RESEARCH ARTICLE

Socio-economic Factors Influencing Tumor Presentation and Treatment Options in Chinese Breast Cancer Patients

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Abstract

The impact of income and education level on the clinical and pathologic characteristics, implementation of clinical breast examination (CBE), and treatment patterns of a small population of Chinese female breast cancer patients was studeied in order to provide a theoretical basis and statistical reference for further nationwide research. We included 484 pathologically confirmed female primary breast cancer inpatients of the First Affiliated Hospital of Medical College of Xi'an Jiaotong University from February 2003 to January 2004. All cases were reviewed and relevant information was collected using a designed case report form (CRF). Chi-square tests, rank-sum tests, and Fisher's exact tests were used in the analysis. Our analysis showed that: (1) women in different occupation groups had significant differences in tumor size, pre-operative mammography, surgical options, post-operative estrogen receptor (ER), progestin receptor (PR) and human epidermal growth factor receptor 2 (Her2) status, and post-operative radiotherapy and chemotherapy ($P < 0.05$); and (2) women with different education levels had statistically significant differences in tumor size, post-operative ER, PR and Her2 status, and post-operative chemotherapy, radiotherapy, and endocrine therapy ($P < 0.05$). In Xi'an, China, women in low-income occupations or with low education levels are more likely to have advanced tumor stages at presentation, lower implementation rate of clinical breast examination, and less treatment.

Keywords: Breast cancer - occupation - education - clinicopathologic characteristics - CBE - treatment patterns

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Introduction

Occupation and education level play a vital role in determining patients' income levels and their perceptions of cancer, thus influencing an individual's medical insurance status, the affordability of medical treatment costs, and therefore the likelihood of early tumor detection and presentation. All of these factors are closely related to the general incidence and development of tumors (Kent et al., 2009; Baade et al., 2010; Chung et al., 2010; Goldsbury et al., 2012), which are also relevant to breast cancer patients. Many studies have shown that socio-economic status and education levels of breast cancer patients have significant impacts on cancer staging at presentation and on clinical and pathologic characteristics that directly influence the prognosis. For example, breast cancer patients with low incomes commonly have lower early detection rates (Wilf-Miron et al., 2011), an advanced tumor stage at diagnosis, and poorer prognosis (Richardson et al., 1992).

Breast cancer is one of the most common malignancies in women today. In recent decades, the breast cancer incidence rate has been increasing rapidly all over the world (Hortobagyi et al., 2005; Anderson et al., 2008; Porter et al., 2008), and especially in Asia (Green et al., 2008). Although many female breast cancer studies have been conducted in Western countries, the incidence and development of female breast cancer may differ between Asian and Western countries. For instance, the peak age of female breast cancer onset is approximately 40 years in Asian countries, while it is about 60 years in Western countries (Green et al., 2008). This difference may be associated with many factors, including regional disparity, ethnic background, genetic background, lifestyle, dietary patterns, economic level, and overall education level (Leong et al., 2010). Therefore, studies on female breast cancer in Western countries may not be relevant to female breast cancer in Asian countries, such as China.

In China, the breast cancer incidence rate is ranked first among female cancers, with an increase of 38.5% from 2000 to 2005 and annual deaths of 13,000 (Yang et al., 2005). Compared with Western countries, China has a very large population of breast cancer patients; however, only a limited number of studies have investigated the influence of occupation and education level on the clinical and pathologic characteristics of breast cancers, the implementation of CBE, and the treatment patterns. This study investigates the impacts of occupation and education level on the clinical and pathologic characteristics, the implementation of CBE, and the treatment patterns in a

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small population of Chinese female breast cancer patients in order to provide a theoretical basis and statistical reference for further nationwide research. Xi'an is a city located in northwestern China that has a less developed economy. Since the First Affiliated Hospital of Medical College of Xi'an Jiaotong University is a representative hospital of this region (Li et al., 2011), the results of this study may, to some extent, reflect the current situation of areas with a less developed economy within China and thus provide a reference to help the Chinese government to develop a female breast cancer prevention program. Furthermore, as China is a developing country, the results of this study may assist other developing countries to improve their breast cancer prevention strategies.

Materials and Methods

Patients

This study included pathologically confirmed female primary breast cancer inpatients from the First Affiliated Hospital of Medical College of Xi'an Jiaotong University from February 2003 to January 2004. All cases were reviewed and patient information was collected using the CRF. All patients enrolled in this study met two key inclusion criteria: (1) pathologically confirmed primary breast cancer and (2) had received treatment (surgery, medical oncology and radiotherapy) for breast cancer.

This study was approved by the Medical Ethics Committee of Xi'an Jiaotong University. Patient consent was not required for this study because there were no anticipated risks for the participants. All patient identifiers were removed from the data, according to approved procedures, and de-identified data were maintained in a secure database. Only research team members had access to the data. All data are reported in aggregate.

By convention, the occupations of the enrolled patients were classified as five groups: housewife, manual worker, professional, private sector worker, and unspecified. The education levels of all patients were classified into six groups: none (i.e., having received no formal education), those having received primary, middle, high, or university and above education, and unspecified (Li et al., 2011; Norsa'adah et al., 2011).

