

Workplace-Based Breast Cancer Screening Intervention in China

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Abstract

Background: Breast cancer continues to be the primary cause of death among East and Southeast Asian women. Although China, the most populous country in the world, is experiencing unprecedented economic growth, its health care system has yet to benefit from the current economic prosperity. Indeed, studies have shown a consistent increase in breast cancer rates among Chinese women over the past two decades in the absence of breast cancer screening guidelines.

Methods: The primary objective of this study was to examine the impact of a workplace intervention on increasing breast cancer screening rates. The study was implemented at eight worksites in Nanjing, four of which were assigned to the intervention group ($n = 232$) and four to the control group ($n = 221$). The intervention group received breast cancer education and screening navigation. The control group was provided with general cancer education and received a delayed intervention after completion of the study. Study measures were completed at pre- and postprogram and at 6-month follow-up to assess uptake of mammography.

Results: Baseline mammography use was low among both intervention and control groups. However, exposure to the workplace intervention dramatically increased the uptake of mammography from 10.3% at baseline to 72.6% at 6-month follow-up in the intervention group ($P < 0.001$).

Conclusions: Findings provide preliminary evidence that the implementation of a comprehensive workplace breast cancer screening intervention program in China can lead to increased uptake of mammography. These data may help facilitate the development of theory-based workplace cancer prevention programs and screening guidelines in China.

Impact: A workplace-based multifaceted intervention could have a strong impact in breast cancer prevention and early detection among women in China. *Cancer Epidemiol Biomarkers Prev*; 21(2); 358–67. ©2011 AACR.

Introduction

Breast cancer incidence and mortality in China and other Asian countries

Consistent with trends in developing countries, breast cancer is a primary cause of death among East and Southeast Asian women. Although rates in most developed countries have decreased, rates in developing Asian nations continue to reflect rising trends. Globally, the age-adjusted rate for breast cancer is 37.4 per 100,000 (1, 2). Recent studies indicate that breast cancer is often diag-

nosed at more advanced stages in developing countries and a higher proportion of young women in these populations are more vulnerable to breast cancer than their counterparts in developed countries (1, 3).

Although China has no standardized epidemiologic cancer data set, independent studies, and critical reviews of recently established Chinese government cancer registries in a number of metropolitan and county-level centers have provided some insights into cancer incidence and mortality rates. The most recent data from the National Central Cancer Registry of China ranked breast cancer number one in incidence (42 per 100,000) and sixth in mortality (6.9 per 100,000) among all cancers in female population (4). And incidence rates tend to be much higher in urban than in rural areas (49.1 vs. 16.9 per 100,000; ref. 4). A comparison of epidemiologic data between 2000 and 2005 revealed a significant increase in breast cancer incidence (470,000) and mortality (130,000; ref. 5) with the number of breast cancer cases projected to increase by 38.5% (4, 6). Similar incidence and mortality rates are observed among Chinese women residing in Hong Kong, Singapore, and Malaysia.

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International initiatives to reduce the burden of breast cancer

One of the WHO's 2010 initiatives is the promotion of breast cancer control within the context of comprehensive national cancer control programs (7), the cornerstone of which is early detection. Early detection of breast cancer enhances treatment outcomes and survival. Although breast cancer screening guidelines vary in the United States, mammography is recommended annually or biannually (every other year) accompanied by a clinical breast exam (CBE) and optional routine breast self-examination (BSE; refs. 8–10). Globally, mammography has been recommended as the preferred detection technology by the Breast Health Global Initiative (BHGI; ref. 11). Where resources for this technology are limited, alternative recommended detection programs may include CBE accompanied by rigorous evaluation components (11). The International Agency for Research on Cancer recommends that mammography should be used as a supplement to CBE for suspicious diagnoses, which can improve survivorship (12–14).

There have been several attempts to develop breast cancer screening guidelines in Mainland China, Taiwan, and Singapore, with the latter 2 focusing on CBE and mammography, respectively (15–19). Although China's urban cancer registries have partial data on breast and other cancers, currently, standards for breast cancer screening are nonexistent in the country despite governmental and academic interest in their development. This interest has been driven, in part, by socioeconomic and cultural change, a growing middle class, a changing pattern of health delivery, and the introduction of Western medical technology (e.g., mammography; ref. 20).

Although mammography technology is available in China's major metropolitan areas, particularly in large hospitals, its use in screening and early detection cancer programs is limited because of a general lack of public awareness about mammography and the absence of standard guidelines for the application of this technology in screening and early detection programs (21). Nonetheless, interest in establishing standard guidelines and the application of new technology remains high among Chinese public health officials.

In 2005, the Chinese Anti-Cancer Association (CACA) launched a nationwide project titled, *Chinese One Million Women Breast Cancer Screening*. The aim of the project was to designate 100 "high-quality" hospitals that will offer, over a period of 6 years, free breast examinations for 1 million women aged 35 years and older. The project, however, was suspended 2 years later because of financial challenges (22). In 2008, China's Ministry of Health launched a scaled-down government-supported breast cancer screening program targeting half a million women in the same age range in 53 China districts. The program included mammary molybdenum target X-ray radiography and breast ultrasonography. The primary aim of the program was to increase awareness and knowledge about breast cancer as well as to establish breast cancer screen-

ing guidelines based on biologic findings (23). This ongoing program has succeeded in generating both local citizens' support and partial financial support from local government (22).

Breast cancer screening rates among Chinese women

Although mammography screening rates in the United States have exceeded the Healthy People 2010 objective of 70% (24), the rates for Chinese American women are significantly lower than those in the general U.S. population and range between 57% and 64% (25–28). Screening rates are even lower among non-English speakers and immigrant Chinese (26, 28–30).

