

## RESEARCH ARTICLE

# Analysis of Cancer Incidence in Zhejiang Cancer Registry in China during 2000 to 2009

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### Abstract

**Objective:** The Zhejiang Provincial Cancer Prevention and Control Office collected cancer registration data during 2000 to 2009 from 6 cancer registries in Zhejiang province of China in order to analyze the cancer incidence. **Methods:** Descriptive analysis included cancer incidence stratified by sex, age and cancer site group. The proportions and cumulative rates of 10 common cancers in different groups were also calculated. Chinese population census in 1982 and Segi's population were used for calculating age-standardized incidence rates. The log-linear model was used for fitting to calculate the incidence trends. **Results:** The 6 cancer registries in Zhejiang province in China covered a total of 60,087,888 person-years during 2000 to 2009 (males 30,445,904, females 29,641,984). The total number of new cancer cases were 163,104 (males 92,982, females 70,122). The morphology verified cases accounted for 69.7%, and the new cases verified only by information from death certification accounted for 1.23%. The crude incidence rate in Zhejiang cancer registration areas was 271.5/10<sup>5</sup> during 2000 to 2009 (male 305.41/10<sup>5</sup>, female 236.58/10<sup>5</sup>), age-standardized incidence rates by Chinese standard population (ASIRC) and by world standard population (ASIRW) were 147.1/10<sup>5</sup> and 188.2/10<sup>5</sup>, the cumulative incidence rate (aged from 0 to 74) being 21.7%. The crude incidence rate was 209.6/10<sup>5</sup> in 2000, and it increased to 320.20/10<sup>5</sup> in 2009 (52.8%), with an annual percent change (APC) of 4.51% (95% confidence interval, 3.25%-5.79%). Age-specific incidence rate of 80-84 age group was achieved at the highest point of the incidence curve. Overall with different age groups, the cancer incidences differed, the incidence of liver cancer being highest in 15-44 age group in males; the incidence of breast cancer was the highest in 15-64 age group in females; the incidences of lung cancer were the highest in both males and females over the age of 65 years. **Conclusions:** Lung cancer, digestive system malignancies and breast cancer are the most common cancers in Zhejiang province in China requiring an especial focus. The incidences of thyroid cancer, prostate cancer, cervical cancer and lymphoma have increased rapidly. Prevention and control measures should be implemented for these cancers.

**Keywords:** Cancer registry - incidence - epidemiology - Zhejiang province - China

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### Introduction

Population-based cancer registry collects the data on cancer incidence and mortality deaths from covered population to describe and survey the epidemics in certain areas (Parkin, 2006). According to the data published by WHO International Agency for Research on Cancer (IACR) (GLOBOCAN 2012), there were 14, 100, 000 new incidence cases, and 8, 200, 000 new death cases in 2012 in the world. There were 3, 060, 000 new incidence cases and 2, 200, 000 new death cases in China (Ferlay et al., 2012). National Central Cancer Registry (NCCR) of China reported the incidence rate was 184.81/10<sup>5</sup> in

1989, and it increased to 285.91/10<sup>5</sup> in 2009 in Chinese cancer registries (Chen et al., 2012; Chen et al., 2013). We checked, sorted and analyzed the incidence data in Zhejiang cancer registry from 2000 to 2009, in order to utilize the data in scientific researches, clinical trials and making decision of cancer prevention and control strategies.

### Materials and Methods

#### Data source

The cancer incidence data were collected from 6 cancer registries in Zhejiang province, including Jiashan, Jiaying,

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Haining, Hangzhou, Shangyu, Xianju. Among the 6 registries, Jiashan, Jiaxing, Haining and Hangzhou cancer registries provided the cancer incidence data from 2000 to 2009. Shangyu and Xianju cancer registries only provided the cancer incidence data of 2009. Jiashan Cancer Registry was the full member of International Association for Cancer Registries (IACR). Jiaxing, Haining and Hangzhou Cancer Registries were the contact member of IACR. The data of Jiashan cancer registry (1993-1997, 1998-2002, 2003-2007) were accepted by Cancer Incidence in Five Continents (Vol.VIII, Vol.IX, Vol.X) (Parkin et al., 2002; Curado et al., 2008). Haining and Jiaxing cancer registry data (2003-2007) were accepted by Cancer Incidence in Five Continents (Vol.X). The 6 cancer registries data were entirely accepted by Chinese Cancer Registry Annual Report (Zhao et al., 2010; Hao et al., 2011; Hao et al., 2012).

