SPECIAL ARTICLE

The Basic Facts of Korean Breast Cancer in 2012: Results from a Nationwide Survey and Breast Cancer Registry Database

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The Korean Breast Cancer Society has constructed a nationwide breast cancer database through utilization of an online registration program. We have reported the basic facts about breast cancer in Korea in 2012, and analyzed the changing patterns in the clinical characteristics and management of breast cancer in Korea over the last 10 years. Data on patients newly diagnosed with breast cancer were collected for the year 2012 from 97 hospitals and clinics nationwide using a questionnaire survey, and from the online registry database. A total of 17,792 patients were newly diagnosed with breast cancer in 2012. The crude incidence rate of female breast cancer, including invasive cancer and *in situ* cancer, was 70.7 cases per 100,000 women. The median age at diagnosis was 51 years, and the proportion of postmenopausal women was higher than that of premenopausal women among those diagnosed with breast cancer. The proportion of cases of early breast cancer increased continuously, and breast-conserving surgery was performed in more cases than total mastectomy in that same year. The total number of breast reconstruction surgeries increased approximately 3-fold over last 10 years. The 5-year overall survival rate for all stages of breast cancer patients was extremely high. The clinical characteristics of breast cancer have changed in ways that resulted in high overall survival over the past 10 years in Korea, and the surgical management of the disease has changed accordingly. Analysis of nationwide registry data will contribute to a better understanding of the characteristics of breast cancer in Korea.

Key Words: *Breast neoplasms, Korea, Online system, Registries*

INTRODUCTION

Cancer care has become a global health priority. Cancer is the leading cause of death worldwide, and it is responsible for one in four deaths [1,2]. Breast cancer, the second most common cancer in Korean women, has become a major health problem in Korea. The age-standardized incidence rate of invasive breast cancer has increased continuously over time, reaching 43.8 cases per 100,000 women in 2011 [3], and the estimated age-standardized prevalence of female breast cancer is 375.2 per 100,000 women [4].

The Korean Breast Cancer Society (KBCS) created a nationwide, hospital-based, breast cancer registry in 1996, and the details of its history, objectives, and activities have been well documented [5-11]. Since the development of an online registration program in 2001, the database has been actively utilized for various studies on breast cancer in Korea.

The aim of the present study was to investigate the basic facts about breast cancer in Korea in 2012, and to analyze changes in clinical characteristics and in the management of breast cancer in women in Korea from 2002 to 2012.

DATA COLLECTION

Data sources

Data were collected on women in Korea who were newly diagnosed with primary breast cancer between January 1,

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2012 and December 31, 2012. A nationwide questionnaire survey was carried out to determine the total number of patients newly diagnosed with breast cancer (including ductal carcinoma *in situ* [DCIS] and invasive breast cancer), and the age, cancer stage, and type of surgery of these patients. A total of 97 hospitals replied to this questionnaire. Additional data such as clinical manifestations, preoperative diagnostic methods used for tissue confirmation, pathological information (biological markers and histological types), and survival information were obtained from the KBCS online breast cancer registry (https://registry.kbcs.or.kr/login.jsp).

Statistical analysis

Data analysis was performed using SPSS version 19.0 (IBM Corp., Armonk, USA). A linear regression analysis was used to determine trends in each parameter over time, and a *p*-value < 0.05 was regarded as statistically significant (95% level of confidence). The Kaplan-Meier method was used to estimate the survival rates. The stage-specific overall survival was compared using the log-rank test.

BASIC FINDINGS OF KOREAN BREAST CANCER IN 2012

Total number of newly diagnosed breast cancer patients

A total of 17,792 patients were newly diagnosed with breast cancer in 2012. Among these, 15,112 had invasive breast cancer and 2,680 had DCIS. Fifty-four cases (0.3% of the total number) of newly diagnosed breast cancer occurred in males (48 cases of invasive breast cancer and six of DCIS). The number of new cases of female breast cancer (crude incidence rate) was 70.7 per 100,000 women per year. Diagnoses were made at university hospitals in 15,347 cases (86.3%), at general hospitals in 2,330 cases (13.1%), and at private clinics in 115 cases (0.6%).

