Preplanned Studies

Breast Cancer Awareness and Association with Frequency of Screening Among Women — China, 2020

Heling Bao[1,2,&]; Liyuan Liu[3,&]; Shu Cong[2]; Fei Wang[3]; Lixiang Yu[3]; Liwen Fang[2]; Xuening Duan[4]; Feng Tan[5,#]; Zhigang Yu[3,#]; Linhong Wang[2,#]

Summary

What is already known about this topic?

Breast cancer awareness plays a crucial role in promoting screening attendance, enabling early detection, and improving survival rates associated with breast cancer. Nevertheless, a persistent issue is the low public awareness of breast cancer warning signs and risk factors.

What is added by this report?

Breast cancer awareness rate was 10.2%, with particularly low rates among never-screened and inadequately screened women. Factors associated with low awareness levels included low income, agricultural occupation, limited educational attainment, smoking, and the absence of professional recommendations.

What are the implications for public health practice?

Consideration should be given to effective health education and delivery strategies aimed at women who have never been screened or have received inadequate screening.

Breast cancer is the most prevalent cancer among women worldwide (*1*). Early detection of breast cancer can enhance survival rates, while delayed diagnoses are often linked to low breast cancer awareness, such as recognizing early warning signs (*2*). Furthermore, insufficient awareness acts as a barrier to both attending screening appointments and adhering to follow-up procedures. Breast cancer awareness among Chinese women has been documented as low (*3*); however, the data have not been updated in recent years. Notably, only 25% of women in China have undergone breast cancer screening (*4*), and limited information is available on breast cancer awareness among never-screened or inadequately screened women.

This population-based cohort study on female breast cancer encompassed 63,219 participants, with an average of 5.3 person-years of follow-up. The findings revealed a breast cancer awareness rate of 10.2%, with particularly low rates among never-screened and inadequately screened women. Factors associated with low awareness levels included low income, agricultural occupation, limited educational attainment, smoking, and the absence of professional recommendations. These results highlight the urgent need for effective health education and targeted delivery strategies to mitigate breast cancer risks.

The study population was derived from the breast cancer cohort study in Chinese women, a population-based cohort focused on precise prevention of breast cancer (*5*). During 2008–2009, 81,191 women aged 25–70 years participated in breast cancer screening and completed an in-person interview. From March 2018 to October 2020, the original participants were followed up, and other eligible women residing in the same area, aged 25–70 years, and not pregnant, were recruited. Ultimately, a total of 63,219 women who completed the interview, clinical examination, and sample collection were included in the standardized cohort. All study participants provided informed consent.

In this study, trained research personnel administered a 30-minute self-developed questionnaire to collect information on participants' demographic characteristics, reproductive history, lifestyle and behaviors, family history, and knowledge of breast cancer. The frequency of breast cancer screening (i.e., clinical examination, ultrasound, and mammography) was assessed based on the most recent date recorded in the baseline data and participants' self-reported screening history. Consequently, women were categorized into three groups: never screened, screened more than three years ago, and screened within the past two years.

The primary outcome assessed in this study was breast cancer awareness at follow-up, measured through a 12-item questionnaire and in-person interviews. The questionnaire comprised three sections: 1) identification of lump and non-lump symptoms, 2)

recognition of modifiable and non-modifiable risk factors, and 3) engagement in breast self-examination (BSE). We utilized a modified definition for breast cancer awareness based on the Breast Cancer Awareness Measure (BCAM) and its applicability within the context of China (*6*). A woman was deemed to be aware of breast cancer if she met the following criteria: identification of at least three symptoms among the list of five provided, acknowledgment of a minimum of one non-modifiable risk factor from the list of three provided, and reported BSE over the past year. Additionally, we established definitions for knowledge of symptoms and risk factors (Table 1).