Similarly, low breast cancer screening rates are found in other predominantly Chinese-populated countries. For example, in Hong Kong (a Chinese territory returned to China in 1997, after 150 years of British rule), only 12% of women in the age group 40 to 49 years have reported being screened within the past 2 years; in Singapore, screening rates for women in the same age group were 26.4% in the past year and 43.2% among women aged 50 to 65 years in the last 2 years (31, 32). Current studies in China indicate that the low average screening rate of 33% to 43% is associated with low levels of knowledge about breast cancer (33–35).

Barriers to breast cancer screening and early detection in China

A number of factors contribute to low breast cancer screening rates and the late stage of diagnosis among women in developing countries. These may include socioeconomic factors, cultural barriers, and a lack of knowledge about breast cancer risks and screening (36), as well as misperceptions about breast cancer, screening procedures, and treatment of cancer. For example, some Chinese women believe that breast cancer surgery can lead to further spread of cancer which, in turn, hastens death, whereas others believe that total mastectomy is the only treatment option. These beliefs may serve as barriers to screening and early detection of disease (37, 38).

Furthermore, among women in China, there is a lack of perceived importance about health promotion and cancer prevention issues, which also serves as a major barrier to cancer screening (31). Awareness about cancer screening and early detection is low among Chinese women in Hong Kong with 58% reporting that they have never heard of mammography, a finding that did not vary based on different age groups or education levels. Financial barriers or the cost associated with screening is also cited as one of the barriers to CBE or mammography (39).

Interventions to improve breast cancer screening and health care system in China

There have been a number of successful interventions to increase knowledge about breast cancer and screening rates among Asian American women in the United States and Canada (40–44). Several educational intervention programs have been tested in Taiwan and Hong Kong

communities as well, using nurses as educators or counselors, and multimedia approaches to increase awareness knowledge about breast cancer and BSE among Chinese women. The programs showed initial success, but the interest tended to decline over time (31, 45, 46).

In contrast, the literature on breast cancer interventions in China is limited. In one study in Shanghai, 267,040 participants were randomized into intervention and control groups. The intervention group received BSE training and was followed over a 10- to 11-year period. Findings indicated that BSE training did not lead to higher rates of early detection or a reduction in mortality rates, suggesting that BSE was not a good investment of limited funds in the absence of mammography (47–50). However, there is an ample evidence indicating that improving women's awareness, knowledge, and preventive health care behavior in Chinese communities outside Mainland China can lead to early detection and decreased mortality rates (40, 41).

China's health care used to be guaranteed under the old State-owned enterprise system but that safety net has gone away as the economy has privatized. Currently, China has a multilevel 3-tiered health care system (tiers 3, 2, and 1). Tier 3 (class III) hospitals provide a range of health care services (e.g., cancer screening and treatment) with highest quality of care and advanced medical equipment, aiming to become regional and international center of excellence; tier 2 (class II) hospitals provide general outpatient services in collaboration with private clinics and community health care centers; and tier 1 (class 1) primary care community health care centers provide community health care services with lower costs (51).

For health insurance coverage, individuals are covered by a work-related health insurance system, *gongfei yiliao* (Government Employee Health Insurance) or *laobao yiliao* (Labor Health Insurance) or out-pocket self-payment. One of the present features of urban health care access is the high degree of dependency on a person's employment for adequate health care (52). Nanjing has 38 tier 3 hospitals located throughout the city, most of which are equipped with mammogram and breast cancer screening capacity. Large companies including our study sites have partnerships with tier 3 hospitals.

Thus, the workplace has been recognized as an important and appropriate setting for health promotion, in general, and breast cancer education and screening (53–55). China reported that its workplace had more than 750 million employees, 45% of whom were women (56, 57). Many Chinese employers (Dainwei) provide health care benefits that include annual checkups, women reproductive health, life planning skills, physical activity promotion, and AIDS education and prevention (58–60). However, to our knowledge, there has been no organized local or national effort to incorporate the use of the workplace for promoting breast cancer screening, especially mammography. The purpose of this study was to examine the feasibility and effectiveness of a workplace

breast cancer screening intervention in increasing breast cancer screening rates among Chinese women.

Methods

Study site and participants

The primary aim of the study was to develop, adapt, and test the feasibility and efficacy of a workplace intervention to promote breast cancer screening among Chinese women aged 40 and older. The study was conducted in Nanjing, the capital of Jiangsu province, one of China's largest cities located in a developed and industrialized region of southeast China. Nanjing is representative of the industrialized cities of China where mammography is accessible. Eight worksites participated in the study, 6 of which were product manufacturing sites and 2 research institutes. Criteria for study site selection included (i) no established program for breast cancer screening, (ii) labor union leadership acquiescence to full participation as partner in the study, (iii) sufficient number of female employees on site (>100 women aged 40 and older), (iv) an established health program that provided annual checkups and care of work-related minor injuries, and (v) availability of space for the study programs and support for navigation of participants with abnormal results. Among the 8 study sites, 4 were assigned to the intervention group ($n = 232$) and another 4 to the control group ($n = 221$) yielding a total of 453 participants. Inclusion criteria were women aged 40 and older, no current diagnosis of breast cancer and not having participated in breast cancer screening within the past 12 months.

Development and adaptation of intervention curriculum

The intervention curriculum, Asian Breast Cancer Prevention and Treatment Navigator Program (ABC), originally developed by Ma and colleagues at Center for Asian Health, Temple University for Chinese immigrants in the United States, was adapted and tested among Chinese women at worksites in Nanjing, China in collaboration with Southeast University in Nanjing.

The adaptation took into consideration local and regional linguistic and cultural elements. The curriculum addressed the following topics: (i) overview of breast cancer in China, (ii) breast cancer risk factors for Chinese women in the workplace, (iii) benefits of breast cancer screening with emphasis on state-of-the-art technology and practice, (iv) cultural perceptions and traditional health beliefs about breast cancer including physical and social barriers, (v) self-initiated prevention strategies in breast cancer, and (vi) workplace leadership role in employee encouragement and empowerment in breast cancer prevention and program sustainability.

