RESEARCH COMMUNICATION

Does Performance of Breast Self-exams Increase the Probability of Using Mammography: Evidence from Malaysia

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Abstract

Objectives: Breast self-examination (BSE) was evaluated to see if it is a significant predictor of mammography. Methods: The decisions of females above age 40 in Malaysia to test for breast cancer using BSE and mammography are jointly modeled using a bivariate probit so that unobserved attributes affecting mammography usage are also allowed to affect BSE. Data come from the Malaysia Non-Communicable Disease Surveillance-1, which was collected between September 2005 and February 2006. Results: Having ever performed BSE is positively associated with having ever undergone mammography among Malay (adjusted OR=7.343, CI=2.686, 20.079) and Chinese (adjusted OR=3.466, CI=1.330, 9.031) females after adjusting for household income, education, marital status and residential location. Neither relationship is affected by jointly modelling the decision problem. Although the association is also positive for Indian females when mammography is modelled separately (adjusted OR=5.959, CI=1.546 - 22.970), the relationship is reversed when both decisions are modelled separately. Conclusions: De-emphasizing BSE in Malaysia may reduce mammography screening among a large proportion of the population. Previous work on the issue in developed countries may not apply to nations with limited resources.

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Introduction

As economic development shifts the mortality burden from infectious diseases toward chronic illnesses (Griffiths & Bentley, 2001; Gu et al., 2005; Popkin, 2008; Van de Poel et al., 2009), breast cancer has become an important health issue in developing nations. According to the World Health Organization, it was projected that 3.0% of all deaths in Southeast Asia for females between the ages of 45 and 69 in 2008 would be associated with breast cancer, compared to 2.8% for tuberculosis and 0.6% for HIV/AIDS(WHO, 2004).

Numerous studies have documented that routine mammography is effective at reducing mortality from breast cancer in women between 50 and 69 years of age(Kerlikowske et al., 1995; Humphrey et al., 2002; Sarkeala et al., 2008), but the high costs associated with mammography, particularly for population-based mass screening programs, have greatly limited the number of females who undergo screening in low resource countries (Miller, 1989; Leung et al., 2002; Anderson et al., 2003; 2006; Okonkwo et al., 2008). Regular clinical breast exams (CBE) are also considered effective in reducing mortality from breast cancer in women above 40 years of age(Barton et al., 1999), but these also require trained medical professionals and thus impose a non-trivial burden on the public health resources of developing countries.

A third screening option is breast self-exams (BSE), which do not require medical staff requirements once the technique is learned. Nevertheless, recent findings cast doubt on the effectiveness of BSE to reduce breast cancer mortality and suggest that the harm of BSE in terms of false positives outweighs any potential benefits (Humphrey et al., 2002; Thomas et al., 2002; Hackshaw & Paul, 2003). The United States Preventative Services Task Force points out, however, that while BSE may not be efficacious in its own right, routine BSE may encourage greater usage of mammography and CBE(Humphrey et al., 2002). If this is indeed the case, de-emphasizing BSE in developing countries might reduce the already small percentage of females who are screened using mammography.

In general, previous research has not considered the choice of different screening methods as a joint decision problem, with the decision to use one method affecting the decision to use others. A notable exception is Jelinski et al. (2005)(Jelinski et al., 2005), who explored whether past screening by BSE and CBE is associated with future mammography usage among females in Canada.

The goal of this paper is to explicitly model the choice of mammography and BSE as a joint problem using a prospective survey of 916 women in Malaysia above the age of 40. We use a bivariate probit estimator, which allows the unobserved attributes that affect the

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decision to undergo mammography to be correlated with the unobserved attributes that affect the decision to engage in BSE. It is thus possible to determine whether using BSE causes an increase in the probability of using mammography or whether unobserved attributes like individual risk tolerance lead women to undergo several types of screening. Since Malaysia is a diverse society, analysis is separated according to the three major ethnic groups: Malay, Chinese and Indian.

Materials and Methods

Data

The Malaysia Non-Communicable Disease Surveillance-1 (MyNCDS-1) is a cross-sectional population based study conducted from September 2005 to February 2006. Respondents were selected according to a two-stage stratified random sampling procedure so that the sample would be representative of the Malaysian population. All Malaysian citizens between 25 and 64 years old within each living quarter were eligible so long as they were not severely ill or pregnant. From an eligible sample of 3,040 a total of 2,572 respondents were retained, with a total response rate of 84.6%.