We estimated the overall breast cancer awareness rate by screening frequency. The bootstrap method, employing 500 resampling iterations, was utilized to calculate 95% confidence intervals (*CI*). The χ^2 test with Rao-Scott correction was implemented to evaluate differences. A mixed-effect regression model, featuring a random intercept for the county, was fitted to investigate associations between screening frequency, demographic and socioeconomic factors, behaviors, family history, professional recommendations, and interaction terms, in relation to breast cancer awareness, while controlling for age and its quadratic and cubic terms. Subsequently, the ggeffects package enabled the calculation of age-specific awareness fitted values by maintaining other covariates at constant values. All analyses were conducted using SAS (version 9.4; SAS Institute, Cary, USA) and R software (version 4.2.2; R Foundation for Statistical Computing, Vienna, Austria).

TABLE 1. Breast cancer awareness by frequency of screening among women — China, 2020.

Item	Overall		Frequency of screening [% (95% *CI*)][§§]			
	N	Rate [% (95% *CI*)]	Never (*n*=22,331)	Screened over 3 years (*n*=23,573)	Screened within 2 years (*n*=16,839)	*P*
1 Breast cancer symptoms						
1.1 Lump in breast	62,517	50.0 (49.6–50.4)	46.5 (39.9–53.1)	42.5 (37.4–47.5)	65.4 (59.6–71.1)	<0.001
1.2 Lump under armpit	62,517	42.7 (42.3–43.1)	40.1 (32.4–47.9)	34.9 (30.4–39.5)	57.1 (51.4–62.9)	<0.001
1.3 Pulling in of nipple	62,517	37.5 (37.1–37.8)	34.6 (27.7–41.5)	30.5 (26.3–34.7)	51.1 (44.0–57.3)	<0.001
1.4 Discharge from nipple	62,518	37.9 (37.5–38.3)	34.6 (27.6–41.5)	30.9 (26.8–35.0)	52.1 (45.9–58.4)	<0.001
1.5 Pain in breast	62,518	44.2 (43.8–44.6)	39.4 (31.6–47.3)	37.7 (32.8–42.7)	59.7 (53.2–66.1)	<0.001
2 Risk factors related to breast cancer						
2.1 Menarche before age 12 years	62,519	20.8 (20.4–21.1)	19.7 (14.5–24.9)	16.8 (13.6–20.0)	27.7 (22.2–33.2)	<0.001
2.2 Reproductive history	62,519	22.5 (22.2–22.9)	20.9 (15.6–26.3)	18.1 (15.1–21.2)	30.9 (26.0–35.8)	<0.001
2.3 Menopause after age 55 years	62,519	21.7 (21.3–22.0)	20.5 (15.2–25.8)	17.7 (14.7–20.7)	28.8 (23.6–34.0)	<0.001
2.4 Drinking alcohol	62,517	28.6 (28.2–29.0)	25.6 (19.3–31.9)	24.0 (21.0–26.9)	39.1 (33.8–44.5)	<0.001
2.5 Taking hormones	62,519	29.7 (29.3–30.0)	26.1 (19.7–32.5)	24.8 (21.7–27.9)	41.2 (35.2–47.2)	<0.001
2.6 Family history of breast cancer	62,517	34.7 (34.3–35.1)	31.5 (24.6–38.3)	29.4 (25.7–33.0)	46.6 (39.3–53.9)	<0.001
3 Breast self-examination	62,743	20.2 (19.9–20.5)	8.1 (5.5–10.6)	13.9 (10.3–17.4)	45.2 (36.4–54.0)	<0.001
4 Knowledge of breast cancer symptoms*	62,517	41.0 (40.6–41.4)	37.2 (29.9–44.6)	33.8 (29.5–38.1)	56.1 (50.2–62.1)	<0.001
4.1 Knowledge of non-lump symptoms[†]	62,517	38.2 (37.8–38.5)	34.7 (27.8–41.7)	31.3 (27.2–35.4)	52.4 (46.2–58.6)	<0.001
5 Knowledge of breast cancer risk factors[§]	62,517	27.7 (27.3–28.1)	24.8 (18.7–30.9)	22.9 (19.9–25.9)	38.5 (33.1–43.8)	<0.001
5.1 Knowledge of changeable factors[¶]	62,517	33.4 (33.0–33.8)	29.6 (22.2–37.0)	28.3 (25.0–31.6)	45.7 (39.4–52.0)	<0.001
5.2 Knowledge of unchangeable factors[**]	62,517	37.1 (36.7–37.5)	33.8 (26.5–41.1)	31.5 (27.9–35.1)	49.2 (42.1–56.4)	<0.001
6 Breast cancer awareness[††]	62,654	10.2 (9.9–10.5)	3.9 (1.9–6.0)	6.1 (4.2–8.1)	24.4 (18.2–30.6)	<0.001