Study design and procedures

The study used a 2-group quasi-experimental design with pre- and postintervention assessments and 6-month

follow-up on mammography screening. Questionnaires were administered to intervention and control groups at baseline, postintervention, and at 6 months. Baseline and postintervention assessments were administered in person whereas the 6-month follow-up was conducted by telephone interviews by trained research assistants of Southeast University, China. Study participants who did not have personal telephones were permitted to use workplace telephones for follow-up assessment.

Theoretical framework and intervention content

The intervention was guided by the theoretical framework of Health Belief Model (HBM) and Social Cognitive Theory (SCT; refs. 61–63). The HBM is used in behavioral research to predict health care behaviors. The theory states that a number of factors affect an individual's willingness to change health care behaviors (26, 29, 63–65). These include (i) perceived susceptibility, (ii) perceived severity, (iii) perceived benefit, and (iv) perceived barriers. The educational intervention was guided by these HBM constructs to facilitate the understanding of breast cancer and the importance of early detection and timely treatment and to assess changes in behavior following the intervention (63, 64). The SCT (61, 62) complements and extends elements of the HBM. It defines human behavior as a dynamic, reciprocal, and unique interaction of personal, behavioral, and environmental factors and is largely regulated antecedently through cognitive processes. Therefore, response consequences of a behavior are used to form expectations of behavioral outcomes. Accordingly, it is the ability to form these expectations that give humans the capability to predict the outcomes of their behavior before the behavior is carried out.

The multilevel and multicomponent intervention was implemented on site by a team of trained researchers in collaboration with workplace union leaders in Nanjing, China. Union leaders facilitated recruitment, provided accessibility to work sites and space, and assisted in the administration of the intervention.

The intervention group received (i) motivational group education on the nature of, evolution, and probable causes of breast cancer, risk factors, early detection strategies, including mammography screening procedures, and breast cancer prevention especially in the workplace; (ii) dynamic group interaction and role play discussion sessions led by trained educators in collaboration with union leaders on perceived susceptibility to breast cancer and benefits of early detection; (iii) printed educational handouts that complemented both didactic lectures and interactive sessions; and (iv) mammography navigation assistance that included arrangement of appointment, transportation to mammography site and workplace financial support, and release time for mammograms. Control group participants received general health care education focusing on healthy lifestyle and disease prevention through routine health care examinations. The group received the same printed materials as the intervention group. After the 6-month assessment, women in the

control group received delayed breast cancer education intervention and navigation for breast cancer screening.

Data collection

Data were collected among intervention and control group participants by researchers at each of the 8 work-sites. Data included baseline demographic characteristics and health care access by both treatment groups; changes in knowledge about breast cancer risk factors and screening; changes in HBM measures in the intervention group; and breast cancer screening rate at 6 months posteducation. Standard procedures for data collection established by our United States–China collaborative research team were followed including confidentiality and protection.

Measures

Study measures included (i) demographic variables; (ii) health care access (e.g., health insurance, history of breast cancer screening, and having health insurance); (iii) knowledge about risk factors associated with breast cancer (e.g., family history, age, early start of menstruation, late menopause, diet, and alcohol use), breast cancer risk factors for Chinese, and breast cancer screening method and guidelines in the United States (because there are no guidelines in China); (iv) HBM and SCT measures that include items of perceived susceptibility (can develop breast cancer in my lifetime), severity (effect on self and family), perceived benefits and barriers to screening (mammogram decreases chance of dying from cancer and whether it is painful), and self-efficacy (person is capable of getting screened) using 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strong agree); and (v) outcome measure in breast cancer screening behavior at 6-month follow-up.

Face and content validity of the questionnaire was conducted among workplace leaders and a panel of health professionals. The measures were validated as described in our previous published studies (26, 65).

Statistical analysis

At baseline, the study sample ($n = 453$) was composed of 232 in the intervention group and 221 in the control group. At 6-month follow-up, 220 participants in the intervention group and 192 participants in the control group completed the telephone follow-up interview.

Descriptive statistics were used to describe demographic characteristics and health care access among intervention and control groups. Other variables include knowledge about breast cancer screening and its risk factors, health beliefs, and mammogram screening rates. Comparison of differences in continuous variables, such as age between the intervention and control groups, was conducted using Student t test, χ^2 test, or Fisher's exact test, where appropriate, were used to evaluate potential differences in dichotomous or categorical variables between the 2 treatment groups. McNemar test was carried out on all knowledge questions to determine whether there were

significant changes from pre- to postintervention within the control and intervention groups. Because of the repeated measures and the dependencies existing between pre- and postintervention, generalized estimating equations (GEE) were used to compare the changes of knowledge from pre- to posteducation between the intervention and control groups. The model used a binomial likelihood function, logit link function, and exchangeable correlation matrix and it incorporated sociodemographic differences identified between the 2 groups. In addition, the paired *t* test was used to examine differences in the intervention group on HBM constructs from pre- to postintervention. Finally, to examine potential differences in mammogram screening uptake at 6-month postintervention between the 2 groups, multivariable logistic regression analyses were used, controlling for sociodemographic differences. The analyses were repeated 4 times with different subgroups: (i) including only participants who completed pre- and postintervention and 6-month follow-up assessments (*n* = 412); (ii) including all participants who completed pre- and postintervention assessments regardless of whether they completed the 6-month follow-up assessment (intention-to-treat analysis) with the assumption of "no mammogram uptake" for those who did not complete the 6-month follow-up (*n* = 453); (iii) those participants in analysis #1 who had not had a mammogram prior to recruitment (*n* = 378); and (iv) those participants in analysis #2 who had not had a mammogram prior to recruitment (*n* = 416).

