increased more than 10% over the same period (Table 1).

In females, the 18 most common cancer sites were oral cavity and pharynx, esophagus, stomach, colon and rectum, liver, gallbladder, pancreas, lung, breast, cervix uteri, corpus uteri, ovary, kidney, bladder, brain and CNS, thyroid, NHL, and leukemia (not in order). The 1-year, 5-year, and 10-year RSRs for most of these increased from the period 1993-1998 to 1999-2007 except for pancreas, cervix uteri and ovarian cancer. The 5-year and 10-year RSRs of pancreatic, the 1-year RSR of cervical, and the 10-year RSR of ovarian cancer decreased. The 5-year RSRs for stomach cancer, NHL, and leukemia increased more than 10% from 1993-1998 to 1999-2007 and the 10-

year RSRs for leukemia, NHL, stomach and kidney cancer increased more than 10% over the same period (Table 2).

The 1-year, 5-year, and 10-year RSRs for all cancers combined and for most of the cancer sites for women were higher than in men. However, the those for stomach, colorectal, gallbladder, and bladder cancer in men were higher than in women. The 5-year and 10-year RSRs for all cancers combined and for most cancer sites in younger individuals were higher than those in men and women 75 years of age or older during 1993-2007 (Tables 3 to 6). In men, for all cancers combined and for most cancer sites, the 5-year and 10-year RSRs increased from the period 1993-1998 to the period 1999-2007 by age group, although increasing rates of RSRs among men 75 years of age or older were lower than all other age groups (Tables 3 and

Table 3. Trends in 5- Year Relative Survival for Korean Adult Men during 1993-2007 by Site and Age Group

Site	20-44		45-54		55-64		65-74		75+						
	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007			
All sites	54.3	45.7	58.8	45.4	35.9	49.9	41.6	32.2	46.2	36.5	27.3	39.6	27.8	24.1	28.8
Oral cavity & pharynx	66.3	58.4	70.5	52.7	41.9	58.9	40.7	34.0	45.1	34.0	27.2	36.7	25.4	22.0	27.4
Esophagus	26.7	23.1	29.3	19.3	16.4	21.7	19.7	13.5	23.9	16.2	10.3	18.5	9.3	5.4	10.6
Stomach	61.7	56.0	65.1	61.8	52.6	66.5	56.8	45.8	62.9	48.0	35.2	53.0	28.8	22.0	30.7
Colon & Rectum	68.4	61.6	71.3	69.2	60.8	71.9	68.0	59.1	71.0	63.7	54.6	65.9	51.1	45.0	52.4
Liver	19.3	15.1	21.8	17.7	11.1	21.2	16.9	10.6	20.1	13.6	9.3	15.3	8.6	6.6	9.1
Gallbladder	36.5	35.0	36.8	30.0	25.4	32.4	24.9	20.2	27.5	18.8	15.0	20.3	11.3	7.8	12.5
Pancreas	17.9	16.1	18.7	12.2	12.5	11.8	7.3	6.0	8.0	5.5	4.8	5.7	3.5	4.1	3.4
Lung	24.1	19.1	26.9	19.8	15.2	22.4	16.3	12.3	18.5	10.8	8.1	11.8	6.0	6.0	5.9
Prostate	52.9	44.1	54.0	74.0	51.2	79.6	78.1	61.2	82.0	78.4	63.8	81.9	70.3	63.5	72.3
Kidney	85.4	79.9	87.3	76.7	70.3	78.7	66.9	58.2	70.0	58.9	51.1	61.0	41.8	40.8	42.2
Bladder	89.2	87.8	90.1	86.7	81.7	89.2	81.4	76.6	84.1	72.5	66.2	75.3	57.6	55.3	58.5
Brain & CNS	51.6	48.5	53.3	32.9	30.2	34.1	19.8	17.6	20.7	12.8	9.3	13.9	10.3	12.1	10.1
Thyroid	99.3	97.6	99.8	97.5	94.0	98.1	91.0	78.6	93.9	78.2	64.8	81.7	55.3	45.0	56.2
NHL	62.5	55.0	66.3	60.4	52.2	63.9	50.9	45.0	53.6	39.4	31.6	42.1	25.6	23.7	26.1
Leukemia	38.0	24.8	46.8	32.6	22.0	37.6	23.2	17.2	26.2	14.3	10.5	15.9	8.7	6.0	9.5
All other cancers	65.4	56.6	69.8	55.5	47.2	59.8	50.5	43.4	54.5	43.5	37.1	46.0	36.1	36.9	35.6

