

## SPECIAL ARTICLE

# The Basic Facts of Korean Breast Cancer in 2011: Results of a Nationwide Survey and Breast Cancer Registry Database

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Breast cancer is the second most frequent malignancy in Korean women, with a continuously increasing incidence. The Korean Breast Cancer Society has constructed a nationwide breast cancer database through an online registration program. The aim of the present study was to report the fundamental facts on Korean breast cancer in 2011, and to analyze the changing patterns in clinical characteristics and breast cancer management in Korea over the last 10 years. Data on newly diagnosed breast cancer patients, including the total number of cases, age, stage, and type of surgery, for the year 2011 were collected from 84 hospitals and clinics nationwide using a questionnaire survey. Additional data relating to the changing patterns of breast cancer in Korea were collected from the online breast cancer registry database and analyzed. According to nationwide survey data, a total of 16,967 patients were newly diagnosed with breast cancer in 2011. The crude incidence of female breast cancer, including invasive cancer and *in situ* cancer, was 67 cases per 100,000

women. Analysis of the survey and registry data gave equivalent results in terms of age distribution, stage, and type of surgery. The median age at diagnosis was 50 years, and the proportion of postmenopausal women (51.3%) was higher than that of premenopausal women (48.7%) with breast cancer. The incidence of stage 0 and stage I breast cancer increased continuously over the last 10 years (56.3% in 2011), and breast conserving surgery (65.7%) was performed more frequently than total mastectomy (33.8%). The total number of breast reconstruction surgeries increased approximately 8-fold. We conclude that the clinical characteristics of breast cancer have changed over the past 10 years in Korea, and surgical management 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 systems, Registries

## INTRODUCTION

Cancer has become a global health priority. It is the leading cause of death worldwide, and one in four deaths is caused by cancer [1,2]. Breast cancer, the second most common cancer in Korean women, has become a major health problem in Korea. The age-standardized incidence of invasive breast cancer has

increased continuously over time, reaching 39.8 cases per 100,000 women in 2010 [3], and the estimated age-standardized prevalence of female breast cancer is 343.8 per 100,000 women [4].

The Korean Breast Cancer Society (KBCS) created a nationwide, hospital-based, breast cancer registry in 1996, in which details on the history, objectives, and activities of the breast cancer registry program have been well documented [5-10]. 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 fundamental facts on breast cancer in Korea in 2011, and to analyze changes in clinical characteristics and management of breast

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cancer in women in Korea from 2000 to 2011.

## METHODS

Data on women in Korea who were newly diagnosed with primary breast cancer from January 1, 2011 to December 31, 2011 were collected. A nationwide questionnaire survey was carried out to determine the total number of newly diagnosed breast cancer patients (including ductal carcinoma *in situ* [DCIS] and invasive breast cancer), and the age, stage, and type of surgery of these patients. A total of 84 hospitals replied to this questionnaire. Additional data such as clinical manifestations, preoperative diagnostic methods used for tissue confirmation, and pathological information (histological type, American Joint Committee on Cancer [AJCC] stage, tumor size, lymph node stage, metastasis [TNM] stage, and biological markers) 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-SPSS, Chicago, USA). A linear regression analysis was used to determine trends in each parameter over time, and a *p*-value < 0.05 was regarded statistically significant (95% level of confidence).

## RESULTS

### Total number of newly diagnosed breast cancer patients

A total of 16,967 patients were newly diagnosed with breast cancer in 2011. Of these, 14,668 had invasive breast cancer, and 2,299 had DCIS. The number of new cases of breast cancer (crude incidence) was 67.0 per 100,000 women per year. Diagnoses were made at university hospitals in 14,695 cases (86.6%), at general hospitals in 2,155 cases (12.7%), and at private clinics in 117 cases (0.7%).