Results

Baseline demographic characteristics and health care access

Demographic characteristics and health care access of the intervention (*n* = 232) and control (*n* = 221) groups are reported in Table 1. No statistical differences were found

between the intervention and control groups in terms of age, marital status, having health insurance, and having regular health check-ups. The mean age was 45.3 years (SD = 4.5) and 46.1 years (SD = 5.1), respectively, for the intervention and control groups. The large majority of participants were married (93% in both groups). More than half of the participants reported having health insurance (55% in both groups). Approximately, 84% in the intervention group and 79% in the control group had regular health check-ups. However, compared with the control group, participants in the intervention group had lower education level (approximately 47% had high school education or less in the intervention group vs. 36% in the control group, *P* = 0.005).

Pre- and postintervention knowledge changes in breast cancer risk factors and screening guidelines

The χ^2 tests showed the differences between the 2 treatment groups in 3 of the 8 factors at preintervention: believing that women aged 40 and older should have annual mammogram (25.9% vs. 17.2%), believing that women aged 40 and older are more likely to develop breast cancer (56% vs. 46.6%), and knowing that age is a risk factor of developing breast cancer (31% vs. 22.6%). Within the intervention group, McNemar tests suggested that the knowledge increased significantly from pre- to posteducation in all breast cancer risk factors and screening guidelines but family history; whereas knowledge increased in 5 factors within the control group. These were believing that women aged 40 and older should have annual mammogram and believing that early start of menstruation, late menopause, high fat diets and obesity, and alcohol use are risk factors for breast cancer. After controlling for educational level, the interaction term between time (from pre to post) and treatment (intervention and control groups) from the GEE model was significant in 5 factors, and the magnitude of knowledge

Table 1. Demographic characteristics and baseline health care access by treatment groups

	Intervention N (%)	Control N (%)	P
Age (mean \pm SD)	45.3 (4.5)	46.1 (5.1)	0.076
Current marital status			
Married	211 (92.5)	197 (92.5)	0.982
Not married	17 (7.5)	16 (7.5)	
Level of education			
Less than high school	8 (3.5)	14 (6.4)	0.005
High school	100 (43.3)	64 (29.1)	
University/graduate	123 (53.2)	142 (64.5)	
Have health insurance			
No	101 (45.3)	92 (44.7)	0.896
Yes	122 (54.7)	114 (55.3)	
Have regular health check-ups			
No	36 (15.7)	45 (20.9)	0.156
Yes	193 (84.3)	170 (79.1)	

Table 2. Changes in knowledge about breast cancer risk factors and screening

Variables	Intervention (N = 232)			Control (N = 221)			Comparison between intervention and control groups			
	Pre (%)	Post (%)	McNemar test P	Pre (%)	Post (%)	McNemar test P	χ^2 test P for pre	GEE model ^a		
								P for time	P for group	P _{interaction}
Believe that women 40 and older should have annual mammogram	25.9	71.1	<0.001	17.2	43.9	<0.001	0.025	<0.001	<0.001	0.033
Believe that women 40 and older are more likely to develop breast cancer	56.0	69.8	<0.001	46.6	47.1	0.903	0.045	0.009	<0.001	0.014
Believe that the following risk factors are related to breast cancer										
Age	31.0	58.6	<0.001	22.6	24.0	0.696	0.044	<0.001	<0.001	<0.001
Family history of breast cancer	96.1	95.7	0.782	95.5	94.1	0.513	0.732	0.383	0.259	0.938
Early start of menstruation	14.7	75.0	<0.001	18.1	57.9	<0.001	0.322	<0.001	0.091	0.001
Late menopause	27.6	71.1	<0.001	25.3	59.3	<0.001	0.588	<0.001	0.018	0.134
High fat diets and obesity	46.1	83.2	<0.001	48.9	76.5	<0.001	0.558	<0.001	0.211	0.074
Alcohol use	38.8	80.6	<0.001	37.6	62.0	<0.001	0.787	<0.001	0.002	<0.001

^aAdjusted for education level that was significantly different between the two treatment groups.

increase was significantly higher in the intervention group than in the control group. These factors were believing that women aged 40 and older should have annual mammogram, changing from 25.9% to 71.1% versus 17.2% to 43.9%; believing that women aged 40 and older are more likely to develop breast cancer, changing from 56% to 69.8% versus 46.6% to 47.1%; believing the following risk factors are related to breast cancer: age, changing from 31% to 58.6% versus 22.6% to 24%; early start of menstruation, changing from 14.7% to 75% versus 18.1% to 57.9%; and alcohol use, changing from 38.8% to 80.6% versus 37.6% to 62%, respectively, for the intervention and control groups from pre- to postintervention (Table 2).

Pre- and postintervention health beliefs and barriers

HBM measures were summarized using means and SDs. The higher the mean, the more likely the participants agreed with the statement. In terms of the change from pre- to posteducation in the intervention group, significant changes occurred in 8 of the 10 items that assessed participants' perceived susceptibility of developing breast cancer, disease severity, benefits of screening, barriers to screening, and self-efficacy (Table 3). These are (i) I feel, I will get breast cancer sometime during my life ($P < 0.001$); (ii) I worry about myself getting breast cancer ($P < 0.001$); (iii) my whole life would change if I had breast cancer ($P = 0.015$); (iv) having a mammogram is the best way for me to find breast cancer at early stage ($P = 0.003$);

Table 3. Changes in HBM measures in the intervention group (means and SDs)

