RESEARCH COMMUNICATION

On-schedule Mammography Rescreening in the National Cancer Screening Program for Breast Cancer in Korea

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Abstract

Breast cancer is the most commonly diagnosed cancer among women in the Republic of Korea. However, many women are not aware of the importance of on-schedule mammography screening for breast cancer. The objectives of this study were to estimate the percentage of women that attended on-schedule mammography rescreening, and to examine the factors associated with rescreening, among the target screening population (women aged ≥40 years) in Korea. The study population was derived from the National Health Insurance (NHI) Corporation database for the National Cancer Screening Program (NCSP), and included 2,511,976 women from the target screening population who attended the NCSP for breast cancer in 2005-2006 (baseline). Study participants were followed-up to determine whether they attended mammography rescreening after 2 years as recommended. Among those who attended mammography screening in 2005-2006, 61.3% were rescreened on schedule 2 years later. The odds of being rescreened were the highest in study participants aged 60-69 years. NHI beneficiaries with a higher premium were significantly more likely to be rescreened than Medical Aid Program recipients. A false-positive screening result at baseline adversely affected subsequent screening behavior. Furthermore, those who had a history of mammography screening before baseline were more likely to return for rescreening. Therefore, assessment of a woman's screening history and socioeconomic status, in combination with interventions to reduce anxiety, such as involving primary care physicians or better informing women about breast cancer and mammography screening, are needed. Efforts to reduce false-positive results and improve the quality of mammography may also increase compliance with breast cancer screening recommendations.

Keywords: Breast cancer - mammography - screening - rescreening - Korea

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Introduction

Breast cancer is the most common cancer among women worldwide, with an estimated 1.38 million new cases diagnosed in 2008 (23% of all cancers), and is the leading cause of cancer death (458,000 deaths) (Ferlay et al., 2010). Incidence rates vary from 19.3 per 100,000 women in Eastern Africa to 89.9 per 100,000 women in Western Europe, and are high (greater than 80 per 100,000) in developed regions of the world and low (less than 40 per 100,000) in most of the developing regions. Although the incidence of breast cancer in Asian countries is still lower than in Western countries, the incidence among Asian women has been rising rapidly (Jemal et al., 2011).

Although breast cancer is the most frequently diagnosed cancer in women in the Republic of Korea (15.1% of all cancer diagnoses in 2007), the incidence of breast cancer (34.7 per 100,000) (Jung et al., 2010) is still lower than in Western countries (e.g., 76.7 per 100,000 among North Americans) (Ferlay et al., 2010). However, the incidence of breast cancer in Korea has been rapidly increasing (annual percent change=6.6% per year between 1999 and 2007) (Jung et al., 2010) and the rate of increase seems to be much higher than that in European countries (annual percent change=0.8–3.0% per year) (Botha et al., 2003; Keegan et al., 2007). To reduce the burden of breast cancer, the Korean Government and National Health Insurance Corporation (NHIC) introduced a mammography-based nationwide breast cancer screening program as a part of the National Cancer Screening Program (NCSP) (Kim et al., 2011). When the program began in 1999, the NCSP for breast cancer offered free-of-charge mammography screening to Medical Aid Program (MAP) recipients only. In 2002 the NCSP expanded the program to include National Health Insurance (NHI) beneficiaries in the lowest 20% income bracket, and in 2005 it included all NHI beneficiaries with a premium 50% or under of the NHIC full premium rate. Currently, MAP recipients and NHI beneficiaries with premiums 50% or under can receive mammography screening without any out-of-

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pocket expense. NHI beneficiaries with premiums over 50% can receive breast cancer screening with a 10% out-of-pocket expense. The NCSP recommends that women 40 years of age and over attend mammography screening every 2 years (Kim et al., 2011) and at the beginning of each year all women in this age group receive an invitation letter from the NHIC.

Regular screening has been shown to reduce long-term cancer mortality for a number of different cancer sites (Smith et al., 2003; 2010). Previous studies have shown that breast cancer screening can reduce corresponding mortality rates by 25%-30% (IARC: World Cancer Report,2003). Despite these benefits, according to the 2008 Annual Report of the NCSP, the participation rate for mammography screening was only 35.0% in Korea (Lim et al., 2010). An important issue related to the early detection of cancer is the extent to which patients continue to use screening services after receiving an initial examination. Despite the importance of attending breast cancer screening at recommended intervals, relatively little known about the factors associated with on-schedule mammography rescreening.