Pathologic diagnostic criteria

Histological subtype categories were based on the 1981 and 2003 World Health Organization (WHO) histological classification criteria (WHO, 1981; Tavassoli et al., 2003). Staging of breast cancer was done according to the American Joint Committee on Cancer (AJCC) Tumor-Node-Metastasis (TNM) staging system of 1997 onwards (Fleming et al., 1997; Greene et al., 2002).

Data collection and quality control

The following data were systematically collected for all enrolled patients via a medical records review: (1) general information, including date of diagnosis, visits to other health care professionals, inpatient admission date, diagnosis at admission, inpatient discharge date, and discharge outcome; (2) demographic characteristics at the time of diagnosis/admission, including occupation and education level; (3) data on the CBE; (4) diagnostic imaging data, including mammography and ultrasound; (5) data on tumor characteristics, including primary tumor location, primary tumor quadrant, tumor size, number of tumor modules, tumor invasion, lymph node metastasis, and tumor staging; (6) data on surgical intervention; (7) data on the use of radiotherapy; (8) data on the use of chemotherapy, including adjuvant chemotherapy and neoadjuvant chemotherapy; (9) data on pathological characteristics, including pre-operative cytology and pathology examinations, intra-operative pathology evaluation, post-operative pathology, ER, PR, and Her-2 expression.

All patient information was retrieved from medical records by trained clerks and added to a paper-based CRF. Two data input clerks were recruited to double-enter data from the paper to computer based database (FoxPro) independently. All finished double entry databases were sent to the Cancer Hospital/Institute, Chinese Academy of Medical Sciences (CICAMS) for validation by running EpiData. Any inconsistencies found between the two databases by CICAMS were reported to the clerks for adjudication until both databases were in agreement. As a final check, one of the databases was chosen to undergo a final consistency check. Logic mistakes (e.g., a woman who had not had surgery but had an intra-operative frozen section diagnosis) were again returned to the data collectors, who checked the original medical records and returned a revised database to CICAMS for the final analysis. During the consistency check, 5% of the medical records were randomly selected, based on the study ID, and sent to CICAMS for quality control review.

Data analysis

The frequencies of variables related to clinical and pathologic characteristics, implementation of clinical examination, and various treatment patterns were calculated to indicate their distribution both overall and among different occupation or education groups. Differences in the distribution of variables among different groups were examined using Chi-square tests, rank-sum tests, and Fisher's exact tests to obtain P-values for the test of non-association. Measurement data were expressed as mean ± standard deviation.

SPSS statistical software version 17.0 was used to analyze the data. Statistical significance was assessed by two-tailed tests with α level of 0.05.

Results

General characteristics of 484 breast cancer cases

A total of 484 female breast cancer cases were included in this study. Manual workers accounted for the majority of all occupation groups (54.3%; 263/484), while housewives 2.9% (14/484), professionals 31.6% (153/484), private sector workers 3.7% (18/484), and unspecified (7.4%; 36/484) made up the remainder. The "none" education group made up 2.9% (14/484) of all enrolled patients, while the remainder comprised those educated to primary school 8.1% (39/484), middle school 23.8% (115/484), high school 24.2% (117/484), and university and above

Table 1. General Characteristics of 484 Breast Cancer Cases (N = 484)

Characteristics		No. of cases(n[1])	n/N (%)
Mean age at diagnosis (Year)	50.1±11.0	484	–
Mean weight (Kg)	59.5±8.6	484	–
Sex	Female	484	–
Occupation	House wife	14	2.9
	Manual worker	263	54.3
	Professional	153	31.6
	Private sector worker	18	3.7
	Unspecified	36	7.4
Education level	None	14	2.9
	Primary school	39	8.1
	Middle school	115	23.8
	High school	117	24.2
	University and above	76	15.7
	Unspecified	123	25.4
Clinical and pathologic characteristics			
Primary tumor location[2]	Left	247	51
	Right	237	49
Primary tumor quadrant	Upper inner	66	13.6
	Upper outer	234	48.3
	Lower inner	38	7.9
	Lower outer	41	8.5
	Areola	11	2.3
	Others2	56	11.6
	Unspecified	38	7.9
Tumor size	≤2 cm	138	28.5
	2–5 cm	207	42.8
	>5 cm	54	11.2
	Unspecified	85	17.6
No. of tumor nodules	1	424	87.6
	≥2	21	4.3
	Unspecified	39	8.1
Local invasion	none	413	85.3
	Skin invasion	46	9.5
	Chest wall invasion	6	1.2
	Both	3	0.6
	Unspecified	16	3.3
Lymph node metastasis[3]	0	247	51
	1~3	112	23.1
	4~9	71	14.7
	≥10	54	11.2
Pathological diagnosis	Invasive ductal carcinoma	405	83.7
	Invasive lobular carcinoma	29	6
	Medullary carcinoma	29	6
	Mucinous carcinoma	7	1.4
	Others4	14	2.9
pTNM stage	I	77	15.9
	IIA	114	23.6
	IIB	57	11.8
	IIIA	50	10.3
	IIIB	26	5.4
	IIIC	51	10.5
	IV	56	11.6
	Unspecified	53	11
Implementation of clinical breast examination			
Pre-operative mammography[5] diagnosis	Positive	98	20.2
	Negative	15	3.1
	Not done	359	74.2
	Unspecified	12	2.5
ER/PR status	ER+&PR+	109	22.5
	ER+&PR-	31	6.4
	ER-&PR+	37	7.6
	ER-&PR-	102	21.1
	Undone	205	42.4
Her2 status	Her2+	29	6
	Her2-	181	37.4
	Undone	274	56.6
Molecular subtypes			
Molecular subtype	Luminal A	230	0.48
	Luminal B	30	0.06
	Her2+	28	0.06
	Basal-like	132	0.27
Treatment patterns			
Surgery	Radical mastectomy	38	7.9
	Modified radical mastectomy	428	88.4
	Breast Conservative Surgery	8	1.7
	Simple mastectomy	10	2.1
Radiotherapy	Done	100	20.7
	Undone	383	79.1
	Unspecified	1	0.2
Chemotherapy	Done	287	59.3
	Undone	197	40.7
	Unspecified	0	0
Endocrine Therapy	Done	93	19.2
	Undone	391	80.8
	Unspecified	0	0

