

ORIGINAL RESEARCH

Correlates of recent and regular mammography screening among Asian-American women

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Abstract

Title. Correlates of recent and regular mammography screening among Asian-American women.

Aim. This paper is a report of a study of the health beliefs, knowledge and selected demographic variables that influence mammography utilization among Asian-American women.

Background. Breast cancer is the most frequently occurring cancer in Asian-American women and its incidence is increasing at a greater rate than for other racial and ethnic groups in the United States of America (USA). Compared to White women, breast cancer also is more likely to be diagnosed at a later stage with larger tumours in Asian-Americans.

Method. A self-administered questionnaire was used with Asian-American women residing in the USA. Data were collected in 2005 and 315 women participated in the study.

Results. Fifty-five per cent of participants reported having their last mammogram within the past 13 months, and 33% reported having annual mammograms in each of the past 5 years. Based on multivariate logistic regression analyses, clinical breast examination, barriers and knowledge of recommendations of the frequency of mammography screening were associated with both recent and regular mammography practice after controlling for all other demographic, psychosocial and behavioural variables in the model.

Conclusion. Intervention strategies tailored to knowledge, language and cultural factors associated with mammography use should target at-risk subgroups, particularly those who are recent immigrants and those with limited English language ability. Culturally appropriate strategies should be developed to promote lifelong mammography screening for this rapidly growing and diverse population.

Keywords: Asian-Americans, correlates, health beliefs, knowledge, mammography, nursing, screening, women

Introduction

According to the United States of America (USA) Census Bureau (2001), the Asian-American population represents the fastest-growing and most diverse ethnic group in the country. Diversity in language, culture, history and lifestyle among Asian-Americans can influence their access to health care or health-related information, opportunities for health maintenance and health outcomes. As a matter of social justice, it is critical to recognize and address the health disparities that exist for all underserved communities (Institute of Medicine 2002, Fu *et al.* 2003). Understanding the factors that influence health behaviours and outcomes for various ethnic Asian groups in the USA, and in China, Taiwan, India, Korea and Philippines is critical and will allow development and implementation of effective intervention programmes, with the goal of reducing health disparities.

Breast cancer is the most frequently occurring cancer in Asian-American women. Compared with Whites and other ethnic groups in the USA, the incidence of breast cancer in Asian-American women increased at a faster rate (with 2.1% per year) between 1992 and 2000. While heart disease is the leading cause of death in all other racial groups in the USA, cancer is the number one cause of death in Asian-Americans (National Center for Health Statistics 2006).

Despite the fact that Asian-American women have a lower incidence rate of breast cancer than either White or African-American women, a study by Ziegler *et al.* (1993) showed that the longer Asian women live in the USA, the greater their risk of developing breast cancer. Compared to Asian women who remained in their native countries, the risk of breast cancer for Asian women residing in the USA is six times greater.

According to the United States Census Bureau, Asian-Americans were the second fastest-growing minority group, with a 3.2% population increase during 2005–2006 (U.S. Census Bureau 2007). In addition, reducing disparities in cancer screening and promotion of early detection in Asian populations is not unique in the USA, but has become a global concern. Thus, the main purpose of this study was to examine relationships between use of mammography (i.e. past year mammography use and regular mammography use) and health beliefs, knowledge and selected demographic variables among Asian-American women.

Background

Early detection and treatment of breast cancer plays a key role in survival rates. The recent decrease in mortality rates due to breast cancer among White women has been

attributed to greater use of breast cancer screening as a part of regular medical care (U.S. Department of Health and Human Services 2000). Asian-American women, however, remain more likely to receive a diagnosis of breast cancer at a later stage and to have larger tumours than White women (Yip 1997, Hedden *et al.* 1999).

Healthy People 2010 provides a framework for improving the health of all US citizens and sets an objective to increase the proportion of women aged 40 years and older who have received a mammogram within the past 2 years to 70% (U.S. Department of Health and Human Services, 2000). However, statistics in *Health, United States* (2006) show that only 58% of Asian-American women aged 40 years and older had received a mammogram within the past 2 years. Furthermore, there is evidence that minority women, including Asian-Americans, are far less likely than the population as a whole to have repeat mammography (Blanchard *et al.* 2004). Because culturally related health beliefs and attitudes appear to vary among different racial and ethnic groups, interventions to improve screening among minority populations may be more successful, if they address group-specific concerns (Moy *et al.* 2006).

