Prevalence Estimation of Three Breast Cancer Screening Methods among Northeastern Women in Thailand

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ABSTRACT

The aim of this study was to estimate the prevalence of three breast cancer screening methods using weighted estimation, non-weighted estimation and the exact binomial method. Northeastern women aged 20 to 64 (n = 1,081) were randomly selected with multi-stage sampling. The results indicated that the prevalence of women who had performed Breast Self-Examination (BSE) and women who had regularly performed BSE, ranged from 75.2% (95% CI: 71.8-78.6) to 81.3% (79.1-83.5) and 49.3% (45.4-53.2) to 51.9% (49.3-54.7), respectively. The prevalence of women who had received Clinical Breast Examination (CBE) and women who had received CBE regularly ranged from 33.4% (31.1-35.8) to 38.6% (34.8-42.4) and 13.1% (11.2-14.9) to 22.3% (19.0-25.6) respectively. Except in rare cases, the prevalence (95% CI) of mammography screenings were computed by the exact binomial method: 0.03% (0.02-0.04) of women aged 40 and older had had a mammography and 0.003% (0.001-0.009) had mammography annually. Since there is such a low rate of breast cancer screenings, the government should re-evaluate its breast cancer screening policy and implement a strategy of breast cancer screenings. Special attention is required in the areas of mammography screenings and in the allocation of mammogram machines and radiologists. These goals could be perhaps best achieved through the increasing of public awareness of the breast cancer screenings.

Key words: Prevalence, breast cancer screening methods, northeastern women

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Introduction

Breast cancer is the most common of cancer deaths among women and accounts for 16% of cancer deaths in adult women worldwide.[1] For Thai women, breast cancer has become the most common cancer after cervical cancer. The highest incidence of breast cancer occurs in the 45-49 age group. From 1997 to 2002 the breast cancer mortality rate increased from 1.6 to 5.3 per 100,000 women, respectively and more than 5,000 new cases of breast cancer were diagnosed in each of those five years.[2-3] According to the data from the Thai cancer registries, the incidence of breast cancer had increased in all regional cancer registries from 1993 to the 1998-2000 period. During this period, the most significant increase was observed in the northeastern region.[4] In addition, Thai women tended to be diagnosed with tumors that were larger, more severe and which had spread more regionally compared to those of Western women.[5] The northeastern region cancer registry showed that 59.2% of patients received late stage cancer treatment.[6] The data implied that women of the northeastern region tended to underutilize breast cancer screenings.

Early detection and prompt treatment of breast cancer in its early stage can play an important role in reducing breast cancer mortality rates.[7-8] The American Cancer Society (ACS) recommends mammography, clinical breast examination (CBE), and breast self-examination (BSE) as the common methods for breast cancer screening (BCS) among asymptomatic women.[9] Though BCS has proved effective in reducing deaths from breast cancer, studies in Thailand showed a low rate of BCS among Thai women.[10-12] Kimpee and colleagues conducted a survey among nurses, breast patients and general female patients (n = 300) at the Siriraj hospital, Bangkok. The results of this survey showed that 67.7% had performed BSE, but only 17.3% had performed BSE monthly. Nearly 35.0% had had CBE, and 7.0% had CBE regularly, while 7.7% of participants had had a mammography, but only 2.3% had had an annual mammography.[10] Based on the report of the national health and welfare survey of 2003, the lowest percentages of Thai women who had performed BSE were northeastern women (29.6%). Only 4.4% of these women performed BSE monthly while 26.2% received CBE by health care providers, but only 9.5% had CBE regularly.[11] A later national survey conducted in 2006, reported that 35.8% of northeastern women had performed BSE and 15.5% performed BSE monthly. In addition, a total of 43.1% of women had received CBE by health care providers.[12]

