Distribution of Dense Breasts Using Screening Mammography in Korean Women: A Retrospective Observational Study

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ABSTRACT

Purpose: This retrospective observational study evaluated the distribution of dense breasts by age group among healthy Korean women.

Methods: Participants were women aged ≥30 years who voluntarily underwent screening mammography between January 2007 and December 2011. Women who received Breast Imaging Reporting and Data System for mammographic density of 3 or 4 category were defined as having dense breasts. The proportion of women with dense breasts (PDB, %) was calculated by dividing the number of participants with dense breasts by the total number of participants. A p-value < 0.05 was considered statistically significant.

Results: Of the 231,058 women who participated, 78.15% were classified as having dense breasts. PDB was the highest in the youngest age group (PDB=94.87%) and the lowest in the oldest age group. The greatest change in PDB between age groups was observed in the group aged 60-64 years.

Conclusion: The results show that the distribution of dense breasts by age group has increased in all age groups, except those age 35-39 years. These findings suggest an association between the age distribution of dense breasts and trends in breast cancer incidence rates. Further studies are needed to estimate change in incidence rates by age and accumulation of fatty breast tissue among Korean women.

Keywords: Breast neoplasms, Early detection of cancer, Mass screening, Mammography
INTRODUCTION

Breast cancer is the second most common type of cancer among Korean women [1] and the most common among women globally [2]. The incidence of breast cancer is lower among women in Asia than among women in Western countries [3], with different trends in age at diagnosis, as well [4]. These epidemiological differences may be due to racial variations in estrogen receptor (ER) status [5] and the prevalence of risk factors such as mammographic breast density [6].

Breast density has been shown to be associated with reproductive and hormonal factors [7], and among Western women, breast density is considered one of the strongest known risk factors for breast cancer development [8]. Breast density also varies between racial groups and may explain some of the racial disparity in breast cancer incidence [9].

Mammographic density and age-specific incidence of breast cancer differ markedly between women in Asian and Western countries [10-13]. Therefore, there may be differences in the relationship between breast density and breast cancer risk in Asian women [9], including Korean women [14, 15], compared to women in Western countries.

Evaluating the distribution of breast density by age group is necessary to determine whether there is an effect of breast density on the risk of breast cancer [16]. Two studies have examined breast density among healthy Korean women [15, 17], although these data were collected in 2002 [15] and 1998 [17]. Because the incidence rate of breast cancer has increased in Asian countries, including Korea [1, 11], the aim of this
study was to describe the distribution of mammographic breast density by age group in a Korean population and to evaluate changes in breast density after an approximately 10-year period.
MATERIALS AND METHODS

Study Participants

Study participants were recruited through cancer screening programs conducted by the Korea Medical Institute (KMI), as described in Bae et al. [18]. The KMI is a non-profit foundation that has specialized in comprehensive health examination services since 1985. In this screening program, digital mammography is the primary modality for both initial and follow-up screenings for breast cancer since 2005.

Study participants were Korean women aged ≥30 years who voluntarily underwent screening mammography between January 2007 and December 2011. Women who reported a prior history of breast cancer on a structured questionnaire were excluded because the mammography was a follow-up, rather than a screening test. Participant age was the age at which the screening mammogram was received.

Definition of Dense Breast

For each participant, breast density was assigned one of four Breast Imaging Reporting and Data System (BI-RADS) categories. Dense breasts were defined as category 3 (heterogeneously dense [51–75% glandular]) or category 4 (extremely dense [>75% glandular]) [19].

All participants consented to screening mammography and the use of personal data for research. This study protocol was approved by the Institutional Review Board of Jeju
Participants were categorized by 5-year age intervals (30-34, 35-39, ---, 80-84 years, and ≥85 years). The proportion of participants with dense breasts (PDB, %) was calculated by dividing the number of women with dense breasts by the total number of participants. **The dropping PDB (%) was estimated by the difference of PDB between adjacent age groups.** We evaluated the change in distribution of dense breasts by age group after a 10-year period by comparing our study population with the data published by Kim et al. [17]. These data, as opposed to those published by Cho et al. [15], were used because more detailed information was available in the older publication. The chi-square test was used to analyze differences in the PDB by age group between the KMI database and the Kim et al. dataset [17]. A p-value of less than 0.05 was considered statistically significant. All statistical tests were performed using STATA (StataCorp, Texas), version 12.
RESULTS

The distribution of PDB by age group is shown in Table 1. In all, 231,058 were enrolled in the study, and the overall PDB was 78.15%. The highest PDB was observed in the youngest age group (age 30-34 years, 94.87%). The PDB decreased as age increased. The greatest difference in PDB was observed among the group aged 60-64 years (-20.04%).

Figure 1 and Table 2 illustrate the difference in PDB distribution between the KMI database and the Kim et al. dataset [17], stratified by age group. There was an increase in PDB after 10 years in all age groups, except women 35-39 years old. The greatest increases were observed among women older than 50 years, where the difference in PDB was greater than 40%. The youngest age group with PDB less than 50% was 50-54 years, which shifted to the 60-64 age group after a 10-year period.
DISCUSSION

Our results show that the distribution of dense breasts by age group has changed over a 10-year period, with an increase in PDB observed for all age groups, except those age 35-39 years. These results suggest that the different patterns in age at diagnosis of breast cancer between Asian and Western women may be related to the difference in PDB by age group. Furthermore, changes in the PDB could be associated with rising incidence rates of breast cancer.