Abbreviation: *CI*=confidence interval.
* identify >3 symptoms.
† identify at least 1 non-lump symptom (1.3, 1.4, and 1.5).
§ identify >2 risk factors.
¶ identify at least 1 changeable risk factor (2.2, 2.4, and 2.5).
** identify at least 1 unchangeable risk factor (2.1, 2.3, and 2.6).
†† meet 4, 5.2, and 6, simultaneously.
§§ 476 cases are missing.

In the standardized cohort of 63,219 participants, the mean age was 47.5 years (standard deviation=11.0). Among these individuals, 53.1% had attained a primary school education or lower, 68.3% reported a monthly household income per capita of 3,000 CNY or less, 15.0% had a family history of cancer, 1.1% were smokers, and 4.8% were drinkers (data not shown).

The overall breast cancer awareness rate was found to be 10.2% (95% *CI*: 9.9%–10.5%), with a notably lower rate observed among women who had never been screened or had not been screened in over 3 years (Table 1). Knowledge regarding breast cancer symptoms varied, with 37.5% to 50.0% of the surveyed women being aware of the different symptoms. In comparison, awareness of risk factors was lower than that of symptoms, with figures ranging from 20.8% to 34.7%.

More specifically, 38.2% (95% *CI*: 37.8%–38.5%) of the participants were able to correctly identify non-lump symptoms, 27.7% (95% *CI*: 27.3%–28.1%) demonstrated knowledge of risk factors, and 20.2% (95% *CI*: 19.9%–20.5%) reported having conducted a BSE within the past year. For each of these items, the awareness rate among women who had been screened within the past two years was significantly higher compared to those who had never been screened or had not been screened in over three years.

Breast cancer awareness was notably higher in women who had been screened within the past two years (*OR*=6.26, 95% *CI*: 4.36–9.01) and those screened over three years ago (*OR*=1.99, 95% *CI*: 1.36–2.91), compared to unscreened women (Table 2). A significant interaction was observed between screening frequency, household income, education, and awareness. Middle and high household income levels, as well as junior school education or higher, were associated with increased awareness. However, these associations were diminished in women screened within two years and those screened over three years, rendering them insignificant. Additionally, breast cancer awareness was linked to nonagricultural occupations, alcohol consumption, family history of cancer, and professional recommendations for screening. Comparable patterns were found for knowledge of symptoms, risk factors, and BSE. Nevertheless, elevated odds in women screened over three years were not observed for knowledge of symptoms and risk factors. In contrast, a high frequency of screening amplified the disparities in knowledge attributed to education.

Figure 1 displays the age-specific breast cancer awareness among women, broken down by the frequency of screening. It was found that overall breast cancer awareness, understanding of symptoms and risk factors, as well as BSE, were notably higher in women who had been screened within the past two years compared to those in other groups. Additionally, breast cancer awareness in women under the age of 50 was observed to be higher than in their older counterparts.

DISCUSSION

Our study demonstrates that 10.4% of women possess awareness of breast cancer, with the lowest level of awareness observed among those who have never undergone screening. Lower awareness is associated with socioeconomic factors such as low socioeconomic status, agricultural occupations, smoking, and lack of professional recommendations for screening. To the best of our knowledge, this is the largest cohort study to date that examines breast cancer awareness in Chinese women and specifically analyzes awareness according to screening frequency. These findings emphasize the necessity for health education initiatives targeting breast cancer, particularly for women who have never been screened or have undergone inadequate screening.

