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SPECIAL ARTICLE

Basic Facts of Breast Cancer in Korea in 2014: The 10-Year Overall Survival Progress

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We, the Korean Breast Cancer Society (KBCS), present the facts and the trends of breast cancer in Korea in 2014. Data on the total number of newly diagnosed patients was obtained from the Korea Central Cancer Registry database, other data were collected from the KBCS online registry database, and the overall survival data of patients were updated from Statistics Korea. A total of 21,484 female patients were newly diagnosed with breast cancer in 2014. The crude incidence rate and the age-standardized incidence rate (ASR) of breast cancer in female patients, including carcinoma *in situ*, were 83.4 cases and 63.9 cases per 100,000 women, respectively. The ASR showed an annual increase of 6.1% from 1999 to 2014; however, although the increase of the ASR had slowed since 2008, the incidence rate itself continuously increased. The proportion of early breast cancer increased consistently, and the pathological features changed accordingly. While breast-conserving surgery was mainly performed, the proportion of total mastectomy was slightly increased. The total number of breast reconstruction surgeries increased rapidly. The 5-year and 10-year overall survival rates for all stages of breast cancer patients were 91.2% and 84.8%, respectively. The overall survival rate of Korean patients with breast cancer was extremely high, compared with other developed countries. Thus, we consider that the clinical characteristics of breast cancer have changed over the past decade. A nationwide registry data will contribute to a better understanding of the characteristics of breast cancer in Korea.

Key Words: *Breast neoplasms, Korea, Online systems, Overall survival, Registries*

INTRODUCTION

Breast cancer is the most common cancer in women worldwide, with approximately 1.7 million cases a year, which accounts for 25.2% of female cancer patients. Breast cancer is also the most common cause of death among female cancer patients; approximately 520,000 patients died of breast cancer worldwide in 2012 [1,2]. Meanwhile, in Korea, breast cancer is the second most common cancer among women, next to thyroid cancer, and its incidence and mortality rate are steadily increasing. According to the statistics of the National Cancer Registration, more than 20,000 new cases of breast cancer were diagnosed in Korea in 2013, which accounts for 15.4% of all cancer cases in female patients [3,4]. In addition, according to Statistics Korea, the mortality rate due to breast cancer was 4.8 women per 100,000 in 2000, which had nearly doubled to 8.8 women per 100,000 by 2013 [5].

The Korean Breast Cancer Society (KBCS) started collecting national data on patients with breast cancer since 1996. Through this, KBCS conducted a large-scale epidemiological survey on breast cancer in Korea, highlighting different aspects from breast cancer in Western countries, which laid the foundation for the development of prophylactic and therapeutic methods to treat breast cancer in Korea. The breast

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cancer registration program, which started offline in 1996, was converted to an online registration project since 2001 [6-9] and has actively collected large-scale epidemiological and clinical data, which has used for research on breast cancer in Korean patients.

The aim of the current study was to investigate the national status of breast cancer in Korea in 2014, and to examine the characteristics, the age of onset, surgical method, and changes in stages of breast cancer in Korean women over 10 years. In addition, we also aimed to report the 5-year and 10-year overall survival rates of breast cancer patients in Korea.

DATA COLLECTION

Data sources

Data were collected on Korean women who were newly diagnosed with primary breast cancer between January 1, 2014 and December 31, 2014. Data on the total number of newly diagnosed breast cancer patients (including invasive cancer and carcinoma *in situ*) and their ages were collected from Korea Central Cancer Registry (KCCR). The KCCR was established by the Ministry of Health and Welfare in 1980. Since 1999, the KCCR has collected data on cancer incidence nationwide by integrating a hospital-based KCCR database with data from regional cancer registry programs [4].

Data of patients characteristics such as the cancer stage, type of surgery, pathological information (histological type and biologic markers), and survival information were obtained from the KBCS online breast cancer registry (http://registry.kbcs.or.kr/ecrf/login.php). Total overall survival data were updated from Statistics Korea until December 31, 2014 (http://kosis.kr) [5].

Statistical analysis

Incidence rates were expressed as crude rate (CR) and age-standardized rates (ASR) per 100,000 individuals. The CR was calculated as the total number of newly diagnosed breast cancer cases from data of the KCCR divided by the mid-year population of 2014. The mid-year population of 2014 was acquired from Statistics Korea [5]. The ASR were obtained from the KCCR data. The Korea 2000 standard population was used when calculating ASR. Trends in incidence rates were summarized as the annual percent change (APC). With the APC approach, the rates of cancer were assumed to change at a constant percentage of the rate of the previous year. The average annual percent change (AAPC) is a summary measure of the trend over a prespecified fixed interval [10]. The AAPC is usually applied to use a single number to describe the average APCs over a period of many years. We used the join-

point regression model (version 4.2.0.2) developed by the U.S. National Cancer Institute [11] to analyze in which years there was a significant change in ASR. This program is a Windows-based statistical software that analyzes joinpoint models [10]. Joinpoint regression method identifies changes in data trends by straight light segments joined at the "joinpoint." At the "joinpoint," the incidence rate trend changes its slope statistically significantly [12]. The APC and corresponding 95% confidence interval (CI) were calculated for each line segment, and the AAPC of total period (i.e., from 1999 to 2014) was estimated. We also analyzed the trends in the proportion of stages, biological markers, and median age using linear regression analysis. A p-value < 0.05 was regarded as statistically significant (95% level of confidence). Data analysis was performed using SPSS Statistics version 18.0 (SPSS Inc., Chicago, USA). The life-table, Cutler-Ederer method was used to estimate survival rates. The stage-specific overall survival was compared using Gehan's generalized Wilcoxon test.