Based on the Health Belief Model (HBM), an individual's perception about benefits and barriers to receiving health services are associated with specific health behaviours; perceived personal susceptibility and severity of the relevant health threat and various cues to action influence an individual's likelihood of taking preventive health actions. According to the HBM, perceived susceptibility refers to a woman's perceived vulnerability or subjective risk of getting breast cancer. Perceived seriousness refers to a woman's perception of how serious breast cancer could be if left untreated. Perceived benefits to taking action include beliefs about positive outcomes of mammogram screening and perceived barriers are the obstacles to having a mammogram (Strecher & Rosenstock 1997). In addition, an individual also must feel confident in her ability about overcoming their perceived barriers to taking action. Bandura (1995, 1997) and Strecher *et al.* (1986) have thus suggested the importance of self-efficacy in accounting for initiation and maintenance of behavioural change. In terms of mediating the effect on cancer screening behaviour, demographic, socio-psychological and structural variables may affect the individual's perceptions, and thus indirectly influence the screening behaviour (Janz *et al.* 2002).

While other studies have shown that perceived susceptibility was associated with mammography participation among women in Samoa, Turkey and Korea (Ham 2006, Mishra *et al.* 2007, Canbulat & Uzun 2008) and among US women (Champion 1992), recent studies with Asian-Americans

did not show an association between susceptibility and breast cancer screening behaviour (Ho *et al.* 2005, Yu & Wu 2005). Perceived seriousness appeared to be the weakest predictor of the HBM variables and has not been used in many studies, because the universally perceived seriousness of breast cancer results in little variance (Champion 1994). As a result, these two HBM constructs (i.e. perceived susceptibility and perceived seriousness) were not included in the current study. Few researchers (Tu *et al.* 2002, Otero-Sabogal *et al.* 2007) have investigated the application of the HBM to the practice of screening mammography among Asian-American women. Furthermore, to our knowledge, no studies are available about *repeat* mammography screening and attitudinal variables such as health beliefs among Asian-American women.

The study

Aim

The aim of this study was to examine the health beliefs, knowledge, and selected demographic that may influence mammography utilization among Asian-American women in a Midwestern region of the USA.

Based on the HBM (Figure 1) and the previous review of the literature, the following hypotheses were formulated:

- The health beliefs, knowledge, and demographic variables are associated with recent mammography screening among Asian-American women.
- The health beliefs, knowledge, and demographic variables are associated with regular mammography use among Asian-American women. Specifically:
 - (a) Health belief variables (perceived benefits, perceived barriers and perceived self-efficacy are associated with (i) recent mammography and (ii) regular mammography.
 - (b) Knowledge related to breast cancer risks and cancer screening and recommendations for frequency of mammography screening is associated with (i) recent mammography and (ii) regular mammography.
 - (c) Demographic variables such as age, marital status, years of residence in the USA, education level, income, employment status, English language ability (speaking, reading, and writing) and insurance coverage for mammograms are associated with (i) recent mammography and (ii) regular mammography.

Design

A cross-sectional and correlational design was used and the data were collected in 2005.

Participants

The study sample consisted of 315 Asian-American women (51 Chinese/Taiwanese, 36 Korean, 109 Asian-Indian and 119 Filipino). These four groups were selected because they are the most populous Asian ethnic groups in the study region (U.S. Census Bureau 2008). Eligibility criteria included women who (i) self-identified as Chinese/Taiwanese, Korean, Asian-Indian or Filipino and (ii) were able to speak and read English or their native languages (i.e. Mandarin/Taiwanese, Korean, Hindi, Tagalog).

A convenience sampling approach was used that involved recruiting every woman who met the selection criteria over a 6-month period. During this time, 346 women were approached and 315 (91%) completed the consent form and study questionnaire. The refusal rate was 9%. The main reasons given for refusal were lack of time to complete the questionnaire and lack of interest in participation.

Potential respondents were recruited through community, religious and professional organizations, as well as Asian festivals, social events and health fairs. In order for the study to be well-connected to each ethnic community, four community coordinators (CCs) were hired to facilitate networking and participant recruitment. The CCs made contact with community-based organizations (including community cultural centres, faith-based organizations and senior housing/apartments) and made arrangements to recruit potential participants at a variety of community events. During these recruitment events, the CCs set up tables and distributed study flyers; they also screened interested women on site for their potential eligibility.