Questions related to breast cancer screening were only posed to females (1,528 observations) and only those between the ages of 40 and 64 are considered in this study (916 observations). Each was asked if they had ever had their breast examined by a doctor/nurse, ever done a mammogram and ever performed a BSE. These questions were used to define dichotomous outcomes variables, e.g. Y=1 if the respondent had ever had a mammogram and Y=0 otherwise. In addition, all females who reported performing a BSE were also asked how often they did so.

Respondents were also asked to report socio-economic and demographic information such as age, years of formal education, annual household income, marital status, ethnicity and residential location (urban or rural). Both AGE and the highest level of formal EDUCATION attained by the respondent were measured in years. Household income was recorded as belonging to one of ten intervals, from RM0-399 per month to more than RM10,000 per month (RM1=$US0.29). Individuals were also given the option of refusal. A continuous income measure was defined using the midpoints of the nine closed intervals and RM15000 was assigned for those in the highest income category. As there are only 8 top-coded observations, regression results were robust to the selection of a value for that category. A dichotomous variable that equaled unity if the respondent was unmarried (single, divorced or widowed) is also defined. Finally, self-reported ethnicity is represented by a set of categorical variables: Malays, Chinese, Indians and Others. Of the 916 females at least 40 years old in the sample, a total of 819 provided answers to all relevant questions. Lack of household income information was the most common reason for omission.

Characteristics of Survey Respondents

Descriptive statistics of the entire sample are reported in the first column of Table 1. BSE is far more common than mammography in Malaysia, though only 57% report ever performing one. Nevertheless, among those who have ever preformed a BSE, 71% report doing so at least once a month (40.6%/57.0%). The second through fifth columns report descriptive statistics by ethnic group. The most striking feature of the data is the behaviour of Indian females compared to the other ethnic groups. A majority of women in each of the Malay (60.8%), Chinese (52.1%) or Other (58.9%) subsamples report ever performing a BSE and the proportion doing so at least once a month ranges between 37.5% and 43.7%. In contrast, only 43.0% of Indian females report ever performing a BSE, while 28.2% report doing so at least once a month. On the other hand, 20.9% of Indian females report ever receiving a mammography, which is more than twice the figure reported by ethnic Malays (9.5%) and Other (7.4%). Chinese females also exhibit relatively high mammography screening rates (19.0%).

Effect of BSE

The effect of BSE on mammography usage among Malaysian females is first examined through a collection of unadjusted and adjusted logistic regressions. The latter include the socio-economic and demographic characteristics described above. Results are reported as

Table 1. Descriptive Statistics of Variables in the Statistical Model

Variables	Pooled (N=819)		Malay (N=475)		Chinese (N=163)		Indian (N=86)		Other (N=95)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Ever used mammography	0.123	0.329	0.095	0.293	0.190	0.396	0.209	0.409	0.074	0.263
Ever performed BSE	0.570	0.495	0.608	0.489	0.521	0.501	0.430	0.498	0.589	0.495
Performed BSE in past month	0.406	0.491	0.437	0.497	0.375	0.486	0.282	0.453	0.415	0.495
Age	49.7	6.8	49.7	6.7	50.6	7.2	48.3	5.7	49.4	7.1
Year of education	6.3	4.4	6.8	4.1	7.1	4.5	5.6	4.4	3.5	4.3
Log of household income	6.86	0.97	6.83	0.94	7.33	0.96	6.69	0.86	6.38	0.92
Rural	0.486	0.500	0.549	0.498	0.313	0.283	0.221	0.417	0.705	0.458
Unmarried	0.129	0.336	0.147	0.355	0.086	0.465	0.174	0.382	0.074	0.263
Malay	0.580	0.494								
Chinese	0.199	0.400								
Indian	0.105	0.307								
Other	0.116	0.320								

odds ratios.

Such a framework treats the decision of whether to screen using one method as conditionally independent of the decision to use other methods. That is, the unobserved attributes that lead an individual to use BSE, such as disease awareness or risk tolerance, do not determine whether the individual is more or less likely to use mammography. It is reasonable to suspect, however, that women who are conscious of breast cancer risk use multiple screening methods, i.e. screening methods are complements. Alternatively, women may have strong preferences toward screening and select only their most preferred method, i.e. screening methods are substitutes. To allow for this type of behaviour, the following latent variable specification is assumed:

$$M_i = \beta_M X_i + \gamma S_i^* + \varepsilon_{Mi}$$
$$S_i = \beta_S X_i + \varepsilon_{Si}$$
$$[\varepsilon_{Mi}\ \varepsilon_{Si}] \sim N(0,\Omega)$$

where

$$M_i^* = 1 \text{ if } M_i > 0,$$
$$S_i^* = 1 \text{ if } S_i > 0,$$

M_i and S_i represent underlying valuations that are unobservable; M_i^* and S_i^* represent the choices that individuals make and are observable; ε_{Mi} and ε_{Si} are unobserved characteristics that affect the decision to undergo mammography and BSE, respectively. The coefficient of interest is γ, which determines whether BSE encourages or discourages use of mammography.