**Table 1.** Age distribution of newly diagnosed breast cancer patients

Age (yr)	Survey data (n = 14,755) No. (%)	KBCS registry data (n = 9,924) No. (%)
<20	5 (0.0)	6 (0.1)
20–29	155 (1.1)	91 (0.9)
30–39	1,824 (12.4)	1,126 (11.3)
40–49	5,501 (37.2)	3,611 (36.4)
50–59	4,198 (28.5)	3,133 (31.6)
60–69	2,118 (14.4)	1,341 (13.5)
70–79	829 (5.6)	547 (5.5)
>80	125 (0.8)	69 (0.7)

KBCS = Korean Breast Cancer Society.

### Age distribution

Analysis of the survey data and registry data gave equivalent results in terms of age distribution (Table 1). The median age at diagnosis was 50 years, the youngest patient was 14 years old, and the oldest was 96 years old. The age group with the highest number of newly diagnosed breast cancer cases was the 40–49-year age group (5,501 cases, 37.2%), followed by the 50–59-year age group (4,198 cases, 28.5%).

### Clinical manifestations

Upon searching the online registry data for 2011, we obtained information on the preoperative clinical manifestations for 6,286 patients. More than half of these patients (3,358 cases, 53.4%) reported a breast lump at their clinical presentation. The second most common symptom was breast pain (241 cases, 3.8%), followed by nipple discharge (181 cases, 2.9%). In addition, 2,319 patients (36.9%) were diagnosed by screening and did not show any symptoms (Table 2).

### Diagnostic methods

Of the 6,206 patients on whom data on the preoperative diagnostic method was available on the online registry, core needle biopsy, the most frequently used diagnostic tool, accounted for 80.2% (4,977 cases) (Table 3).

### Surgery and staging

Of the 15,567 patients on whom information on surgical methods was obtained from survey data, breast conserving surgery was most frequently performed (10,115 cases, 65.0%), followed by total mastectomy (5,254 cases, 33.8%). Analysis of survey data and online registry data gave equivalent results in terms of surgery type (Table 4). Survey data on breast cancer stage distribution was obtained for 15,533 patients. Of these, stage I was the most frequent diagnosis (6,165 cases, 39.7%), and stage II, the second most frequent (5,281 cases, 34.0%) (Table 5).

**Table 2.** Clinical manifestations (KBCS registry data)

Symptom	No. of patients (%) (n = 6,286)
None	2,319 (36.9)
Lump	3,358 (53.4)
Pain	241 (3.8)
Nipple discharge	181 (2.9)
Skin change	61 (1.0)
Nipple retraction	49 (0.8)
Axillary mass	35 (0.5)
Others	42 (0.7)

KBCS = Korean Breast Cancer Society.

**Table 3.** Preoperative diagnostic methods (KBCS registry data)

Diagnostic method	No. of patients (%) (n=6,206)
Fine needle aspiration	322 (5.2)
Core needle biopsy	4,977 (80.2)
Incisional biopsy	65 (1.0)
Excisional biopsy	444 (7.2)
Vacuum assisted biopsy	354 (5.7)
Others	44 (0.7)

KBCS=Korean Breast Cancer Society.

**Table 4.** Surgical management

Surgery	Survey data (n=15,567) No. (%)	KBCS registry data (n=9,898) No. (%)
Mastectomy	5,254 (33.8)	3,348 (33.8)
Breast conserving surgery	10,115 (65.0)	6,504 (65.7)
Others	198 (1.2)	46 (0.5)

KBCS=Korean Breast Cancer Society.

**Table 5.** Stage distribution

Stage	Survey data (n=15,533) No. (%)	KBCS registry data (n=9,580) No. (%)
0	2,246 (14.5)	1,274 (13.3)
I	6,165 (39.7)	4,118 (43.0)
II	5,281 (34.0)	3,215 (33.6)
III	1,606 (10.3)	881 (9.1)
IV	235 (1.5)	92 (1.0)

KBCS=Korean Breast Cancer Society.