BASIC FINDINGS OF KOREAN BREAST CANCER IN 2014

Total number of newly diagnosed breast cancer patients

A total of 21,484 patients were newly diagnosed with breast cancer in 2014. Among these, 18,381 patients had invasive breast cancer and 3,103 had carcinoma *in situ*. There were 82 breast cancer cases in male patients, including carcinoma *in situ*, which accounted for 0.4% of the total number. The CR and ASR of breast cancer in female patients, including carcinoma *in situ*, in 2014, were 84.3 and 63.9 cases per 100,000 women, respectively.

Age distribution

Analysis of the KBCS registry data and the KCCR data gen-

Table 1. Age distribution of newly diagnosed breast cancer patients in Korea

Age (yr)	KBCS registry data No. of patients (%)	KCCR data No. of patients (%)
<20	2 (0.01)	6 (0.01)
20–29	114 (1.0)	202 (0.9)
30–39	1,233 (10.5)	2,264 (10.5)
40–49	4,166 (35.6)	7,602 (35.4)
50–59	3,653 (31.2)	6,550 (30.5)
60–69	1,641 (14.0)	2,967 (13.8)
70–79	692 (5.9)	1,495 (7.0)
≥80	113 (1.0)	398 (1.9)
Unknown	76 (0.7)	0
Total	11,690 (100.0)	21,484 (100.0)

KBCS = Korean Breast Cancer Society; KCCR = Korea Central Cancer Registry.

erated equivalent results in terms of the age distribution of newly diagnosed patients (Table 1). According to the KBCS registry data, the median age at diagnosis was 50 years; the youngest patient was 15 years old, and the oldest was 114 years old. The age group with the highest number of newly diagnosed breast cancer cases was the 40 to 49 years old age group (7,602 cases, 35.4% of total cases), followed by the 50 to 59 years old age group (6,550 cases, 30.5% of total cases).

Surgery and staging

Data about surgical methods were obtained from the KBCS online registry. Among 11,653 patients, the most frequent surgical method was breast-conserving surgery (BCS; 7,573 cases, 65.0% of total cases), followed by total mastectomy (3,967 cases, 34.0% of total cases) (Table 2). Further, breast cancers were most frequently diagnosed at stage I (41.3% of total cases), followed by stage II (32.4%), stage 0 (12.0%), and stage III (8.8%). Stage IV only accounted for a small portion of total cases (133 cases, 1.1% of total cases) (Table 3).

Pathology and biological markers

Among 10,120 patients whose pathological results were reported in the online registry, invasive ductal carcinoma was the most common histological type, followed by ductal carcinoma *in situ* and invasive lobular carcinoma (Table 4). The proportions of patients with tumors that were positive for estrogen receptor (ER) and progesterone receptor (PR) expression were 74.1% and 62.4%, respectively. When c-erb B2 expression was identified, 41.4% of all patents had negative im-

munohistochemical (IHC) staining in the tumor, and 18.9%, 20.4%, and 19.1% of all cases had an IHC stain rating of 1+, 2+, and 3+, respectively (Table 5).

CHANGING PATTERNS OF BREAST CANCER IN KOREA

Incidence

The number of newly diagnosed breast cancer patients in Korea has continuously increased over the last decade. In 2014, there were 21,402 newly diagnosed breast cancer cases in female patients, which was about 3.6 times higher than the 6,025 cases that were reported in 1999 (255.2% increase; $R^2 = 0.995$, $p < 0.001$) (Figure 1). The CR of breast cancer in female patients in Korea in 2014, including cases of carcinoma *in situ*, was 84.3 cases per 100,000 women. Analysis of the individual breast cancer types revealed that the CR in 2014 of invasive cancer was 72.1 cases per 100,000 women, which was

Table 4. Histological types

Histologic type	No. of patients (%)
Ductal carcinoma *in situ*	1,302 (12.9)
Invasive ductal carcinoma	7,893 (78.0)
Lobular carcinoma *in situ*	67 (0.7)
Invasive lobular carcinoma	429 (4.2)
Paget's disease (pure form)	8 (0.1)
Malignant phyllodes tumor	29 (0.3)
Lymphoma	1 (0.01)
Sarcoma	2 (0.01)
Unknown	389 (3.8)
Total	10,120 (100.0)

Table 2. Surgical management of newly diagnosed breast cancer patients

Surgery	No. of patients (%)
Mastectomy	3,967 (34.0)
BCS	7,573 (65.0)
Others	61 (0.5)
Unknown	52 (0.5)
Total	11,653 (100.0)

BCS = breast-conserving surgery.

Table 3. Stage distribution of newly diagnosed breast cancer patients

Stage	No. of patients (%)
0	1,398 (12.0)
I	4,824 (41.3)
II	3,787 (32.4)
III	1,027 (8.8)
IV	133 (1.1)
Unknown	521 (4.5)
Total	11,690 (100.0)

Table 5. Biological markers

Biologic marker	No. of patients (%)
ER	
Negative	2,538 (25.7)
Positive	7,326 (74.1)
Unknown	17 (0.2)
Total	9,881 (100.0)
PR	
Negative	3,252 (37.5)
Positive	5,407 (62.4)
Unknown	10 (0.1)
Total	8,669 (100.0)
c-erb B2	
Negative	3,957 (41.4)
Weak (1+)	1,803 (18.9)
Intermediate (2+)	1,954 (20.4)
Strong (3+)	1,830 (19.1)
Unknown	17 (0.2)
Total	9,561 (100.0)