[1]Number of breast cancer cases in the corresponding group; [2]Other areas of primary tumor quadrant cover the area just below nipple, for example; [3]Lymph node metastasis mainly refers to axillary lymph node metastasis; [4]Pathological types of breast cancer, for example undifferentiated carcinoma and intraductal papilloma with local cancerization are included in others of pathological diagnosis; [5]The remaining mammography results include imaging ungraded by breast imaging-reporting and data system (BIRAD), such as soft tissue and nodules

15.7% (76/484) levels, as well as an unspecified 25.4% (123/484) group. Table 1 illustrates the clinical and pathologic characteristics, the CBE implementation status, and the treatment patterns of all enrolled patients.

Data analysis of different occupation groups

Comparison of the clinical and pathologic characteristics of different occupation groups: Our analysis showed some significant differences in clinical and pathological characteristics among the different occupation groups. First, regarding tumor size, professionals and private sector workers made up 36.6% and 38.9%, respectively, of the category of "tumors ≤ 2 cm", higher than the proportion of housewives (21.4%) and manual workers (21.7%) with tumors of this size classification. The overall percentage distribution indicated that housewives and manual workers are more likely to present with larger tumors, compared with professionals and private sector workers ($P < 0.05$). Second, although the P values among groups for lymph node metastasis ($P = 0.097$) and pathological TNM stage ($P = 0.150$) were not below 0.05, they showed similar statistical trends. The "negative for metastasis" group accounted for 66.7% of private sector workers, 54.2% of professionals, 47.5% of manual workers, and 28.6% of housewives. A similar trend was observed in the tumor stage distribution. By convention, TNM stages I and II are classified as early breast cancer stages (Li et al., 2011). We found that 55.6% of private sector workers, 54.2% of professionals, 48.6% of manual workers, and 35.7% of housewives presented with early stage tumors (Table 2). No obvious significant differences were found in other clinical and pathologic characteristics (data not shown).

Comparison of the implementation of clinical breast examination among different occupation groups: Large differences in the implementation of CBE were observed among the various occupation groups ($P < 0.05$). The percentage distribution of pre-operative mammography and post-operative ER, PR, and Her2 status showed a similar trend, i.e., that the highest proportion of private sector workers had undergone these tests, followed by professionals and manual workers, and the lowest proportion of housewives (Table 2).

Comparison of molecular subtypes in different occupation groups: Molecular subtype division is a recently developed method for classifying breast cancer subtypes. Most clinicians regard it as a more accurate method of characterizing breast cancers compared with the traditional pathological morphology classification. As a consequence, it is more suitable for guiding the clinical treatment of breast cancer patients. We adopted the immunochemistry standard for molecular subtype division according to Carey et al. (2006). Luminal A represents ER(+)/ PR(+) and Her2(-); Luminal B includes the category ER(+)/ PR(+) and Her2(+); Her2 subtype represents ER(-), PR(-) and Her2(+) and Basal-like subtype means ER(-), PR(-) and Her2(-). Our study showed that in a total of 210 cases in which molecular subtypes were identified, no significant differences were found among different occupation groups ($P = 0.182$).