Our study had three main limitations. The first issue is the possibility of self-selection bias, a type of selection bias. Because the study participants voluntarily participated in the screenings, they are not representative of all Korean women. However, the aim of this study was not to evaluate any benefit from the screening intervention, but rather to describe the distribution of dense breasts. Since the participants did not know whether they had dense breasts as the time of the screening, they are likely to be representative of women who would volunteer in a screening mammography study. The second issue is the reliability of mammographic density determination. The PDB was determined using the BI-RADS 4-category scoring system for mammographic density [19], not the BI-RADS 5-category scoring system for recommendation. Kerlikowske et al. [20] reported that the kappa value in breast density was highest (0.81) among BI-RADS parameters in cancer cases. The last issue is the comparability of our results with those in Kim et al. [17]. The source population in both was healthy women who were examined in screening mammography served in a medical institute. And the reporting system in both was same
as BI-RADS [19]. The trends of PDB could be interpreted whereas the direct comparison of PDB did not possible because of differing institute and mammographic machine.

The phenomenon of rapidly increasing incidence rates of breast cancer among Asian women could be explained by the combination of a diet rich in saturated fat and a sedentary lifestyle, as well as early menarche, decreased parity, and delayed childbearing, commonly referred to as the Westernization of lifestyle [21]. Shin et al. [11] and Sehn et al. [21] have argued that the changing trends in incidence patterns among Asian women are due to a birth cohort effect that corresponds to the adoption of a Western lifestyle. However, data published by Bae et al., showing incidence trends in Korean women over a 10-year period [4] cast doubt on the birth cohort effect hypothesis. In addition, Westernization of lifestyle has been associated with breast density [15]. Thus, an age-period-cohort analysis is needed to evaluate an association between changes of distribution of dense breasts and trends in incidence rates among Asian women.

Because the PDB is higher among women from Asian countries than women from Western countries [17], the accuracy of screening mammography could be reduced, leading to higher rates of interval cancers and worsening prognosis [22, 23]. If dense breasts are shown to be an independent risk factor for breast cancer in Asian women [24, 25], a woman with dense breasts could be considered at high risk for breast cancer development and included in high-risk screening programs [19, 26]. Further cohort studies incorporating follow-up screening mammography are therefore required to
evaluate the relative risk of breast cancer among women whose breasts remain dense and women whose breasts develop adipose tissue over time [27].

In conclusion, this study suggests that the PDB has changed by age group in Korean women over 10 years. This suggests an association between age distribution of women with dense breasts and trends in incidence rates of breast cancer. Additional studies are needed to estimate the change in incidence rates by age group and accumulation of breast fatty tissue in Korean women.

Conflict of Interest

Dr. Shin is an employee of the Korea Medical Institute. We have no other conflicts of interest to declare.

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References


Table 1. Proportion of dense breast (PDB) by age group in study participants*

<table>
<thead>
<tr>
<th>Age at baseline mammography</th>
<th>Voluntary screenees (n) [A]</th>
<th>Dense breast (n) [B]</th>
<th>PDB (%) [C]</th>
<th>Dropping PDB (%) [D]</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-34</td>
<td>24,339</td>
<td>23,091</td>
<td>94.87</td>
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<tr>
<td>35-39</td>
<td>39,460</td>
<td>35,848</td>
<td>90.85</td>
<td>-4.03</td>
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<tr>
<td>40-44</td>
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<td>41,636</td>
<td>86.65</td>
<td>-4.20</td>
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<tr>
<td>45-49</td>
<td>39,403</td>
<td>33,180</td>
<td>84.21</td>
<td>-2.44</td>
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<tr>
<td>50-54</td>
<td>27,914</td>
<td>22,360</td>
<td>80.10</td>
<td>-4.10</td>
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<td>55-59</td>
<td>21,049</td>
<td>14,177</td>
<td>67.35</td>
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<td>60-64</td>
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<td>6,048</td>
<td>47.31</td>
<td>-20.04</td>
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<td>65-69</td>
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<td>2,514</td>
<td>31.68</td>
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<td>70-74</td>
<td>5,039</td>
<td>1,116</td>
<td>22.15</td>
<td>-9.54</td>
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<td>75-79</td>
<td>2,885</td>
<td>442</td>
<td>15.32</td>
<td>-6.83</td>
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<td>80-84</td>
<td>1,582</td>
<td>132</td>
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<td>-6.98</td>
</tr>
<tr>
<td>85+</td>
<td>616</td>
<td>39</td>
<td>0.06</td>
<td>-2.01</td>
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<tr>
<td>Total</td>
<td>231,058</td>
<td>180,583</td>
<td>78.15</td>
<td></td>
</tr>
</tbody>
</table>

* C = B / A; D = C_i - C_{i-1}
Table 2. Comparison of the proportion of dense breast (PDB)

<table>
<thead>
<tr>
<th>Age at baseline mammography</th>
<th>PDB in Table 1</th>
<th>PDB in Reference [17]</th>
<th>Difference</th>
<th>P-value*</th>
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<tr>
<td>30-34</td>
<td>94.87</td>
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<td>90.85</td>
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<td>23.1</td>
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<td>80.10</td>
<td>30.06</td>
<td>50.0</td>
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<tr>
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* using chi-square test
Fig 1. Curves of proportion of dense breast by age groups