ER = estrogen receptor; PR = progesterone receptor.
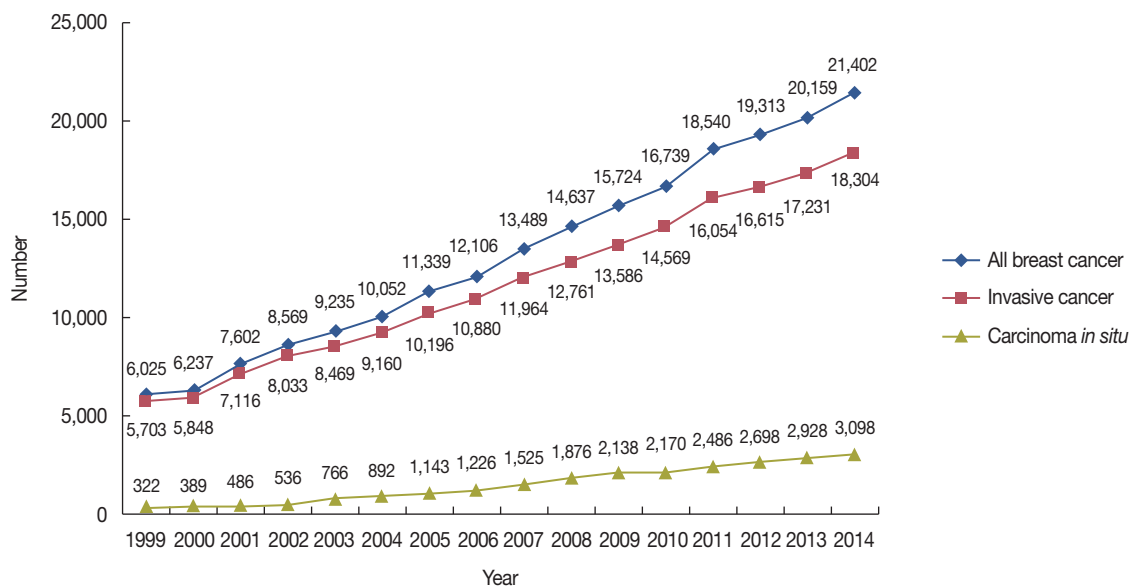
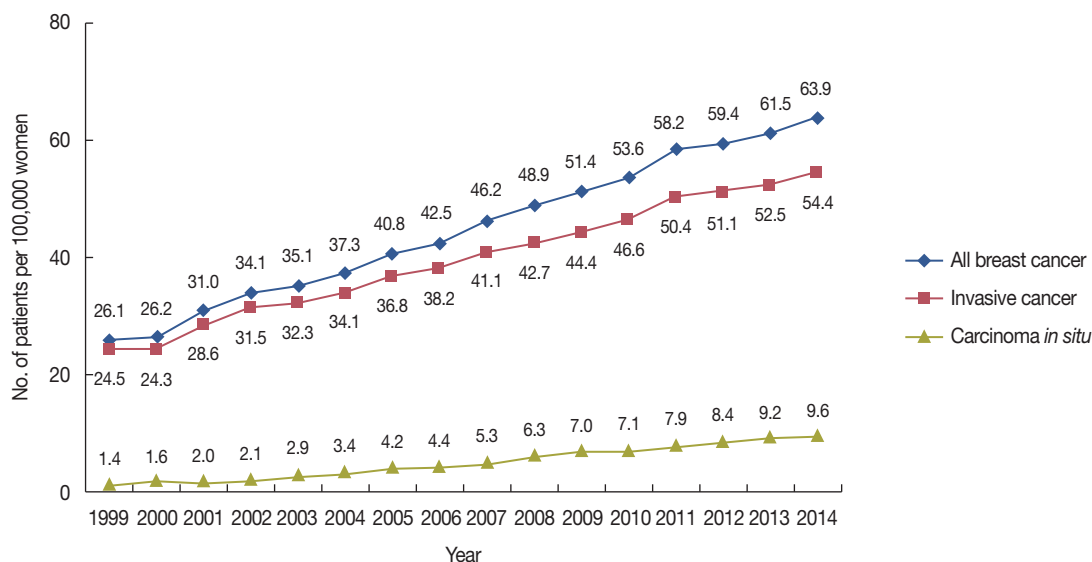**Figure 1.** Number of newly diagnosed Korean female breast cancer patients.

Figure 2. Trends in age-standardized incidence rates of Korean female breast cancer from 1999 to 2014.

three times higher than the 24.3 cases reported in 1999 (196.7% increase; $R^2 = 0.992$, $p < 0.001$). The CR of carcinoma *in situ* showed a marked increase of 8.7 times, from 1.4 cases per 100,000 women in 1999 to 12.2 cases per 100,000 women in 2014 (771.4%; $R^2 = 0.984$, $p < 0.001$). The CR of invasive cancer increased from 1999 through 2014, with an AAPC of +7.1%, and the CR of carcinoma *in situ* significantly increased with an AAPC of +15.6%. The CR of all breast cancer cases (invasive and carcinoma *in situ*) increased with an AAPC of +8.2%. Moreover, the ASR for female breast cancer, including

carcinoma *in situ*, increased from 26.1 per 10,000 in 1999, to 63.9 per 10,000 in 2014 (AAPC was +6.1%) (Figure 2). The ASR of invasive breast cancer in particular increased from 1999 to 2014 with an AAPC of +5.5%, while the ASR of carcinoma *in situ* increased from 1999 to 2014 with an AAPC of +13.5% (Table 6).

