

## RESEARCH ARTICLE

# Incidence and Mortality of Female Breast Cancer in Jiangsu, China

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### Abstract

**Objectives:** The aim of this study was to describe and analyze the incidence and mortality of female breast cancer in Jiangsu Province of China. **Methods:** Incidence and mortality data for female breast cancer and corresponding population statistics from eligible cancer registries in Jiangsu from 2006 to 2010 were collected and analyzed. Crude rates, age-specific rates and age-standardized rates of incidence and mortality were calculated, and annual present changes (APCs) were estimated to describe the time trends. **Results:** From 2006 to 2010, 11,013 new cases and 3,068 deaths of female breast cancer were identified in selected cancer registry areas of Jiangsu. The annual average crude incidence and age-standardized incidence by world population (ASW) were 25.2/ and 17.9/100,000 respectively. The annual average crude and ASW for mortality rates were 7.03/ and 4.81/100,000. The incidence was higher in urban areas than that in rural areas, and this was consistent in all age groups. No significant difference was observed in mortality between urban and rural areas. Two peaks were observed when looking at age-specific rates, one at 50-59 years and another at over 85 years. During the 5 years, incidence and mortality increased with APCs of 4.47% and 6.89%, respectively. Compared to the national level, Jiangsu is an area with relatively low risk of female breast cancer. **Conclusion:** Breast cancer has become a main public health problem among Chinese females. More prevention and control activities should be conducted to reduce the burden of this disease, even in relatively low risk areas like Jiangsu.

**Keywords:** Breast cancer - incidence - mortality - trend analysis - cancer registry - Jiangsu, China

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### Introduction

Breast cancer is the most common malignancy among women in the world (Jemal et al., 2011). It was estimated that 1.38 million new cases and 458,000 deaths occurred worldwide in 2008 (Curado et al., 2011). Although the risk of breast cancer is relatively lower in China than in developed countries, the incidence and mortality of this disease have been sustainably increased in the past decades (Yang et al., 2006). According to the latest Chinese Cancer Registry Annual Report (Hao and Chen, 2012), breast cancer has become the most common cancer occurred among Chinese women and ranked the fifth leading cause of female cancer deaths in 2009. The age-standardized rate of incidence and mortality by world standard population (ASW) was 29.0 and 6.56 per 100,000 in Chinese females, respectively.

As the national cancer registry system has not been well established yet, the distribution of cancer including breast cancer in China still need to be further depicted. Jiangsu Province is one of the developed coastal areas in

China. It is located in the South-eastern part of the country with a population of more than 80 million, 49.96% of which are women. Jiangsu is also a high-risk area for cancer incidence, according to the results of the 1990-1992 National Mortality Retrospective Sampling Survey, cancer mortality was 159.8 per 100,000 in Jiangsu and was about 50% higher than the national average at the same period (108.3 per 100,000) (Li et al., 1996). To date, the incidence and mortality of female breast cancer in this province have not been sufficiently reported. In this paper, we used the data from 2006 to 2010 from established cancer registries in Jiangsu to describe and analyze the incidence and mortality of female breast cancer in this province, aiming to provide further information for policy making and benefit the disease control at provincial and national level as well.

### Materials and Methods

Population data and the information of female breast cancer cases from 2006 to 2010 were extracted from the

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**Table 1. The Incidence and Mortality for Breast Cancer in Cancer Registration in Jiangsu, 2006-2010**

Index		Population	Cancer cases	Crude rate (1/10 <sup>5</sup> )	ASR China (1/10 <sup>5</sup> )	ASW World (1/10 <sup>5</sup> )	Cumulative rate 0-74 (%)	Ratio (%)	Rank
Incidence	All areas	43,646,290	11,013	25.2	14.3	17.9	1.88	11.7	4
	Urban	19,168,709	5,872	30.6	17.5	21.9	2.29	13.6	1
	Rural	24,477,581	5,141	21.0	11.9	14.8	1.57	10.2	4
Mortality	All areas	43,646,290	3,068	7.03	3.81	4.81	0.53	5.15	6
	Urban	19,168,709	1,412	7.37	4.05	5.11	0.57	5.72	6
	Rural	24,477,581	1,656	6.77	3.64	4.59	0.50	4.74	6

Provincial Cancer Registry of Jiangsu.