Table 2. Significantly Different Characteristics among Various Occupation Groups

Characteristics		Housewife	Manual worker	Professional	Private sector worker	Unspecified	*P* value
n[1]		14	263	153	18	36	
Tumor size	≤2 cm	3(21.4)	57(21.7)	56(36.6)	7(38.9)	15(41.7)	0.014[b]
	2–5 cm	6(42.9)	125(47.5)	53(34.6)	7(38.9)	16(44.4)	
	>5 cm	0(0.0)	35(13.3)	15(9.8)	3(16.7)	1(2.8)	
	Unspecified	5(35.7)	46(17.5)	29(19.0)	1(5.6)	4(11.1)	
Pre-operative mammography	Done	2(14.3)	51(19.4)	36(23.5)	10(55.6)	14(38.9)	0.010[c]
	Not done	11(78.6)	205(77.9)	113(73.9)	8(44.4)	22(61.1)	
	Unspecified	1(7.1)	7(2.7)	4(2.6)	0(0.0)	0(0.0)	
ER&PR status	Done	6(42.9)	132(50.2)	102(66.7)	13(72.2)	26(72.2)	0.004[a]
	Not done	8(57.1)	131(49.8)	51(33.3)	5(27.8)	10(27.8)	
Her2 status	Done	6(42.9)	92(35.0)	77(50.3)	12(66.7)	23(63.9)	0.003[a]
	Not done	8(57.1)	171(65.0)	76(49.7)	6(33.3)	13(36.1)	
Surgery	Radical Mastectomy	3(21.4)	17(6.5)	17(11.1)	0(0.0)	1(2.8)	0.001[c]
	Modified Radical Mastectomy	10(71.4)	241(91.6)	131(85.6)	14(77.8)	32(88.9)	
	Breast Conservative Surgery	0(0.0)	1(0.4)	2(1.3)	3(16.7)	2(5.6)	
	Simple Mastectomy	1(7.1)	4(1.5)	3(2.0)	1(5.6)	1(2.8)	
Radiotherapy	Done	0(0.0)	47(17.9)	40(26.1)	5(27.8)	8(22.2)	0.028[c]
	Not done	14(100.0)	216(82.1)	112(73.2)	13(72.2)	28(77.8)	
	Unspecified	0(0.0)	0(0.0)	1(0.7)	0(0.0)	0(0.0)	
Chemotherapy	Done	8(57.1)	139(52.9)	102(66.7)	15(83.3)	23(63.9)	0.007[a]
	Not done	6(42.9)	124(47.1)	51(33.3)	3(16.7)	13(36.1)	
	Unspecified	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	

[1]Number of breast cancer cases in the corresponding group; [a]Chi-square test; [b]Rank-sum test; [c]Fisher's exact test

Table 3. Significantly Different Characteristics among Various Education Level Groups

Characteristics		None	Primary school	Middle school	High school	University and above	Unspecified	*P* value
n[1]		14	39	115	117	76	123	
Tumor size	≤2 cm	3(21.4)	7(17.9)	38(33.0)	30(25.6)	32(42.1)	28(22.8)	0.049[b]
	2–5 cm	7(50.0)	20(51.3)	43(37.4)	50(42.7)	25(32.9)	62(50.4)	
	>5 cm	2(14.3)	8(20.5)	10(8.7)	10(8.5)	9(11.8)	15(12.2)	
	Unspecified	2(14.3)	4(10.3)	24(20.9)	27(23.1)	10(13.2)	18(14.6)	
ER&PR status	Done	10(71.4)	19(48.7)	59(51.3)	92(78.6)	62(81.6)	37(30.1)	<0.001[a]
	Not done	4(28.6)	20(51.3)	56(48.7)	25(21.4)	14(18.4)	86(69.9)	
Her2 status	Done	10(71.4)	15(38.5)	41(35.7)	69(59.0)	53(69.7)	22(17.9)	<0.001[a]
	Not done	4(28.6)	24(61.5)	74(64.3)	48(41.0)	23(30.3)	101(82.1)	
Radiotherapy	Done	1(7.1)	3(7.7)	24(20.9)	36(30.8)	20(26.3)	16(13.0)	0.017[a]
	Not done	13(92.9)	36(92.3)	91(79.1)	80(68.4)	56(73.7)	107(87.0)	
	Unspecified	0(0.0)	0(0.0)	0(0.0)	1(0.9)	0(0.0)	0(0.0)	
Chemotherapy	Done	6(42.9)	18(46.2)	68(59.1)	93(79.5)	58(76.3)	44(35.8)	<0.001[a]
	Not done	8(57.1)	21(53.8)	47(40.9)	24(20.5)	18(23.7)	79(64.2)	
Endocrine Therapy	Done	0(0.0)	7(17.9)	17(14.8)	33(28.2)	14(18.4)	22(17.9)	0.031[c]
	Not done	14(100.0)	32(82.1)	98(85.2)	84(71.8)	62(81.6)	101(82.1)	
	Unspecified	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	

[1]Number of breast cancer cases in the corresponding group; [a]Chi-square test; [b]Rank-sum test; [c]Fisher's exact test

Nevertheless, private sector workers had largest proportion of the luminal A subtype tumors (83.3%). Unfortunately, the differences among subtypes did not reach statistical significance in this study. We recommend that these data should be confirmed in a further larger scale study.