Variables	Pre	Post	Paired t test (P)
I feel, I will get breast cancer sometime during my life.	2.6 (1.0)	2.8 (0.9)	<0.001
I worry about myself getting breast cancer.	2.7 (1.1)	3.0 (1.0)	0.011
My whole life would change if I had breast cancer.	3.6 (1.1)	3.8 (0.9)	0.015
Breast cancer would have a very bad effect on my family.	3.5 (1.1)	3.6 (1.0)	0.116
Having a mammogram is the best way for me to find breast cancer at early stage.	4.1 (0.9)	4.3 (0.7)	0.003
Having a mammogram will decrease my chance of dying from breast cancer.	4.0 (0.9)	4.2 (0.7)	0.015
Having a mammogram will be painful and unpleasant.	2.6 (0.8)	2.4 (0.8)	0.004
I am scared to have a mammogram because I might learn that I have cancer.	2.2 (0.9)	2.2 (0.9)	0.710
I feel capable of arranging a mammogram for myself.	3.6 (0.8)	3.8 (0.7)	<0.001
I am confident about my abilities to get a mammogram.	3.6 (0.8)	3.9 (0.7)	<0.001

(v) having a mammogram will decrease my chance of dying from breast cancer ($P = 0.015$); (vi) having a mammogram will be painful and unpleasant ($P = 0.004$); (vii) I feel capable of arranging a mammogram for myself ($P < 0.001$); and (viii) I am confident about my abilities to get a mammogram ($P < 0.001$).

Postintervention mammogram screening behavior

At baseline, 8.2% of total participants (10.3% of the intervention group and 5.9% of the control group) reported that they had ever had mammogram screening ($P > 0.05$ for differences between the groups). The screening rates at 6-month postintervention increased to 72.6% in the intervention group and decreased to 4.7% in the control group ($P < 0.001$). Using the intention-to-treat analysis and assuming those who did not complete the 6-month follow-up did not take mammogram, the screening rates were 69% versus 4.1% ($P < 0.001$). The differences in 6-month mammogram uptake between the 2 groups remained significant after adjusting for education level (both P values < 0.001 ; see Table 4).

When screening behavior was examined among the subgroup of participants who had not had a mammogram prior to participation in the study, a similar pattern was observed with significantly higher screening rates in the intervention group (72.6%) than in the control group (5%) among the 6-month completers and 68.8% versus 4.3% using the intention-to-treat analysis (both P values < 0.001 for unadjusted and adjusted comparison).

Discussion

The primary aim of this study was to test the feasibility and effectiveness of a workplace education intervention to promote breast cancer screening among women aged 40

and older in Nanjing, China. To our knowledge, this innovative program is the first of its type in China, where the availability of mammographic technology is widespread but seriously underutilized, and where standards for breast cancer screening are still a topic of discourse among health care authorities. Study results transcended our expectations: nearly 73% ($n = 143$) of participants who had no prior mammograms reported receiving one at 6-month postintervention. In terms of the change from pre- to posteducation in the intervention group, significant improvement occurred in 8 of the 10 items that cover participants' perceived susceptibility of getting breast cancer, disease severity, benefits of screening, barriers to screening, and self-efficacy.

Majority of HBM construct factors contributed to the success of the intervention program. Postintervention, women's awareness of breast cancer increased, so was their perception of the importance and benefits of breast cancer screening. In addition, cues to action and self-efficacy played important roles in women's participation of the screening program as both take into consideration an individual's need to overcome physical, psychologic, or social barriers to effect health care behavior change. When applied to China's workplace, these attributes of the HBM are facilitated by a built-in leader-support system and a social environment conducive to participatory action. On the one hand, workplace cues to action are external elements (congregation of workers and a participatory leadership) that serve as "green lights" to action, whereas on the other hand, self-efficacy represented participants' belief in their ability to make the health behavior change. Both factors are enhanced by increased knowledge and awareness of the importance of screening in preventing the adverse consequences of breast cancer. SCT defines and support this

Table 4. Breast cancer screening rate at 6-month posteducation (%)

Variables	Intervention	Control	χ^2 test P value	Multivariable logistic regression P value ^a
Mammogram prior to the education	10.3 (24/232)	5.9 (13/221)	0.083	
Mammogram at 6-month posteducation				
All women				
Among those who completed the 6 months follow-up	72.7 (160/220)	4.7 (9/192)	< 0.001	< 0.001
Intention-to-treat analysis: assumption of "no mammogram" for the study noncompleters	69.0 (160/232)	4.1 (9/221)	< 0.001	< 0.001
Participants who have not had a mammogram prior to the recruitment				
Among those who completed the 6-month follow-up	72.6 (143/197)	5.0 (9/181)	< 0.001	< 0.001
Intention-to-treat analysis: assumption of "no mammogram" for the study noncompleters	68.8 (143/208)	4.3 (9/208)	< 0.001	< 0.001

^aAdjusted for education level that was significantly different between the 2 treatment groups.

dynamic interaction between a participant's personal factors, behaviors, and the environment. This unique interaction represents the basis of a participant's ability to form expectations of behavioral outcomes and/or to predict the outcomes of behavior before the behavior is carried out. In our intervention, we reinforced these elements (personal, behavior, and environment) to effect changes in participant's abilities to formulate decisions (self-efficacy). This theory-based approach was further reinforced by the participatory process that included counseling interactive sessions that involved worksite leadership willingness to institutionalize breast cancer screening and prevention.

For example, using intention-to-treat analysis with the assumption of "no mammogram" for the study noncompleters, the intervention group achieved nearly 70% mammography screening rate at 6-month postintervention compared with 4% in the control group. The intervention effect is more pronounced than in other studies conducted among African Americans and Hmong women living in the United States, ranging from 40% to 50% (66–68). However, our results suggested that a combination of education and counseling program with timely screening navigation can achieve favorable results over a short period of time.

In our study, the 8% uptake of mammography prior to education intervention was consistent with other studies conducted in China. Zhao and colleagues found that among Beijing women aged 35 and older, 19% had reported ever having mammography (35). A study in Shenzhen reported 5.2% mammography or ultrasound in last 3 years (33) and another in Hong Kong reported 12% mammography in the last 2 years (31). These rates are significantly lower than that of Chinese Americans and Singaporeans (25–29, 32, 69).