Age distribution

Analyses of the survey data and registry data generated equivalent results in terms of age distribution among the newly diagnosed patients (Table 1). The median age at diagnosis was 51 years, the youngest patient was 20 years old, and the oldest was 92 years old. The age group with the highest number of newly diagnosed breast cancer cases was the 40–49 year olds (6,110 cases, 34.5%), followed by the 50–59 year olds (5,589 cases, 31.5%).

Clinical manifestations and diagnostic methods

Upon searching the online registry data for 2012, we obtained information on the preoperative clinical manifestations in 7,442 patients. More than half of these patients (4,108 cases, 55.2%) reported a breast lump at their clinical presentation. The second most common symptom was breast pain (331 cases, 4.4%), followed by nipple discharge (221 cases, 2.9%). In addition, 2,486 patients (33.4%) were diagnosed through screening and did not show any symptoms (Table 2).

Data on the preoperative diagnostic method was available on the online registry for 7,013 patients. Core needle biopsy was the most frequently used diagnostic tool, accounting for 78.7% of diagnoses (5,517 cases) (Table 3).

Surgery and staging

Among the 17,734 patients for whom information on surgi-

Table 1. Age distribution of newly diagnosed breast cancer patients

Age (yr)	Questionnaire survey data No. (%)	KBCS registry data No. (%)
<20	6 (0.03)	2 (0.01)
20–29	171 (1.0)	124 (0.9)
30–39	1,803 (10.2)	1,229 (9.7)
40–49	6,110 (34.5)	4,532 (35.9)
50–59	5,589 (31.5)	4,041 (32.0)
60–69	2,593 (14.6)	1,812 (14.4)
70–79	1,103 (6.2)	786 (6.2)
≥80	159 (0.9)	99 (0.8)
Unknown	300 (1.6)	0
Total	17,734 (100.0)	12,625 (100.0)

KBCS = Korean Breast Cancer Society.

Table 2. Clinical manifestations (KBCS registry data)

Symptom	No. of patients (%)
None	2,486 (33.4)
Lump	4,108 (55.2)
Pain	331 (4.4)
Nipple discharge	221 (2.9)
Skin change	60 (1.0)
Nipple retraction	81 (1.1)
Axillary mass	74 (0.9)
Others	81 (1.1)
Total	7,442 (100.0)

KBCS = Korean Breast Cancer Society.

Table 3. Preoperative diagnostic methods (KBCS registry data)

Diagnostic method	No. of patients (%)
Fine needle aspiration	454 (6.5)
Core needle biopsy	5,517 (78.7)
Incisional biopsy	39 (0.5)
Excisional biopsy	528 (7.5)
Vacuum assisted biopsy	426 (6.1)
Others	49 (0.7)
Total	7,013 (100.0)

KBCS = Korean Breast Cancer Society.

cal methods was obtained from survey data, breast-conserving surgery was most frequently performed (10,926 cases, 61.6%), followed by total mastectomy (6,475 cases, 36.5%). Analyses of survey data and online registry data generated equivalent results in terms of surgery types (Table 4). Survey data on breast cancer stage was also obtained for 17,734 patients. Among these, stage I was the most frequent diagnosis (6,956 cases, 39.2%) and stage II the second most frequent (5,630 cases, 31.7%) (Table 5).

Pathology and biological markers

Invasive ductal carcinoma was the most common breast cancer type (8,353 cases, 79.6%) among the 10,488 patients whose pathologic results could be confirmed by the registry data, followed by DCIS (1,481 cases, 14.1%) and invasive lob-

Table 4. Surgical management of newly diagnosed breast cancer patients

Surgery	Questionnaire survey data No. (%)	KBCS registry data No. (%)
Mastectomy	6,475 (36.5)	4,055 (32.1)
BCS	10,926 (61.6)	8,449 (67.0)
Others	236 (1.3)	63 (0.5)
Unknown	97 (0.5)	58 (0.4)
Total	17,734 (100.0)	12,625 (100.0)

KBCS=Korean Breast Cancer Society; BCS=breast-conserving surgery.