Based on the "Guideline for Chinese Cancer Registration" (The National Central Cancer Registry, 2004) and the recruitment criteria of "Cancer Incidence in Five Continents Volume IX" (Ferlay et al., 2008), data quality of each cancer registry was checked from the aspects of completeness, validity and reliability, including the proportion of morphologic verification (MV%), the percentage of cancer cases identified by death certification only (DCO%), the mortality-to-incidence ratio (M/I) and the percentage of cancer with undefined or unknown primary site (secondary) (O&U%). Cases were identified by International Classification of Disease, 10th revision (ICD-10). Provincial capital, prefecture-level cities, and municipalities were considered as urban areas, while counties and county-level cities were considered as rural areas, following the definition used by "Chinese Cancer Registry Annual Report" (National Central Cancer Registry, 2004).

Similar to the situation in China, most cancer registries in Jiangsu were established in late 2000s, but it has been rapidly developed this province. In 2006, only 9 counties past the annual quality evaluation, but till 2010, 27 cancer registries passed the quality examination and were involved in the present analysis.

From 2006 to 2010, the total population size observed in selected registry areas was 43,646,290 person-years (19,168,709 in urban areas and 24,477,581 in rural areas), accounted for about 11% of the total population in Jiangsu.

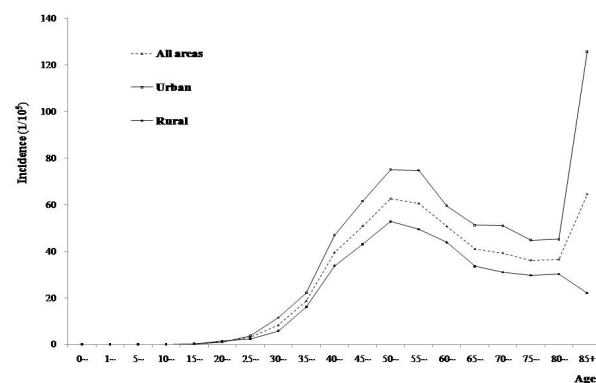
Crude rates, age-specific rates and age-standardized rates of incidence and mortality of female breast cancer were calculated for the present analyses. Crude rates were calculated using the number of cases/deaths divided by the number of the total population of the registry areas during the same period. Age-specific rates were calculated for 19 age groups. Age-standardized were calculated by using 1982 Chinese standard population (ASR) and Segi's world population (ASW) as the standard population distributions. The differences of rates between urban and rural areas were tested by two sample U test. To describe the time trends in incidence and mortality, annual percent changes (APCs) were estimated by a linear regression on the logarithm scale during the five years. In the model

$$y = \alpha + \beta x + \varepsilon \text{ and } APC = 100 \times (e^{\beta} - 1) \text{ (Xiang et al., 2004),}$$

where  $\alpha$  means constant term,  $\beta$  represents regression coefficient and  $\varepsilon$  stands for random error. Database management software including MS-FoxPro, MS-Excel, SAS and IARCcrgTools issued by IARC/IACR (Ferlay 2008) were used for data checking, evaluation and analysis,  $p < 0.05$  means statistically significant.

**Table 2. Age-specific Incidence and Mortality of Breast Cancer in Cancer Registration in Jiangsu, 2006-2010 (1/10<sup>5</sup>)**

Age group	Incidence			Mortality		
	All areas	Urban	Rural	All areas	Urban	Rural
0~	0.00	0.00	0.00	0.00	0.00	0.00
1~	0.00	0.00	0.00	0.00	0.00	0.00
5~	0.00	0.00	0.00	0.00	0.00	0.00
10~	0.00	0.00	0.00	0.00	0.00	0.00
15~	0.27	0.15	0.37	0.00	0.00	0.00
20~	1.28	1.02	1.50	0.19	0.07	0.30
25~	3.03	3.72	2.40	0.53	0.37	0.67
30~	8.31	11.5	5.77	1.11	1.08	1.13
35~	18.8	22.2	16.1	3.14	3.34	2.99
40~	39.5	46.9	33.7	6.99	6.89	7.07
45~	50.8	61.6	43.0	9.28	9.62	9.04
50~	62.6	75.1	52.7	16.0	18.3	14.3
55~	60.5	74.7	49.4	19.4	20.8	18.3
60~	50.7	59.5	43.7	15.7	15.8	15.5
65~	41.0	51.2	33.5	16.3	16.7	16.0
70~	39.3	51.0	30.9	17.9	21.1	15.7
75~	36.2	44.9	29.7	18.9	22.0	16.5
80~	36.5	45.2	30.2	24.4	26.1	23.2
85+	64.5	125.8	22.0	31.9	33.0	31.1
all	25.2	30.6	21.0	7.03	7.37	6.77

