

## ORIGINAL ARTICLE

**Esophageal cancer statistics in China, 2011: Estimates based on 177 cancer registries**

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**Abstract****Background:** Esophageal cancer has been a common cancer in China for many years. Using the most recent data collected from the National Central Cancer Registry, we present estimates of the esophageal cancer burden in China in 2011.**Methods:** Age-specific incidence and mortality rates by gender and area for 18 age groups were calculated based on data from 177 qualified population-based cancer registries. The number of new cases of esophageal cancer and cancer deaths were computed by multiplying these rates by the 2011 population. Crude incidence and mortality rates of esophageal cancer were estimated.**Results:** The estimated number of new esophageal cancer cases and deaths were 291 238 and 218 957, respectively. The crude incidence and mortality rates for esophageal cancer were 21.62/100 000 and 16.25/100 000, respectively. The age-standardized incidence and mortality rates by world population were 15.83/100 000 and 11.62/100 000, respectively. Both the incidence and mortality rates of esophageal cancer were higher in rural areas than in urban areas, and in men than in women. The age-specific esophageal cancer incidence and mortality rates increased with age. In China, squamous cell cancer was the most common pathological type of the disease.**Conclusion:** Esophageal cancer remains a major public health issue in China. Primary and secondary prevention are essential for disease control.**Introduction**

Esophageal cancer is a major public health problem in China. It is the eighth most common cancer worldwide, and the sixth most common cause of death from cancer. About 80% of the cases occur in developing countries. China contributed almost half of the global new esophageal cancer cases in 2012; it was the sixth most common cancer in China in 2011.<sup>1–3</sup> While published studies have shown that incidence rates of esophageal cancer have decreased in China over the last 20 years, esophageal cancer still represents a significant burden.<sup>4</sup> Subtypes of the disease include esophageal adenocarcinoma (EAC) and esophageal squamous cell carcinoma (ESCC).

The National Central Cancer Registry (NCCR) in China has collected population-based cancer statistics for more than 20 years and is the only source to report national population-based cancer incidence and mortality data. The cancer registration network has expanded during the past five years. Up to 2014, there were a total of 304 cancer registries in

China, covering 300 million of the population.<sup>3</sup> In the present study, we provide the expected numbers of new esophageal cancer cases and deaths in 2011 in the Chinese population, as well as a comprehensive overview of esophageal cancer incidence and mortality using the latest population-based cancer registration data. Because of the time required for data collection, quality control, and analysis, the latest cancer statistics available have a three to four year lag behind the current year.

**Materials and methods****Source of the data**

Population-based cancer registries systematically collect the data of all new cancer cases and deaths from local hospitals, healthcare centers, the health insurance database, the death surveillance system, and clinics, using passive and active methods. Cancer registries are responsible for compiling new cancer cases and cancer deaths, using identification card

numbers as personal identification codes. However, cancer death records should be matched with incidence records to enable detection of missing and duplicated cases. Local registries collect information on patient age, gender, date of diagnosis, identification number, anatomical and sub-sites, and diagnostic methods. Each year, local registries report new cancer incidence and mortality data to NCCR. By June 2014, 234 cancer registries from 31 provinces submitted population-based data of new cancer cases and cancer deaths to NCCR. Of the 234 registries, 98 registries were from urban areas and 136 from rural areas. The overall population coverage for the registries was 221.4 million, accounting for 16.43% of the whole Chinese population.

The quality and completeness of cancer registration data was assessed using IARC-crgTools (International Agency for Research on Cancer, Lyon, France) to identify errors, inconsistencies, and unusual combinations of cancer site, morphology, gender, and age at diagnosis. Questionable records were returned to the cancer registry for verification and correction. After data quality control, a total of 177 cancer registries (77 in urban and 100 in rural areas), from 28 provinces, met quality requirements for reporting the cancer statistics, covering 13.01% of the national population. A detailed distribution of the cancer registries has previously been reported.<sup>3</sup> All cancer cases were classified according to the International Classification of Diseases for Oncology-3 (ICD-O-3) and ICD-10. Invasive cases of esophageal cancer (C15) were retrieved from the entire cancer database.

The National Bureau of Statistics provided the 2011 overall population data by area and gender.<sup>5</sup> The fifth and sixth National Population Census data provided 2000 and 2010 population data by age group, gender, and area.<sup>5</sup> To further estimate the 2011 age-specific population data in each age strata (0–, 1–4, 5–84 by 5 years, 85+ years) by gender and area, we first calculated a change in the age specific death probability between the fifth and sixth National Population Census data, assuming a linear interpolation. With the estimated death probability in each age group, the 2011 age-specific population by gender, area, and age were derived based on the existing population statistics.