In all breast cancer cases that were analyzed there was 1 joinpoint in 2008. The ASR for all breast cancer cases until 2008 (APC, +7.2%; 95% CI, 6.3%–8.2%) had increased more rapidly than between 2008 and 2014 (APC, +4.5%; 95% CI,
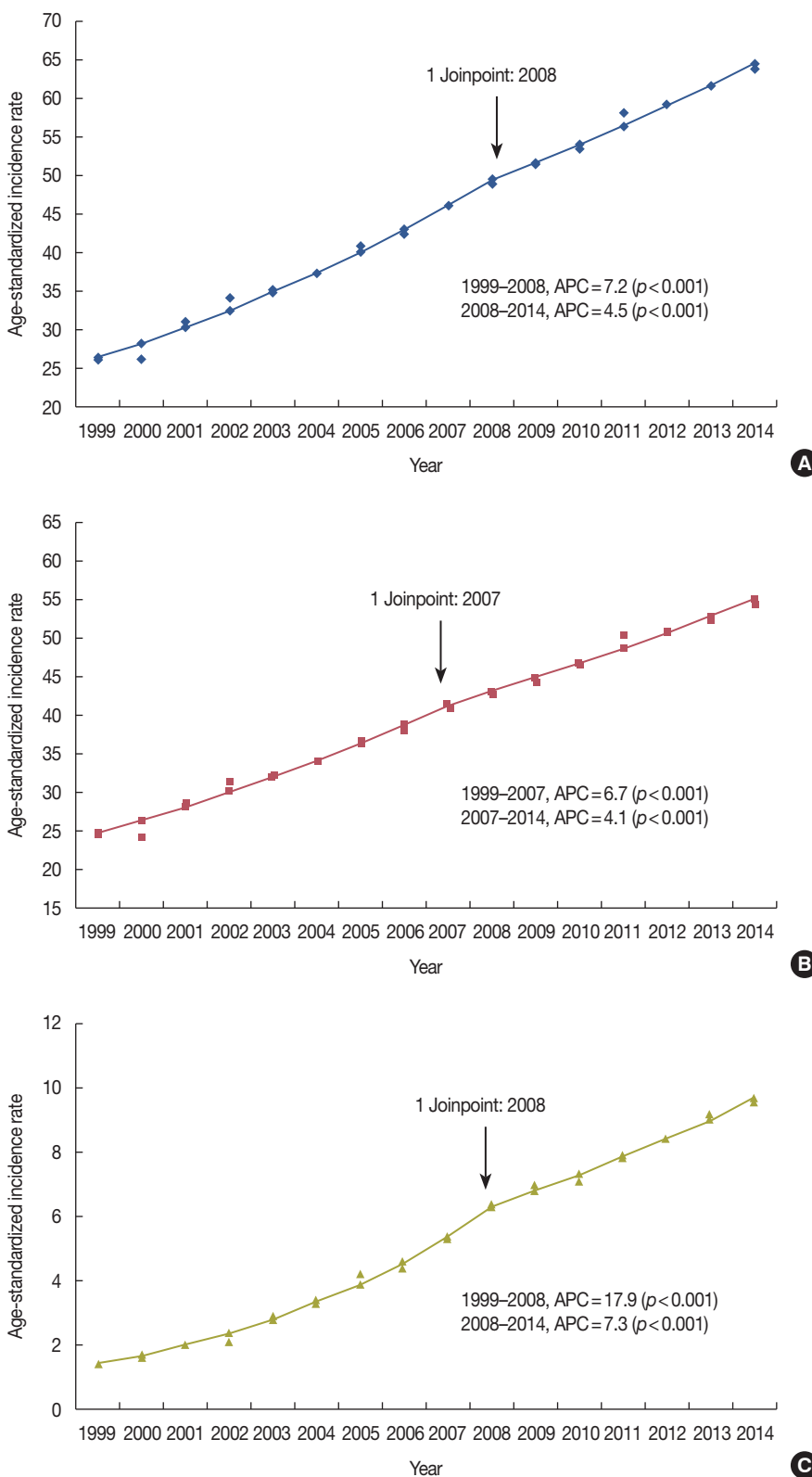
Figure 3. Joinpoint regression analysis in age-standardized incidence rates of Korean female breast cancer from 1999 to 2014. (A) All breast cancer (invasive cancer+carcinoma *in situ*). (B) Invasive breast cancer. (C) Ductal carcinoma *in situ*.
APC=annual percent change.

Table 6. Trends in age-standardized incidence rates for breast cancer according to joinpoint analysis (1999–2014)

	AAPC 1999–2014	Trend 1				Trend 2			
		Period	APC	95% CI		Period	APC	95% CI	
				Lower	Higher			Lower	Higher
All breast cancer	+6.1*	1999–2008	+7.2*	6.3	8.2	2008–2014	+4.5*	3.5	5.5
Invasive breast cancer	+5.5*	1999–2007	+6.7*	5.5	7.9	2007–2017	+4.1*	3.2	5.1
Carcinoma *in situ*	+13.5*	1999–2008	+17.9*	15.6	20.2	2008–2014	+7.3*	6.0	8.6