Studies on attitudes and behavior toward breast cancer screening in China showed that more than 90% of women participants favored large-scale dissemination of information on breast cancer that includes education on prevention and screening (33). Our study underscored this need and emphasized the important role of theory-based education in increasing awareness and changing women's behavior toward breast cancer screening. The success of our study represents a step forward in the establishment of standards for breast screening in China. It is also timely as it follows China's successful implementation of workplace health promotion programs in AIDS education and prevention, women's reproductive health, life planning skills, and physical activity promotion (55, 58–60).

The workplace offers several advantages in that a substantial number of the working population can be reached and multiple levels of influence on behavior can be targeted. In China, the labor union is an important department of a Danwei (or company) charging employees' benefits and negotiation. Partnership with labor union leaders and engaging them in the planning, development, recruitment, and implementation process were essential

to the success of our intervention at the studied worksites. For example, union leaders actively coordinated the intervention session schedules to fit women on different shifts with factory managers and negotiated time and financial assistance for women's mammogram test with company management. Our intervention indicated that worksite leaders can make significant influence on women's participation in both breast cancer education and group breast cancer screening events.

In addition, a workplace breast cancer screening intervention program offers a motivational learning environment given that women tend to share experience with their trusted colleagues and/or are influenced by peers for health behavior change. The dynamic group discussion about the risks of breast cancer and benefits of early detection during the educational session and group mammogram event well facilitated the effect of the designed intervention.

Our study has limitations. First, this study used a convenient sample derived from 8 sites in Nanjing, China, which are within reach of our collaborating institution, Southeast University; this sampling approach can lead to sampling bias. Second, although we attempted to mix factory worksites with other sites to broaden the range of our convenience sample, the overall sample represented a homogeneous group of employed, urbanized individuals, most of whom are married and have health coverage. Generalizations based on our findings therefore should be made cautiously: China is a large country with more than 1.3 billion citizens who represent various cultural, linguistic, beliefs, educational, and socioeconomic backgrounds. Third, our study focus was on increasing mammography screening; we did not collect data on BSE and CBE uptake, even though these were components of the curriculum. Participants who did not undergo mammography might have received a CBE, which could be counted as breast cancer screening. Fourth, although we observed a significant increase in screening rates in the intervention group at 6-month follow-up postintervention, the long-term outcome of the intervention, such as adherence to screening guidelines and sustainability of the program, cannot be ascertained from the findings; these require follow-up large-scale studies.

Implications and Conclusion

Notwithstanding its inherent limitations, our study findings provide preliminary evidence for the implementation of a comprehensive workplace-based breast cancer screening intervention program in China. Our experience has shown that a theory-based, multifaceted educational program can substantially affect higher levels of knowledge and awareness of breast cancer and prevention with concomitant short- and long-term policy changes, in particular, establishment of indigenous standards and culturally relevant cutting-edge programs as the one successfully piloted. Today, China

is experiencing rising incidence and mortality rates in a variety of cancers but specifically breast cancer. Trends in cancer research in China indicate increasing interest in the disease and its prevention. It is inevitable that national standards and new detection technology will accelerate the development of prevention programs in general and mammography specifically; these trends combined with the implementation of evidence-based screening programs should greatly reduce incidence and prevalence and mortality of breast cancer in China (70, 71).