CNS, central nervous system; NHL, non-Hodgkin lymphoma

Table 4. Trends in 5-Year Relative Survival for Korean Adult Women during 1993-2007 by Site and Age Group

Site	20-44			45-54			55-64			65-74			75+		
	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007
All sites	78.7	71.6	81.9	73.6	63.3	77.5	60.2	51.2	64.4	45.0	36.9	47.9	27.2	25.0	27.8
Oral cavity & pharynx	80.2	77.9	81.3	70.5	63.5	73.6	65.7	62.3	67.5	51.1	43.0	54.4	40.5	40.8	40.0
Esophagus	51.4	41.7	59.5	42.2	37.0	44.5	32.6	24.4	39.0	27.6	19.9	31.8	12.5	10.5	13.3
Stomach	54.1	46.0	58.7	62.6	52.5	67.8	61.4	51.7	67.2	49.6	36.2	55.2	24.6	19.6	25.9
Colon & Rectum	65.9	57.1	70.0	69.5	61.6	72.7	68.4	60.7	71.5	60.6	52.7	63.1	41.6	37.4	42.6
Liver	28.7	23.2	31.9	24.1	16.0	28.5	19.4	13.5	22.3	13.0	8.8	14.3	7.1	6.9	7.0
Gallbladder	35.8	31.2	39.0	31.6	26.5	34.7	26.8	20.8	30.2	18.6	15.0	20.1	10.0	9.7	9.9
Pancreas	30.1	34.5	27.1	12.3	12.9	11.5	8.8	7.2	9.5	5.4	5.1	5.4	4.1	5.1	3.9
Lung	25.0	21.0	26.8	26.0	17.4	29.4	23.4	15.6	27.0	16.5	12.3	18.0	11.4	10.8	11.5
Breast	86.5	81.8	88.5	87.7	82.0	89.6	84.4	79.3	86.3	81.4	75.7	83.2	65.3	66.3	64.5
Cervix uteri	88.0	86.6	89.1	82.4	80.1	84.2	78.6	76.6	80.7	67.2	64.5	68.9	42.6	41.9	43.0
Corpus uteri	91.3	89.9	92.0	89.0	85.5	89.9	80.1	74.7	81.7	65.3	62.1	66.4	47.9	43.0	49.4
Ovary	76.6	74.7	77.6	61.2	56.7	62.8	49.7	41.5	53.6	37.0	37.0	36.6	25.6	32.8	23.9
Kidney	83.0	77.4	85.0	85.8	78.1	88.4	74.7	67.1	77.6	62.5	51.9	66.2	42.7	37.2	43.7
Bladder	84.5	78.7	87.3	84.0	86.4	82.6	79.5	78.3	80.3	68.6	61.7	71.4	45.8	43.2	46.8
Brain & CNS	55.7	49.5	59.4	42.6	37.9	44.7	29.4	27.3	30.2	20.1	18.8	20.0	17.7	11.2	18.7
Thyroid	99.8	99.5	99.8	99.6	98.1	99.9	97.6	91.5	98.9	90.1	80.3	92.1	65.2	50.4	68.1
NHL	71.2	59.9	76.2	70.8	59.0	75.5	58.9	48.4	63.7	43.0	39.3	44.4	29.6	29.2	29.9
Leukemia	40.7	30.0	47.4	36.7	23.8	43.7	25.5	15.9	31.0	16.8	9.4	19.9	10.5	11.5	10.4
All other cancers	68.8	64.3	71.4	60.4	50.2	65.2	51.8	40.9	57.4	47.4	38.5	50.6	42.8	39.4	43.6

CNS, central nervous system; NHL, non-Hodgkin lymphoma

Table 5. Trends in 10-Year Relative Survival for Korean Adult Men during 1993-2007 by Site and Age Group