Comparison of the treatment patterns experienced by different occupation groups: Previous results have shown some notable clinical and pathologic differences among different occupation groups, and we wanted to investigate whether these differences affect patients' and clinicians' choices about treatment patterns. A further comparison of treatment patterns among different occupation groups demonstrated that different surgical treatment patterns exist in different occupation groups ($P < 0.05$). Manual workers were more likely to choose mastectomy, including radical mastectomy and modified radical mastectomy, than professionals and housewives, with the lowest proportion choosing this option being private sector workers. However, the opposite trend was observed for breast-conserving surgery and simple mastectomy. There were also significant differences in the choice of radiotherapy and chemotherapy among different occupation groups ($P < 0.05$), with the largest proportion making this choice being private sector workers, followed by professionals. No significant differences among occupation groups were found in the choice of endocrine therapy, although private sector workers seemed to prefer this choice most (27.8%), followed by professionals (24.8%) (Table 2).

Effect of patient education level on tumor characteristics

Comparison of clinical and pathologic tumor characteristics in patients with different education levels: Table 3 illustrates the differences in tumor size among patient groups with different educational backgrounds. We found that patients with higher levels of education presented with smaller tumor sizes ($P < 0.05$). However, we did not find any obvious differences in other clinical and pathologic characteristics among the different education level groups (data not shown).

Comparison of the implementation of clinical breast examination in patients with different education levels: Table 3 indicates that the level of education has an impact on the implementation of CBE in breast cancer patients. Overall, the implementation rates for all groups were relatively high. However, the implementation rate of ER, PR, and Her2 status examination in patients with university level education and above was higher than that of patients with primary and middle school level education. This indicates that the patients educated to a higher level are more likely to undergo ER, PR, and Her2 status examination. There was no statistical difference in the pre-operative mammography ($P = 0.330$).

Comparison of molecular subtypes in patients with different education levels: The research shows that education level does not exert a significant influence on the molecular subtypes of breast cancers on presentation ($P = 0.098$).

Comparison of the treatment patterns among patients with different education levels: An individual's education level affects disease recognition and therefore impacts the choice of treatment patterns. We found large differences in treatment patterns, except for surgery (data not shown), among patients with different education levels ($P < 0.05$): the higher the level of education received by the patient, the more likely she was to undergo radiotherapy, chemotherapy, or endocrine therapy (Table 3)

Discussion

This study reports that occupation and education level significantly affect some of the clinical and pathologic characteristics of breast cancers presented in the clinic and the type of treatment option administered to patients.

For most Chinese people, occupation determines income level. Commonly, private sector workers have the highest income level, followed by professionals, and then manual workers. Housewives have almost no income, but suffer from relatively high levels of stress. Many studies have shown that income is closely related to the incidence and development of breast cancer. For example, previous reports indicate that people with low incomes have a higher chance of developing advanced breast cancer with a poorer diagnosis (Lannin et al., 1998; MacKinnon et al., 2007; Byers et al., 2008). Similar data was obtained in our study: we found that housewives and manual workers are more likely to present with larger tumor sizes, compared with private sector workers and professional groups, thus indicating that economic levels inversely correlate with tumor size in breast cancer patients. We also found a similar inverse relationship between lymph node metastasis or TNM stage and income level, classified according to occupation group, although without statistical significance ($P = 0.097$ or 0.150, respectively). Analogously, education level correlates with income level, and therefore has an impact on breast cancer characteristics at presentation. Our analysis showed that patients with higher education levels present with smaller tumors ($P = 0.049$).

We interpret these results as follows. First, regarding the delay in clinical diagnosis in patients with low-income levels, this patient group is likely to have less medical insurance and to suffer from a heavier life burden. As the early stages of breast cancer lack severe symptoms, these individuals may avoid linking their symptoms to a malignant disease in order to minimize the effect on their family until the appearance of severe symptoms, such as larger tumor size, axillary lymph node metastasis, local invasion, and even distant metastasis. This delay in diagnosis leads directly to a diagnosis of advanced stage breast cancer at presentation. Our data is in agreement with that of other academics. For example, Richardson reported that patients with lower income levels have a longer delay before diagnosis, resulting in a diagnosis of advanced stage disease and a poorer prognosis (Richardson et al., 1992). The delay in clinical diagnosis of breast cancer is longer and the incidence rate is higher in less developed countries than in developed countries (Arndt et al., 2002; Meechan et al., 2003; Norsa'adah et al., 2011). In addition, whether breast cancer patients seek early medical help depends on their recognition of early stage symptoms and when these early symptoms first develop (Grunfeld et al., 2003). Some studies have reported that the patient's own medical knowledge is the main source of symptom evaluation at early breast cancer stages (Lannin et al., 1998). Patients with higher education levels generally have more medical knowledge, resulting in earlier presentation and thus a shorter delay before treatment (Bish et al., 2005).