AAPC = average annual percent change (%); APC = annual percent change (%); CI = confident interval.
*The APC or AAPC is significantly different from zero (*p* < 0.05).
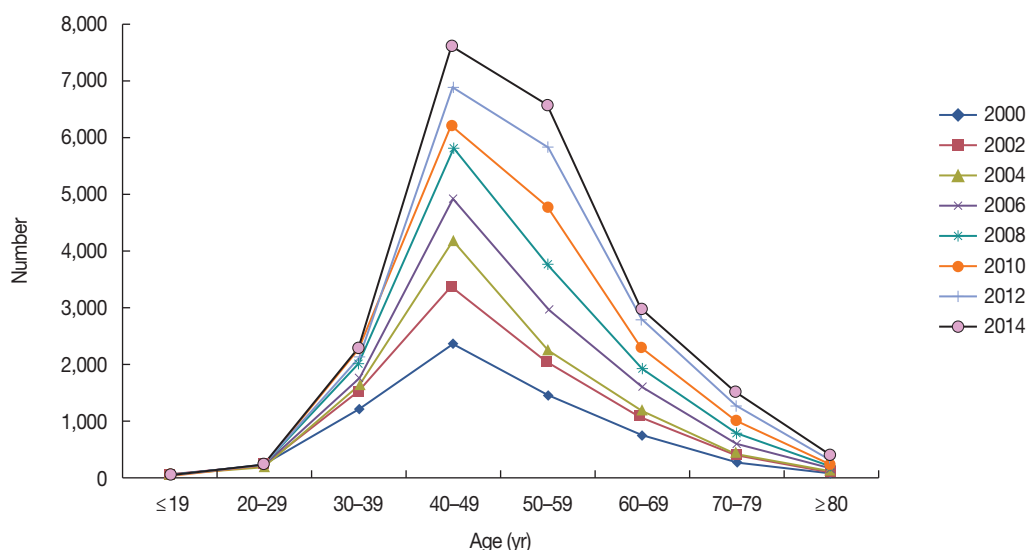
Figure 4. Trends in age distribution pattern of Korean female breast cancer from 2000 to 2014.

3.5%–5.5%). Table 6 and Figure 3 shows the trends in breast cancer incidence in Korea according to invasiveness. For invasive breast cancer, there was 1 joinpoint at 2007. An increase in the ASR, with an APC of +6.7% (95% CI, 5.5%–7.9%), was observed until 2007. Thereafter the increase in ASR had slowed down, with an APC of +4.1% (95% CI, 3.2%–5.1%). For carcinoma *in situ*, there was 1 joinpoint at 2008. A continuous significant increase of the ASR of carcinoma *in situ* was observed with an APC of +17.9% (95% CI, 15.6%–20.2%) until 2008; thereafter the ASR increase had slowed with an APC of +7.3% (95% CI, 6.0%–8.6%) (Table 6, Figure 3).

Age distribution and median age at diagnosis

We analyzed the trends in the number of breast cancer cases by age from 2000 to 2014. In 2014, the largest number of newly diagnosed cases were in women aged 40 to 49 years (7,602 cases, 35.4%), followed by those aged 50 to 59 years (6,550 cases, 30.5%), which were followed by those in their 60s, 30s, and 70s, according to decreasing frequency (Table 1). Despite the increased breast cancer incidence and age at diagnosis, however, the age distribution pattern was similar to that

recorded in the past (Figure 4).

The median age at diagnosis was 47 years in 2002, which gradually increased to 50 years in 2011, and was maintained at 50 years in 2014. The proportion of postmenopausal women with breast cancer rose from 40.6 % in 2002 to 52.1% in 2014 (28.3% increase; R² = 0.921, *p* < 0.001). Thus, postmenopausal women accounted for more than half of the total cases of breast cancer since 2011 (Figure 5).

Biologic markers and stage distributions

The proportions of both ER- and PR-positive breast cancer patients has consistently increased since 2002, from 58.2% to 74.1% in 2014 (27.3% increase; R² = 0.975, *p* < 0.001), and 50.7% to 62.4% in 2014 (23.1% increase; R² = 0.840, *p* = 0.001), respectively. In terms of the distribution of cancer stage, the proportion of patients with stage 0 and stage I breast cancer has steadily increased from 2002 and accounted for more than half of the total breast cancer cases since 2010. Specifically, the proportion of stage 0 cancer patients increased from 7.0% to 12.5% (78.6% increase; R² = 0.812, *p* = 0.002), while that of stage I cancer patients increased from 31.1% to 43.2% (38.9%
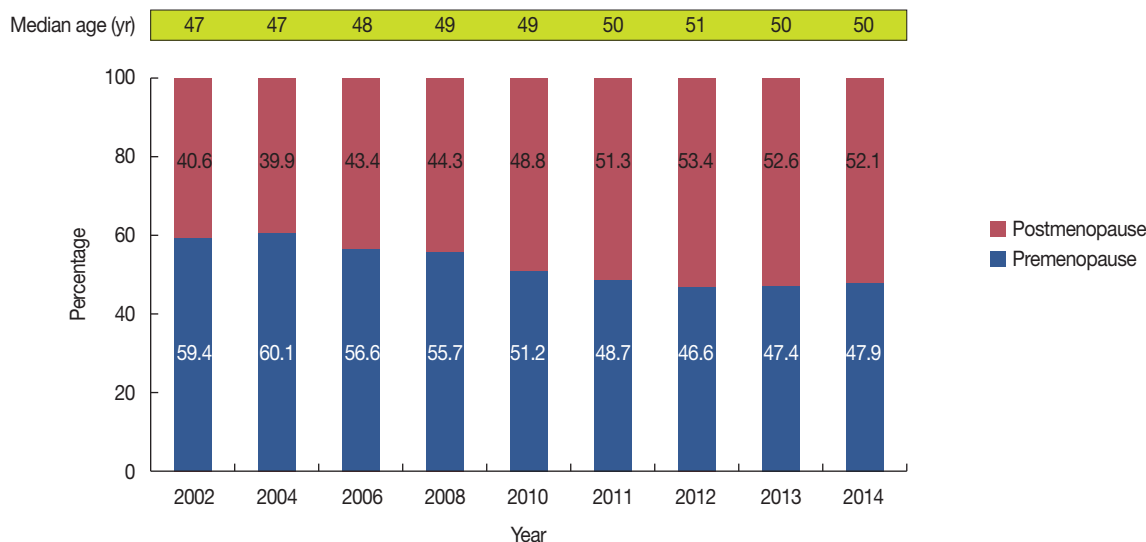
Figure 5. Trends in the median age at breast cancer diagnosis in Korea and the ratio of postmenopausal to premenopausal women at diagnosis.
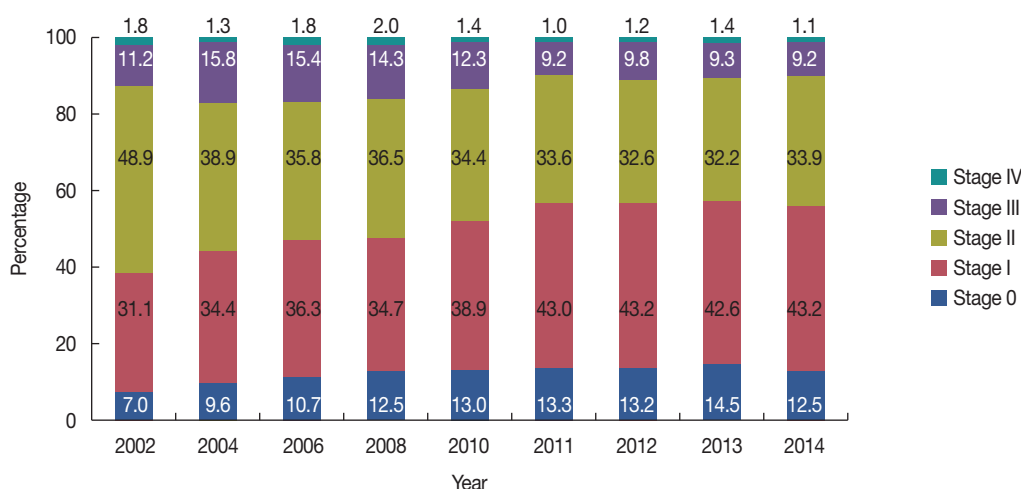