Table 5. Stage distribution of newly diagnosed breast cancer patients

Stage	Questionnaire survey data No. (%)	KBCS registry data No. (%)
0	2,500 (14.1)	1,601 (12.7)
I	6,956 (39.2)	5,235 (41.5)
II	5,630 (31.7)	3,958 (31.4)
III	1,871 (10.6)	1,187 (9.4)
IV	241 (1.4)	146 (1.1)
Unknown	536 (3.0)	498 (3.9)
Total	17,734 (100.0)	12,625 (100.0)

KBCS=Korean Breast Cancer Society.

Table 6. Histological types (KBCS registry data)

Histologic type	No. of patients (%)
Ductal carcinoma *in situ*	1,481 (14.1)
Invasive ductal carcinoma	8,353 (79.6)
Lobular carcinoma *in situ*	65 (0.6)
Invasive lobular carcinoma	358 (3.4)
Paget's disease (pure form)	20 (0.2)
Malignant phyllodes tumor	26 (0.2)
Lymphoma	2 (0.01)
Sarcoma	8 (0.1)
Others	175 (1.7)
Total	10,488 (100.0)

KBCS=Korean Breast Cancer Society.

ular carcinoma (358 cases, 3.4%) (Table 6).

The proportions of patients with tumors positive for estrogen receptor (ER) and progesterone receptor (PR) expression were 73.0% and 62.4%, respectively. When c-erbB 2 expression was analyzed, 34.4% of all patients were found to have tumors negative for immunohistochemical (IHC) staining, 24.2% had an IHC stain rating of 1+, 19.6% had a rating of 2+, and 18.2% had a rating of 3+ (Table 7).

CHANGING PATTERNS OF BREAST CANCER IN KOREA

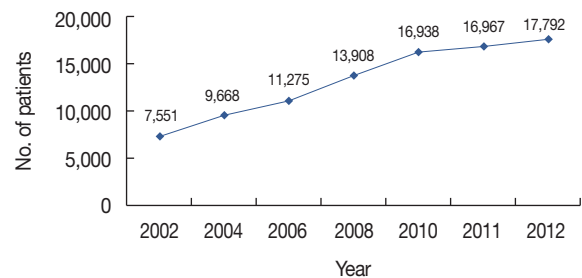### Incidence

The incidence of breast cancer in Korea has risen continuously over the past 10 years. In 2012, the number of breast cancer patients was 17,792, a figure 2.5 times higher than the 7,551 cases reported in 2002 (135.6% increase; $R^2 = 0.997$,

Table 7. Biological markers (KBCS registry data)

Biological marker	No. of patients (%)
ER	
Negative	2,721 (25.8)
Positive	7,706 (73.0)
Unknown	124 (1.2)
Total	10,551 (100.0)
PR	
Negative	3,837 (36.4)
Positive	6,585 (62.4)
Unknown	127 (1.2)
Total	10,549 (100.0)
c-erbB 2	
Negative	3,535 (34.4)
Weak (1+)	2,487 (24.2)
Intermediate (2+)	2,016 (19.6)
Strong (3+)	1,870 (18.2)
Unknown	373 (3.6)
Total	10,281 (100.0)

KBCS=Korean Breast Cancer Society; ER=estrogen receptor; PR= progesterone receptor.