Furthermore, mammography is now an important tool for the detection of early stages of breast cancer (Smith et al., 2003; Adibelli et al., 2009) and thus has a large influence on breast cancer stage at presentation (Dalton et al., 2006; Masi et al., 2007; Pasick et al., 2008). Previous studies have found that the implementation rate of mammography is closely related to income level: people with lower incomes have lower mammography implementation rate (Ward et al., 2008; Cunningham et al., 2009), which suggests that these patients have a higher risk of presentation with a larger, more advanced stage tumor. Our data on the implementation rate of mammography among different occupation groups supports these reports. We found that the mammography implementation rate increased with income level, from 14.3% of housewives to 55.6% of private sector worker group. Two primary reasons may account for the low implementation rate of mammography in low-income patient groups: first, these individuals may not be able to afford the expense of the examination (Ward et al., 2008; Cunningham et al., 2009); and second, these patients are usually residents of poorer regions in which hospitals are unable to buy advanced mammography equipment (Ferrante et al., 2000; Andersen et al., 2002; Barry et al., 2005). A similar finding was made regarding other types of examinations. Information about the ER, PR, and Her2 status of primary breast cancer is very important for evaluating the prognosis and treatment options, and is now an essential panel of tests for breast cancer patients. However, we found variation in the use of these tests among different patient income groups: higher income and education levels were associated with higher examination rates of these tests. Thus, the economic capacity of the patients correlates with their choices of treatment. For instance, a breast cancer patient who is unable to afford endocrine or Her2-targeted therapy will not accept this examination. These results indicate that the governments in less developed regions should provide health education about breast cancer to people with lower incomes and education levels in order to develop their awareness of early breast cancer symptoms. In addition, it is essential to improve the implementation rate of mammography and ultrasound to ensure early diagnosis and treatment of all breast cancer patients, thus resulting in a better overall prognosis.

In this study, a total of 210 tumors were classified as distinct molecular subtypes. However, we found no significant differences in the subtypes present in patients with different occupations or education levels. Nevertheless, the luminal A subtype accounted for most tumors in private sector workers, while the basal-like subtype was least common in this patient group. This finding supports reports by other researchers that ER-positive tumors–positive are more common in higher socio-economic groups (Twelves et al., 1998; Thomson et al., 2001). Unfortunately, these differences did not reach statistical significance. This may be a result of the limited number of patients involved and should therefore be confirmed in a larger scale study.

Factors such as economic capacity, recognition of breast cancer, and breast cancer clinical and pathologic characteristics may influence the choice of treatment options made by breast cancer patients and clinicians. We found large differences in treatment options chosen by patients in different occupation groups. First, regarding the surgical option, occupation groups with the greatest stress levels were more likely to choose radical mastectomy and less likely to choose breast-conserving surgery. This may be because patients with low-income and high-stress occupations delay in presenting at clinic and are therefore more likely to present with advanced stages of breast tumors (Grunfeld et al., 2002; Bish et al., 2005), thus losing the opportunity for sentinel lymph node biopsy and breast-conserving surgery. In contrast, patients in higher income occupations are more likely to accept new concepts and technologies, thus leading to their increased acceptance of sentinel lymph node biopsy and breast-conserving surgery (Gilligan et al., 2002; Keating et al., 2003). Furthermore, it is difficult for patients with low incomes to afford the expense of radiotherapy following breast-conserving surgery. In addition, these patients usually live in areas in which it may be difficult to obtain radiotherapy (Gilligan et al., 2002). Our research did not find any influence of education level on surgical treatment options, which may reflect the small numbers of breast cancer cases in this study or the large number of patients with unidentified education backgrounds that were included. In general, radical mastectomy was the predominant surgical treatment option in Xi'an, China in 2004, and the implementation rate of breast-conserving surgery was only 1.7%, far lower than that of developed countries. At present, sentinel lymph node and breast-conserving surgery are the main surgical options in developed countries (Burak et al., 2004; Goyal et al., 2008; Povoski et al., 2009), with breast-conserving surgery accounting for more than 50% of all surgical treatments in America, 70–80% in Singapore, and more than 30% in Japan (Zhang et al., 2002). Our results suggest that economically developed countries should provide medical aid to less developed countries to help their patients receive an earlier benefit from optimized surgery techniques.

Significant differences in radiotherapy, chemotherapy, and endocrine therapy choices were made by patients in different occupation and education level groups. We observed that the rates of radiotherapy and chemotherapy for private sector workers and professionals were remarkably higher than those of housewives and manual workers. In addition, a similar trend was observed for endocrine treatment, albeit without statistical significance ($P = 0.063$). In general, the higher their education levels, the more likely patients were to undergo radiotherapy, chemotherapy, and endocrine therapy. Several factors may contribute to these findings. First, people of low education levels and manual workers are more likely to lose their jobs following the diagnosis of malignant tumors (Carlsen et al., 2008a; 2008b). Therefore, to avoid unemployment, they choose not to take advantage of post-surgery treatment options. Second, patients in low education level groups may not recognize the importance of radiotherapy and endocrine treatment after the surgery: some may believe that the side-effects of radiotherapy and chemotherapy are actually more harmful than the cancer itself (Norsa'adah et al., 2011), and others may consider breast cancer to be incurable (Andersen et al., 2009). Finally, low-income patients cannot afford the expense of radiotherapy and chemotherapy after the surgery.

In conclusion, our study has demonstrated that the occupation and education level of female breast cancer patients affect the clinical and pathologic characteristics of their tumors, the implementation rate of CBE and treatment patterns. We discovered that people with low incomes or lower education levels are more likely to have larger tumors at presentation and lower implementation rates of both CBE and treatment. This finding indicates that the Chinese government should provide more assistance to patients with low-income occupations and low education levels as part of its breast cancer prevention policy.