Estimation through a set of logistic regressions is akin to the assumption that the unobservables (errors) are independently distributed according to the logistic rather than jointly distributed according to the standard normal. In a joint estimation framework, the covariances between the error terms in Ω are parameters to be estimated. A positive covariance implies that methods are complements whereas a negative covariance implies that the methods are substitutes. Unlike logistic regression, coefficient estimates from probit regression are not readily transformable into odds ratios. Therefore, we report the marginal effect of a unit change in each explanatory variable on the probability of undergoing mammography evaluated at the mean. The analysis is carried out for the full sample, as well as segmented by ethnicity. All analysis was carried out in STATA 10 (StataCorp, 2007).

Results

The first three columns of Table 2 report unadjusted and adjusted odds ratios from logistic regression on the decision to screen for breast cancer using a mammogram, while the fourth column reports adjusted odds ratios from logistic regression on the decision to screen for breast cancer using BSE. Results indicate that in comparison to Malay females, ethnic Chinese are more likely to have undergone a mammography, but less likely to have ever performed a BSE. Indian females are also more likely to use mammography and less likely to perform BSE. Females from rural areas are less likely to have undergone mammography or to have performed a BSE. Education level is positively associated with each screening method and the relationship is statistically significant for BSE.

Table 3 reports unadjusted and adjusted odds ratios for the effect of BSE participation on ever undergoing a mammography by ethnic group. In the adjusted analysis, each of the odds ratios is substantially larger than unity and all are statistically significant at the 5% level. The

Table 2. Odds Ratios from Logistic Regression on Screening Method

	Outcome: ever undergone			
	Mammography Unadjusted	**Mammography Adjusted**	**Mammography Adjusted**	**BSE Adjusted**
Ever done BSE	4.011***		5.771***	
	(2.360 - 6.816)		(3.235 - 10.296)	
Age		1.339	1.388	1.073
		(0.796 - 2.253)	(0.806 - 2.388)	(0.754 - 1.529)
Age2		0.772	0.76	0.878
		(0.465 - 1.281)	(0.448 - 1.290)	(0.622 - 1.240)
Years of formal education		1.037	1.007	1.099***
		(0.978 - 1.098)	(0.949 - 1.069)	(1.055 - 1.145)
Log of household income		0.688***	0.667***	1.072
		(0.534 - 0.888)	(0.509 - 0.873)	(0.899 - 1.279)
Rural residence		0.362***	0.415***	0.658**
		(0.220 - 0.599)	(0.249 - 0.694)	(0.478 - 0.907)
Unmarried		0.945	0.965	0.986
		(0.495 - 1.804)	(0.496 - 1.880)	(0.631 - 1.539)
Chinese ethnicity		2.119***	2.559***	0.603**
		(1.247 - 3.598)	(1.464 - 4.471)	(0.403 - 0.902)
Indian ethnicity		1.923**	2.858***	0.401***
		(1.016 - 3.640)	(1.456 - 5.611)	(0.241 - 0.665)
Other Bumiputera		0.875	0.779	1.358
		(0.370 - 2.069)	(0.327 - 1.858)	(0.825 - 2.237)
Observations	819	819	819	819

Adjusted regressions include all explanatory variables in the column for which results are reported. 95% confidence intervals in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 3. Unadjusted and Adjusted Odds Ratios for the Effect of BSE Participation on Ever Undergoing a Mammography from Logistic Regression by Ethnic Group

	Unadjusted	Adjusted
Malay [475]	5.815***	7.343***
	(2.251 - 15.024)	(2.686 - 20.079)
Chinese [163]	3.991***	3.466**
	(1.608 - 9.902)	(1.330 - 9.031)
Indian [86]	3.440**	5.959***
	(1.149 - 10.303)	(1.546 - 22.970)