Figure 6. Changes in the stage distribution of Korean breast cancer.

increase; $R^2 = 0.915$, $p < 0.001$). On the contrary, the proportion of patients with stage II to IV cancers decreased from 61.9% to 44.2% over the same period (28.6% decrease; $R^2 = 0.952$, $p < 0.001$) (Figure 6).

Surgical patterns

Patterns in the surgical treatment of breast cancer were observed between 2002 and 2014. Although total mastectomy was the most common breast cancer operation in 2002, the number of breast cancer patients undergoing BCS and total mastectomy has reversed since 2006. While the proportion of patients who underwent total mastectomy decreased from 61.3% in 2002 to 32.3% in 2012 (47.3% decrease; $R^2 = 0.984$, $p < 0.001$), the proportion of patients who was performed

BCS increased from 37.6% in 2002 to 67.2% in 2012 (78.2% increase; $R^2 = 0.987$, $p < 0.001$). However, since 2013, the number of patients undergoing total mastectomy gradually increased from 32.3% in 2012 to 34.0% in 2014 (5.2% increase; $R^2 = 0.794$, $p = 0.299$) and those undergoing BCS slightly decreased from 67.2% in 2012 to 64.9% in 2014 (3.4% decrease; $R^2 = 0.783$, $p = 0.309$) (Figure 7). The number of breast reconstruction performed after total mastectomy markedly increase from 380 cases in 2002 to 1,279 cases in 2014 (236.6% increase; $R^2 = 0.923$, $p < 0.001$) (Figure 8).

Five-year and 10-year overall survival rates

The stage-specific overall survival rates were calculated utilizing the online registry data from 2001 to 2012. The median
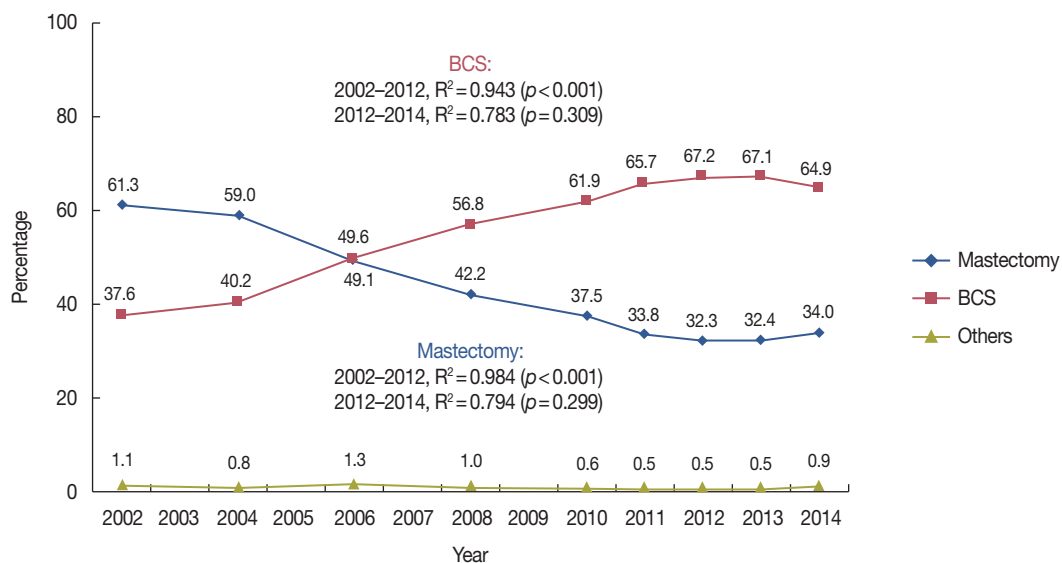
Figure 7. Changes in the surgical management of breast cancer.
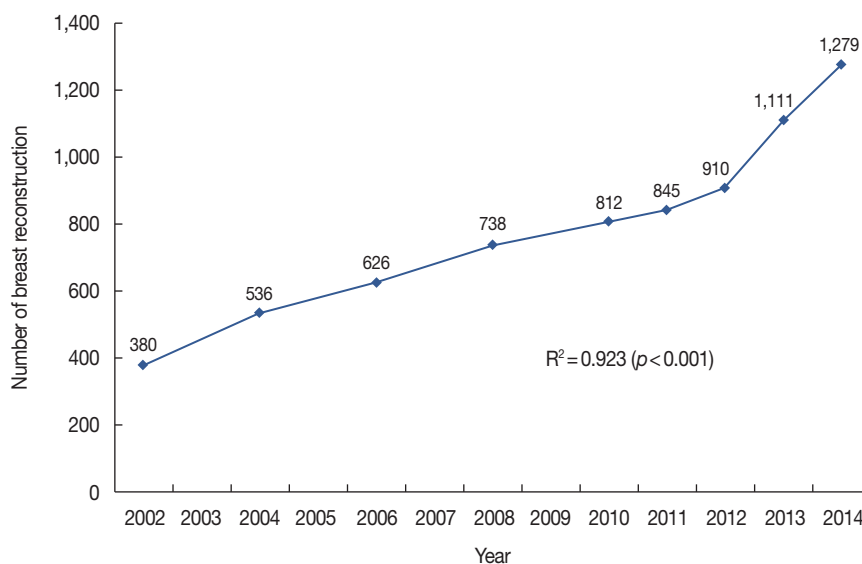BCS = breast-conserving surgery.