**Figure 1. Age-specific Incidence of Breast Cancer in Cancer Registration in Jiangsu, 2006-2010**

## Results

From 2006 to 2010, a total number of 11,013 newly diagnosed breast cancer cases were identified in selected cancer registry areas, which ranked the fourth and accounted for 11.7% of total new cancer cases among females. The annual average crude incidence was 25.2/100,000, while the ASR and ASW were 14.3 and 17.9/100,000, respectively. The annual average crude incidence rate in urban areas was 30.6/100,000, which was 46% higher than that in rural areas (21.0/100,000),

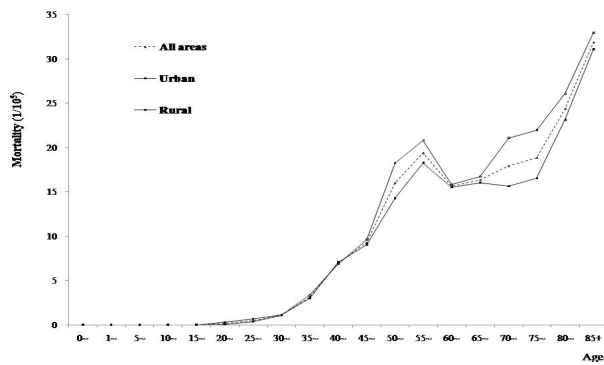


Figure 2. Age-specific Mortality of Breast Cancer in Cancer Registration in Jiangsu, 2006-2010

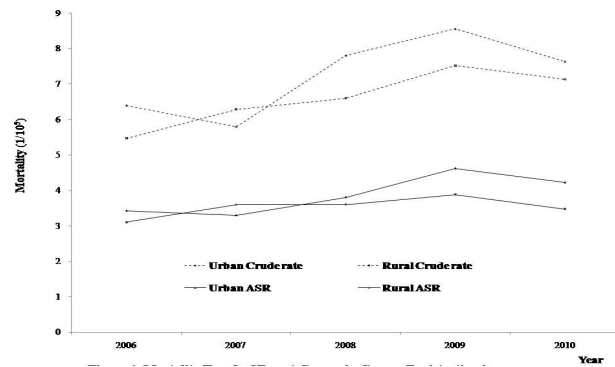


Figure 4. Mortality Trend of Breast Cancer in Cancer Registration in Jiangsu, 2006-2010

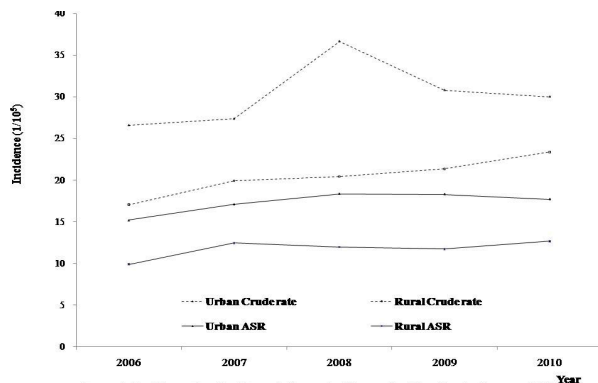


Figure 3. Incidence Trend of Breast Cancer in Cancer Registration in Jiangsu, 2006-2010

and similar difference was observed after adjustment for age. Moreover, breast cancer was the first leading cancer among urban females while it ranked the fourth in rural areas (Table 1).

A total number of 3,068 women died from breast cancer in these areas from 2006 to 2010. The annual average crude mortality was 7.03/100,000, while the ASR and ASW were 3.81 and 4.81/100,000, respectively. Breast cancer was the sixth cause of cancer death among women in both urban and rural areas. Different from incidence, no statistically significant difference in mortality was observed between urban and rural areas (Table 1).