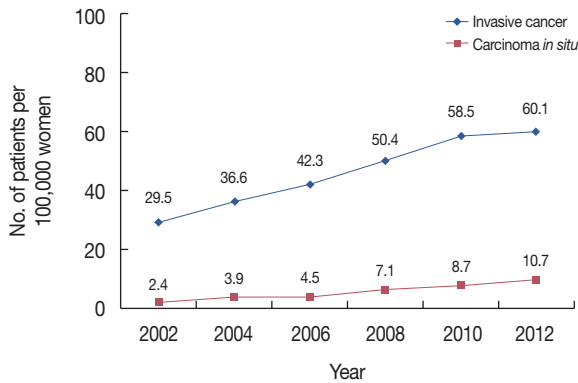

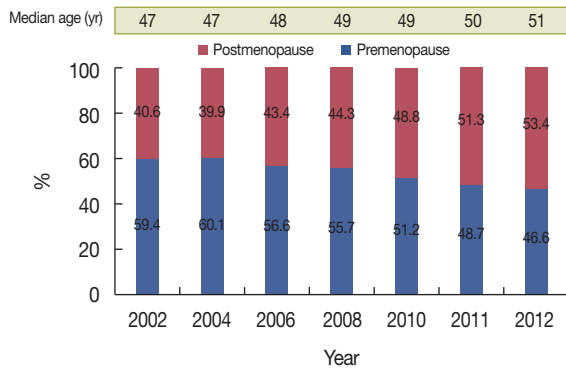**Figure 1.** Number of newly diagnosed breast cancer patients (Korean Breast Cancer Society survey data).

$p < 0.001$) (Figure 1) [9-11]. The crude incidence rate of female breast cancer in Korea in 2012, including cases of DCIS, was calculated to be 70.7 cases per 100,000 women. Analysis of the individual breast cancer types revealed that the 2012 crude incidence rate of invasive cancer was 60.1 cases per 100,000 women, 2 times higher than the 29.5 cases reported in 2002 (103.7% increase; $R^2 = 0.992$, $p < 0.001$). In addition, the crude incidence rate of DCIS showed a marked 4.5 time increase, from the 2.4 cases per 100,000 women reported in 2002 to a figure of 10.7 in 2012 (345.8% increase; $R^2 = 0.990$, $p < 0.001$) (Figure 2) [9-11].

Median age at diagnosis

We also observed that the median age at diagnosis has increased over time, reaching 51 years in 2012, and the proportion of postmenopausal women with breast cancer rose from 40.6% in 2002 to 53.4% in 2012 (31.5% increase; $R^2 = 0.956$, $p = 0.001$); thus postmenopausal women accounted for more than half of the total cases of breast cancer in 2012 (Figure 3).

Biologic markers and stage distributions

Regarding hormone receptor-positive breast cancer, both the proportions of ER- and PR-positive breast cancer patients demonstrated steady increases. The proportion of ER-positive breast cancer patients increased from 58.2% in 2002 to 73.0% in 2012 (25.5% increase; $R^2 = 0.988$, $p < 0.001$), and that of PR-positive breast cancer patients increased from 50.7% in 2002 to 62.4% in 2012 (23.1% increase; $R^2 = 0.902$, $p = 0.005$) (Figure 4).

In terms of stage distribution, the proportion of patients with stage 0 and stage I breast cancer increased from 2002 to 2012. Specifically, the proportion of stage 0 cancer patients increased from 6.9% to 13.2% (91.3% increase; $R^2 = 0.960$, $p = 0.001$), and that of stage I cancer patients increased from 31.2% to 43.2% (38.5% increase; $R^2 = 0.934$, $p = 0.002$). The proportion of patients with stage II to IV cancers, meanwhile, decreased from 61.9% to 43.6% over the same period (29.6% decrease; $R^2 = 0.979$, $p < 0.001$) (Figure 5).
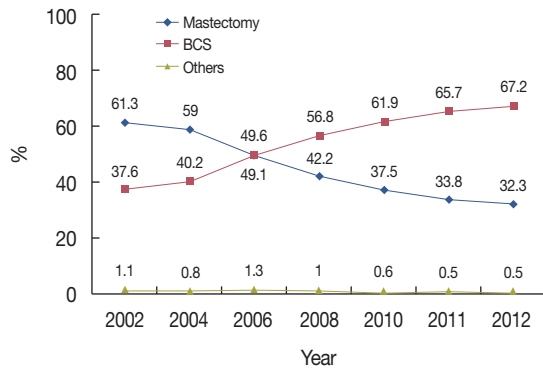
Surgical patterns