Registry data were further classified according to American Joint Committee on Cancer (AJCC) staging 7th edition (Table 6). Tumor size data was available for 9,949 cases, 52.3% of which were size T1, and 27.9% of which were size T2. For nodal staging, N0 was the most common (5,761 cases, 72%), followed by N1 (1,569 cases, 19.6%), N2 (430 cases, 5.4%), and N3 (241 cases, 3.0%).

**Pathology**

Of the 7,967 patients whose pathologic results could be confirmed by the registry data, invasive ductal carcinoma (IDC) was the most common breast cancer type (6,555 cases, 82.3%), followed by DCIS (1,013 cases, 12.7%) and invasive lobular carcinoma (226 cases, 2.8%) (Table 7).

**Biological markers**

The proportion of patients positive for estrogen and progesterone receptor expression was 71.2% and 60.5%, respectively. Upon analysis of c-erbB-2 expression, 41.0% of all patients were negative for immunohistochemical (IHC) staining, and 20.3% had an IHC stain rating of 1+, 17.7% 2+, and 18.9% 3+.

**Table 6.** American Joint Committee on Cancer Staging (7th edition) (KBCS registry data)

	No. of patients (%)
Stage (n=9,920)	
0	1,274 (12.8)
IA	4,048 (40.8)
IB	70 (0.7)
IIA	2,304 (23.2)
IIB	911 (9.2)
IIIA	560 (5.6)
IIIB	15 (0.2)
IIIC	306 (3.1)
IV	92 (0.9)
Unknown	340 (3.4)
T staging (n=9,949)	
T0	60 (0.6)
Tis	1,323 (13.3)
T1	5,206 (52.3)
T2	2,780 (27.9)
T3	302 (3.0)
T4	39 (0.4)
Tx	213 (2.2)
Others	26 (0.3)
N staging (n=8,001)	
N0	5,761 (72.0)
N1	1,569 (19.6)
N2	430 (5.4)
N3	241 (3.0)

KBCS=Korean Breast Cancer Society.

**Table 7.** Histologic type (KBCS registry data)

Histologic type	No. of patients (%) (n=7,967)
Ductal carcinoma <i>in situ</i>	1,013 (12.7)
Invasive ductal carcinoma	6,555 (82.3)
Lobular carcinoma <i>in situ</i>	46 (0.6)
Invasive lobular carcinoma	226 (2.8)
Paget's disease (pure form)	7 (0.1)
Malignant phyllodes tumor	19 (0.2)
Lymphoma	2 (0.0)
Sarcoma	8 (0.1)
Others	91 (1.1)

KBCS=Korean Breast Cancer Society.

For p53 expression, 68.2% of patients were negative, 15.0% were 1+, 5.5% 2+, and 11.1% 3+ (Table 8).

**Changing patterns of breast cancer in Korea**

The incidence of breast cancer in Korea has risen continuously over the past 10 years. The number of breast cancer patients in 2011 was 16,967, 3 times the 5,401 cases reported in 2000 (214.1% increase; R<sup>2</sup> = 0.997, p < 0.001) (Figure 1) [9,10]. The crude incidence of female breast cancer in Korea in 2011, including DCIS cases, was calculated as 67.0 cases per 100,000

women. Of all breast cancers types, the incidence of infiltrating cancer was 58.0 cases per 100,000 women, and that of DCIS was 9.0 cases per 100,000 women. The median age at diagnosis increased over time reaching 50 years in 2011, and the proportion of postmenopausal women with breast cancer rose from 39.2% in 2000 to 51.3% in 2011 (30.9% increase;  $R^2 = 0.881$ ,  $p = 0.002$ ), thus postmenopausal women accounted for half the total cases (Figure 2). Clinical manifestations at breast cancer diagnosis also changed over the 10-year study period. The proportion of breast cancer patients without symptoms diagnosed by screening increased from 12.7% in 2000 to 36.9% in 2011 (190.6% increase;  $R^2 = 0.768$ ,  $p = 0.010$ ) (Table 9). The incidence of DCIS increased from 6.3% in 2000 to 12.7% in 2011 (101.6% increase;  $R^2 = 0.934$ ,  $p < 0.001$ ), whereas that of IDC decreased slightly from 89.3% in 2000 to 82.3% in 2011 (7.8% decrease;  $R^2 = 0.660$ ,  $p = 0.026$ ), however, there were no notable