Instruments

Data were collected at various locations (e.g. churches, temples, community cultural centres) using self-administered questionnaires that included three major categories: (i) demographic variables; (ii) health beliefs and knowledge and (iii) behavioural outcomes. Demographic variables included age, marital status, years of residence in the USA, education level, income, employment status, English language ability (speaking, reading and writing) and insurance coverage for mammograms.

Measurement strategies for the proposed cognition-related health beliefs (i.e. perceived benefits, perceived barriers, perceived self-efficacy) and knowledge-related measures (i.e. knowledge of cancer screening, misconception/knowledge about breast cancer risks and knowledge about recommendations for frequency of mammography screening) are given in Table 1. The perceived benefits and barriers subscales were

Table 1 Measurement strategies for the proposed psychosocial predictors

Psychosocial factor	No. items	Item description	Item response categories	Total score ranges	Mean (SD)/% correct	Internal consistency
Perceived benefits	6	Positive aspects of regular mammography	1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree	6–24	20.22 (3.06)	0.86
Perceived barriers	15	Negative aspects of receiving regular mammography	Same as above	15–60	26.73 (7.33)	0.91
Perceived self-efficacy	1	Confident in one's ability to obtain a regular mammogram	Same as above	1–4	3.04 (0.92)	N/A
Knowledge of breast cancer screening	5	Questions related to American Cancer Society specified recommended intervals for breast self-exam, clinical breast exam and mammography	4–6 responses were provided for each question, but only one response was correct. If participant correctly answered a question, she got a 1, if not, she got a 0	0–5	3.61 (0.93)	N/A
Misconception/knowledge about breast cancer risks	8	Questions related to the knowledge of which of the following conditions increases a woman's chance of getting breast cancer: (i) hitting, bumping or fondling the breasts; (ii) doing something morally bad; (iii) immigrated to the USA; (iv) overweight; (v) air pollution; (vi) large breasts and (vii) ovarian cancer	Responses included yes, no and don't know. If participant correctly answered a question, she got a 1, if not, she got a 0	0–8	3.61 (0.93)	0.52
Knowledge of recommendations for frequency of mammography screening	5	Questions related to knowledge of the recommended frequency of having a mammogram for women with the following conditions: (i) does not have any family history of breast cancer; (ii) does not have any breast symptoms; (iii) feels healthy; (iv) had previously breastfed a child; (v) older age and (vi) eats a healthy diet and exercises regularly	Responses included every year, every 2, 3–5 years, never and other. If participant correctly answered a question (in this case, every year), she got a 1, if not, she got a 0	0–5	3.41 (0.95)	0.89
BSE behaviour	1	The frequency of participant performing breast self-examination (BSE)	The responses included, never, 1–6 times a year, 7–11 times a year, once a month*, once a week and other. Participant who correctly answered this question* got a 1	0–1	34% (% correct)	N/A
CBE behaviour	1	The interval as participant last had a clinical breast exam	The responses included a year or less*, 1–2 years ago, 2–5 years ago, 5 or more years ago, never had one and other. Participant who correctly answered this question* got a 1	0–1	23% (% correct)	N/A

Note: (*) denotes the correct answer

tested in a previous study, and good internal consistency (Cronbach's- $\alpha = 0.83-0.90$) and construct and predictive validity were demonstrated. Details on individual items and the process of questionnaire development have been published elsewhere (Wu & Yu 2003, Wu & Brady 2007). Cronbach's- α for the benefits and barriers subscale with the current sample was 0.85 and 0.85 respectively.

Mammography status was based on self-reported questions and measured by asking each woman if she had had a screening mammogram in each of the past 5 years. Each year of screening receipt was recorded individually and then summed (range: 0–5 years). According to American Cancer Society recommendations, having an up-to-date mammography (or recent mammography use) is defined as reporting the last mammogram as being within the past year, and regular mammography use is defined as having an annual mammogram in each of the last 5 years.

Data collection

Participants received a study package that included a cover letter, consent form and the study questionnaire at the recruiting events. The questionnaire took 20–30 minutes to complete and participants could select a version in either English or their native language. Completed questionnaires were returned to the CCs at the event where the participant was recruited. Interestingly, more than 85% of participants in each ethnic group selected the English language version. Participants received a \$10 gift certificate in recognition of their contribution to the study.