An important goal of screening programs is not only to achieve high participation rates, but also to maintain these high rates at each subsequent screening round (O'Sullivan, Sutton, Dixon, et al., 2001). Therefore, it is just as important to understand why some women come back for rescreening, whereas others do not, as it is to understand why women attend in the first place. Although some of the factors associated with initial screening attendance may be similar to those associated with rescreening attendance, we cannot automatically assume that the same factors are relevant at different screening rounds. One issue that may be especially important when women are considering rescreening is whether they have had a previous positive mammography screening result, which, after further assessment, revealed a non-malignant condition (false-positive).

In view of the importance of achieving high participation rates at all recommended screening rounds in reducing breast cancer mortality, this study examined the factors associated with rescreening attendance at recommended intervals. In particular, we considered the potential effects of previous false-positive screening results on subsequent screening behavior.

Materials and Methods

Study population

The major data source for this study was the NHIC database for the NCSP. Data were collected from 2005 to 2008 for the target screening population of the NCSP for breast cancer. Selection of study participants was carried out in two steps as described in Figure 1. First, the study population was restricted to the target screening population invited through the NCSP for breast cancer between January 1, 2005 and December 31, 2006. Among those invited during this period, 2,885,448 women attended mammography screening in 2005 and 2006 (baseline). Second, to estimate the rescreening participation rate, we excluded 1) 313,995 women who were not eligible for rescreening 2 years after baseline due to death, relocation, etc.; 2) 4,578 women diagnosed with breast cancer after baseline (both true-positive and false-negative cases), based on information from the Korean National Cancer Incidence database (KNCIDB), which contains 95% of newly diagnosed malignancies in Korea (Won et al., 2009). This left 2,536,915 women (88.8% of those screened at baseline) who were invited to breast cancer screening again in 2007 and 2008. Finally, we excluded 24,939 otherwise eligible women with missing values for some of the variables needed for this study. Therefore rescreening behavior was examined in a final study population of 2,511,976 participants (Figure 1).

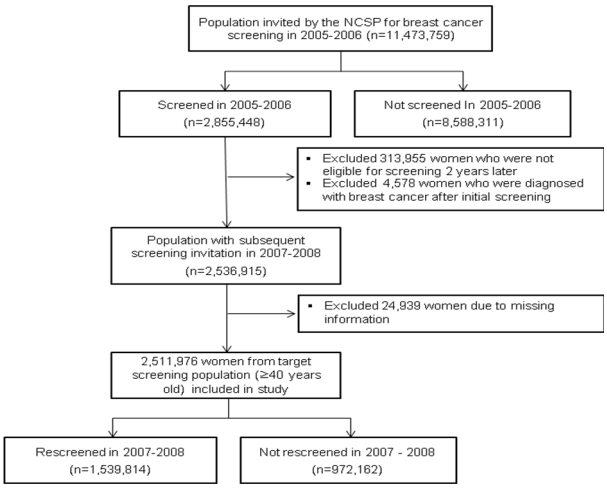

Figure 1. Participant Selection Process

Study variables

The NHIC database for the NCSP includes information on age, gender, health insurance type (MAP, NHI), breast cancer screening date, and screening results. We used health insurance type and health insurance premium as a proxy for socioeconomic status (Liberator et al., 1998; Marcin et al., 2003). Based on this information, we classified the participants into three groups: MAP recipients; NHI beneficiaries with a premium 50% or under; and NHI beneficiaries with a premium over 50%. Mammography screening results were reported in four categories (negative, benign, suspicious, highly suggestive of malignancy). The mammography results were defined as positive if they were categorized as 'suspicious' or 'highly suggestive of malignancy'. The categories of 'negative' and 'benign' were defined as negative. To confirm the accuracy of mammography screening at baseline, we ascertained whether study participants had been subsequently diagnosed with breast cancer through linkage with the KNCIDB. After excluding study participants who developed breast cancer, baseline screening accuracy was evaluated as follows: screening results of 'negative' and 'benign' were classified as true-negatives, and 'suspicious' and 'highly suggestive of malignancy' were classified as false-positives.