The main potential limitations of this study are that: (1) the breast cancer cases included may not be representative owing to their inclusion from only one region of China over a period of only one year; (2) data quality depends on the thoroughness of the medical history, treatment, and outcome documentation; and (3) the large amount of unspecified patient data may limit the validity of the results. Despite its limitations, this study provides data that allows a useful comparison of female breast cancers in Asian countries and Western countries. Furthermore, our data indicate that improving breast cancer prevention policies will be beneficial for developing countries.

References

Adibelli ZH, Oztekin O, Postaci H, Uslu A (2009). The Diagnostic Accuracy of Mammography and Ultrasound in the Evaluation of Male Breast Disease: A New Algorithm. *Breast Care (Basel)*, **4**, 255-9.

Andersen BL, Cacioppo JT (1995). Delay in seeking a cancer diagnosis: delay stages and psychophysiological comparison processes. *Br J Soc Psychol*, **34**, 33-52.

Andersen RM, Yu HJ, Wyn R, et al (2002). Access to medical care for low-income persons: How do communities make a difference? *Med Care Res Rev*, **59**, 384-411.

Andersen RS, Vedsted P, Olesen F, et al (2009). Patient delay in cancer studies: a discussion of methods and measures. *BMC Health Serv Res*, **9**, 189.

Anderson BO, Jakesz R (2008). Breast cancer issues in developing countries: an overview of the Breast Health Global Initiative. *World J Surg*, **32**, 2578-85.

Arndt V, Sturmer T, Stegmaier C, et al (2002). Patient delay and stage of diagnosis among breast cancer patients in Germany - a population based study. *Brit J Cancer*, **86**, 1034-40.

Baade PD, Aitken JF, Ferguson M, et al (2010). Diagnostic and treatment pathways for men with prostate cancer in Queensland: investigating spatial and demographic inequalities. *BMC Cancer*, **10**, 452.

Barry J, Breen N (2005). The importance of place of residence in predicting late-stage diagnosis of breast or cervical cancer. *Health Place*, **11**, 15-29.

Bish A, Ramirez A, Burgess C, Hunter M (2005). Understanding why women delay in seeking help for breast cancer symptoms. *J Psychosom Res*, **58**, 321-6.

Burak WE, Jr., Agnese DM, Povoski SP (2004). Advances in the surgical management of early stage invasive breast cancer. *Curr Probl Surg*, **41**, 882-935.

Byers TE, Wolf HJ, Bauer KR, et al (2008). The impact of socioeconomic status on survival after cancer in the United States : findings from the National Program of Cancer Registries Patterns of Care Study. *Cancer*, **113**, 582-91.

Carey LA, Perou CM, Livasy CA, et al (2006). Race, breast cancer subtypes, and survival in the Carolina Breast Cancer Study. *JAMA*, **295**, 2492-502.

Carlsen K, Dalton SO, Diderichsen F, Johansen C (2008a). Risk for unemployment of cancer survivors: A Danish cohort study. *Eur J Cancer*, **44**, 1866-74.

Carlsen K, Oksbjerg Dalton S, Frederiksen K, et al (2008b). Cancer and the risk for taking early retirement pension: a Danish cohort study. *Scand J Public Health*, **36**, 117-25.

Chung HW, Noh SH, Lim JB (2010). Analysis of demographic characteristics in 3242 young age gastric cancer patients in Korea. *World J Gastroenterol*, **16**, 256-63.

Cunningham PJ, O'Malley AS (2009). Do Reimbursement Delays Discourage Medicaid Participation By Physicians? *Health Affair*, **28**, w17-28.

Dalton SO, During M, Ross L, et al (2006). The relation between socioeconomic and demographic factors and tumour stage in women diagnosed with breast cancer in Denmark, 1983-1999. *Brit J Cancer*, **95**, 653-9.

Ferrante JM, Gonzalez EC, Pal N, Roetzheim RG (2000). Effects of physician supply on early detection of breast cancer. *J Am Board Fam Pract*, **13**, 408-14.

Fleming ID (1997). American Joint Committee on Cancer: AJCC cancer staging manual. *Lippincott-Raven Philadelphia, Philadelphia*.

Gilligan MA, Kneusel RT, Hoffmann RG, et al (2002). Persistent differences in sociodemographic determinants of breast conserving treatment despite overall increased adoption. *Med Care*, **40**, 181-9.

Greene FL (2002). American Joint Committee on Cancer: AJCC cancer staging manual. *Springer Verlag*, New York.

Grunfeld EA, Hunter MS, Ramirez AJ, Richards MA (2003). Perceptions of breast cancer across the lifespan. *J Psychosom Res*, **54**, 141-6.

Grunfeld EA, Ramirez AJ, Hunter MS, Richards MA (2002). Women's knowledge and beliefs regarding breast cancer. *Brit J Cancer*, **86**, 1373-8.