Ethical considerations

This study was approved by an institutional review board.

Data analysis

Data analyses were performed using the SPSS statistical software package (version 16.0) (SPSS Inc., Chicago, IL, USA). Descriptive statistics, including percentages, means and standard deviation (SD), were calculated for all measures. Next, multivariate logistic regression analysis was performed to examine the associations between demographics, health beliefs and knowledge and the probability of having received recent and regular mammograms, after accounting for all other factors in the model. These associations were expressed in the form of adjusted odds ratios with 95% confidence intervals (CI). Nagelkerke's approximate R^2 value was used to present a normalized (i.e. range, 0–1) approximation of the variance in each binary outcome explained by the predictors of interest,

and likelihood ratio chi-squared tests were used to assess the importance of each predictor in the multivariate models.

Power analysis

A power analysis was performed using PASS software (Hintze 2008). A logistic regression of a binary response variable (Y) on a continuous, normally distributed variable (X) with a sample size of 189 observations achieves 81% power at a 0.05 statistical significance level to detect a change in $\text{Prob}(Y = 1)$ from the value of 0.400 at the mean of X to 0.516, when X is increased to 1 SD above the mean. This change corresponds to an odds ratio of 1.600. An adjustment was made for the multiple correlation of the independent variable of interest with the other independent variables with an R^2 of 0.200. Power greater than 80% at a 0.05 level of significance is generally considered adequate for statistical tests. With the sample size of 208 with complete data that was used in the logistic regression analysis for *regular* mammography use and 252 for *recent* mammography use, the power for these two analyses was greater than 80%.

Results

Participant demographics

Participant demographics are provided in Table 2. Their mean age was 56 years, with a range of 40–84. All but two were born in China/Taiwan, Korea, India or the Philippines. The women in this sample had high educational attainment, with 84% having college/university education or higher; about 63% were employed on a full-time basis. More than three-quarters (78%) were married or living with a partner. Length of residence in the USA ranged from 1 to 55 years (mean = 21.4). Ninety-two per cent had health insurance and 83% reported that their insurance covered mammograms.

Among the 310 women who responded to the question about the timing of their last mammogram, 56% (95% CI = 0.50–0.62) indicated that this matched the American Cancer Society (ACS) recommended interval (within the last 13 months). Of 253 participants who had complete data for regular mammography use, 33% (CI = 0.27–0.39) reported that they had received an annual mammogram in each of last past 5 years.

Factors associated with having recent and regular mammograms

The results did not support all the hypothesized relationships between health beliefs, knowledge, demographic variables and recent mammography. Specifically, selected demographic,

Table 2 Demographic characteristics of participants

Characteristics	<i>n</i> *	% of number available	% of cases available
Ethnicity			
Filipino	119	38	100
Asian-Indian	109	35	
Chinese/Taiwanese	51	16	
Korean	36	11	
Age (years)			
40–49	86	30	98
50–65	145	51	
> 65	54	19	
Education			
High school or lower	49	16	98
College/university or higher	260	84	
Employment status			
Full-time	198	63	100
Part-time	33	11	
None	84	26	
Marital status			
Married	244	78	99
Not married	70	22	
Length of residency in the United States of America (years)			
< 10	61	21	93
> 10	232	79	
English speaking ability			
Yes	259	82	99
No	54	18	
English reading ability			
Yes	271	83	99
No	40	17	
English writing ability			
Yes	262	84	99
No	49	16	
Health insurance			
Insured	288	92	99
Uninsured	26	8	
Insurance coverage of mammogram			
Yes	255	83	98
No	30	10	
Do not know	22	7	

*Numbers do not sum to 315 due to missing values.

beliefs and knowledge variables [i.e. education, perceived barriers, perceived cancer risks and reporting an up-to-date clinical breast examination (CBE)] were statistically significantly associated with the probability of having had a mammogram within the past 13 months (see Table 3). In the multivariate logistic analyses, the full model for the outcome variable of recent mammogram use explained approximately 44% (Nagelkerke $R^2 = 0.44$) of the variance, with an overall success rate of 75.0% for classification of women's recent mammogram use. Knowledge of recommendations on the

frequency of mammography screening was also marginally associated with regular mammogram use ($P = 0.052$), with women with higher scores of knowledge having higher odds of adherence to having a recent mammogram, after controlling for the other predictors.