Patterns in the surgical treatment of breast cancer were also

Figure 2. Annual crude incidence of Korean female breast cancer (Korean Breast Cancer Society survey data).
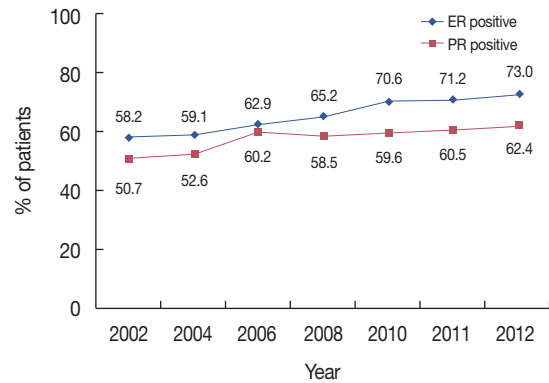
Figure 4. Changing trends in the hormone receptor-positive breast cancer.

Figure 3. Trends in the median age at breast cancer diagnosis in Korea and the ratio of postmenopausal to premenopausal women at diagnosis.
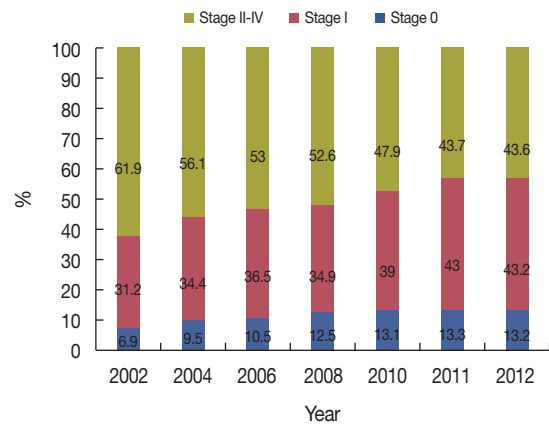
Figure 5. Changes in breast cancer incidence according to stage.

Figure 6. Changes in the surgical management of breast cancer. BCS = breast-conserving surgery.
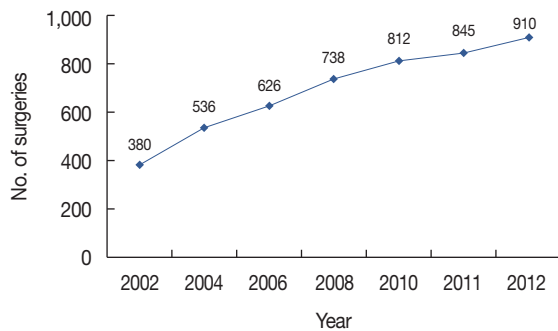
Figure 7. Changing trends in breast reconstruction in patients with breast cancer surgery.

Table 8. Stage-specific 5-year overall survival rates (2001–2010, KBCS registry data)

Stage	No. of patients	Total No. of events	5-Year survival rate (%)
0	8,905	135	98.8
I	28,962	837	97.2
II	32,243	2,467	92.8
III	11,507	2,343	78.7
IV	1,369	660	44.1
Total	82,986	6,442	-

KBCS = Korean Breast Cancer Society.

observed to change between 2002 and 2012. While the proportion of patients who underwent total mastectomy decreased from 61.3% in 2002 to 32.3% in 2012 (47.3% decrease; $R^2 = 0.992$, $p < 0.001$), the proportion of patients who underwent breast-conserving surgery increased from 37.6% in 2002 to 67.2% in 2012 (78.2% rise; $R^2 = 0.993$, $p < 0.001$) (Figure 6). The number of breast reconstructions performed after mastectomy also increased markedly over the 10-year interval we examined, from 380 cases in 2002 to 910 cases in 2012 (139.5% increase; $R^2 = 0.994$, $p < 0.001$) (Figure 7).

Five-year overall survival rates

The stage-specific survival rates were calculated utilizing the online registry data from 2001 to 2010. The median follow-up period was 55 months. Survival information for 82,986 patients was obtained from the registry data. The 5-year overall survival rate for stage 0 breast cancer was 98.8%, followed by rates of 97.2% for stage I, 92.8% for stage II, 78.7% for stage III, and 44.1% for stage IV breast cancer (Table 8).