Consistent with prior research conducted in China (18.6%) (*3*), the present study identifies a substantial gap in breast cancer awareness among Chinese women, primarily due to their limited knowledge of risk factors and BSE practices. Regardless of screening frequency, fewer than 40% of women were found to be aware of both modifiable and non-modifiable risk factors for breast cancer. In this investigation, we employed a modified definition of BCAM that does not include older age as a non-modifiable factor, which consequently led to more challenging questions and decreased levels of awareness. This decision was made based on the observation that peak breast cancer incidence in Chinese women occurs around menopause, rather than increasing with age (*7*). Gaining knowledge of non-modifiable risk factors not only enables women to assess their own risk but also encourages adherence to routine screening and timely diagnosis (*8*). While BSE is not widely endorsed as a method for reducing mortality (*9*), conducting regular BSEs can positively impact women's awareness and facilitate early detection (*10*).

Increased awareness of breast cancer contributes to higher rates of screening attendance and subsequent

TABLE 2. Associations between screening frequency, potential factors, and breast cancer awareness among women — China, 2020.

Independent variable	Model 1: breast cancer awareness*		Model 2: knowledge of breast cancer symptom†		Model 3: knowledge of breast cancer risk factor§		Model 4: breast self-examination¶	
	OR (95% *CI*)	*P*	*OR* (95% *CI*)	*P*	*OR* (95% *CI*)	*P*	*OR* (95% *CI*)	*P*
Frequency of screening (*vs*. never)								
Screened over 3 years	1.99 (1.36–2.91)	<0.001	0.98 (0.88–1.09)	0.69	0.99 (0.86–1.13)	0.83	2.03 (1.67–2.46)	<0.001
Screened within 2 years	6.26 (4.36–9.01)	<0.001	1.42 (1.24–1.62)	<0.001	1.44 (1.23–1.68)	<0.001	4.59 (3.76–5.60)	<0.001
Occupation (*vs*. agricultural occupation)								
Non-agricultural occupation	1.78 (1.63–1.94)	<0.001	1.31 (1.24–1.39)	<0.001	1.58 (1.49–1.67)	<0.001	1.57 (1.46–1.68)	<0.001
Housework/unemployed	1.24 (1.14–1.36)	<0.001	0.93 (0.89–0.98)	0.003	1.10 (1.04–1.16)	<0.001	1.20 (1.12–1.27)	<0.001
Household income per capita per month (*vs*. <1,000)								
1,000–2,999	2.00 (1.43–2.79)	<0.001	1.64 (1.50–1.80)	<0.001	1.56 (1.40–1.74)	<0.001	1.28 (1.07–1.53)	0.007
3,000 and more	3.07 (2.19–4.30)	<0.001	2.22 (2.01–2.45)	<0.001	2.45 (2.18–2.75)	<0.001	1.41 (1.17–1.69)	<0.001
Education (junior school and higher *vs*. primary school and lower)	2.20 (1.83–2.64)	<0.001	1.80 (1.69–1.92)	<0.001	1.59 (1.48–1.71)	<0.001	1.28 (1.14–1.43)	<0.001
Pregnancy (*vs*. never)								
1 pregnancy	1.17 (0.89–1.53)	0.26	1.26 (1.08–1.46)	0.003	1.13 (0.96–1.33)	0.13	1.19 (0.97–1.47)	0.10
2 pregnancies and more	1.02 (0.78–1.33)	0.89	1.31 (1.13–1.52)	<0.001	1.05 (0.90–1.23)	0.51	1.11 (0.91–1.36)	0.31
Smoking (smoker *vs*. non-smoker)	0.75 (0.48–1.18)	0.21	0.70 (0.57–0.86)	<0.001	0.71 (0.56–0.91)	0.006	0.90 (0.68–1.18)	0.44
Alcohol (drinker *vs*. non-drinker)	1.26 (1.12–1.42)	<0.001	1.04 (0.95–1.13)	0.40	1.00 (0.92–1.10)	0.91	1.25 (1.13–1.38)	<0.001
Family history of cancer (Yes *vs*. No)	1.25 (1.16–1.34)	<0.001	1.30 (1.24–1.36)	<0.001	1.16 (1.10–1.22)	<0.001	1.24 (1.17–1.32)	<0.001
Professional recommendation (Yes *vs*. No)	>3.34 (3.13–3.57)	<0.001	1.29 (1.23–1.36)	<0.001	1.30 (1.24–1.37)	<0.001	5.62 (5.32–5.93)	<0.001
Interaction between household income and screening frequency (*vs*. low × never)								
Middle × screened over 3 years	1.02 (0.69–1.51)	0.94	1.03 (0.91–0.16)	0.65	1.21 (1.05–1.40)	0.009	0.93 (0.75–1.15)	0.51
Middle × screened within 2 years	0.77 (0.53–1.12)	0.17	1.07 (0.94–1.24)	0.31	1.02 (0.87–1.20)	0.77	0.92 (0.74–1.14)	0.43
High × screened over 3 years	0.86 (0.58–1.28)	0.47	0.93 (0.81–1.05)	0.24	0.94 (0.80–1.09)	0.39	0.86 (0.69–1.07)	0.17
High × screened within 2 years	0.67 (0.46–0.97)	0.04	1.05 (0.91–1.22)	0.49	0.81 (0.69–0.96)	0.01	0.92 (0.74–1.14)	0.43
Interaction between education and screening frequency (*vs*. primary school × never)								
Junior school × screened over 3 years	0.94 (0.75–1.17)	0.58	1.21 (1.11–1.32)	<0.001	1.15 (1.04–1.27)	0.004	1.02 (0.89–1.17)	0.77
Junior school × screened within 2 years	0.74 (0.61–0.91)	0.003	1.10 (1.00–1.20)	0.04	1.11 (1.00–1.22)	0.04	0.99 (0.87–1.14)	0.92