In terms of testing hypothesized relationships between study variables and regular mammography, the results revealed that not all health beliefs, knowledge and demographic variables were associated with regular mammography screening among these women. Five study variables (CBE behaviour, knowledge of recommendations on the frequency of mammography screening, length of US residency, English language ability and perceived barriers) showed statistically significant associations (see Table 4). In particular, women who had their last CBE within the last 2 years reported higher scores on the items related to the frequency of screening recommendations, and had resided in the US statistically significantly longer had the greatest odds of reporting receipt of regular mammograms. In addition, those women who reported that they were able to speak, read and write English were nearly 12 times more likely to report that they had regular mammograms, after controlling for the other predictors in the model. Perceived barriers were also associated with regular mammogram use, women with higher barrier scores had lower odds of reporting adherence to regular mammogram recommendations, after controlling for the other predictors. The full model explained approximately 43% (Nagelkerke $R^2 = 0.43$) of the variance in regular mammogram use.

Discussion

The study was limited by the fact that it focused on self-reported mammography use, which may be related to telescoping recall error and the social desirability of reporting past mammograms. Nevertheless, studies of the accuracy of self-reported mammography suggest relatively high concordance with actual behaviour (McGovern *et al.* 1998, Thompson *et al.* 1999, Caplan *et al.* 2003). Other studies have shown that over-reporting of single mammography tends to occur relatively more frequently in low-income and ethnic minority women (Champion *et al.* 1998, McGovern *et al.* 1998). Even with a relatively low survey refusal rate (in our case 9%), potential selection bias (e.g. CCs only approached and enrolled those women sufficiently interested in the proposed study who were able to read the displayed information) could threaten the overall representativeness of the study population. We had a convenience sample of Asian-Americans who had been in the USA for a long period of time (mean = 21 years) and those with higher

Table 3 Logistic regressions for having a recent mammogram

	Adjusted odds ratio (95% CI)	P values
Demographic characteristics		
Ethnicity		
Filipino	0.51 (0.16–1.63)	0.66
Asian-Indian	0.69 (0.21–2.32)	
Korean	1.03 (0.19–5.47)	
Chinese	1.00	
Age	0.97 (0.92–1.03)	0.38
Marital status		
Married	1.00	0.53
Not married	1.34 (0.55–3.26)	
Education		
> College	1.00	0.01*
< College	0.23 (0.07–0.73)	
Income (annual household)		
> US \$300,000	1.00	0.22
< US \$300,000	0.53 (0.19–1.48)	
Employment		
Full-time (no)	1.00	0.11
Full-time (yes)	2.06 (0.86–4.92)	
Insurance coverage		
No (for mammogram)	1.00	0.91
Yes (for mammogram)	0.93 (0.28–3.13)	
Years residing in the United States of America	1.01 (0.97–1.06)	0.54
English ability (speaking, writing and reading)		
Proficient in one/two categories or none	1.00	0.43
Proficient in all categories	1.71 (0.46–6.35)	
Psychosocial-behavioural factors		
Perceived self-efficacy	2.19 (0.90–5.33)	0.09
Perceived benefits	1.02 (0.49–2.14)	0.96
Perceived barriers	0.59 (0.14–0.86)	0.02*
Knowledge about breast cancer screening	1.05 (0.68–1.62)	0.83
Knowledge about breast cancer risks	0.76 (0.59–0.78)	0.03*
Knowledge of recommendations for frequency of mammography screening	2.07 (0.99–4.33)	0.05*
Breast self-examination performance (once a month)		
No	1.00	0.28
Yes	1.53 (0.70–3.36)	
Clinical breast examination performance (every year)		
No	1.00	0.01**
Yes	13.34 (4.89–36.37)	

* $P < 0.05$; ** $P < 0.01$; of the 315 participants, 252 with complete data were used in this analysis.

socio-economic status (SES) and more resources. Therefore, our findings cannot be generalized to Asian-American women with different characteristics who live in other communities. Future researchers will need to examine whether these findings can be applied to more recent immigrants or replicated with Asian-Americans living in other regions of the USA. In addition, because of the nature of cross-sectional data, causality of the associations cannot be inferred; further studies with a longitudinal design are

needed to determine whether increased knowledge in fact promotes higher prevalence of mammography screening. Because the scale used to evaluate misconception/knowledge about breast cancer risk had low internal consistency (i.e. Cronbach's- $\alpha < 0.60$), it is likely that participants were knowledgeable in one or a few (rather than all six) aspects of breast cancer risk; therefore, future researchers should re-examine the reliability of this scale with other Asian populations.