**Table 8.** Biological markers (KBCS registry data)

Biological marker	No. of patients (%)
ER	
Negative	2,269 (28.3)
Positive	5,713 (71.2)
Unknown	43 (0.5)
Total	8,025 (100.0)
PR	
Negative	3,129 (39.1)
Positive	4,846 (60.5)
Unknown	36 (0.4)
Total	8,011 (100.0)
c-erbB-2	
Negative	3,168 (41.0)
Weak (1+)	1,572 (20.3)
Intermediate (2+)	1,369 (17.7)
Strong (3+)	1,459 (18.9)
Unknown	161 (2.1)
Total	7,729 (100.0)
p53	
Negative	4,104 (68.2)
Weak (1+)	905 (15.0)
Intermediate (2+)	333 (5.5)
Strong (3+)	668 (11.1)
Unknown	10 (0.2)
Total	6,020 (100.0)

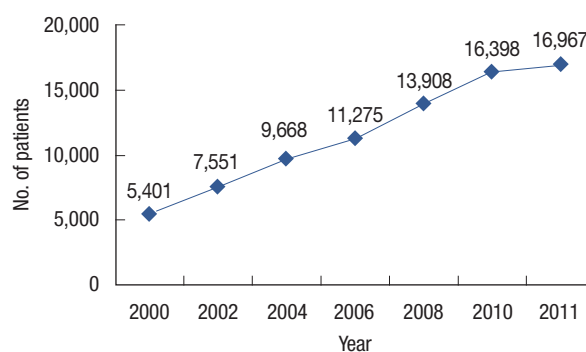
KBCS = Korean Breast Cancer Society; ER = estrogen receptor; PR = progesterone receptor.

**Table 9.** Changes in the clinical manifestations (2000–2011) (KBCS registry data)

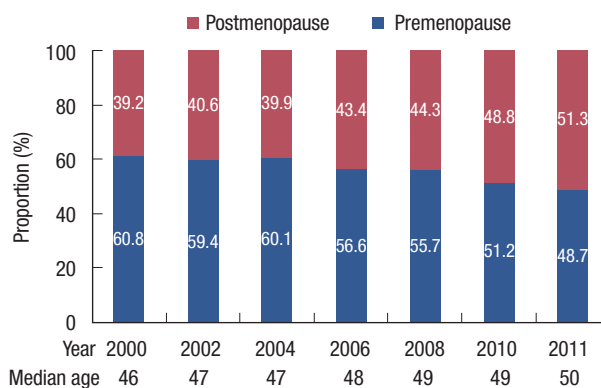
	Year						
	2000	2002	2004	2006	2008	2010	2011
Asymptomatic*	377 (12.7)	1,109 (17.7)	1,140 (15.6)	1,936 (20.9)	2,568 (24.0)	2,439 (23.6)	2,319 (36.9)
Symptomatic	2,595 (87.3)	5,170 (82.3)	6,162 (84.4)	7,348 (79.1)	8,143 (76.0)	7,887 (76.4)	3,967 (63.1)
Total	2,972	6,279	7,302	9,284	10,711	10,326	6,286

Values are presented as number (%). KBCS = Korean Breast Cancer Society. \*Breast cancer detected on screening.