The population of 6 registries covered 60, 087, 888 person-years (30, 445, 904 for male and 29, 641, 984 for female) from 2000 to 2009. The 6 registries coverage population was 9, 560, 699, accounting for 20.27% of whole population in Zhejiang province in 2009. The total incidence cases were 163, 104 (92, 982 for male and 70, 122 for female) (Table 1).

**Quality control**

Proportion of morphological verification (MV%), percentage of cancer case identified with death certification only (DCO%), mortality to incidence ratio (M/I), percentage of cancer with undefined or unknown primary site (secondary) (O&U%) were used to evaluate the completeness, validity and reliability of cancer statistics. According to the IACR and NCCR requirements of cancer registry data (Parkin et al., 2002; Curado et al., 2008), our data evaluation was as follows: MV% was 69.74%, DCO% was 1.23%, M/I was 0.58, O&U% was 6.09%.

**Statistical analysis**

The qualified data was assessed based on “Guideline of Chinese Cancer Registration” and referred to the criteria for “Cancer Incidence in Five Continents Volume IX” by IACR and IARC. The data were stratified by cancer site, sex and age (group by 0, 1-4, 5-9, ...80-84, 85 years old and above), and crude incidence rates were calculated, age-standardized incidence rates according to the 1982 Chinese population and World Segi’s population were

also calculated. Proportion and cumulative rates were also calculated. Softwares, including MS-Excel, SAS, IACRcrgTools and Joinpoint Regression Program (4.0.0) were used for checking and evaluating data (Kim et al., 2000).

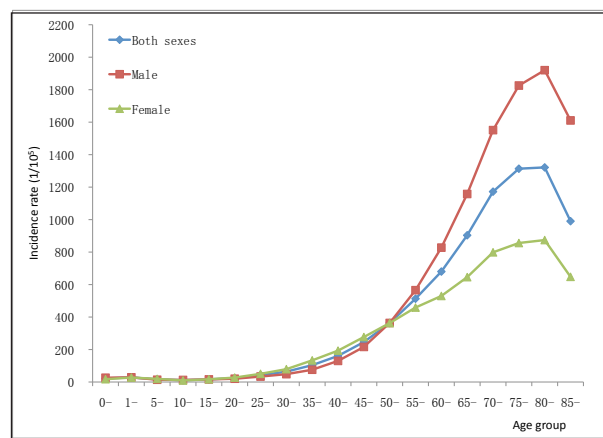
**Results**

*Incidence rate*

The crude incidence rate of all cancer in Zhejiang registration areas in China from 2000 to 2009 was 271.50/10<sup>5</sup> (305.41/10<sup>5</sup> in male and 236.58/10<sup>5</sup> in female). The age-standardized incidence rate was 147.06/10<sup>5</sup> and 188.20/10<sup>5</sup> respectively by ASIRC and ASIRW. Among the patients aged 0-74 years, the cumulative incidence rate was 21.71%, 35-64 years truncated rate was 311.36/10<sup>5</sup>.

*Age-specific incidence rate*

From 2000 to 2009 in Zhejiang registration areas, the cancer incidence rate of all cancer was relatively low before 34 years old. Then it increased dramatically after 35 years old and finally reached the peak in the age group of 80-84 years (1321.44/10<sup>5</sup>). Then it slightly decreased after 85 years old. The cancer incidence in the male in the age group of 15-49 years was lower than that in the female. But the incidence rate in the male was higher than that in the female after 50 years old, and the disparity of incidence rates between the male and the female was striking after age group 55 (Figure 1).