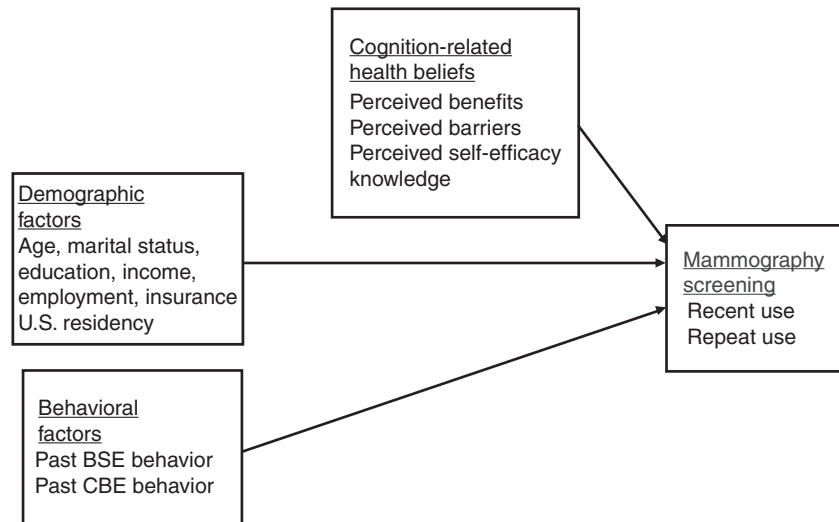


Figure 1 Application of the health belief model constructs in mammography screening. BSE, breast self-examination; CBE, clinical breast examination.

This is one of the first studies to investigate breast cancer screening behaviours, (i.e. recent and repeat mammogram use) among Asian-American women. Unlike previous studies of mammogram use among Asian-Americans that examined ever having had a mammogram or having received a mammogram within the past 2 years (Tu *et al.* 2002, Ho *et al.* 2005, Yu & Wu 2005, Lee-Lin *et al.* 2007, Wu & Brady 2007), the present study provides important new information on regular mammography adherence (based on five consecutive mammograms) for four groups of Asian-American women, which allows an initial understanding and comparisons of patterns in screening disparities among the Asian women in the USA. Our results give partial support for the HBM variables in explaining breast cancer screening behaviours among Asian-American women, whereas perceived benefits was not associated with either recent or repeated mammography use. Pender’s Health Promotion Model (HPM), which integrates aspects of several well-established theories and models of health behaviour including the HBM, uses a variety of individual characteristics and experiences, behaviour-specific cognitions and affects to predict and explain health-promoting behaviour (Pender *et al.* 2006). The relationships found in the current study between two HPM behaviour-specific cognitions (i.e. perceived barriers and knowledge) and breast cancer screening behaviours in Asian-American women supported Pender’s propositions.

Using the Behavioral Risk Factor Surveillance System to analyse mammography screening and demography variables, Rakowski *et al.* (2006a) cautioned about using national data to inform regional or local intervention planning, and urged that those planning interventions should obtain local and regional data to target programmes to groups with the greatest need for such interventions. The percentages of

women who reported having an up-to-date annual mammogram (55%) and who reported receiving regular mammograms (33%) in the current sample of Asian-American women residing in the midwestern USA were far lower than the objectives set for *Healthy People 2010*. This finding further emphasizes the need to develop effective and culturally tailored interventions to promote regular mammography screening for Asian-American populations.