Under utilization of BCS and delayed detection has resulted in breast cancer not being treated until the cancer had reached more advanced stages. Knowledge about the current situation and trends of BCS reflect the magnitude of the breast cancer problem. In order to assess the current situation of BCS, statistical estimates have been widely used. Two common approaches for prevalence estimation are: (i) the non-weighted 'pool' method, which in its simplicity ignores stratification; was proposed to estimate the prevalence because it is a simple method of calculation without the undefined problem though

it is usually result in decreased performance for inference when the correlation between the stratification factors and the binary response variable increases[13] and (ii) inverse-variance weighted prevalence with stratification (the stratum-specific differences in proportions) was used for avoiding severe bias and to increase the performance estimation. However, the weighted estimate may encounter an undefined-weight problem when it is being used to estimate a small sample. The purpose of this study was to estimate the prevalence of BSE, CBE and mammography screening among northeastern women aged 20 to 64 by using these methods. This study was also undertaken to help administrators plan and evaluate preventative efforts as well as to assist in the allocation of resources. Further, the results of this study provided useful information for the future surveillance of breast cancer prevalence.

Materials and Methods

After receiving approval from the ethical committee of the Faculty of Medicine, Khon Kaen University, this cross-sectional study, using multi stage sampling, was conducted among a random sample of women aged 20 to 64, all of whom resided in the northeastern region. After being informed that their responses would be kept in confidence, and that their privacy was assured, the participants signed consent forms.

The three-stage cluster sampling, stratified before the second stage, was applied in this study. At the first stage, simple random sampling was used to randomly select two provinces from the upper level (Khon Kaen and Nong Khai), and two from the lower level (Nakon Ratchasima and Si Sa Ket) of the northeastern region. Based on each selected province, the province was stratified by residential areas. Specific municipal areas were called 'blocks' and non-municipal areas were called 'villages'. The national statistical organization (NSO) staffs used all the blocks and villages of the year 2000 census as a sampling frame. Approximately three blocks from the municipal areas and seven villages from the non-municipal areas were randomly selected from each province at the second stage. At the third stage, and proportional to the size of selected villages or blocks, about 15-40 households from each identified cluster were randomly selected. Only one woman per house was interviewed. Initially a household was selected at random by a researcher who went to a central community location such as a market, a temple or a village shop. Then, using a glass bottle, span the bottle and according to the direction the bottle neck pointed when the bottle ceased rotating, the interviewer would then commence to interview residents in that direction. After a woman from the first household was interviewed, a woman from each of the next three neighboring houses/rooms was subsequently interviewed. This process was repeated until the quota of households per village or block was reached. A total of 1,081 women aged 20 and older were interviewed on the subject of breast cancer screening methods.

To estimate the prevalence of BSE, CBE and screening mammography, the pool method, the inverse-variance weighted method and the exact binomial method were used.

Suppose the population contains M primary sampling units ($i = 1,2,...,M$): each of the primary sampling units is divided into L strata ($h = 1,2,...,L$). The number of secondary sampling units is M_{ih} ($j = 1,2,...,M_{ih}$). Within stratum h of the selected primary sampling unit i, each of second-stage units has N_{ihj} third-stage units ($k = 1,2,...,N_{ihj}$,). The numbers of the three-stage units that correspond to the sample are m, m_{ih}, and n_{ihj}, respectively. In this study, the first-stage unit is a province, its stratum being a rural or an urban area, the second-stage unit is a village or a block, and the third-stage unit is a household. Only one woman per household was eligible for an interview.