## Statistical analysis

The crude incidence and mortality rates of esophageal cancer were calculated by area, gender, and age group using data from 177 cancer registries. Using the cancer registration statistics in each strata (by age group, gender, and area), we calculated the estimated numbers of new cases and deaths of esophageal cancer using the respective 2011 Chinese population. The overall cancer incidence and mortality rates were estimated. The age-standardized incidence and mortality rates were based on the 2000 standard Chinese population and world Segi's population, and expressed per 100 000

population. The cumulative risk of developing or dying from cancer before the age of 75 (in the absence of competing causes of death), was calculated and presented as a percentage.

## Results

Detailed quality control indicators of esophageal cancer for the 177 cancer registries are shown in Table 1. The mortality/incidence (M/I) ratio for all qualified registries was 0.76 (0.81 in urban and 0.73 in rural areas). The percentage of morphologic verification (MV) was 80.02% overall (78.37% for urban and 81.05% for rural areas). The percentage of death certificate only (DCO) was 2.09% overall (2.34% in urban and 1.94% in rural areas). The percentage of uncertified basis of diagnosis (UB%) was 0.16%.

Based on data from 177 population based cancer registries from 28 provinces, we calculated the crude incidence and mortality rates in cancer registration areas by age, gender, and area. The age-specific esophageal cancer incidence and mortality rates are shown in Table 2 and Figure 1. The age-specific incidence and mortality rates were relatively low up to 40 years of age in each area and increased dramatically after age 40. The incidence rates for men in urban areas reached a peak at 85+ years, whereas for women in urban areas and subjects in rural areas, the incidence rates were highest at 80– years. The mortality rates were highest for subjects aged 80– or 85+ years.

Using age-specific incidence and mortality rates by area and gender in cancer registration areas, we estimated esophageal cancer incidence in China using 2011 Chinese population data in each strata. As shown in Table 3, in 2011, a total of 291 238 new cases of esophageal cancer occurred, with crude rates of 21.62/100 000. The estimated crude incidence rate for men was 29.76/100 000, which was higher than for women at 13.05/100 000. The crude incidence rates were 13.46/100 000 in urban and 30.19/100 000 in rural areas. The age-standardized incidence rates by China (ASR<sub>CN</sub>) and world

**Table 1** Quality control indicators of esophageal cancer in 177 Chinese cancer registries

Areas	Gender	M/I	MV%	DCO%	UB%
ALL	Both	0.76	80.02	2.09	0.16
	Male	0.76	80.25	2.08	0.16
	Female	0.76	79.46	2.13	0.16
Urban	Both	0.81	78.37	2.34	0.26
	Male	0.80	78.92	2.29	0.25
	Female	0.82	76.82	2.47	0.28
Rural	Both	0.73	81.05	1.94	0.10
	Male	0.74	81.15	1.93	0.10
	Female	0.73	80.84	1.96	0.09

DCO, death certificate only; M/I, mortality/incidence; MV, morphologic verification; UB, uncertified basis.

**Table 2** Age specific incidence and mortality rates of esophageal cancer by area and gender in cancer registries (per 100 000)

Age group	Incidence				Mortality			
	Urban male	Urban female	Rural male	Rural female	Urban male	Urban female	Rural male	Rural female
0	0.00	0.00	0.23	0.00	0.00	0.00	0.23	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
10	0.00	0.00	0.04	0.00	0.00	0.00	0.04	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.08	0.03	0.12	0.03	0.00	0.08	0.12	0.03
25	0.12	0.10	0.27	0.17	0.02	0.05	0.27	0.17
30	0.31	0.13	0.65	0.25	0.08	0.05	0.65	0.25
35	1.21	0.39	1.93	0.83	0.48	0.19	1.93	0.83
40	3.46	0.90	7.17	3.04	1.95	0.51	7.17	3.04
45	12.21	2.31	22.79	7.08	7.80	1.19	22.79	7.08
50	25.81	4.02	49.56	15.71	18.13	2.21	49.56	15.71
55	47.32	10.84	106.55	37.06	32.29	5.65	106.55	37.06
60	75.92	20.25	167.56	70.17	49.65	12.29	167.56	70.17
65	96.80	35.14	195.13	90.78	72.94	26.54	195.13	90.78
70	111.11	40.80	241.01	117.51	95.08	31.97	241.01	117.51
75	118.22	55.22	267.98	135.58	115.40	51.78	267.98	135.58
80	129.32	59.63	280.25	149.95	141.29	68.48	280.25	149.95
85	132.10	57.52	259.36	118.61	173.23	75.24	259.36	118.61

population (ASR<sub>wld</sub>) were 15.58/100 000 and 15.83/100 000, respectively. The ASR<sub>cn</sub> in urban areas was 9.57/100 000, which was much lower than in rural areas (22.06/100 000). The cumulative rate for subjects (0–74) developing esophageal cancer was 2.01%. The truncated age-standardized rate (TASR) (age 35–64) using world standard population was 23.87/100 000.