Despite previous findings from the Health Information National Trends (HINT) Survey indicated that both having health insurance and a regular source of health care were related to having regular or repeat mammograms in Korean-American (Juon *et al.* 2004) and African-American women (Rosenberg *et al.* 2006) and in the overall US population (Rakowski *et al.* 2006a, 2006b), we did not find an association between insurance coverage and having recent or regular mammograms. Nevertheless, consistent with other studies conducted in North America (Blustein 1995, Snider *et al.* 1996), our results indicated the effect of SES (i.e. education) on mammography screening (both recent and regular mammography practice). More importantly, having had an annual CBE also was strongly associated with both mammography behaviours. It is likely that for these Asian-American women, being non-adherent with CBE recommendations could also be indicative of non-adherence with both of these mammography behaviours. Based on the odds ratio findings in Tables 3 and 4, having CBE was more strongly associated with having had a recent mammogram than with having regular mammograms. In the USA, CBE usually takes place during a woman’s annual physical examination and is performed by their primary care provider, whereas most mammograms occur outside of a woman’s annual healthcare visit. As a result, going to the annual examination gives an

Table 4 Logistic regression for having regular mammograms†

	Adjusted odds ratio (95% CI)	P values
Demographic characteristics		
Ethnicity		
Filipino	0.53 (0.18–1.57)	0.51
Asian-Indian	0.66 (0.21–2.04)	
Korean	1.98 (0.19–20.54)	
Chinese	1.00	
Age	0.97 (0.91–1.04)	0.43
Marital status		
Married	1.00	0.50
Not married	0.73 (0.29–1.85)	
Education		
> College	1.00	0.03*
< College	0.24 (0.07–0.85)	
Income (annual household)		
> US \$300,000	1.00	0.71
< US \$300,000	0.82 (0.29–2.31)	
Employment		
Full-time (no)	1.00	0.11
Full-time (yes)	2.22 (0.84–5.85)	
Insurance coverage		
No (for mammogram)	1.00	0.27
Yes (for mammogram)	0.82 (0.10–1.93)	
Years residing in the United States of America	1.08 (1.03–1.14)	0.003**
English ability (speaking, writing and reading)		
Proficient in one/two categories or none	1.00	0.02*
Proficient in all categories	11.92 (1.48–95.71)	
Psychosocial-behavioural factors		
Perceived self-efficacy	0.67 (0.25–1.78)	0.42
Perceived benefits	1.00 (0.47–2.13)	0.49
Perceived barriers	0.38 (0.15–0.98)	0.046*
Knowledge about breast cancer screening	1.46 (0.89–2.41)	0.14
Knowledge about breast cancer risks	0.88 (0.68–1.13)	0.31
Knowledge of recommendations for frequency of mammography screening	3.65 (1.63–8.13)	0.002**
Breast self-examination performance (once a month)		
No	1.00	0.50
Yes	0.77 (0.36–1.65)	
Clinical breast examination performance (every year)		
No	1.00	0.008**
Yes	5.34 (1.55–18.44)	

* $P < 0.05$; ** $P < 0.01$.

†The analyses were performed for the subset of women (age >45 years; $n = 259$) with the outcome variable of performing regular mammograms for last 5 years; the 208 participants with complete data were used in this analysis.

opportunity for women to discuss mammography screening with their primary care providers, and the visit may act as a reminder for obtaining a mammogram during the same year. This finding suggests the importance of CBE for mammography practices and the need for effective interventions to improve adherence with both screening modalities. It is also interesting that, after accounting for demographic variables,

health beliefs and knowledge, ethnicity did not predict mammography adherence in this sample of Asian women. Future investigation is warranted in other geographical locations to examine whether this produces similar findings.

While numerous national-level surveys (e.g. HINTS 2003) have included a wide range of variables, no information was available about the influence of attitudes and beliefs, such as

What is already known about this topic

- Despite the fact that Asian-American women have lower incidence rates of breast cancer than White and African-American women, breast cancer risk among Asian women increase after immigrating to the United States of America.
- Breast cancer screening with mammograms reduces the number of deaths from breast cancer, nevertheless, lower rates of breast cancer screening were observed in Asian-Americans.
- Asian-American women continue to have lower rates of mammography screening rates than women of other racial/ethnic groups.

What this paper adds

- Mammography screening behaviours (both recent and repeat mammogram use) were associated with health beliefs (i.e. barriers) and screening-related knowledge. In addition, the longer Asian women resided in the United States of America, the higher were the odds of adhering to having regular mammograms.
- Asian-American women believed that annual/repeat mammograms is not necessary because of not having a family history of breast cancer or any breast symptoms, feeling healthy and getting older.
- Asian women residing in the United States of America who had had annual clinical breast examinations had higher education had higher odds of adhering to having up-to-date mammogram practice.