Let x_{ihjk} be the binary outcomes of a breast cancer screening obtained by one woman (one sample point) from the k^{th} household, in the j^{th} village or block, in the h^{th} rural or urban region, and from the i^{th} province. Usually, x_{ihjk} was recorded as 1 if a breast cancer screening occurred and as 0 if it did not occur. It is clear that the prevalence estimate of breast cancer screening for the j^{th} village, of the h^{th} rural area in the i^{th} province was obtained as $\hat{p}_{ihj} = \dfrac{\sum_{k=1}^{n_{ihj}} x_{ihjk}}{n_{ihj}}$ where n_{ihj} is the number of selected households of i, h, and j. To get the pool prevalence estimate, the success rate is calculated by simply dividing the total number of successes by the corresponding total sample size regardless of the stratification. This yields the following formula:

$$\hat{p}_{pool} = \frac{\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} n_{ihj}\,\hat{p}_{ihj}}{\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} n_{ihj}} = \frac{\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}}\sum_{k=1}^{n_{ihj}} x_{ihjk}}{\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} n_{ihj}}$$

The 95% confidence interval for p is:

$$\hat{p}_{pool} \pm 1.96 \sqrt{\frac{\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} n_{ihj}\,\hat{p}_{ihj}\,(1-\hat{P}_{ihj})}{\left(\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} n_{ihj}\right)^2}}$$

The prevalence estimate of an inverse-variance weight is:

$$\hat{p}_w = \frac{\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} w_{ihj}\,\hat{p}_{ihj}}{\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} w_{ihj}}$$

where $w_{ihj} = \dfrac{1}{\hat{p}_{ihj}(1-\hat{p}_{ihj})/n_{ihj}}$ denotes the weighted estimator. The estimated variance of $\hat{p}_w$ is given as $\hat{\text{var}}\,(\hat{p}_w) = \dfrac{1}{\sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} w_{ihj}}$. The 95% confidence interval for p is

$$\hat{p}_w \pm 1.96\sqrt{\hat{\text{var}}\,(\hat{p}_w)}.$$

The inverse-variance prevalence encounters a number of problems if n_{ihj} is small. For example, if $\sum_{k=1}^{n_{ihj}} x_{ihjk} = 0$ or $(\sum_{k=1}^{n_{ihj}} x_{ihjk} = n_{ihj})$, when the weighted estimates w_{ihj} are undefined. To solve this problem, Böhning and Viwatwongkasem[14] suggested estimating

$\hat{p}_{ihj}$ by using $\hat{p}_{ihj} = \dfrac{\left(\sum_{k=1}^{n_{ihj}} x_{ihjk}\right)+1}{n_{ihj}+2}$.

In sparse data, the binomial variable, $y = \sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}}\sum_{k=1}^{n_{ihj}} x_{ihjk}$, can not be normally followed as an approximation. The researchers have utilized the exact binomial method to estimate its confidence interval for p. The confidence interval was proposed by Morisette and Khorram[15] as follows:

$$\frac{((y+1)\ /\ (n-y))\ F_{(2(y+1),2(n-y)):\ \alpha/2}}{1 + \dfrac{y+1}{n-y} F_{(2(y+1),2(n-y));\ \alpha/2}} \le p \le \frac{1}{1 + \dfrac{n-y+1}{y} F_{(2(n-y+1),2y);\ \alpha/2}}$$

where $n = \sum_{i=1}^{m}\sum_{h=1}^{2}\sum_{j=1}^{m_{ih}} n_{ihj}$ and $F_{(v1,v2);\ q}$ is the upper 100 × (1-q) percentile from F distribution with $v1$ and $v2$ degrees of freedom.

Results

The sample consisted of 1081 women aged 20 to 64 who resided in the northeastern region. The mean age was 41.9 (SD=10.9) years old. The participant's ages ranged from 20 to 64. The majority of the women lived in non-municipal areas (65%). Most of the participants were married or had partners (81%) and had a maximum of 12 years of schooling (61%). Nearly half of the women worked in the agricultural and labor industries while 17% were housewives or retired women. Slightly more than half of the women had a monthly household income of 5,000 baht or less as shown in Table 1.

Table 2 shows the assessing of breast cancer screening behaviors based on self-reported data. The three recommended methods for the detection of breast cancer were BSE, CBE by a health care provider, and mammography screenings. Of the study's participants, the greatest percentage, 75-81%, claimed to perform BSE, but nearly a quarter of the women had never performed BSE. Of all women, approximately 49-52% performed BSE monthly in the last year.