changes in incidence for the other cancer types (Table 10). In terms of stage distribution, the proportion of patients with early breast cancer (stage 0 and stage I) increased from 2000 to 2011, with the proportion of stage 0 cancer patients increasing from 6% to 13.3% (121.7% increase;  $R^2 = 0.969$ ,  $p < 0.001$ ), and stage I cancer patients increasing from 26.6% to 43% (61.7% increase;  $R^2 = 0.891$ ,  $p < 0.001$ ). The proportion of patients with stage II to IV cancers, meanwhile, decreased from 67.4% to 43.7% (35.2% decrease;  $R^2 = 0.960$ ,  $p < 0.001$ ) (Figure 3). Patterns in the surgical treatment of breast cancer also changed between 2000 and 2011. While the proportion of patients who underwent total mastectomy decreased from 71.2% in 2000 to 33.8% in 2011 (52.5% decrease;  $R^2 = 0.988$ ,  $p < 0.001$ ), the pro-



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



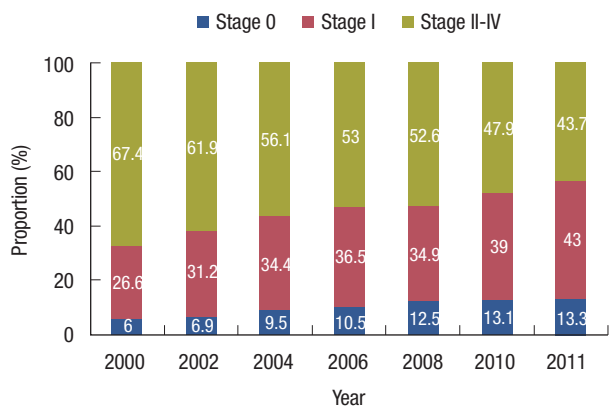
**Figure 2.** Trends in the median age at breast cancer diagnosis in Korea, and the ratio of postmenopausal to premenopausal women at diagnosis.

**Table 10.** Changes in the histological types (2000–2011) (KBCS registry data)

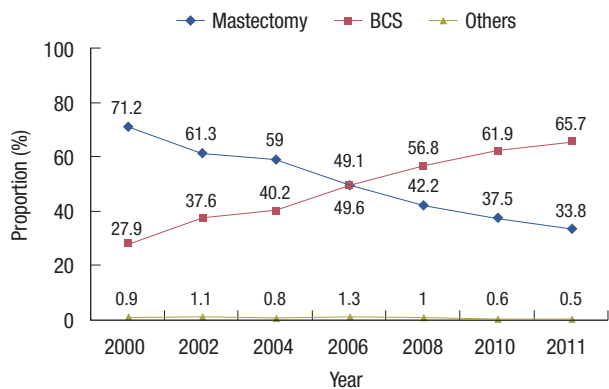
	Year						
	2000	2002	2004	2006	2008	2010	2011
DCIS	152 (6.3)	418 (7.2)	641 (9.6)	934 (10.9)	1,248 (12.4)	1,118 (12.2)	1,013 (12.7)
IDC	2,139 (89.3)	5,133 (88.7)	5,491 (82.2)	7,193 (83.9)	8,400 (83.7)	7,607 (82.8)	6,555 (82.3)
LCIS	3 (0.1)	8 (0.1)	9 (0.1)	16 (0.2)	31 (0.3)	39 (0.4)	46 (0.6)
ILC	59 (2.5)	125 (2.2)	131 (2.0)	203 (2.4)	231 (2.3)	301 (3.3)	226 (2.8)
Paget's disease	4 (0.2)	19 (0.3)	14 (0.2)	11 (0.1)	8 (0.1)	12 (0.1)	7 (0.1)
Other	37 (1.5)	85 (1.5)	98 (1.5)	214 (2.5)	114 (1.1)	109 (1.1)	120 (1.4)

Values are presented as number (%).

KBCS=Korean Breast Cancer Society; DCIS=ductal carcinoma *in situ*; IDC=invasive ductal carcinoma; LCIS=lobular carcinoma *in situ*; ILC=invasive lobular carcinoma.