**Figure 1. Age-Specific Cancer Incidence in Zhejiang Province in China from 2000 to 2009**

**Table 1. Distribution of Total Population and New Incidence Cases in Zhejiang Cancer Registries from 2000 to 2009**

Year	Both sexes		Male		Female	
	Incidence case	Population	Incidence case	Population	Incidence case	Population
2000	6, 190	2, 953, 809	3, 616	1, 510, 220	2, 574	1, 443, 589
2001	6, 620	2, 957, 597	3, 801	1, 510, 773	2, 819	1, 446, 824
2002	6, 465	3, 012, 001	3, 845	1, 538, 773	2, 620	1, 473, 228
2003	8, 401	3, 264, 790	4, 728	1, 662, 663	3, 673	1, 602, 127
2004	16, 750	6, 637, 180	9, 811	3, 356, 947	6, 939	3, 280, 233
2005	19, 733	7, 340, 689	11, 356	3, 770, 376	8, 377	3, 570, 313
2006	20, 201	7, 876, 110	11, 445	3, 967, 391	8, 756	3, 908, 719
2007	24, 130	8, 208, 769	13, 583	4, 147, 033	10, 547	4, 061, 736
2008	24, 001	8, 276, 244	13, 407	4, 172, 455	10, 594	4, 103, 789
2009	30, 613	9, 560, 699	17, 390	4, 809, 273	13, 223	4, 751, 426
Total	163, 104	60, 087, 888	92, 982	30, 445, 904	70, 122	29, 641, 984

### The time trends of incidence rate

The incidence rate in 2000 was 209.56/10<sup>5</sup> and it increased to 320.20/10<sup>5</sup> in 2009 which increased about 52.78%, with the Annual Percent Change (APC) of 4.51% (95% confidence interval (CI), 3.25%-5.79%) (Figure 2). Among the male the incidence rate was 239.44/10<sup>5</sup> in 2000, it increased to 361.59/10<sup>5</sup> in 2009, with APC of 4.28% (95% CI, 3.04%-5.53%) (Figure 2). In female, the incidence rate in 2000 was 178.31/10<sup>5</sup>. It increased to 278.30/10<sup>5</sup> in 2009, with the Annual Percent Change (APC) of 4.90% (95% CI, 3.42%-6.40%) (Figure 2). After standardizing age, the increment of incidence rate was reduced. ASIRC rate was 118.52/10<sup>5</sup> in 2000, it increased to 161.99/10<sup>5</sup> in 2009, the ASIRW rate was 153.40/10<sup>5</sup> in 2000, it increased to 207.92/10<sup>5</sup> in 2009 (Figure 3).

### Incidence rates of 10 most common cancers

Lung cancer was the most common cancer in Zhejiang cancer registration areas in China, followed by stomach cancer, colorectal cancer, liver cancer, and breast cancer. The 10 most common cancers accounted for 73.66% of new cases of all sites. Meanwhile it was 81.60% in the male and 74.73% in the female, respectively. Lung cancer was the most frequently diagnosed cancer in males followed by stomach cancer, liver cancer, colorectal cancer and esophageal cancer. Breast cancer was the most frequently diagnosed cancers followed by lung cancer, colorectal cancer, stomach cancer and liver cancer in females (Table 2).

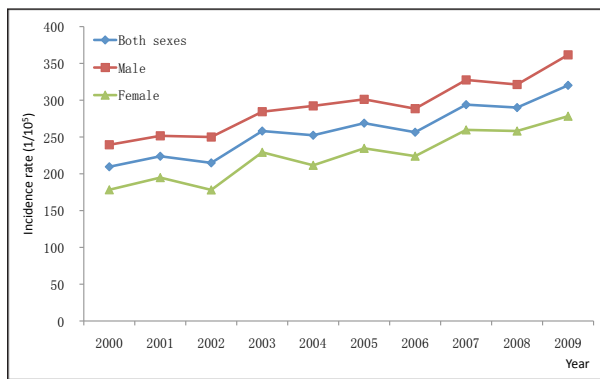


Figure 2. The Changes of Crude Incidence Rate in Zhejiang in China from 2000 to 2009