We also collected information on history of mammography screening to confirm whether previous screening was correlated with subsequent screening behavior. This information was obtained through linkage with the NCSP database from 2002-2004, and was

Table 1. Descriptive Information for the Study Population at Baseline, Korean National Cancer Screening Program for Breast Cancer, 2005-2006

	n	(%)
Total	2,511,976	
Age (years)		
40-49	913,628	36.4
50-59	808,916	32.2
60-69	544,780	21.7
≥70	244,652	9.7
Health insurance type		
MAP	160,420	6.4
NHI (premium under 50%)	1,339,032	53.3
NHI (premium over 50%)	1,012,524	40.3
Screening results		
Negative	1,677,973	66.8
Benign	561,493	22.4
Suspicious	272,391	10.8
Highly suggestive of malignancy	119	0.0
Accuracy of mammography		
True-negative	2,239,466	89.1
False-positive	272,510	10.9
History of mammography screening		
Never invited before baseline†	163,890	6.5
Previously invited but not screened‡	1,525,589	60.7
Previously screened§	822,497	32.8
Year recruited		
2005	1,057,452	42.1
2006	1,454,524	57.9

MAP, medical aid program; NHI, national health insurance; n, number, †Women who had never been invited, nor screened before baseline, ‡Women who had been invited, but did not attend screening before baseline, §Women who had been invited and attended screening once or more before baseline.

categorized into one of the following groups for all study participants: (a) never invited before baseline (women who had never been invited nor screened before baseline); (b) previously invited but not screened (women who had been previously invited, but did not attend screening before baseline); (c) previously screened (women who had been invited, and attended screening once or more before baseline).

Statistical analysis

Descriptive analyses were carried out for age, health insurance type, screening results at baseline, accuracy of mammography at baseline, and rescreening rate. Bivariate analyses

Results

Characteristics of the study population

Table 1 presents descriptive data for the study population of 2,511,976 women (as described in Figure 1). Women aged 40-49 years comprised more than one-third of total study population, and NHI beneficiaries with a premium under 50% represented more than half of the total study population. Most screening results at baseline were true-negatives (89.1%) (Table 1).

On-schedule rescreening rate

Among study participants who attended breast cancer screening in 2005-2006, 61.3% attended rescreening in 2007-2008 (Table 2). In bivariate analyses, women 50-69 years old were more likely to be rescreened (p <0.001). Among health insurance types, NHI beneficiaries with

Table 2. Characteristics of the Study Population According to Rescreening Status in 2007-2008

Rescreening	Yes, n	(%)	No, n	(%)	p-value
Total	1,539,814	(61.3)	972,162	(38.7)	
Age (years)					
40-49	513,553	(56.2)	400,075	(43.8)	<0.001
50-59	537,760	(66.5)	271,156	(33.5)	
60-69	362,061	(66.5)	182,719	(33.5)	
≥70	126,440	(51.7)	126,440	(48.3)	
Health insurance type					
MAP	75,187	(46.9)	85,233	(53.1)	<0.001
NHI (premium under 50%)	830,859	(62.1)	508,173	(37.9)	
NHI (premium over 50%)	633,768	(62.6)	378,756	(37.4)	
Screening results at baseline					
Negative	1,044,871	(62.3)	633,102	(37.7)	<0.001
Benign	334,526	(59.6)	226,967	(40.4)	
Suspicious	160,358	(58.9)	112,033	(41.1)	
Highly suggestive of malignancy	59	(49.6)	60	(50.4)	
Accuracy of mammography at baseline					
True-negative	1,379,397	(61.6)	860,069	(38.4)	<0.001
False-positive	160,417	(58.9)	112,093	(41.1)	
History of mammography screening					
Never invited before baseline†	83,868	(51.2)	80,022	(48.8)	<0.001
Previously invited but not screened‡	862,793	(56.6)	662,796	(43.4)	
Previously screened§	593,153	(72.1)	229,344	(27.9)	
Year recruited					
2005	617,733	(58.4)	439,719	(41.6)	<0.001
2006	922,081	(63.4)	532,443	(36.6)	

MAP, medical aid program; NHI, national health insurance; n, number., †Women who had never been invited, nor screened before baseline, ‡Women who had been invited, but did not attend screening before baseline, §Women who had been invited and attended screening once or more before baseline.