Site	20-44			45-54			55-64			65-74			75+		
	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007
All sites	49.6	41.6	54.1	40.1	31.4	44.8	35.9	27.8	39.7	31.1	23.3	34.0	24.6	21.8	25.2
Oral cavity & pharynx	59.7	53.2	63.6	43.9	34.7	48.4	31.4	25.9	34.9	25.0	20.8	26.7	17.2	15.1	24.2
Esophagus	23.1	21.0	24.7	14.9	11.8	19.6	13.3	8.6	16.9	11.1	6.8	14.7	8.6	5.6	6.9
Stomach	58.2	52.8	61.4	57.8	48.8	63.5	52.4	42.2	58.0	42.8	31.3	48.2	24.4	19.6	25.9
Colon & Rectum	63.2	56.4	66.9	63.8	55.5	67.3	61.9	53.3	65.5	60.9	51.6	64.0	53.0	48.1	50.1
Liver	14.2	11.1	15.9	11.2	6.7	14.1	8.8	5.6	10.2	6.7	4.5	7.7	5.3	5.2	5.0
Gallbladder	33.2	31.1	35.9	24.8	20.7	26.4	21.3	17.3	23.7	14.6	12.0	16.5	10.7	8.1	9.8
Pancreas	13.7	11.4	14.7	9.9	10.1	10.2	5.3	4.7	4.6	4.4	3.8	4.8	4.1	4.5	4.2
Lung	21.3	16.8	23.0	16.1	12.5	17.5	12.6	9.4	14.3	7.9	6.0	8.2	4.7	5.3	3.9
Prostate	41.8	38.0	-	60.9	40.5	68.9	63.5	47.4	68.6	63.0	51.3	64.3	52.0	44.6	58.8
Kidney	80.5	74.4	84.1	70.4	63.4	75.0	59.5	52.8	56.1	53.6	45.5	62.3	35.4	35.9	42.5
Bladder	87.2	85.8	87.3	81.3	76.2	84.1	75.9	71.7	77.0	64.5	59.3	64.5	54.6	53.3	56.0
Brain & CNS	40.3	37.7	41.9	26.5	23.6	30.8	14.4	12.9	15.3	7.2	5.7	7.3	9.3	11.1	9.0
Thyroid	98.4	96.5	99.2	94.4	90.9	97.4	83.8	71.5	89.4	66.1	55.8	75.2	77.3	72.5	71.9
NHL	58.4	50.7	63.6	55.4	47.7	55.7	42.5	36.9	46.1	32.6	25.1	35.4	24.0	26.4	21.6
Leukemia	31.9	19.6	41.3	24.8	15.6	31.9	17.2	12.7	19.1	9.6	7.3	7.0	5.2	-	9.7
All other cancers	60.2	52.2	64.5	48.8	40.8	55.3	44.4	37.9	48.0	37.2	32.1	39.3	35.4	35.2	35.7

CNS, central nervous system; NHL, non-Hodgkin lymphoma

5). However, in the 5-year RSR for thyroid cancer among men 75 years of age or older, the increase was higher than those of age 20-44 and 45-54 (Table 3).

In women, the 5-year and 10-year RSRs for all cancers combined increased from the period 1993-1998 to the period 1999-2007 by age group, although increasing rates of RSRs among women 75 years of age or older were lower than all other age groups (Tables 4 and 6). However, the 5-year and 10-year RSRs for thyroid cancer among women 75 years of age or older was higher than those of all other age groups (Tables 4 and 6).

Figures 1 and 2 show that the long-term RSRs had different patterns according to the type of cancer among the seven most common cancers. Risk of death after five years among some of the cancers rarely increased, as

compared to the general population. However, among other cancers, especially female breast and male prostate cancer, there was a considerable risk of death for many years after diagnosis.

Discussion

This is the first report that details the long-term RSR for cancer in Korea using a nationwide population-based study. In our results, the 5-year and 10-year RSRs for all cancers combined and for most major cancers improved over time. Younger patients have a better outcome than older patients, and improvements of survival for young patients are also more significant than for older patients. While the improvement of survival for all cancers

Table 6. Trends in 10-Year Relative Survival for Korean Adult Women during 1993-2007 by Site and Age Group