Note: All four models are adjusted for age, quadratic term, and cubic term of age.
Abbreviation: *OR*=odds ratio; *CI*=confidence interval.
* In Model 1, the dependent variable is breast cancer awareness (*6*).
† In Model 2, the dependent variable is knowledge of all five breast cancer symptoms (*4*).
§ In Model 3, the dependent variable is knowledge of all six breast cancer risk factors (*5*).
¶ In Model 4, the dependent variable is breast self-examination (*3*).

diagnoses (*2*). Our study findings reveal a notably low level of awareness among unscreened women, emphasizing the urgent need to prioritize this population in future health education programs. Additionally, our results demonstrate a positive correlation between breast cancer screening and awareness, as well as socioeconomic disparities. However, this effect may diminish over time. When the screening interval exceeds 3 years, participants' awareness drops to levels comparable to those of unscreened individuals. This highlights the importance of regular health education initiatives to maintain and

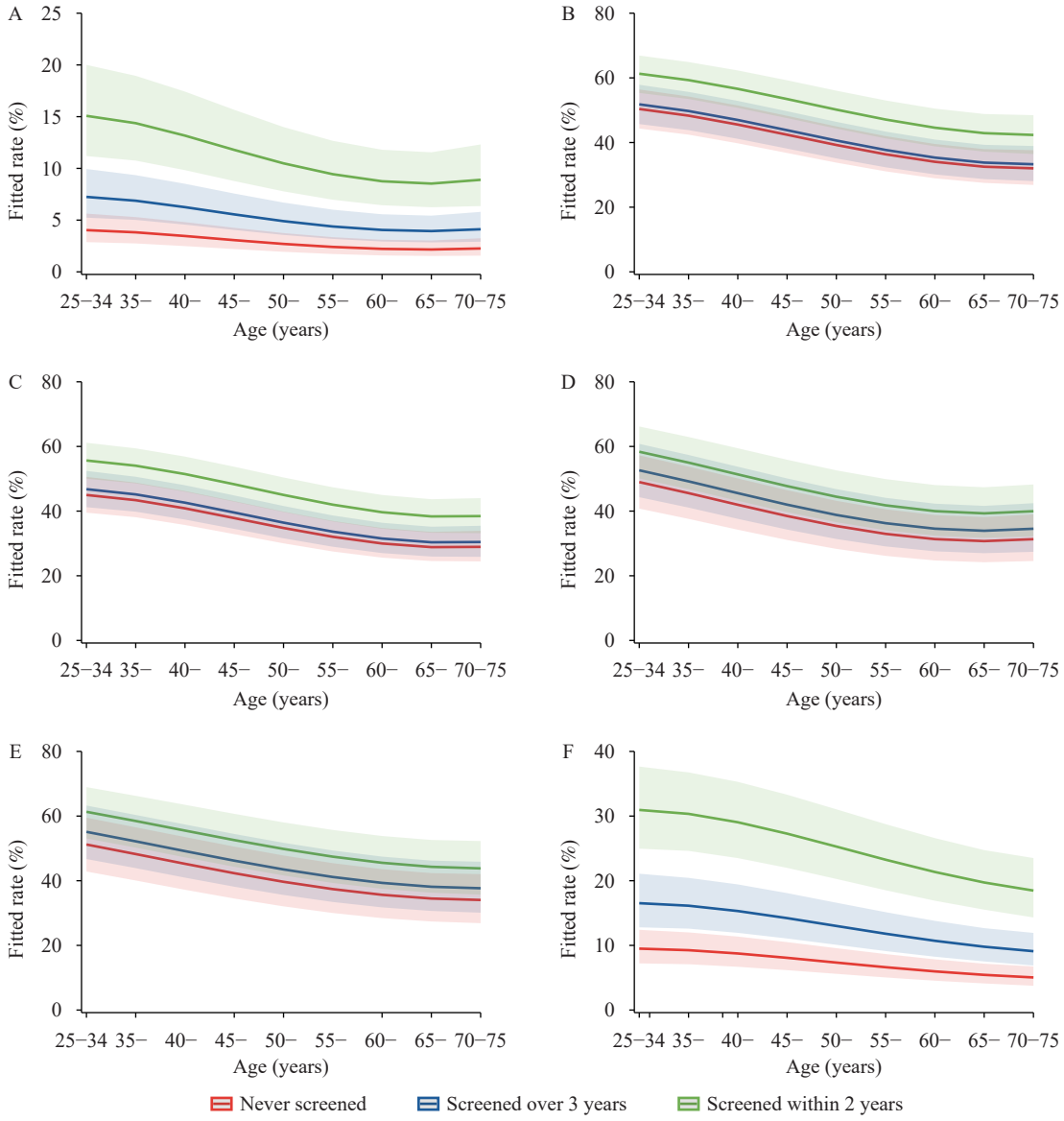

FIGURE 1. Fitted age-specific breast cancer awareness by frequency of screening among women — China, 2020. (A) Breast Cancer Awareness; (B) Knowledge of breast cancer symptoms; (C) Knowledge of breast cancer non-lump symptoms; (D) Knowledge of modifiable breast cancer risk factors; (E) Knowledge of non-modifiable breast cancer risk factors; (F) Breast self-examination.

promote breast cancer prevention awareness at the population level.

Conversely, frequent screening has been found to slightly exacerbate the disparity in awareness among groups with different education levels. This phenomenon can be partially attributed to the lack of targeted health education strategies for women with lower education levels. In line with previous research (*8*), our study reveals that women exhibiting lower awareness are more likely to be older, smokers, possess lower education and income, and lack professional recommendations. Our findings offer insights into potential areas for targeted health education, including the utilization of informational booklets, verbal interactions, and future investigation of effective intervention strategies.

A primary limitation of this study is the lack of consideration for the impact of baseline breast cancer awareness among newly recruited participants. However, this is unlikely to alter the conclusion as all participants reside in the same geographic region and share similar demographic attributes and cultural backgrounds.