CBE was the second most often mentioned screening method and 33-39% claimed to have been examined by health personnel. Of all these women, 13-22% had regular CBE's based on the ACS guidelines. These findings indicated that most of the women aged 40 and older (97.0-99.8%) reported never having had a mammography screening but approximately 0.003-0.03% of women had mammograms annually.

Table 1 Socio-demographic characteristics of northeastern women aged 20 to 64 (n=1,081)

Characteristics	Number	Percentage
Province		
Nong Khai	262	24.2
Khon Kaen	297	27.5
Nakorn Ratchasrima	291	26.9
Sai Sa Ket	231	21.4
Living in municipal areas		
Yes	376	34.8
No	705	65.2
Age (years)		
20-34	277	25.6
35-49	517	47.8
50-64	287	26.6
Marital status		
Single	108	10.0
Married / Partner	873	80.8
Divorced / Separated / Widowed	100	9.2
Education		
None	19	1.8
Primary school	442	40.9
Secondary school	197	18.2
High school	247	22.9
Diploma	54	5.0
Bachelor degree and higher	122	11.2
Employment Status		
Agriculturist / Laborer	525	48.6
Private employee / Commerce	250	23.2
Housewives / Retired	182	16.8
Government official / enterprise	75	6.9
Unemployed / Students	49	4.5
Monthly Household Income (Baht) (n=1,033)		
< 5,000	405	39.2
5,000 - 9,999	313	30.3
10,000-19,999	159	15.4
≥ 20,000	156	15.1
Median = 5,000; Min-Max: 500-100,000		

Table 2 Percentage and 95% Confidence Interval (CI) of breast cancer screening methods classified by methods of estimation

Methods	Percentage (95%CI)		
	Weighted	Non-weighted	Exact Binomial
Breast Self-Examination (BSE) (n=1,081)			
Have done	81.3 (79.1-83.5)	75.2 (71.8-78.6)	
*Monthly BSE	51.9 (49.3-54.7)	49.3 (45.4-53.2)	
Clinical Breast Examination (CBE) (n=1,078)			
Have done	33.4 (31.1-35.8)	38.6 (34.8-42.4)	
*Regular CBE	13.1 (11.2-14.9)	22.3 (19.0-25.6)	
Mammography screening (n = 622)+			
Have done	0.22 (0.0-0.5)	2.7 (1.4-4.0)	0.03 (0.02-0.04)
* Annual mammography	0.13 (0.0-0.3)	0.3 (0.0-0.7)	0.003 (0.001-0.009)

* Breast cancer screening methods based on the American Cancer Society's recommendations

\+ Women aged 40 and older

Discussion

Since a representative sample of this study was randomly selected by stratified three-stage sampling, the BCS rates can be generalized within the target population of northeastern women aged 20 to 64. However, the 1,081 households, sampled in this study, was quite small compared with the two previous national surveys which were also conducted in order to determine the rates of BSE and CBE among women of the northeastern region. The first of these two surveys was conducted in 2003, (n = 5,904 households)[11], and the second was conducted in 2006, (n = 17,712 households).[12]

The weighted rate of women who had practiced BSE (81.3%) in this study was concordant with the results of a third National Health Personnel Survey (NHPS) which reported that 80.4% of health personnel aged 20 to 59 had practiced BSE.[16] These particular rates were comparatively much higher than the two previous national surveys, the results of which were 48.5% in 2003 and 24.6% in 2006 for the whole country.[11-12] The rates of women who had practiced BSE in the northeastern region (29.5% in 2003[11] and 35.8% in 2006[12]) were also comparatively similar. The rate of women who practiced BSE monthly in this study (51.9%)