Adjusted regressions include all explanatory variables from Table 2. 95% confidence intervals in parentheses. Number of observations in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table 4. Unadjusted and adjusted marginal effects of BSE participation on ever undergoing a mammography from probit and bivariate probit regression by ethnic group

	Outcome: ever undergone mammography		
	Unadjusted	Adjusted	Adjusted and jointly estimated†
Full sample [819]	0.127***	0.139***	0.152
Malay [475]	0.112***	0.108***	0.114
Chinese [163]	0.193***	0.163***	0.205
Indian [86]	0.202**	0.251***	-0.158

Adjusted regressions include all explanatory variables from Table 2. Number of observations in brackets; †Standard errors (and thus confidence intervals) cannot be calculated on for the marginal effect in bivariate probit; *** p<0.01, ** p<0.05, * p<0.1

association between BSE and mammography is strongest for Malay females and weakest for Chinese females.

The first two columns of Table 4 report unadjusted and adjusted marginal effects of BSE participation on ever undergoing a mammography from probit regression by ethnic group. Consistent with the odds ratios from logistic regression, BSE has a strong positive association with mammography usage. Although Indian females exhibit the largest marginal effect, their baseline mammography participation is above that of Malay females, which explains the larger odds ratio for Malays in the logistic analysis.

The third column repeats the adjusted analysis when the decision to use mammography and the decision to use BSE are estimated jointly (standard errors for the marginal effect on the probability of using mammography are not calculable and thus confidence cannot be constructed). For both Malay and Chinese females, the marginal effect of ever performing BSE increases slightly compared to when the unobservable attributes that affect the mammography decision are assumed independent of the attributes that affect the BSE decision. In contrast, estimating both choices simultaneously for Indian females leads to the relationship between BSE and mammography usage to reverse sign.

Discussion

Although a number of studies have called the efficacy of BSE into question, many policy-makers have been reticent to explicitly advise against BSE. While BSE may not reduce mortality from breast cancer directly, the practice of self-examination may lead females to also adopt other screening mechanisms like mammography. If this were true, guidelines that de-emphasize BSE may have the unintended consequence of reducing mammography screening as well.

The results of the current study suggest that for some groups in Malaysia, this concern is valid. For both Malay and Chinese females, mammography and BSE are strongly complementary: having ever under performed BSE is a significant predictor of mammography usage even after controlling for the possibility that the unobservable attributes affecting the mammography decision also affect the BSE decision.

These findings stand in contrast to those of Jelinski et al (2005). A potential explanation is that their results using women in Canada, a highly developed nation with a strong public health system, may not be generalizable to developing countries. In limited resource countries, BSE may be a more important factor in inculcating the general importance of breast cancer awareness. This certainly suggests caution in using results from developed nations to craft health policies in developing ones.

For Indian females, however, performance of BSE seems to lower the probability of mammography screening once the choice over screening methods are modelled as a joint decision problem. Not surprisingly, Indian females exhibit the highest mammography screening rates and the lowest BSE screening rates. For this group in Malaysia, it appears that mammography and BSE stand as substitutes. One interpretation is that reduction of BSE would result in greater mammography usage among Indian females, but we would strongly recommend further study before suggesting this as a policy. It is also possible that Indian females who are adopting BSE are doing so because they (incorrectly) consider it as an equally effective means of screening. In this case, information that led individuals to believe that BSE was ineffective may also lead them to believe that all screening methods were ineffective, so that reduction of BSE might not induce substitution toward mammography.

There are two main limitations of the current study besides the usual issues with observational data, self-reporting of screening history and representativeness of the sample. First, respondents were asked to report whether they had ever undergone a mammography, but were not asked the date of their last mammography. Information that tied recent BSE behaviour with recent mammography usage should be an important consideration in future work and data collection efforts. Second, the data is cross-sectional in nature. Identification of causal effects would be cleaner if respondents were asked about their screening behaviour at different points in time. There is hope that the MyNCDS will become a longitudinal survey, however, so future data may yet become available to do so.

In conclusion, the results of our study suggest that Malaysia should proceed cautiously with respect to de-emphasizing BSE as a screening method for breast cancer. This is particularly true in a multi-ethnic country

where differences in religion, culture and belief systems may yield differing outcomes. Nevertheless, BSE may be an effective means in developing nations to improve awareness of breast health and to encourage females to adopt other screening methods that have been shown to be efficacious. Further research in other developing nations should be undertaken to determine whether this explains the difference between the current results and those in developed nations.

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