In conclusion, awareness of breast cancer remains

limited in China, particularly among women who have not received screening or have been inadequately screened. Emphasis should be placed on implementing effective health education and targeted delivery strategies within this population.

Conflicts of interest: No conflicts of interest.

Acknowledgement: All research staff from the local Centers for Disease Control and Prevention, hospitals, and health centers associated with this project.

Funding: National Key R&D Program of China (2016YFC0901300, 2016YFC0901301).

doi: 10.46234/ccdcw2023.063

[#] Corresponding authors: Feng Tan, tanfeng@chinacdc.cn; Zhigang Yu, yuzhigang@sdu.edu.cn; Linhong Wang, linhong@chinawch.org.cn.

[1] Institute of Medical Information, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, China; [2] National Center for Chronic and Non-communicable Disease Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing, China; [3] The Second Hospital of Shandong University, Jinan City, Shandong Province, China; [4] Peking University First Hospital, Beijing, China; [5] Chinese Center for Disease Control and Prevention, Beijing, China.
[&] Joint first authors.

Submitted: February 28, 2023; Accepted: April 10, 2023

REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2021;71(3):209 – 49. http://dx.doi.org/10.3322/caac.21660.
2. Baccolini V, Isonne C, Salerno C, Giffi M, Migliara G, Mazzalai E, et al. The association between adherence to cancer screening programs and health literacy: a systematic review and meta-analysis. Prev Med 2022;155:106927. http://dx.doi.org/10.1016/j.ypmed.2021.106927.
3. Liu LY, Wang F, Yu LX, Ma ZB, Zhang Q, Gao DZ, et al. Breast cancer awareness among women in eastern China: a cross-sectional study. BMC Public Health 2014;14:1004. http://dx.doi.org/10.1186/1471-2458-14-1004.
4. Zhang M, Zhong YJ, Bao HL, Zhao ZP, Huang ZJ, Zhang X, et al. Breast cancer screening rates among women aged 20 years and above - China, 2015. China CDC Wkly 2021;3(13):267 – 73. http://dx.doi.org/10.46234/ccdcw2021.078.
5. Bao HL, Liu LY, Fang LW, Cong S, Fu ZT, Tang JL, et al. The breast cancer cohort study in Chinese women: the methodology of population-based cohort and baseline characteristics. Chin J Epidemiol 2020;41(12):2040 – 5. http://dx.doi.org/10.3760/cma.j.cn112338-20200507-00695.
6. Linsell L, Forbes LJL, Burgess C, Kapari M, Thurnham A, Ramirez AJ. Validation of a measurement tool to assess awareness of breast cancer. Eur J Cancer 2010;46(8):1374 – 81. http://dx.doi.org/10.1016/j.ejca.2010.02.034.
7. Lei SY, Zheng RS, Zhang SW, Wang SM, Chen R, Sun KX, et al. Global patterns of breast cancer incidence and mortality: a population-based cancer registry data analysis from 2000 to 2020. Cancer Commun (Lond) 2021;41(11):1183 – 94. http://dx.doi.org/10.1002/cac2.12207.
8. Smith J, Dodd RH, Gainey KM, Naganathan V, Cvejic E, Jansen J, et al. Patient-reported factors associated with older adults' cancer screening decision-making: a systematic review. JAMA Netw Open 2021;4(11):e2133406. http://dx.doi.org/10.1001/jamanetworkopen.2021.33406.
9. Kösters JP, Gøtzsche PC. Regular self-examination or clinical examination for early detection of breast cancer. Cochrane Database Syst Rev 2003;2003(2):CD003373. http://dx.doi.org/10.1002/14651858.CD003373.
10. Hassan LM, Mahmoud N, Miller AB, Iraj H, Mohsen M, Majid J, et al. Evaluation of effect of self-examination and physical examination on breast cancer. Breast 2015;24(4):487 – 90. http://dx.doi.org/10.1016/j.breast.2015.04.011.