### Incidence rates for 10 most common cancers in each age group

Different types of cancers occurred differently at each age group and gender. Whether in the male, female or both sexes, leukemia, lymphoma and brain tumor were the top 3 most common cancer, and leukemia ranked the first, accounting for 41.99% of all new cases in the age group of 0-14 years. Among male, liver cancer was the most common cancer in the age group of 15-44 years, accounting for 19.25% of all new cases, followed by colorectal cancer, lung cancer, stomach cancer and brain tumor; While breast cancer was the most common cancer in female, accounting for 23.02% of all new cases, followed by cervix cancer, thyroid gland cancer, colorectal cancer and stomach cancer in the age group of 15-44 years. Lung cancer became to the most common cancer in the age group of 45-64 years in men, accounting for 20.99% of all new cases, followed by liver cancer, stomach cancer, colorectal cancer, and esophagus cancer. In the age group of 45-64 years, breast cancer was the still most common cancer in female and it accounted for 22.03% of all new cases, followed by lung cancer, colorectal cancer, stomach cancer and liver cancer. In the 65 years old and over 65 years old age group, lung cancer was the most common cancer in the male, accounting for 27.18% of all new cases, followed by stomach cancer, colorectal cancer, liver cancer and esophagus cancer and meanwhile in the female lung cancer accounted for 17.46% of all new cases, followed by colorectal cancer, stomach cancer, liver cancer and breast cancer, respectively (Table 3).

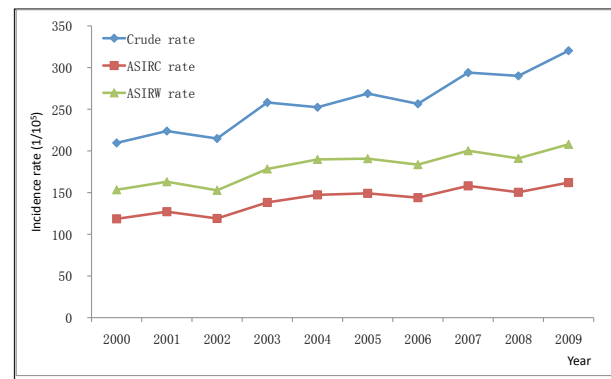


Figure 3. The Changes of Incidence Rate in Zhejiang in China from 2000 to 2009

Table 2. Top 10 Cancer Incidence in Zhejiang Cancer Registration Areas in China from 2000 to 2009

Rank	Both sexes				Male				Female			
	Site	Incidence rate (1/10 <sup>5</sup> )	Frequency (%)	ASIRC (1/10 <sup>5</sup> )	Site	Incidence rate (1/10 <sup>5</sup> )	Frequency (%)	ASIRC (1/10 <sup>5</sup> )	Site	Incidence rate (1/10 <sup>5</sup> )	Frequency (%)	ASIRC (1/10 <sup>5</sup> )
1	Lung	49.57	18.26	24.64	Lung	70.13	22.96	35.54	Breast	39.24	16.59	21.92
2	Stomach	30.88	11.37	15.75	Stomach	41.05	13.44	21.23	Lung	28.43	12.02	14.04
3	Colorectal	30.24	11.14	15.54	Liver	39.4	12.9	21.29	Colorectal	27.11	11.46	13.85
4	Liver	27.07	9.97	14.26	Colorectal	33.28	10.9	17.32	Stomach	20.43	8.63	10.38
5	Breast	19.66	7.24	10.95	Esophagus	18.44	6.04	9.5	Liver	14.4	6.09	7.15
6	Esophagus	11.47	4.23	5.7	Bladder	10.69	3.5	5.26	Cervix	11.78	4.98	7.05
7	Brain	8.53	3.14	5.72	Prostate	9.79	3.21	4.47	Thyroid gland	10.8	4.56	7.24
8	Pancreas	8.48	3.13	4.11	Pancreas	9.65	3.16	4.85	Brain	8.86	3.75	5.81
9	Lymphoma	7.12	2.62	4.64	Lymphoma	8.55	2.8	5.53	Uterus	7.92	3.35	4.64
10	Bladder	6.97	2.57	3.3	Brain	8.2	2.68	5.65	Ovary	7.83	3.31	4.8
	Top 10	199.99	73.66	104.64	Top 10	249.2	81.6	130.64	Top 10	176.79	74.73	96.87