DISCUSSION

In 1996, the KBCS initiated a nationwide breast cancer re-

search program and began to introduce analytical resources to monitor the status of breast cancer in Korea. An online registration program was implemented after 2000, and this has been actively utilized for various research studies on breast cancer in Korea. The registry data were made public biennially until 2010 and have been announced annually since that time.

Steady increases have been observed over the years up to 2012 in a number of fundamental measurable clinical parameters related to breast cancer in Korea, particularly the number of newly diagnosed breast cancer patients and the median age at breast cancer diagnosis (51 years in 2012). In addition, the proportion of ER positive breast cancer positive breast cancer patients demonstrated an increase to up to 73.0% in 2012. It was also noted that the proportion of patients with stage 0 and stage I cancer increased to more than half of cases (56.4%) in 2012, and the proportion of patients who underwent breast-conserving surgery increased accordingly to 67.2%, a figure almost double that of the number of patients who underwent mastectomy (32.3%). Finally, over the past 10 years, the number of breast reconstructions performed has increased by as much as 2.5 times.

According to the World Cancer Report 2014, the highest incidence rates for all cancers combined (excluding nonmelanoma skin cancer) are found in the high-income countries of North America and Western Europe (along with Japan, Republic of Korea, Australia, and New Zealand) [12]. Breast cancer is the most common cause of cancer death and the most frequently diagnosed cancer among women in 140 of 184 countries worldwide. Korea was rated to have the highest incidence rate of breast cancer in Asia (52.1 cases per 100,000 women) in 2012, closely followed by Japan (51.5 cases per 100,000). The global age-standardized incidence in 2012 was 43.4 [13].

In Korea, the incidence rate of breast cancer has shown a consistent increase in recent years, rising from 20.9 cases per 100,000 women in 1999 to 43.8 cases per 100,000 women in 2011 (annual percentage change [APC], 6.3%; $p < 0.05$) [3]. Interestingly, however, the growth of the APC for breast can-

cer incidence stopped after 2011 (APC in 2011 and 2012, 6.3%; $p < 0.05$) [14]. In addition, the increase in the number of breast cancer patients diagnosed annually in our data became steadier in the most recent 3 years compared to the previous period. These changes will be followed to ascertain the meaning of the apparent plateau of the APC.

The median age of patients at the time of diagnosis of breast cancer was 51 years in 2012, with the proportion of postmenopausal women exceeding half the total number of cases (53.4%). The proportion of hormone receptor-positive breast cancer patients has increased over the past 10 years (25.5% increase), in accordance with these results [15-17]. Although we found a steady rise in median age at diagnosis over the period we examined, the median age in Korea is still lower by 10 years than that of the United States, which, between 2006 and 2010, was 61 years [18]. This observation likely requires further investigation through the calculation of age-specific incidence using a standardized measure such as an age-period cohort analysis.

With regard to the detection of breast cancer, the proportion of breast cancer patients without any symptoms who were identified through screening was 33.4% of the total cases identified in 2012, a significant increase from the figure of 17.7% in 2002 (88.7% in crease; $R^2 = 0.877$, $p = 0.010$) [11]. In this context, an increase in the proportion of patients with early breast cancer (stage 0 and I) was also noted. In particular, the proportion of patients with stage 0 cancer increased markedly from 6.9% in 2002 to 13.2% in 2012 (91.3% increase; $R^2 = 0.960$, $p < 0.001$), and that of patients with stage I breast cancer also increased from 31.2% in 2002 to 43.2% in 2012 (38.5% increase; $R^2 = 0.934$, $p = 0.002$). These results can be explained, to some degree, by improved awareness in relation to breast cancer, and by increased screening rates in Korea over time. It has been suggested that mammographic screening for breast cancer has reduced mortality rates [19-21]; however, the impact of screening on overall survival still needs to be determined.