Figure 8. Changing trends in breast reconstruction in patients with breast cancer surgery.

Table 7. Stage-specific 5- and 10-year overall survival rates (2001–2012, Korean Breast Cancer Society registry data)

Stage	No. of patients	No. of events	5-Year survival rate (%)	10-Year survival rate (%)
0	12,285	266	98.3	95.4
I	39,284	1,557	96.6	92.7
II	40,024	3,951	91.8	84.8
III	13,774	6,544	75.8	63.4
IV	1,619	1,029	34.0	22.2
Unknown	2,998	343	-	-
Total	109,988	10,690	91.2	84.8

follow-up period was 72.7 months. Survival information for 109,979 patients was obtained from Statistics Korea. Through all stages, the 5-year and 10-year overall survival rates of breast cancer were 91.2% and 84.8%, respectively. For stage 0 breast cancer, the 5-year and 10-year overall survival rates were 98.3% and 95.4%, respectively. For the rest of the breast cancer stages, the 5-year and 10-year overall survival rates were 96.6% and 92.7% for stage I, 91.8% and 84.8% for stage II, 75.8% and 63.4% for stage III, and 34.0% and 22.2% for stage IV, respectively (Table 7).

DISCUSSION

According to the 2014 World Cancer Report, the incidence of cancer was greater in high-income countries, such as Korea, and countries in North America and Western Europe. The incidence and mortality rate of breast cancer have increased worldwide; breast cancer incidence is the highest among cancers in female patients globally, and is the most common cause of death as it accounts for 14.7% of female patients who die from cancer [2]. The incidence of breast cancer in Korea has increased steeply, and the ASR in 2012 reached 52.1 per 100,000 people, which was higher than Japan (51.5 per 100,000 peoples), and ranked top among East Asian countries. The global ASR is 43.3 per 100,000 people, and the average breast cancer incidence in East Asian countries, including China, Mongolia and North Korea, is 27 per 100,000 [1].

The KBCS has regularly presented the incidence and the trends of the characteristics of breast cancer in Korea, combining it with a nationwide survey, until 2016 [7,8]. From 2017, we substituted the KCCR database for the nationwide survey data about the incidence of breast cancer between 1999 and 2014. Thus, we investigated the incidence and basic data of Korean breast cancer in 2014 using KBCS registry and KCCR database, and analyzed the characteristics of breast cancer and changes in its treatment methods in recent years. While GLOBOCAN 2012 (an international report) [1] and the data from the Statistic Korea are based only on invasive breast cancer, the current study is the only report on Korean breast cancer including carcinoma *in situ* and invasive breast cancer.

In this study, the annual trends of patients with breast cancer were quantified as APC and AAPC of the ASR. The ASR of breast cancer in Korea has increased from 26.1 per 100,000 people in 1999 to 63.9 per 100,000 people in 2014, with an AAPC of 6.1%. In the United States, breast cancer incidence has been maintained without a major change since 2003 with an AAPC of 0.2% [13]. Although the reasons for the rising trend of breast cancer incidence in Korea are not completely understood, it is likely to reflect birth-cohort effects, changes

in reproductive factors (early menarche, late child bearing, and having fewer children), diet (i.e., consumption of high calorie food), obesity, and the introduction of screening programs. [6,9,14].

There was a fine change in the incidence of breast cancer in female patients in Korea between 1999 and 2014; there was one joinpoint in the ASR of breast cancer (i.e., all, invasive cancer and carcinoma *in situ*). The APC of the ASR of all breast cancer decreased during the latter period (from 7.5% in 1999–2008 to 4.5% in 2008–2014). In particular, the APC of ASR of invasive cancer had slightly declined since 2007 (from 6.7% in 1999–2007 to 4.1% in 2007–2014) and the APC of carcinoma *in situ* dropped during the second period (from 17.9% in 1999–2008 to 7.3% in 2008–2014). In Japanese studies, the trend in breast cancer incidence was continuously increasing without any joinpoint between 1985 and 2010. The APC of the ASR for invasive breast cancer was 3.9% (95% CI, 3.7%–4.1%) without a joinpoint. Also, the APC of female breast cancer incidence including carcinoma *in situ* has increased since 2002 (3.8% in 1985–2002, 95% CI, 3.4%–4.2%; and 5.9% in 2002–2010, 95% CI, 5.0%–6.8%) [8,15]. The APC of female breast cancer incidence rate remained stable in the United States (1.3% in 1992–1999, -2.2% in 1999–2004, and 0.2% in 2004–2010) [13]. Thus, the incidence of breast cancer in Korea was more steeply increasing than in Japan and the United States. The actual declining trend in breast cancer incidence in Korea will need to be followed.