Table 3. Results of Logistic Regression for Factors Influencing Rescreening for Breast Cancer (n=2,511,976)

	Crude OR (95% CI)		Adjusted OR (95% CI)	
Age (years)				
40-49	1.00	Reference	1.00	Reference
50-59	1.55	(1.54-1.55)	1.45	(1.44-1.46)
60-69	1.54	(1.53-1.55)	1.51	(1.50-1.52)
≥70	0.83	(0.83-0.84)	0.90	(0.90-0.91)
Health insurance type				
MAP	1.00	Reference	1.00	Reference
NHI (premium under 50%)	1.85	(1.83-1.87)	1.91	(1.89-1.93)
NHI (premium over 50%)	1.90	(1.88-1.92)	1.97	(1.95-1.99)
Accuracy of mammography at baseline				
True-negative	1.00	Reference	1.00	Reference
False-positive	0.89	(0.88-0.90)	0.92	(0.91-0.93)
History of mammography screening				
Never invited before baseline†	1.00	Reference	1.00	Reference
Previously invited but not screened‡	1.24	(1.23-1.26)	1.01	(1.00-1.03)
Previously screened§	2.47	(2.44-2.49)	2.02	(2.00-2.05)
Year recruited				
2005	1.00	Reference	1.00	Reference
2006	1.23	(1.23-1.24)	1.19	(1.19-1.20)

MAP, medical aid program; NHI, national health insurance; OR, odds ratio; CI, confidence interval, †Women who had never been invited, nor screened before baseline, ‡Women who had been invited, but did not attend screening before baseline, §Women who had been invited and attended screening once or more before baseline

a premium over 50% showed the highest rescreening rate ($p < 0.001$). Study participants with screening results of 'benign', 'suspicious', or 'highly suggestive of malignancy' at baseline were less likely to be rescreened, as were those who had a false-positive result at baseline ($p < 0.001$). Regarding history of mammography screening, women who attended screening once or more before baseline were more likely to be rescreened than either those for whom baseline was their first screening invitation, or those who had been previously invited but did not attend screening before baseline ($p < 0.001$). The rescreening rate slightly increased in 2008; 63.4% of women who attended breast cancer screening in 2006 were rescreened in 2008.

Factors associated with on-schedule mammography rescreening for breast cancer

Factors most predictive of on-schedule breast cancer screening were explored using a logistic regression model at baseline (Table 3). Overall, the odds of attending rescreening were the highest in study participants aged 60-69 years old. Those with a NHI premium over 50% were significantly more likely to be rescreened than MAP recipients (adjusted odds ratio [OR]=1.97, 95% confidence interval [CI]=1.95–1.99). In addition, those who attended screening once or more before baseline were significantly more likely to attend rescreening (adjusted OR=2.02, 95% CI=2.00–2.05). Women who had a false-positive screening result at baseline were statistically significantly less likely to attend rescreening (adjusted OR=0.92, 95% CI=0.91–0.93).

Discussion

The present study estimated the on-schedule rescreening rate as per recommended screening intervals in an average-risk population in Korea; 61.3% of participants were rescreened on-schedule. This is lower than the participation rate for breast cancer screening among population-based samples in Western countries (Gilliland et al., 2000; O'Byrne et al., 2000; Pinckney et al., 2003; Bobo et al., 2004). For example, in 1997, on-schedule mammography rescreening rates for breast cancer were between 72.4 and 81.5% in the US National Breast and Cervical Cancer Early Detection Program (NBCCEDP) (Bobo et al., 2004). However, this high rescreening rate may be explained by the fact that the NBCCEDP offers free screening to low-income women. In this study, we divided health insurance recipients into three types: MAP recipients, NHI beneficiaries with a premium 50% or under, and NHI beneficiaries with a premium over 50%, and these three groups served as a proxy for socioeconomic status. In contrast to the results of the NBCCEDP, low-income women in Korea (MAP recipients) were less likely to attend rescreening for breast cancer than NHI beneficiaries, despite the fact that it is free of charge. As determined by multivariate logistic regression, MAP recipients were less likely to attend rescreening for breast cancer. These results are not limited to Korea; in other countries as well people with lower socioeconomic status are less likely to participate in screening programs (Song and Fletcher, 1998; Bobo et al., 2004; 2006), underlining the need for continuous efforts to reduce the socioeconomic disparities in the use of screening programs.