**Table 3. Proportion of Top 10 Cancer Incidence Rate in Each Age Group**

Sex	Rank	0-4		5-14		15-44		45-64		65+	
		Site	Frequency (%)	Site	Frequency (%)	Site	Frequency (%)	Site	Frequency (%)	Site	Frequency (%)
Both	1	Leukemia	18.24	Leukemia	23.75	Breast	13.97	Lung	16.22	Lung	23.73
	2	Lymphoma	9.95	Brain	17.87	Liver	9.39	Liver	11.31	Stomach	13.01
	3	Brain	9.95	Lymphoma	13.59	Thyroid gland	8.42	Stomach	11.02	Colorectal	12.71
	4	Lung	7.63	Bone	6.61	Colorectal	7.71	Colorectal	10.62	Liver	9.11
	5	Colorectal	5.14	Lung	3.67	Stomach	7.23	Breast	10.21	Esophagus	5.3
	6	Kidney	4.81	Colorectal	3.18	Cervix	7.03	Esophagus	4.19	Pancreas	4.28
	7	Stomach	4.48	Stomach	3.18	Lung	6.22	Brain	3.22	Bladder	3.63
	8	Liver	4.31	Liver	2.82	Brain	6.2	Thyroid gland	2.83	Prostate	3.42
	9	Breast	2.49	Thyroid gland	2.2	Leukemia	4.89	Pancreas	2.56	Breast	2.86
	10	Bone	1.99	Kidney	1.96	Lymphoma	3.69	Lymphoma	2.56	Gallbladder	2.47
Male	1	Leukemia	19.69	Leukemia	22.98	Liver	19.25	Lung	20.99	Lung	27.18
	2	Brain	11.08	Brain	20.05	Colorectal	9.42	Liver	16.17	Stomach	14.08
	3	Lymphoma	8.92	Lymphoma	16.38	Lung	8.97	Stomach	13.98	Colorectal	11.41
	4	Lung	7.38	Bone	6.85	Stomach	8.5	Colorectal	10.69	Liver	9.53
	5	Liver	5.54	Stomach	4.16	Brain	7.33	Esophagus	6.73	Esophagus	6.38
	6	Colorectal	5.23	Colorectal	3.42	Leukemia	6.78	Pancreas	2.92	Prostate	5.31
	7	Kidney	4.92	Liver	3.42	Lymphoma	5.25	Lymphoma	2.88	Bladder	4.36
	8	Stomach	4.62	Lung	2.44	Nasopharynx	5.24	Brain	2.79	Pancreas	3.68
	9	Testis	3.08	Nasopharynx	2.2	Thyroid gland	4.37	Nasopharynx	2.73	Lymphoma	2.15
	10	Esophagus	2.46	Kidney	1.22	Kidney	2.3	Bladder	2.72	Kidney	1.69
Female	1	Leukemia	16.55	Leukemia	24.51	Breast	23.02	Breast	22.03	Lung	17.46
	2	Lymphoma	11.15	Brain	15.69	Cervix	11.75	Lung	10.59	Colorectal	15.06
	3	Brain	8.63	Lymphoma	10.78	Thyroid gland	11.14	Colorectal	10.54	Stomach	11.08
	4	Lung	7.91	Bone	6.37	Colorectal	6.56	Stomach	7.54	Liver	8.36
	5	Breast	5.4	Lung	4.9	Stomach	6.38	Liver	5.57	Breast	7.78
	6	Colorectal	5.04	Thyroid gland	3.68	Brain	5.45	Cervix	5.04	Pancreas	5.34
	7	Kidney	4.68	Colorectal	2.94	Ovary	4.84	Uterus	5.02	Gallbladder	4.29
	8	Stomach	4.32	Ovary	2.94	Lung	4.37	Thyroid gland	4.81	Esophagus	3.36
	9	Liver	2.88	Kidney	2.7	Leukemia	3.63	Ovary	4.05	Brain	2.7
	10	Bone	2.52	Stomach	2.21	Uterus	3.21	Brain	3.73	Bladder	2.3

## Discussion

Zhejiang province, located on the east coast of China, belongs to more economically advanced regions, and the per capita GDP exceeded \$10000 for the first time in 2012. With the economic and social development, population aging and increasingly serious environmental pollution, the incidence of cancer in Zhejiang province in China showed obviously upward trend (Wu et al., 2013; Li et al., 2013; Shen et al., 2014; Ding et al., 2014; Li et al., 2014; Wang et al., 2014; Li et al., 2014). Now we made a preliminary presentation on the incidence of cancer registries in Zhejiang in China in the first decade of the 21st century in order to provide basic data for cancer control.