Implications for practice and/or policy

- It is imperative to develop a multi-strategy intervention for the target population that takes into account knowledge, language and cultural factors and addresses the at-risk subgroups (i.e. recent immigrants and those with limited English ability) to reduce disparities in breast cancer screening rates.
- Healthcare professionals working with this population should be more proactive by carefully assessing and addressing the misconceptions that these women hold, and should give direct and clear provider–patient messages that are culturally sensitive and appropriate.

perceived benefits and barriers toward breast cancer screening, and such investigations were even less frequently conducted with Asian-American women. The growing liter-

ature on mammography screening will benefit from the current findings, which provide new information on the influence of health beliefs and knowledge on mammography (Rakowski *et al.* 2006a,b). One of the strengths of the current study is that, with the application of the HBM, we investigated the relationships between health beliefs, knowledge of mammography, selected demographic variables and both recent and repeated use of mammography among Asian-American women. Our findings support the conclusion that both mammography screening behaviours in this sample of Asian-American women were associated with cancer-related beliefs (i.e. barriers) and knowledge specific to recommended intervals for this screening. Similar to previous studies on breast cancer screening among Singaporean- and Chinese-American women (Wu & Yu 2003; Straughan & Seow 2000), perceived barriers were associated with mammography receipt in this sample. However, different from other studies (Yi & Prows 1996, Ramirez *et al.* 2000, Juon *et al.* 2004) showing an association between mammography screening behaviour and *general* knowledge about breast cancer screening, our study makes a unique contribution by assessing different aspects of knowledge specifically related to mammography screening. For example, the knowledge factor addressed specific misconceptions that could lead women to believe that having regular/annual mammograms is not necessary because of not having a family history of breast cancer, lack of any breast symptoms, feeling healthy and getting older. Asian-American women in this study who believed that having a mammogram was not necessary under these specific conditions were less likely to report having had a recent mammogram or to have had repeat mammograms. The findings from a previous focus group study (Wu & Bancroft 2006) confirms that immigrant women from Asian countries where cancer screening and control may not be a priority for public health initiatives could benefit from being better informed about current recommendations for breast cancer screening. Receiving only a recommendation or a referral from a physician may not be sufficient to motivate these Asian women to adhere to mammography recommendations. Therefore, healthcare professionals working with this population should be proactive and carefully assess and address the misconceptions that these women hold and provide direct and clear provider–patient messages that are culturally sensitive and appropriate.

The other statistically significant predictors of having repeat mammograms found in this study were the length of US residency and ability to speak, write and read English. Our results indicate that the longer Asian women reside in the USA, the higher the odds of adhering to annual mammogram practice. This finding could be related to decreased cultural

barriers and increased language proficiency associated with longer residence; in particular, our previous qualitative study (Wu & Bancroft 2006) on barriers to mammogram use also verified that those women who had lived in the USA for a shorter period (i.e. <10 years) reported greater cultural barriers related to language and cultural beliefs. This suggests that to promote adherence with recommendations on regular mammography use among at-risk Asian-American women, intervention strategies should be developed and tested for effectiveness among those most at risk for non-compliance with mammography screening guidelines (i.e. recent immigrants and those with limited English language ability).

Conclusion

This study makes several contributions to the literature on women's health and breast cancer screening. Currently, relatively limited information exists about mammography screening practices among various Asian-American and Pacific Islander populations. Investigating the health beliefs, knowledge, demographic and behavioural correlates and their associations with mammography screening behaviours among Asian-American women is an important first step in promoting mammography adherence in this population.

The findings of this study have some important implications for nursing practice. In order to reduce disparities in adoption of breast cancer screening among Asian-American women, nurses working with this population should recognize their lower screening rates and incorporate measures to assess their knowledge, attitudes, beliefs and needs related to breast cancer screening. Although our sample was Asian-American women residing in a Midwestern US community, the findings may also be relevant to nurses working with Asian populations who reside in countries other than the USA. These findings provide preliminary support for development of multi-strategy interventions carefully tailored to the knowledge, language and health beliefs of this at-risk population. It is expected that focusing on identified barriers and misconceptions among Asian-American women will result in such interventions being more effective in promoting the use of lifelong mammography screening for this rapidly growing population.

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Conflict of interest

No conflict of interest has been declared by the authors.

Author contributions

TW was responsible for the study conception and design. TW performed the data collection. TW analysed the data with the statistical consultation by DR. TW drafted the manuscript and DR made critical revisions to the manuscript.

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