Goldsbury D, Harris MF, Pascoe S, et al (2012). Socio-demographic and other patient characteristics associated with time between colonoscopy and surgery, and choice of treatment centre for colorectal cancer: a retrospective cohort study. *BMJ Open*, **2**, 1-13.

Goyal A, Mansel RE (2008). Recent advances in sentinel lymph node biopsy for breast cancer. *Curr Opin Oncol*, **20**, 621-6.

Green M, Raina V (2008). Epidemiology, screening and diagnosis of breast cancer in the Asia-Pacific region: Current perspectives and important considerations. *Asian Pac J Clin Onco*, **4**, 5-13.

Hortobagyi GN, de la Garza Salazar J, Pritchard K, et al (2005). The global breast cancer burden: variations in epidemiology and survival. *Clin Breast Cancer*, **6**, 391-401.

Keating NL, Weeks JC, Borbas C, Guadagnoli E (2003). Treatment of early stage breast cancer: do surgeons and patients agree regarding whether treatment alternatives were discussed? *Breast Cancer Res Tr*, **79**, 225-31.

Kent EE, Sender LS, Largent JA, Anton-Culver H (2009). Leukemia survival in children, adolescents, and young adults: influence of socioeconomic status and other demographic factors. *Cancer Cause Control*, **20**, 1409-20.

Lannin DR, Mathews HF, Mitchell J, et al (1998). Influence of socioeconomic and cultural factors on racial differences in late-stage presentation of breast cancer. *JAMA*, **279**, 1801-7.

Leong SPL, Shen ZZ, Liu TJ, et al (2010). Is Breast Cancer the Same Disease in Asian and Western Countries? *World J Surg*, **34**, 2308-24.

Li J, Zhang BN, Fan JH, et al (2011). A Nation-Wide multicenter 10-year (1999-2008) retrospective clinical epidemiological study of female breast cancer in china. *BMC Cancer*, **11**, 364.

MacKinnon JA, Duncan RC, Huang YJ, et al (2007). Detecting an association between socioeconomic status and late stage breast cancer using spatial analysis and area-based measures. *Cancer Epidem Biomar*, **16**, 756-62.

Masi CM, Blackman DJ, Peek ME (2007). Interventions to enhance breast cancer screening, a diagnosis, and treatment among racial and ethnic minority women. *Med Care Res Rev*, **64**, S195-42.

Meechan G, Collins J, Petrie KJ (2003). The relationship of symptoms and psychological factors to delay in seeking medical care for breast symptoms. *Prev Med*, **36**, 374-8.

Norsa'adah B, Rampal KG, Rahmah MA, et al (2011). Diagnosis delay of breast cancer and its associated factors in Malaysian women. *BMC Cancer*, **11**, 141.

Pasick RJ, Burke NJ (2008). A critical review of theory in breast cancer screening promotion across cultures. *Annu Rev Public Health*, **29**, 351-68.

Porter P (2008). "Westernizing" women's risks? Breast cancer in lower-income countries. *N Engl J Med*, **358**, 213-6.
Povoski SP, Jimenez RE, Wang WP, Xu RX (2009). Standardized and reproducible methodology for the comprehensive and systematic assessment of surgical resection margins during breast-conserving surgery for invasive breast cancer. *BMC Cancer*, **9**, 254.
Richardson JL, Langholz B, Bernstein L, et al (1992). Stage and delay in breast cancer diagnosis b1y race, socioeconomic status, age and year. *Br J Cancer*, **65**, 922-6.
Smith RA, Saslow D, Sawyer KA, et al (2003) American Cancer Society guidelines for breast cancer screening: update 2003. *Ca-Cancer J Clin*, **53**, 141-69.
Tavassoli FA, Devilee P (2003). Pathology and genetics of tumors of the breast and female genital organs. *World Health Organization*, Lyon.
Thomson CS, Hole DJ, Twelves CJ, et al (2001). Prognostic factors in women with breast cancer: distribution by socioeconomic status and effect on differences in survival. *J Epidemiol Commun H*, **55**, 308-15.
Twelves CJ, Thomson CS, Gould A, Dewar JA (1998). Variation in the survival of women with breast cancer in Scotland. The Scottish Breast Cancer Focus Group and The Scottish Cancer Therapy Network. *Br J Cancer*, **78**, 566-71.
Ward E, Halpern M, Schrag N, et al (2008). Association of insurance with cancer care utilization and outcomes. *CA Cancer J Clin*, **58**, 9-31.
WHO (1981). Histological typing of breast tumors. *World Health Organization*, Geneva.
Wilf-Miron R, Peled R, Yaari E, et al (2011). The association between socio-demographic characteristics and adherence to breast and colorectal cancer screening: analysis of large sub populations. *BMC Cancer*, **11**, 376.
Yang L, Parkin DM, Ferlay J, et al (2005). Estimates of cancer incidence in China for 2000 and projections for 2005. *Cancer Epidem Biomar*, **14**, 243-50.
Zhang BN (2002). Progress in surgical treatment of early stage breast cancer. *J Practical Oncol*, **17**, 367-9.