Trends in surgical treatment have changed in response to the increase in early breast cancer. The proportion of patients undergoing breast-conserving surgery has increased over time, surpassing that of patients undergoing mastectomy in 2008 (56.8% vs. 42.2%), and reaching double the rate of mastectomy in 2012 (67.2% vs. 32.3%).

Increases in the proportion of early breast cancer patients and the wide adoption of oncoplastic surgery and neoadjuvant chemotherapy may have contributed to these observed changes in surgical trends. In Japan, the reported rates of breast-conserving surgery increased from 2004 to 2007, and reached a plateau between 2007 and 2011 [22]. However, in the United States, different trends have been noted in the surgical treatment of breast cancer. The proportion of breast cancer patients treated by mastectomy decreased from 40.1% in 2000 to 35.6% in 2005. Subsequently, the rate increased to 38.4% in 2008, the highest recorded since 2002 (38.5%) [23]. Reasons for the changes in surgical treatment are unclear, but wider use of breast magnetic resonance imaging, increased awareness and use of genetic testing, evolving patient attitudes toward mastectomy, and trends in surgical choice (the use of mastectomy by high-profile celebrities and increased rates of contralateral prophylactic mastectomy) have all been suggested in the literature [24-26].

The number of breast reconstructions after mastectomy increased steadily in Korea over the 10 years examined by the study (139.5% increase; $R^2 = 0.994$, $p < 0.001$). In the United States, the number of breast reconstructions has also increased, probably as a result of the increased rates of mastectomy. Jagsi et al. [27] reported that the proportion of patients who underwent breast reconstruction after mastectomy increased from 46% in 1998 to 63% in 2007. While the number of mastectomies has decreased over time in Korea, changes in public perceptions of body image and quality of life may have influenced the trend toward breast reconstruction after mastectomy. Further investigation to confirm this trend and to determine its underlying cause is warranted.

There are a number of limitations in this study. Firstly, as our data was based on a survey, there were differences between our data and that of the National Cancer Registry (NCR) in terms of the total number of newly diagnosed breast cancer patients in 2012. The number of invasive breast cancer cases reported by the NCR in 2012 was 16,589 [4]. Of the 17,792 patients in our study, 15,160 patients were diagnosed with invasive breast cancer; this figure accounts for 91.4% of the NCR number. However, we believe that this number is not insufficient to support our results, considering that the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program covers 28% of the U.S. population [28].

Secondly, data regarding mortality rates was unavailable. According to GLOBOCAN, an online database managed by the World Health Organization which provides the most recent estimates for 28 types of cancer in 184 countries, breast cancer was the second leading cause of cancer death among women (522,000 deaths in 2012) after lung cancer, and mortality has increased by 14% since 2008 [13]. Thus, the provision of mortality data by the KBCS registry may be required in the future.

Meanwhile, we do have overall survival data for the breast cancer patients included in our study. First of all, we have the data from the single population-based registry. The informa-

tion regarding stages is well documented and there is almost no missing data. The stage-specific 5-year overall survival rates obtained from the KBCS registry data for the period between 2001 and 2010 were 98.8% for stage 0 breast cancer, 97.2% for stage I, 92.8% for stage II, 78.7% for stage III, and 44.1% for stage IV breast cancer (Table 8). The 5-year relative survival rate (RSR) increased to 91.3% between 2008 and 2012, according to the Korean NCR report [4]. In addition, according to a study by the Korean NCR, the estimated 5-year RSR for female breast cancer was 91.0 (95% confidence interval [CI], 90.7%–91.4%) between 2006 and 2010, and the 5-year RSR differed depending on whether the breast cancer stage was designated as localized, regional, or distant by the SEER staging system [1]. Our study was able to confirm the high overall survival of Korean breast cancer patients. Since our results showed an increase in the proportion of patients with early breast cancer, we also predict enhanced survival rates over time.

CONCLUSION

The fundamental facts about Korean breast cancer have undergone several changes in the years leading up to 2012, and these findings suggest that the clinical characteristics of breast cancer in Korea are slowly changing over time. A continuous study of the nationwide registry data will provide more defined information that can be used to understand the characteristics and nature of breast cancer in Korea.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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