was also greater than the rates reported in the two national surveys of 2003 (4.5%) and 2006 (15.5%). Furthermore, the BSE rates reported in this study are higher than those of other nations. For example, of the Korean immigrants to the United States, 58.1% had performed BSE but only 46.3% performed BSE monthly[17], while 55.6% of Malaysian women[18] had performed BSE but only 19.0% of them had performed BSE monthly. Several explanations may account for the higher rates of the northeastern Thai women practicing BSE. Firstly, one needs to consider the impact of the Thai government's national Healthy Thailand Strategy for Health Promotion goals. One of the goals of this campaign was to have "80% of women aged 35 and older practicing BSE". This goal was perhaps achieved through the implementation of a mass media campaign which promoted breast cancer screening in Thailand, especially in regards to BSE. Facilitatively then, health care providers aimed to achieve this goal.[4] Secondly, Thai women respect health personnel and have a tendency to listen and follow the advice of physicians.[19] A third explanation may be that some participants may have exaggerated their BSE performance in order to provide a result they perceived as being desirable to the interviewers interests and/or to try and portray themselves as being healthier than they really were.[20] Although northeastern women in this study practiced BSE at a higher rate, the monthly rate of BSE practice is still below the national goal of 80%. Therefore, ongoing activities in health promotion should be planned and routinely implemented. Such promotions should include the employment of trained staff who can provide demonstrative assistance when necessary. Further studies are needed to identify the barriers preventing women from both beginning to practice BSE as well performing BSE on a more regular basis. The results of this study will help authorities plan and implement appropriate strategies to facilitate an increase in BSE monthly practice rates. Furthermore, additional studies are needed to evaluate the validity of BSE self- reporting and to examine women's proficiency in BSE.

The reported rate of having a CBE (33.4-38.6%) in this study lay between the two previous national surveys conducted in the northeastern region (26.2% in 2003 and 43.1% in 2006, respectively).[11-12] However, it shows a higher rate of having had a CBE from health personnel than the earlier reports of 2004 and 2006 which reported rates of 22.7% and 24.5% respectively.[16,21] The rate of receiving regular CBE in this study (13.1%) is slightly lower than the 2003 national survey's rate of 19.1%.[11] The findings of this report then have met the set "Health Promotion" goal which is that at least 10% of women aged 40 and older receive an annual CBE. However, northeastern Thai women may have similar barriers to those of other Asian women such as modesty or a conservative attitude and feel uncomfortable and embarrassed at the prospect of revealing their breasts to others. The same barriers may also prevent them from having CBE when they are feeling healthy. It is possible that lower CBE rates are characteristic of cultures where cultural values such as modesty

and conservatism are the norm. The findings of this study suggest a need for the development of strategies which encourage northeastern women to have CBE's. Further studies are also needed in order to establish appropriate professional development programs for health care providers. Such programs would result in an increase in health care provider's proficiency, skills and confidence which would then enable them to effectively raise CBE rates. In addition, health care providers from health centers, especially female nurses need to be encouraged to perform CBE as a routine part of health care and health promotion programs. Further, the mass media can play an important role. Television and radio networks need to produce culturally appropriate programs specifically designed to help women overcome their modesty, so that early signs of breast cancer can be detected.

At present, there have been very few population based-studies from the northeastern region reporting mammography screening rates. According to a national study conducted in 2004, only 4% of women aged 40 to 59 had had a mammography, but in the northeast, only 2% of women had had a mammography.[21] However, the prevalence of mammogram screening is not likely to be reliable due to the violated assumption of the normal approximation to the binomial distribution. The values of $n\hat{p}_w$, $n\hat{p}_{pool}$ and, $n(1\text{-}\hat{p}_w)$, $n(1\text{-}\hat{p}_{pool})$ are less than 5 (or 10) for this violation wheren is the sample size ($n = 622$). The findings of this study reported that the weighted rate of asymptomatic women aged 40 and older having mammography ranged from 0.22% to 2.7%. However, only 0.13% to 0.3% of these women had had an annual mammography. To solve this problem, the exact Binomial confidence interval for proportions was used to make estimation, given that 0.03% of women had had a mammography and 0.003% had mammography annually. These estimations fall far from the national survey's goal of '10% of women aged 40 and older having a mammogram every 2 years'. These same rates are also lower than those of a previous survey.[4,15] This may be explained by the lack of a national policy promotion which specifically addresses mammography screening issues. The results of this study showed that nearly 80% of participants reported never having heard of, nor had they ever received information about mammography screenings from any sources because the availability of routine mammography screenings for women aged 40 and older had not been widely promoted. Secondly, more often than not, screenings were used for the diagnosis of breast cancer in women with existing symptoms rather than for the early detection of breast cancer in asymptomatic women. Thirdly, many studies showed that women who had had a mammography screening, were more likely to have a subsequent screening as per their doctor's recommendation.[22-23] Lastly, there is very little mammogram equipment available in the northeastern region. The very few that are available are located in a provincial hospital and the private hospitals and operate at high costs.[24]