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

References

- Agarwal G, Pradeep PV, Aggarwal V, Yip CH, Cheung PS. Spectrum of breast cancer in Asian women. *World J Surg* 2007;31:1031–40.
- Parkin DM, Fernandez LM. Use of statistics to assess the global burden of breast cancer. *Breast J* 2006;12 Suppl 1:S70–80.
- Lee JH, Yim SH, Won YJ, Jung KW, Son BH, Lee HD, et al. Population-based breast cancer statistics in Korea during 1993–2002: incidence, mortality, and survival. *J Korean Med Sci* 2007;22 Suppl:S11–6.
- Chen WQ, Zhang SW, Zou XN, Zhao P. Cancer incidence and mortality in China, 2006. *Chin J Cancer Res* 2011;23:3–9.
- Yang L, Parkin DM, Ferlay J, Li L, Chen Y. Estimates of cancer incidence in China for 2000 and projections for 2005. *Cancer Epidemiol Biomarkers Prev* 2005;14:243–50.
- Yang L, Li LD, Chen YD, Parkin DM. [Time trends, estimates and projects for breast cancer incidence and mortality in China]. *Zhonghua Zhong Liu Za Zhi* 2006;28:438–40.
- World Health Organization. Breast cancer: prevention and control 2010. [cited 2010 Jul 7]. Available from: <http://www.who.int/cancer/detection/breastcancer/en/index.html>.
- American Cancer Society. Breast cancer facts and figures 2007–2008. Atlanta, GA: American Cancer Society, Inc.; 2009.
- National Cancer Institute. NCI statement on mammography screening 2002. [cited 2010 Jul 7]. Available from: <http://www.cancer.gov/news-center/pressreleases/2002/mammstatement31jan02>.
- U.S. Preventive Services Task Force (USPSTF). Screening for breast cancer: U.S. Preventive Service Task Force Recommendation Statement. *Ann Intern Med* 2009;151:716–26.
- Yip CH, Smith RA, Anderson BO, Miller AB, Thomas DB, Ang ES, et al. Guideline implementation for breast healthcare in low- and middle-income countries: early detection resource allocation. *Cancer* 2008;113:2244–56.
- International Agency for Research on Cancer. IARC handbooks of cancer prevention: breast cancer screening. Vol. 7. Lyon, France: IARC; 2002.
- Morimoto T, Okazaki M, Endo T. Current status and goals of mammographic screening for breast cancer in Japan. *Breast Cancer* 2004;11:73–81.
- Chiarelli AM, Majpruz V, Brown P, Theriault M, Shumak R, Mai V. The contribution of clinical breast examination to the accuracy of breast screening. *J Natl Cancer Inst* 2009;101:1236–43.
- Huang CS, Chang KJ, Shen CY. Breast cancer screening in Taiwan and China. *Breast Dis* 2001;13:41–8.
- Ng EH, Ng FC, Tan PH, Low SC, Chiang G, Tan KP, et al. Results of intermediate measures from a population-based, randomized trial of mammographic screening prevalence and detection of breast carcinoma among Asian women: the Singapore Breast Screening Project. *Cancer* 1998;82:1521–8.
- Seow A, Straughan PT, Ng EH, Emmanuel SC, Tan CH, Lee HP. Factors determining acceptability of mammography in an Asian population: a study among women in Singapore. *Cancer Causes Control* 1997;8:771–9.
- Wang SC. The Singapore National Breast Screening Programme: principles and implementation. *Ann Acad Med Singapore* 2003;32:466–76.
- Wee SB. The case for breast cancer screening in Singapore. *Singapore Med J* 2002;43:221–3.
- Linos E, Spanos D, Rosner BA, Linos K, Hesketh T, Qu JD, et al. Effects of reproductive and demographic changes on breast cancer incidence in China: a modeling analysis. *J Natl Cancer Inst* 2008;100:1352–60.
- Yu M, Wang Q, Li R. Survey on breast health behavior and consciousness in Tianjin women. *Chin J Prev Contr Chron Non-commun Dis* 2002;10:20–2.
- Li H. The plight of China's breast cancer screening program. *China Today* 2009;30–3.
- Chinese Anti-Cancer Association. The Breast Cancer Screening Project was launched in Tianjin on March 11, 2008 2009. [cited 2010 Jul 7]. Available from: <http://www.caca.org.cn/system/2009/01/23/010020029.shtml>.
- Centers for Disease Control and Prevention (CDC). Use of mammograms among women aged > or = 40 years—United States, 2000–2005. *MMWR Morb Mortal Wkly Rep* 2007;56:49–51.
- Lee-Lin F, Menon U, Pett M, Nail L, Lee S, Mooney K. Breast cancer beliefs and mammography screening practices among Chinese American immigrants. *J Obstet Gynecol Neonatal Nurs* 2007;36:212–21.
- Ma GX, Shive SE, Wang MQ, Tan Y. Cancer screening behaviors and barriers in Asian Americans. *Am J Health Behav* 2009;33:650–60.
- Tu SP, Yasui Y, Kuniyuki AA, Schwartz SM, Jackson JC, Hislop TG, et al. Mammography screening among Chinese-American women. *Cancer* 2003;97:1293–302.
- Wu TY, West B, Chen YW, Hergert C. Health beliefs and practices related to breast cancer screening in Filipino, Chinese and Asian-Indian women. *Cancer Detect Prev* 2006;30:58–66.
- Su X, Ma GX, Seals B, Tan Y, Hausman A. Breast cancer early detection among Chinese women in the Philadelphia area. *J Womens Health (Larchmt)* 2006;15:507–19.
- Hiatt RA, Pasick RJ, Stewart S, Bloom J, Davis P, Gardiner P, et al. Community-based cancer screening for underserved women: design and baseline findings from the Breast and Cervical Cancer Intervention Study. *Prev Med* 2001;33:190–203.
- Chan SS, Chow DM, Loh EK, Wong DC, Cheng KK, Fung WY, et al. Using a community-based outreach program to improve breast health awareness among women in Hong Kong. *Public Health Nurs* 2007;24:265–73.
- Leong HS, Heng R, Emmanuel SC. Survey on mammographic screening among women aged 40 to 65 years old at polyclinics. *Singapore Med J* 2007;48:34–40.