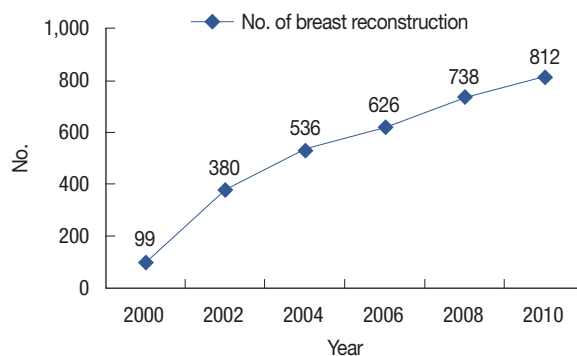


**Figure 3.** Changes in breast cancer incidence according to stage.



**Figure 4.** Changes in the surgical management of breast cancer in Korea. BCS=breast conserving surgery.

portion of patients who underwent breast conserving surgery more than doubled, from 27.9% in 2000 to 65.7% in 2011 (135.5% rise;  $R^2 = 0.991$ ,  $p < 0.001$ ) (Figure 4). The number of breast reconstructions performed after mastectomy also increased markedly in the space of 10 years, from 99 cases in 2000 to 812 cases in 2010 (720.2% increase;  $R^2 = 0.939$ ,  $p < 0.001$ ) (Figure 5).



**Figure 5.** Changing trends in breast reconstruction in patients with breast cancer surgery.

## DISCUSSION

In 1998 the KBCS initiated a nationwide research program for breast cancer and began to introduce analytical resources to monitor the status of breast cancer in Korea. After 2000, an online registration program was implemented and it has been actively utilized for various research studies on breast cancer in Korea since.

Fundamental parameters relating to breast cancer in Korea have shown a steady increase up to 2011, particularly the number of newly diagnosed breast cancer patients and the median age at breast cancer diagnosis (50 years in 2011). It was also noted that the proportion of patients with early breast cancer (stage 0 and I) increased to more than half of cases (56.3%), and the proportion of patients who underwent breast conserving surgery increased to 65.7% accordingly, which is almost double that of patients who underwent mastectomy (33.8%). Over the past 10 years, the proportion of breast cancer patients identified through screening has increased to 36.9%, and breast reconstructions have increased by up to 8 times.

Breast cancer is the second most common malignancy worldwide, and the most common cancer in women, with an estimated 1.67 million new cases in 2012 (25% of all cancers)

[11]. The incidence of breast cancer differs between Asian and Western countries. Generally, the incidence is higher in Caucasian populations in North America and Western European countries than in Asian countries [12-15]. However, Korea is reported to have the highest incidence of breast cancer in Asia (52.07 cases per 100,000 women) along with Japan (51.53 per 100,000), in comparison with countries like the Philippines (47.01 cases per 100,000 women), India (25.76 cases per 100,000 women), and China (22.07 cases per 100,000 women); the global age-standardized incidence was 43.3 in 2012 [11].

In Korea, breast cancer incidence has shown a steady increase from 20.9 cases per 100,000 women in 1999 to 39.8 case per 100,000 women in 2010 (annual percent change 6.3%,  $p < 0.05$ ) [3]. A similar trend was seen in the Korean American population with incidence increasing from 53.9 cases per 100,000 women (95% confidence interval [CI], 50.1–57.9) between 1998 and 2002 to 69.5 cases per 100,000 women (95% CI, 65.5–73.6) between 2004 and 2008 [16]. The factors contributing to this increase in incidence are not fully understood, but these results reflect the fact that breast cancer is, in part, affected by lifestyle changes associated with westernization, such as reproductive factors (early menarche, late child bearing, and having fewer children), diet (consumption of calorie dense food), obesity, and reduced physical activity.