The crude incidence rate from 2000 to 2009 in Zhejiang registration areas was 271.50/10<sup>5</sup>. The incidence rate was higher in males than that in females, and the ratio of incidence rate was 1.29. The age-standardized incidence rate was 147.06/10<sup>5</sup> by Chinese population (ASIRC), which is slightly higher than the figure in the National Cancer Institute National Cancer Registry's from 2003 to 2007 (Zhao et al., 2012) and its incidence rate was 144.25/10<sup>5</sup> (Hao et al., 2012). The incidence rate was 209.56/10<sup>5</sup> in 2000, and it increased to 320.20/10<sup>5</sup> in 2009 which increased about 52.78%, with the Annual Percent Change (APC) of 4.51%. The ASIRC rate was 118.52/10<sup>5</sup> in 2000, and it increased to 161.99/10<sup>5</sup> in

2009, the increment is significantly higher than that of the national incidence rates which were 133.04/10<sup>5</sup> in 2000 and 149.93 in 2009 (Hao et al., 2012).

Age-specific incidence rate of 80-84 years old achieved at the highest point, which reached 1321.44/10<sup>5</sup> in Zhejiang registration areas. While in the national registration areas, the incidence peak was in the age group of 80-84 years in urban areas and peak in the age group of 75-79 years in rural areas, respectively (Hao et al., 2012). It might be the reason that most of cancer registrations in Zhejiang province are urban areas. In the age group of 0-14 years, leukemia was the most common cancer followed by lymphoma and brain tumor, accounting for 41.99% of all new cases. In males, the incidence of liver cancer was the highest in 15-44 years old group and lung cancer became the most common cancer in the age group of 45-64 years. In females, the incidence of breast cancer was the highest in 15-64 years old group. However, Wu et al reported that the age-specific incidence curve of female breast cancer had two peaks: age of 50-54 years and over 85 years old (Wu et al., 2014). Another group also found that the incidence was higher in the age group of 50-54 years and 65-69 years (Zhang et al., 2012). Further studies focused on breast cancer could clarify whether this "two-peaks" was a common phenomenon. In the age group of 65 years and over, the incidence of lung cancer was the highest both in males or females. Based on the incidences of various types of tumors in age groups, we can plan to



carry out cancer prevention.

Lung cancer was the most common cancer in both sexes, followed by stomach cancer and colorectal cancer. Lung cancer was the most frequently diagnosed cancer in the male followed by stomach cancer and liver cancer, which is consistent with the national cancer incidence rate from 2003-2007 (Zhao et al., 2012). According to the latest Chinese Cancer Registry Annual Report, breast cancer ranks the most common cancer among Chinese women, and it was also the most frequently diagnosed cancer in Zhejiang province followed by lung cancer and colorectal cancer (Hao et al., 2012). The age-standardized incidence rate by ASIRC of prostate cancer in the male is  $4.47/10^5$  and ranked No.7, higher than  $4.05/10^5$  in Chinese other registration areas (Zhao et al., 2012). The ASIRC of thyroid cancer in the female is  $7.24/10^5$  and ranked No. 7, while the incidence of thyroid cancer failed to rank in the top 10 in China cancer registries (Zhao et al., 2012). Lung cancer, digestive malignancies and breast cancer were the most common cancers in Zhejiang province in China, these cancers should be focused on. At the same time, the incidence rates of thyroid cancer, prostate cancer, cervical cancer and lymphoma increased, therefore prevention and control should be implemented on these cancers.

The data of Zhejiang cancer registration areas in China shows that the incidence of cancer is rising, and it is consistent with the National cancer intelligence, but some cancer incidence showed slightly higher, such as thyroid cancer and prostate cancer. According to the cancer feature of our province, we should be done: targeting to carry out synthetical prevention, strengthening early diagnosis and treatment of cancer screening work, making basic and clinical research in depth, to further improve the geographical distribution of the province cancer registry, combining prevention with control, so as to effectively control the cancer hazard.

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