Table 2 shows the age-specific incidence and mortality of breast cancer in Jiangsu. Overall, an obvious trend was observed that both incidence and mortality increased with

age. Two peaks were found when looked into age-specific incidences. The first peak appeared at the age group of 50-54 years, and then the rate gradually decreased after 55 but dramatically increased again in the group of over 85 years. The trend in urban areas was similar as the overall situation, while in rural areas only one peak was found at the age group of 50-54 years (Table 2 and Figure 1).

Similar to the incidence curve, the age-specific mortality also had two peaks. The first peak appeared at the group of 55-59 years and the second was observed in those aged over 85 years. The patterns of age-specific mortality in urban and rural areas were consistent, while urban populations showed higher age-specific mortality than rural areas among all age groups over 45 years. (Table 2 and Figure 2)

Changes of breast cancer in five years were analyzed and results are shown in Table 3, Figure 3 and Figure 4. Although there is no statistically significant difference, crude incidence increased from 22.3/100,000 in 2006 to 26.5/100,000 in 2010 with an APC of 4.47% ( $p=0.22$ ), and crude mortality rates also elevated from 5.98 in 2006 to 7.36/100,000 in 2010 with an APC of 6.89% ( $p=0.05$ ). In rural areas, incidence and mortality were observed significantly increased during 2006 to 2010 with an APC of 7.26% ( $p=0.01$ ) and 7.38% ( $p=0.03$ ). Similar trend was observed in urban areas, the APC was 3.68% ( $p=0.44$ ) for incidence and was 7.70% ( $p=0.15$ ) for mortality. After adjusting for Chinese standard population, we found that the increasing trends of ASR still exist but not statistically significant.

Table 3. Incidence and Mortality Trends for Breast Cancer in Cancer Registration in Jiangsu, 2006-2010 (1/10<sup>5</sup>)

Index	Area	2006	2007	2008	2009	2010	APC	<i>p</i>
Incidence								
Crude rate (1/10 <sup>5</sup> )	All areas	22.3	22.3	28.1	24.5	26.5	4.47	0.22
	Urban	26.6	27.4	36.7	30.8	30.0	3.68	0.44
	Rural	17.0	19.9	20.4	21.3	23.4	7.26	0.01
ASR China (1/10 <sup>5</sup> )	All areas	12.8	13.9	15.0	13.8	14.9	2.90	0.19
	Urban	15.2	17.1	18.3	18.3	17.7	3.85	0.13
	Rural	9.84	12.4	11.9	11.7	12.6	4.46	0.19
Mortality								
Crude rate (1/10 <sup>5</sup> )	All areas	5.98	6.13	7.17	7.86	7.36	6.89	0.05
	Urban	6.39	5.79	7.80	8.55	7.63	7.70	0.15
	Rural	5.46	6.28	6.60	7.52	7.13	7.38	0.03
ASR China (1/10 <sup>5</sup> )	All areas	3.28	3.50	3.70	4.12	3.79	4.63	0.08
	Urban	3.43	3.30	3.81	4.62	4.22	7.78	0.07
	Rural	3.10	3.59	3.60	3.88	3.47	3.07	0.30

## Discussion

In this present analysis, we found breast cancer has become one of the most common cancers among women in Jiangsu during the period of 2006 to 2010. The incidence was higher in urban areas than that in rural areas and was consistent in all age groups. But no significant difference was observed for the mortality between urban and rural areas. Moreover, the incidence and mortality of this disease remained slightly increasing during the five years.

Although breast cancer incidence and mortality in developed countries have been decreasing or remaining stable in recent years (Peter and Bernard, 2008; Canfell et al., 2009; Marliace et al., 2011; Adetunji and Graham, 2013), both rates have been increasing rapidly in many developing countries (Jemal et al., 2010), such as India (Dhillon et al., 2011), Thailand (Hutchins et al., 2006), Iraq (Ramadhan et al., 2011; Muzahem and Wang, 2014), Iran (Taghavi et al., 2012) and Mongolia (Rebecca et al., 2012). In China, as previously published study reported (Huang et al., 2012), the ASR of incidence has increased from 21.2/100,000 in 2003 to 24.7/100,000 in 2007. According to the results of three National Mortality Retrospective Surveys (Zheng et al., 2011), the ASR of mortality has increased from 2.88/100,000 in 1973-1975 to 3.97/100,000 in 2005. Similar increasing trend was also observed in Jiangsu Province, for instance, the ASR of breast cancer mortality in Jiangsu had increased from 3.50/100,000 in 1973-1975 to 3.65/100,000 in 2005 (Han et al., 2011).