The analysis of the age of Korean women with breast cancer in 2014 showed that patients in their 40s represented the highest population at 35% of all cases, followed by those in their 50s, 60s, 30s, and 70s. These results were similar to trends that were seen since 1999. According to the incidence curve by age, while breast cancer incidence in U.S. women increased with age, the highest incidence in Korean women was observed between the ages of 40 and 49 years which then decreased for those aged over 50 years, showing an inverted V-shape peaking around 50 years of age. Although the incidence by age in Japan was similar to that in Korea, an intermediate form of the incidence curve between those of Korea and the U.S. was observed in Japan [1].

The consistent clinical facts derived from the current study were as follow. First, the number of patients with postmenopausal breast cancer has surpassed half of the total number since 2011, and accounted for 52.1% of all breast cancer patients in 2014. Second, the ratio of early breast cancer (stage 0, I) increased gradually from 38.1% of total breast cancer in 2002 to 55.7% of cases in 2014. Third, neither the proportion of classifications according to histological type nor the proportion of patients who had cancer with +3 expression of c-erbB-2

had changed in 2014. Finally, although the proportion of patients with ER- and PR-positive breast cancer had steadily increased until 2013, no further increase was observed in 2014.

Meanwhile, we found an interesting change in the surgical methods of breast cancer. Patients undergoing BCS increased steadily from approximately 5% in the late 1980s [16], to 56.8% in 2008, exceeding the number of patients undergoing mastectomy. These trends continued until 2012 as the proportion of BCS patients reached the twice that of mastectomy patients (67.2% vs. 32.3%) [7]. The proportion of patients undergoing BCS in 2013 did not increase anymore, and showed a very slight reduction to 67.1%. In contrast, the proportion of patients undergoing mastectomy decreased steadily until 2012, and then increased slightly to 32.4% in 2013 [8]. The trends in surgical methods in 2014 showed a further decrease in the proportion of patients undergoing BCS to 67.1% and an increase in those undergoing mastectomy (i.e., 34%). Although these results were not statistically significant, the change in pattern of surgical methods should be followed in the future.

Such a reversal of surgical patterns was seen in the surgical trends of the U.S. as well. The Surveillance, Epidemiology and End Results (SEER) program showed that the rate of mastectomy dropped from 40% in 2000 to 36% in 2006, but then rose again to 38% by 2008 [17,18]. These changes were attributed to a wider availability of breast magnetic resonance imaging, increased genetic testing, shared decision making with patients, and the surgical choice like breast reconstruction [19-21]. In addition, studies on breast cancer in Japan between 2004 and 2011 showed that although the annual rates of patients treated with BCS increased until 2006, this increase stopped in 2007 and plateaued at approximately 60% thereafter. The proportion of modified radical mastectomy steadily decreased between 2004 and 2011 while that of simple mastectomy increased during the same period [22].

Cases of breast reconstruction following total mastectomy increased sharply over the last 12 years in Korea, and the number of reconstruction surgery in 2014 was 3.4 times that of 2002. In the United States, the performance of reconstruction increased dramatically from 46% of patients in 1998 to 63% in 2007, while the proportion of bilateral mastectomy increased from 3% to 18%, between those respective years. A total of 76% of patients with bilateral mastectomy underwent reconstruction, which was significantly higher than the reconstruction rates of ipsilateral mastectomy cases [23]. This could be attributed to the fact that breast reconstruction in breast cancer patients has been partly covered by National Health Insurance since 2015 in Korea, and is likely to keep increasing in future.

The overall survival data for breast cancer patients enrolled in the KBCS registry between 2001 and 2012 had distinct differences when compared to the international data (GLOBOCAN study) or KCCR survival data. First, the KBCS registry included all overall survival data of invasive breast cancer and *in situ* carcinomas, while the survival data of GLOBOCAN and the KCCR were only for invasive breast cancer. The 5-year total overall survival rate of our study was 91.2%, while the 10-year total overall survival was 84.8%. Second, we had data from a single population-based registry, in which information regarding stages was well documented, with almost no missing values. The stage-specific 5-year overall survival rates were 98.3% for stage 0 breast cancer, 96.6% for stage I, 91.8% for stage II, 75.8% for stage III, and 34.0% for stage IV. Thirdly, this report included the 10-year overall rate of breast cancers, which for early stages (i.e., Stage 0 and Stage I) was over 90%. The 5-year and 10-year overall survival rates of patients enrolled between 1993 and 2002 studied by the KBCS were 81.2% and 71.3%, respectively [24], indicating that the survival rate of breast cancer increased significantly over 10 years.

According to the SEER data from the U.S. National Cancer Institute, the 332,526 patients were diagnosed with breast cancer between 2006 and 2012, and their 5-year relative survival rate was 89.7% [25]. Data from the National Cancer Center Japan showed that the 5-year relative survival rate of patients with breast cancer, who diagnosed between 2006 and 2008, in Japan was 91.1% [26]. Thus, our study was able to confirm the high overall survival of Korean breast cancer patients.

CONCLUSION

The fundamental characteristics of breast cancer in Korea have undergone several changes in recent years until 2014. The clinical features of breast cancer have changed distinctively and the survival rate has improved greatly. A continuous study of the nationwide registry data will provide better defined information that can be useful to understand the characteristics of breast cancer in Korea.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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