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33. Li J-M, Wang W, Wei Y-H, Wen R-Y, Huang Y-H. The investigation of rate of screening and KAP of breast cancer in a community of Shenzhen. *Matern Child Health Care China* 2010;8:1100-3.
34. Liu L-Y, Jia C-X, Yu Z-G. Knowledge related to breast cancer and its influencing factors among women. *Chin J Public Health* 2009;25:1275-6.
35. Zhao L, Li S-J, Wang T. Cross-sectional study on knowledge, attitude and behavior of breast cancer screening among women in Beijing. *Chin J Public Health* 2008;24:658-59.
36. Green M, Raina V. Epidemiology, screening and diagnosis of breast cancer in the Asia-Pacific region: current perspectives and important considerations. *Asia-Pacific J Clin Oncol* 2008;4:S5-13.
37. Tan PH. Breast screening in Singapore: implications for pathology. *Ann Acad Med Singapore* 2007;36:827-33.
38. Tan SM, Evans AJ, Lam TP, Cheung KL. How relevant is breast cancer screening in the Asia/Pacific region? *Breast* 2007;16:113-9.
39. Chua MS, Mok TS, Kwan WH, Yeo W, Zee B. Knowledge, perceptions, and attitudes of Hong Kong Chinese women on screening mammography and early breast cancer management. *Breast J* 2005;11:52-6.
40. Yu MY, Song L, Seetoo A, Cai C, Smith G, Oakley D. Culturally competent training program: a key to training lay health advisors for promoting breast cancer screening. *Health Educ Behav* 2007;34:928-41.
41. Black ME, Frisina A, Hack T, Carpio B. Improving early detection of breast and cervical cancer in Chinese and Vietnamese immigrant women. *Oncol Nurs Forum* 2006;33:873-6.
42. Kim YH, Sarna L. An intervention to increase mammography use by Korean American women. *Oncol Nurs Forum* 2004;31:105-10.
43. Juon HS, Choi S, Klassen A, Roter D. Impact of breast cancer screening intervention on Korean-American women in Maryland. *Cancer Detect Prev* 2006;30:297-305.
44. Ahmad F, Cameron JI, Stewart DE. A tailored intervention to promote breast cancer screening among South Asian immigrant women. *Soc Sci Med* 2005;60:575-86.
45. Wu IC. [The effect of nursing intervention on the knowledge, attitude and practice of women's breast self-examination in Ta-An district]. *Hu Li Za Zhi* 1980;27:86-101.
46. Lu ZJ. Effectiveness of breast self-examination nursing interventions for Taiwanese community target groups. *J Adv Nurs* 2001;34:163-70.
47. Gao DL, Hu YW, Wang WW, Chen FL, Pan LD, Yuan Y, et al. [Evaluation on the effect of intervention regarding breast self-examination for decreasing breast cancer mortality]. *Zhonghua Liu Xing Bing Xue Za Zhi* 2006;27:985-90.
48. Gao DL, Thomas DB, Ray RM, Wang WW, Allison CJ, Chen FL, et al. [Randomized trial of breast self-examination in 266,064 women in Shanghai]. *Zhonghua Zhong Liu Za Zhi* 2005;27:350-4.
49. Thomas DB, Gao DL, Ray RM, Wang WW, Allison CJ, Chen FL, et al. Randomized trial of breast self-examination in Shanghai: final results. *J Natl Cancer Inst* 2002;94:1445-57.
50. Thomas DB, Gao DL, Self SG, Allison CJ, Tao Y, Mahloch J, et al. Randomized trial of breast self-examination in Shanghai: methodology and preliminary results. *J Natl Cancer Inst* 1997;89:355-65.
51. IBM Global Business Services and IBM Institute for Business Value Analysis. *Healthcare in China*. Somers, NY: IBM Global Services; 2011.
52. Wong BA, Gabriel S. The influence of economic liberalization on urban health care access in the People's Republic of China 2011. [cited 2011 Nov 9]. Available from: <http://www.mtholyoke.edu/courses/sgabriel/chinahealth.htm>.
53. World Health Organization. Bangkok charter for health promotion in a globalized world. 6th Global Conference on Health Promotion; 2005 Aug 7-11; Thailand. Geneva, Switzerland: WHO; 2005.
54. World Health Organization Regional Office for Europe. Good practice in occupational health services: a contribution to workplace health 2002. [cited 2010 Jul 7]. Available from: <http://www.euro.who.int/document/e77650.pdf>.
55. Quintiliani L, Sattelmair J, Sorensen G. The workplace as a setting for interventions to improve diet and promote physical activity: Background paper prepared for the WHO/WEF Joint Event on Preventing Noncommunicable Diseases in the Workplace (Dalian/China, September 2007) 2007. [cited 2010 Jul 6]. Available from: <http://www.who.int/dietphysicalactivity/Quintiliani-workplace-as-setting.pdf>.
56. National Bureau of Statistics. China statistics 2005: employment 2005. [cited 2010 Jul 7]. Available from: http://www.allcountries.org/china_statistics/5_1_employment.html.
57. Women of China. Women make up 45 percent of China's work force 2007. [cited 2010 Jul 9]. Available from: http://www.womenofchina.cn/Data_Research/Latest_Statistics/15892.jsp.
58. Geng Q. Building life skills in the workplace: a training program for migrant youth in Shenzhen 2006. [cited 2010 Jul 7]. Available from: http://www.path.org/files/HIV_ChinaYRH_Shenzhen.pdf.
59. Qian X, Smith H, Huang W, Zhang J, Huang Y, Garner P. Promoting contraceptive use among unmarried female migrants in one factory in Shanghai: a pilot workplace intervention. *BMC Health Serv Res* 2007;7:77.
60. State Council AIDS Working Committee Office and the United Nations Theme Group on AIDS. UNGASS country progress reports 2008, China 2008. [cited 2010 Jul 7]. Available from: http://data.unaids.org/pub/Report/2008/china_2008_country_progress_report_en.pdf.
61. Bandura A. Social cognitive theory: an agentic perspective. *Annu Rev Psychol* 2001;52:1-26.
62. Bandura A. Health promotion by social cognitive means. *Health Educ Behav* 2004;31:143-64.
63. Strecher VJ, Rosenstock IM. The health belief model. In: Glanz K, Lewis FM, Rimer BK, editors. *Health behavior and health education: theory, research, and practice*. 2nd ed. San Francisco, CA: Jossey-Bass; 2002. p. 41-56.
64. Champion VL. Revised susceptibility, benefits, and barriers scale for mammography screening. *Res Nurs Health* 1999;22:341-8.
65. Wang X, Fang C, Tan Y, Liu A, Ma GX. Evidence-based intervention to reduce access barriers to cervical cancer screening among underserved Chinese American women. *J Womens Health (Larchmt)* 2010;19:463-9.
66. Champion VL, Springston JK, Zollinger TW, Saywell RM, Monahan PO, Zhao Q, et al. Comparison of three interventions to increase mammography screening in low income African American women. *Cancer Detect Prev* 2006;30:535-44.
67. Garza MA, Luan J, Blinka M, Farabee-Lewis RI, Neuhaus CE, Zabora JR, et al. A culturally targeted intervention to promote breast cancer screening among low-income women in East Baltimore, Maryland. *Cancer Control* 2005;12 Suppl 2:34-41.
68. Kagawa-Singer M, Tanjasiri SP, Valdez A, Yu H, Foo MA. Outcomes of a breast health project for Hmong women and men in California. *Am J Public Health* 2009;99 Suppl 2:S467-73.
69. Ma CD, Zhou Q, Nie XQ, Liu GY, Di GH, Wu J, et al. Breast cancer in Chinese elderly women: pathological and clinical characteristics and factors influencing treatment patterns. *Crit Rev Oncol Hematol* 2009;71:258-65.
70. Humphrey LL, Helfand M, Chan BK, Woolf SH. Breast cancer screening: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med* 2002;137:347-60.
71. Tabar L, Yen MF, Vitak B, Chen HH, Smith RA, Duffy SW. Mammography service screening and mortality in breast cancer patients: 20-year follow-up before and after introduction of screening. *Lancet* 2003;361:1405-10.