It is widely believed that the risk factors of breast cancer include genetic susceptibility, unhealthy lifestyle and environmental factors, such as unhealthy diet, physical inactivity, smoking, using of oral contraceptives etc, age of menarche, age of first full term pregnancy, and so on (Lee et al., 2008; Malcolm et al., 2009; Inumaru et al., 2011; Iwasaki and Tsugane, 2011; Ilic et al., 2013; Kruk and Marchlewicz, 2013). Epidemiological studies have also indicated that weight gain during adult life has been consistently associated with breast cancer incidence (Eliassen et al., 2006; Ahn et al., 2007; Melissa et al., 2013). Suleeporn et al found that BMI was significant associated with breast cancer (OR=1.33, 95%CI 1.07-1.65), and the risk was higher among post-menopausal women (OR=1.67, 95%CI 1.24-2.25) (Suleeporn et al., 2013). As the prevalence rates of overweight, obesity and central obesity increased rapidly in women in China including Jiangsu Province (Lv et al., 2010), together with the great changes of the environment and unhealthy lifestyles (Qian et al., 2009; Pou et al., 2010;), it is reasonable to hypothesize that the disease burden of breast cancer will keep rising in Jiangsu and China in the near future.

In this study, we observed 1.46 folds higher incidence of breast cancer in urban areas than in rural areas, and the urban-rural differences were consistent in all age groups. This difference found in Jiangsu was also found at national level and in other developing countries, such as India, Thailand, Korea, Argentina, and Egypt (Dey et al., 2010; Huang et al., 2012). For example, the ASW of breast cancer in urban area of Shanghai was 38.7/100,000 while

was 27.9/100,000 in nearby rural areas of Jiashan (Hao and Chen 2012). Similarly in Egypt, incidence of breast cancer was 3-4 folds higher in urban areas (Dey et al., 2010). The urban-rural differences indicate that the risk of breast cancer is positively associated with socioeconomic conditions (Schootman et al., 2010; Marzieh et al., 2012), and also suggest a relationship to the introduction and increased use of xenoestrogens in environment (Wael et al., 2012), and this could also partly explain the difference level between developed and developing countries (Bray et al., 2004; Youlten et al., 2012).

Our results showed that the age-specific incidence curve of female breast cancer had two peaks. The first incidence peak appeared around the age of 50-54 years and the second appeared over 85 years old. This "two-peaks" also has been found in Chinese women by other studies. Zhang et al reported that the incidence was higher in the age group of 50-54 years and 65-69 years (Zhang et al., 2012). Interestingly, most literatures reported (Althuis et al., 2005; Toi et al., 2010; Curado 2011, Manas and Chaowanee, 2013) that the age-specific incidence for female breast cancer in China as well as in other Asian countries is high before menopause and then declined, however in Western countries, the incidence shows continuous increasing even after menopause. The reasons for the difference between oriental and occidental remain obscure, but estrogen may play important roles in causing the population heterogeneity. Estrogen is the main cause of breast cancer (Vogel, 2008; Cummings et al., 2009; Nelson et al., 2012), due to ovarian atrophy in postmenopausal women, the level of endogenous estrogen may decrease and thus may reduce the risk of breast cancer. As compared to female Caucasians, Asians including Chinese women are less exposed to estrogen related risk factors, such as using oral contraceptives and hormone replacement therapy (HRT). Several researches indicated that HRT can increase the risk of breast cancer (Bouchardy et al., 2010; Li et al., 2011).

Several limitations need to be discussed here. Firstly, the data we used in this study were collected from established population-based cancer registries in Jiangsu. However, most cancer registries in this province were established in 2000s, therefore we are not able to describe the long time trends of breast cancer. Secondly, only 9 registries were involved in our analysis in 2006, this might not sufficiently represent the whole province. But till 2010, 27 cancer registries passed the quality examination, accounted for about 32% of the total population.

Despite these limitations, we confirmed breast cancer has become one of the major health problems in Jiangsu and China, and the disease may continue increasing in the population. More control and prevention activities including health education and health promotion, cancer screening should be strengthened in the population to reduce the burden of this disease.

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