Site	20-44		45-54		55-64		65-74		75+						
	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007	1993-2007	1993-1998	1999-2007			
All sites	74.3	67.5	77.3	68.6	58.9	72.6	54.7	46.3	59.0	39.5	32.5	42.3	25.2	23.2	25.5
Oral cavity & pharynx	73.4	72.0	72.5	61.3	56.5	63.3	59.0	55.6	60.7	42.3	33.4	49.3	37.3	37.1	45.9
Esophagus	47.4	39.5	49.0	39.9	36.2	22.6	27.5	20.8	33.2	16.0	9.6	20.4	5.1	3.6	7.1
Stomach	50.5	42.8	54.9	59.4	49.7	65.0	57.9	48.7	63.1	45.2	32.7	51.7	22.1	16.9	24.8
Colon & Rectum	60.7	52.2	64.7	63.7	56.6	66.4	62.7	54.8	66.4	56.0	48.8	57.8	41.5	37.4	41.1
Liver	23.6	19.0	26.1	17.4	10.9	22.7	11.9	8.6	13.5	6.8	4.9	7.2	5.1	4.6	5.8
Gallbladder	31.9	27.5	35.8	27.2	22.9	28.9	23.1	17.9	25.3	14.9	12.6	14.5	9.3	8.8	10.4
Pancreas	28.2	32.4	22.3	10.9	11.5	10.7	7.4	6.0	8.1	4.5	4.3	4.5	3.9	6.0	2.9
Lung	20.3	16.8	20.4	20.1	13.9	22.6	18.3	12.3	21.6	12.8	9.6	14.2	9.6	10.1	8.0
Breast	78.2	73.7	80.7	81.2	75.5	83.6	76.3	70.9	78.5	72.2	67.5	73.3	60.9	58.4	70.6
Cervix uteri	86.0	84.8	87.0	79.4	77.2	81.1	74.0	71.4	77.8	60.8	58.3	62.9	39.8	39.0	39.7
Corpus uteri	89.1	88.0	88.9	85.8	82.7	87.3	76.1	71.7	78.2	62.1	59.2	63.8	35.9	30.9	44.2
Ovary	71.7	69.9	71.7	51.1	48.1	51.4	39.5	33.2	42.0	29.4	29.4	27.5	23.8	33.6	20.0
Kidney	78.8	73.8	76.0	82.7	74.0	87.0	68.4	60.1	72.3	55.5	43.3	64.8	39.0	29.1	48.5
Bladder	81.8	75.8	85.2	79.3	83.0	77.8	73.9	72.1	75.6	60.8	54.2	65.1	42.9	39.0	44.9
Brain & CNS	45.3	41.3	46.4	34.5	29.6	40.4	22.1	18.4	26.2	16.0	17.3	14.8	11.6	15.6	6.1
Thyroid	99.4	99.1	99.8	98.4	96.5	99.6	94.4	88.0	96.8	80.7	70.9	84.1	59.3	41.5	75.5
NHL	68.6	57.4	73.8	64.9	53.4	70.0	52.0	41.4	59.3	35.4	32.5	35.1	27.1	26.9	28.5
Leukemia	36.7	26.4	44.4	31.6	19.2	40.6	20.8	12.4	27.4	9.8	5.4	11.1	9.4	10.5	8.7
All other cancers	63.6	59.5	66.3	53.1	44.3	56.7	44.5	34.6	51.6	40.7	33.3	43.8	40.4	39.4	34.6

CNS, central nervous system; NHL, non-Hodgkin lymphoma

combined was 9% to 10% for both males and females, that for patients aged 75 years or older was approximately 3%. Several studies have reported poor survival and the need for different treatment strategies for older cancer patients (Newcomb and Carbone, 1993; Goodwin et al., 1996; Chen et al., 2003; Brenner and Arndt, 2004; Ito et al., 2007; Storm et al.).

Long-term survival has two important implications. First, 10-year survival will reflect the positive advances seen in cancer care including earlier diagnosis and more effective therapy. Second, as rates of other major causes of death have been declining, life expectancy at the average age of cancer onset has risen, making long-term survival estimates more meaningful.

There is substantial variability in short- and long-term survival which is dependent on the form of cancer. Some cancers including gallbladder, pancreas, lung, thyroid and leukemia, have declined slightly between the 5 and 10 year periods under analysis. But, cancers for prostate, breast, and brain and CNS have consistently declined.

The improving survival rates can be attributed to early detection, as well as improved treatment (Gondos et al., 2009). To interpret trends in survival for cancer, we must consider not only the trends in survival but also the trends in incidence and mortality (Dickman and Adami, 2006).