The findings indicate the need to increase the rate of mammography screenings through health education campaigns. In addition, health

care providers need to encourage and advise interested women where they can go to get a screening. Finally, the use of mobile and low-cost screening mammography can be utilized as an alternative to reach women in northeastern provinces.

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บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อประมาณค่าความชุกของการตรวจคัดกรองมะเร็งเต้านมโดยการใช้วิธีประมาณค่าแบบถ่วงน้ำหนัก แบบไม่ถ่วงน้ำหนัก และวิธี exact binomial กลุ่มตัวอย่างของการศึกษานี้คือสตรีในภาคตะวันออกเฉียงเหนือของประเทศไทยที่มีอายุระหว่าง 20 ถึง 64 ปี จำนวน 1,081 คน ที่ได้จากการสุ่มตัวอย่างแบบหลายขั้นตอน ผลการศึกษาพบว่าความชุกของการเคยตรวจเต้านมด้วยตนเองพบร้อยละ 75.2 (95% CI, 71.8-78.6) ถึง ร้อยละ 81.3 (79.1-83.5) และความชุกของการตรวจเต้านมด้วยตนเองอย่างสม่ำเสมอพบร้อยละ 49.3 (45.4-53.2) ถึงร้อยละ 51.9 (49.3-54.7) ขณะที่ความชุกของการเคยตรวจเต้านมโดยบุคลากรทางการแพทย์ และความชุกของการตรวจเต้านมโดยบุคลากรทางการแพทย์อย่างสม่ำเสมอ พบร้อยละ 33.4 (31.1-35.8) ถึงร้อยละ 38.6 (34.8-42.4) และร้อยละ 13.1 (11.2-14.9) ถึงร้อยละ 22.3% (19.0-25.6) ตามลำดับ ยกเว้นกรณีพบผู้ตรวจคัดกรองน้อย วิธี exact binomial ถูกนำมาใช้ประมาณช่วงความเชื่อมั่นของความชุกการตรวจแมมโมแกรม พบว่าร้อยละ 0.03 (0.02-0.04) ของสตรีที่มีอายุ 40 ปี และมากกว่า เคยตรวจเต้านมด้วยแมมโมแกรม และร้อยละ 0.003 (0.001-0.009) ตรวจเต้านมด้วยแมมโมแกรมเป็นประจำทุกปี จากข้อค้นพบความชุกของการตรวจคัดกรองมะเร็งเต้านมที่ต่ำ รัฐบาลควรจะทบทวนนโยบายและแผนกลยุทธ์การตรวจคัดกรองมะเร็งเต้านม โดยเฉพาะการตรวจแมมโมแกรม และการจัดสรรเครื่องตรวจแมมโมแกรม และรังสีแพทย์อย่างเหมาะสม เป้าหมายจะสำเร็จได้โดยการเพิ่มความตระหนักของสาธารณชนในการตรวจคัดกรองมะเร็งเต้านม

คำสำคัญ: ความชุก, การตรวจคัดกรองมะเร็งเต้านม, สตรีในภาคตะวันออกเฉียงเหนือ

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