Several studies have investigated the potential effects of a false-positive screening result on subsequent screening behavior. Some studies reported that an initial false-positive screening result did not discourage women from being rescreened (Burman et al., 1999; O'Sullivan et al., 2001; Pinckney et al., 2003). In fact, women with a false-positive result were more likely to return (Katz et al., 2000; O'Sullivan et al., 2001; Pinckney et al., 2003). Indeed, women who have had a false-positive screening result have higher levels of anxiety about breast cancer than other women do, and therefore have a higher stated intention of being rescreened at recommended intervals (Gram et al., 1990; Lerman et al., 1991). In contrast, the current study showed that women with a false-positive screening result at baseline were less likely to return for rescreening at recommended intervals than those with true-negative results (OR=0.92, 95% CI=0.91-0.93), and similar results have been reported in several previous studies (Johnson et al., 1996; McCann et al., 2002; Chiarelli et al., 2003; Hofvind et al., 2003; Alamo-Junquera et al., 2011; Seigneurin et al., 2011). The uncertainty that occurs during the screening process while a woman is waiting for the results of additional testing

performed as a consequence of a positive mammography screening result may produce more worries than a negative, or clearly positive result (Marteau, 1994). Some of the discrepancy between studies surrounding the effect of a false-positive result on subsequent screening behavior could be due to the differences in breast cancer screening policies between countries. Many European countries have organized population-based screening programs, but the populations are gleaned from the patients of general physicians or family doctors. In the Korean NCSP, the involvement of a family doctor or general physician in the screening process is very limited. Mammography is performed at a clinic or hospital that has been designated as a breast cancer screening unit. Any clinic, hospital, or specific screening facility can apply to be certified as a breast cancer screening unit, and those who are invited to attend screening can visit any of these certified screening units. The lack of a close relationship or continuous connection between a physician in the breast cancer screening unit and participants, which does exist between a family doctor and their patients, might have affected the low rescreening rate among women who had false-positive results.

In the present study, we also found that age and history of mammography screening were associated with on-schedule rescreening. Specifically, women aged 70 years or over were less likely to be rescreened than women aged 40-69 years. In the NCSP, there is no age limit for breast cancer screening. All women in the target population receive an invitation letter from the NHIC at the beginning of the year. Therefore, the lower rescreening rate among women aged 70 or over may be due to a hesitancy to follow the recommendation for breast cancer screening. Also, it may be more difficult for the elderly to understand the need to attend regular breast cancer screening. Previous studies have shown that clinicians often fail to discuss key information about breast cancer screening with older women. Interestingly, previous mammography screening was strongly associated with rescreening in the present study. Compared with people who had never been invited nor screened before baseline, women who had been invited and screened once or more before baseline were significantly more likely to be rescreened (OR=2.02, CI=2.00–2.05). These results suggest that previous experience with mammography screening positively influences subsequent screening behavior. We also observed an effect of study period on rescreening. The levels of rescreening were 58.4% in 2007 and 63.4% in 2008. A future study to examine time trends in rescreening is therefore highly recommended.

A number of limitations should be considered when interpreting these results. Although the NCSP is a nationwide population-based screening program, it cannot take into account screening performed outside the NCSP, as the NCSP does not capture tests carried out in the private sector (e.g., opportunistic screening). In addition, other factors that influence screening were not considered in this study, such as psychological factors (e.g., discomfort, embarrassment, fear of the results, or complication concerns) and socioeconomic factors besides income (e.g., education, occupation).

Despite these limitations, to our knowledge, this is the largest study performed to-date that assesses the effect of a false-positive breast cancer screening result on attendance at the next recommended screening round and takes women's personal characteristics into account. A better understanding of the factors that affect rescreening is fundamental if we are to increase the impact of breast cancer screening. In this study, 61.3% of women were rescreened on schedule, which is lower than the rate in Western countries. Although the NCSP for breast cancer in Korea has different policies, efforts to improve the rescreening rate are nevertheless needed. Our study results also highlight that having a false-positive screening result negatively affects subsequent screening behavior. Given the frequency of false-positive results, the corresponding deterrence from screening could be a serious public health problem in Korea. Therefore, it may be necessary to assess a woman's screening history, and socioeconomic status, in combination with interventions to reduce anxiety, such as involvement of primary care physicians or providing information to women about breast cancer and screening. Furthermore, efforts to reduce false-positive results and improve the quality of mammography may increase compliance with breast cancer screening recommendations. Our results could be useful to improve the screening process and increase compliance with this program.

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