The median age at diagnosis of breast cancer was 50 years in 2011, with the proportion of postmenopausal women exceeding half the total cases (51.3%) for the first time. Although there was a steady rise in median age at diagnosis over this time, it is still lower than that of the United States by 10 years, which, between 2006 and 2010, was 61 years [17]. This 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 36.9% of the total cases identified in 2011, a significant increase from 2000 (190.6% increase;  $R^2 = 0.768$ ,  $p = 0.010$ ) (Table 9). In this context, an increase in the proportion of patients with early breast cancer (stage 0 and I) was noted. In particular, the proportion of patients with stage 0 cancer increased markedly from 6% in 2000 to 13.3% in 2011 (121.7% increase;  $R^2 = 0.969$ ,  $p < 0.001$ ), and that of patients with stage I breast cancer also increased from 26.6% in 2000 to 43% in 2011 (61.7% increase;  $R^2 = 0.891$ ,  $p < 0.001$ ). These results can be explained, to some degree, by improved awareness in relation to breast cancer, and increased screening rates in Korea over time. It has been suggested that mammographic screening for breast cancer has reduced mortality rates [18,19]; 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 mastectomy in 2008 (56.8% vs. 42.2%), and reaching approximately double the rate of mastectomy in 2011 (65.7% vs. 33.8%).

Increases in the proportion of early breast cancer patients and the wide adoption of oncoplastic surgery and neoadjuvant chemotherapy may have contributed to this. In Japan, reported rates of breast conserving surgery increased from 2004 to 2007, and reached a plateau between 2007 and 2009 [20]. 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%) [21]. Reasons for the changes in surgical treatment are unclear but the increased use of breast magnetic resonance imaging, increased awareness and use of genetic testing, increased patient voice in shared decisions, the use of mastectomy by high-profile celebrities, and increased rates of contralateral prophylactic mastectomy of the unaffected breast, have all been suggested in the literature [22,23].

The number of breast reconstructions after mastectomy increased steadily in Korea over the 10 years of the study (720.2% increase;  $R^2 = 0.939$ ,  $p < 0.001$ ) (Figure 5). 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. [24] report 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, changes in public perceptions of body image and quality of life may have affected this trend in Korea. Further investigation to confirm this trend and determine its underlying cause and impact 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 2011. The number of invasive breast cancer cases reported by the NCR was 15,942 in 2011 [4]. Of the 16,967 patients in our study, 14,668 patients were diagnosed with invasive breast cancer, this accounts for 92.0% of the NCR number. However, we believe that this number is no insufficient to support our results, considering the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program covers 28% of the United States population [25].

Secondly, while the survey data included the total number of

cases, age, stage, and type of surgery, data on other parameters were available in the KBCS registry. This resulted in differences in the total number of patients for each category of our results. However, both datasets showed equivalent distribution, as shown in the data tables (Tables 1, 4, 5), and we believe the data broadly represents the overall outcomes of the patients.

Thirdly, data regarding mortality rates was unavailable. According to GLOBOCAN, an online database of the World Health Organization which provides the most recent estimates for 28 types of cancer in 184 countries, breast cancer was the most common cause of cancer death among women (522,000 deaths in 2012), and mortality has increased by 14% since 2008 [11]. Thus the provision of mortality and survival data by KBCS registry may be required in future.

Although the cancer stage at diagnosis is one of the most important prognostic factors for patient survival, there are a limited number of population-based studies of stage-specific survival [26,27]. According to a study by the Korean NCR, the estimated 5-year relative survival rate (RSR) for female breast cancer was 91.0% (95% CI, 90.7–91.4) between 2006 and 2010, and the 5-year RSR was different depending on whether breast cancer stage was designated as localized, regional, or distant by the SEER staging system [1]. Since our study results showed an increase in the proportion of patients with early breast cancer, we also predict enhanced survival rates over time. It would also be useful if the KBCS registry could provide more precise information on survival through more detailed staging information.

In conclusion, the fundamental facts of Korean breast cancer have undergone several changes up to 2011, and these results suggest that the clinical characteristics of breast cancer in Korea are slowly changing over time. A continuous study on the nationwide registry data will provide more defined information that can be used to understand the characteristics and nature of breast cancer in Korea.

## ACKNOWLEDGMENTS

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## CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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