Widespread use of the Prostate Specific Antigen (PSA) test in Korea may have led to the diagnosis and treatment of many asymptomatic prostate cancers that might never have been diagnosed during a man's lifetime (Evans and Moller, 2003). Age-standardized incidence and mortality for prostate cancer increased from 1999 to 2007 (Jung et al., 2010).

In both men and women, survival for stomach cancer increased (Tables 1 and 2). Age-standardized incidence and mortality for stomach cancer decreased from 1999 to 2007 (Jung et al., 2010). Korea has carried out a

nationwide stomach screening for men and women aged 40 years and older, with esophagogastroduodenoscopy (EGD) or upper gastrointestinal (GI) series, which may have led to early diagnosis and treatment of stomach cancers.

Survival of lung cancer increased slightly in both males and females (Tables 1 and 2). Lack of progress in early detection and treatment can explain this small improvement in the survival rate of lung cancer (Dickman and Adami, 2006).

Survival for liver cancer increased (Tables 1 and 2). Age-standardized incidence and mortality for liver cancer decreased from 1999 to 2007 in men and women (Jung et al., 2010). More patients are being diagnosed with asymptomatic disease via active screening employing serum alpha fetoprotein testing, abdominal ultrasound, and diagnostic imaging, and aggressive treatments including transplantation and resection of localized-stage tumors appear to be improving long-term survival in the US (Altekruse et al., 2009). Korea has also carried out a nationwide liver screening for men and women aged 40 years and older who were at high risk for liver cancer, such those with liver cirrhosis, HBsAg positive, or anti-HCV positive, together with alpha-fetoprotein (AFP) and ultrasonography tests, which may have led to early diagnosis and treatment of liver cancers (Yoo, 2008).

Survival for female breast cancer increased (Table 2). Age-standardized incidence and mortality for breast cancer increased from 1999 to 2007 (Jung et al., 2010). This trend is attributable to several factors (Dickman and Adami, 2006); the main reason for the increase in survival is due to early diagnosis by means of mammography screening and widespread use of systemic adjuvant treatment with chemotherapy, anti-estrogens or both (Berry et al., 2005; Elmore et al., 2005).

Survival for colorectal cancer increased (Tables 1

and 2). In the US, incidence and mortality for colorectal cancer decreased and survival for colorectal cancer increased. Their favorable temporal trends in colorectal cancer survival reflect real progress, probably with approximately equal contributions from improved surgical technique and from preoperative radiotherapy (Dickman and Adami, 2006). In Korea, improved surgical technique and preoperative radiotherapy would contribute to improvements in survival. However, age-standardized incidence and mortality for colorectal cancer increased from 1999 to 2007, and the main reasons behind this may ensue from a change in general nutrition in Korea where diets are now higher in energy (Park et al., 1996; Jung et al., 2010).

Long-term RSRs, which are followed up for 15 years, show that the 5-year survival rates cannot be equivalent to a cure in several cancers such as male prostate and female breast cancers. A previous study also reported similar results in the US (Wingo et al., 1998).

There are a number of limitations in our study. Firstly, we have only 15 years follow-up, which is relatively short for estimating long-term survival. Secondly, for cancers with a poor prognosis, such as pancreatic cancer, the numbers of survivors are too small for a reliable, 10-year survival rate. Thirdly, long-term survival should be interpreted with caution. The 10-year survival rates are based on patients who were diagnosed and treated at least 10 years ago and do not completely reflect the most recent advances in treatment. Also, we did not collect information on detection methods, coexisting morbidity, or treatment protocol and, therefore, interpretation of survival trends is limited.

In summary, among Korean men and women, the 5-year and 10-year RSR for all cancers combined and for most major cancer sites among females and younger males are higher than those of older males. Also, the 5-year and 10-year RSR for all cancers combined and for most of the major cancer sites improved over time. In patients 75 years or older, increases in the 5-year and 10-year RSR for all combined and for most major cancer sites are lower than all other age groups.

Cancer has become a very important public health concern in Korea, and the cancer burden will continue to increase. The results may help clinicians and patients assess long-term prognosis and can be used as an important source to effectively plan and evaluate the cancer control program in Korea.

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