The estimated esophageal cancer mortality rates in China are shown in Table 4. In 2011, 218 957 esophageal cancer deaths occurred, with a crude mortality rate of 16.25/100 000. The estimated crude mortality rate was higher for men (22.38/100 000) than for women (9.80/100 000) and was lower in urban (10.67/100 000) than in rural (22.12/100 000) areas. The ASR<sub>cn</sub> and ASR<sub>wld</sub> mortality rates were 11.51/100 000 and 11.62/100 000, respectively. The ASR<sub>cn</sub> in urban

areas was 7.46/100 000, which was lower than in rural areas, at 15.85/100 000. The cumulative rate (0–74) of death from esophageal cancer was 1.40%. The TASR (age 35–64) using world standard population was 14.26/100 000.

Using data with detailed pathological information, we analyzed the pathological types of esophageal cancer in China. As shown in Figure 2, ESCC was the most common type, accounting for 88.84% of all esophageal cancer, while EAC only accounted for 8.39%.

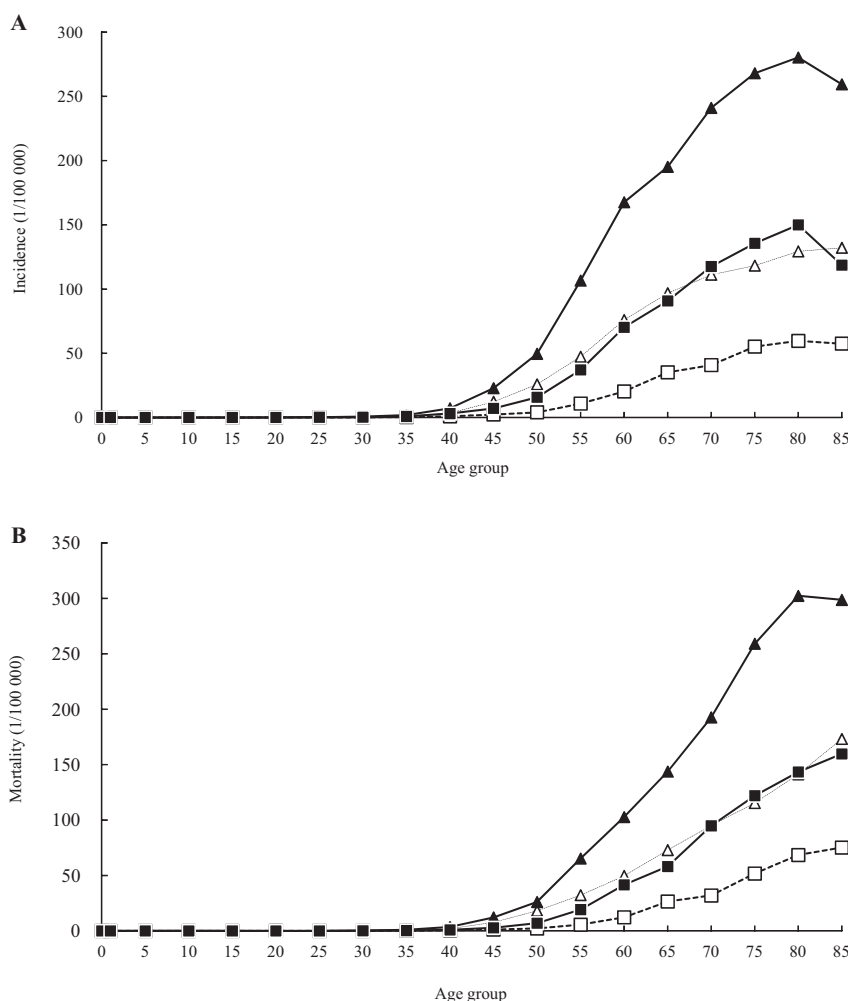
## Discussion

In the present study, we used a data from 177 qualified population-based cancer registries to estimate the overall esophageal cancer statistics in China in 2011. The crude

**Table 3** Estimated esophageal cancer incidence in China in 2011

Areas	Gender	Number of cases	Crude rate (1/10 <sup>5</sup> )	ASR <sub>cn</sub> (1/10 <sup>5</sup> )	ASR <sub>wld</sub> (1/10 <sup>5</sup> )	Cumulative rate 0–74 (%)	TASR 35–64 (1/10 <sup>5</sup> )
All	Both	291 238	21.62	15.58	15.83	2.01	23.87
	Male	205 560	29.76	22.47	22.90	2.90	35.78
	Female	85 678	13.05	8.85	8.94	1.12	11.61
Urban	Both	92 996	13.46	9.57	9.71	1.22	14.49
	Male	69 386	19.68	14.62	14.88	1.87	23.33
	Female	23 610	6.98	4.67	4.69	0.57	5.36
Rural	Both	198 242	30.19	22.06	22.41	2.85	34.22
	Male	136 174	40.28	30.93	31.49	3.96	49.54
	Female	62 068	19.49	13.39	13.54	1.71	18.49

ASR<sub>cn</sub>, age-standardized rate (using China standard population, 2000); ASR<sub>wld</sub>, age-standardized rate (using world standard population); TASR, truncated age-standardized rate (using world standard population).

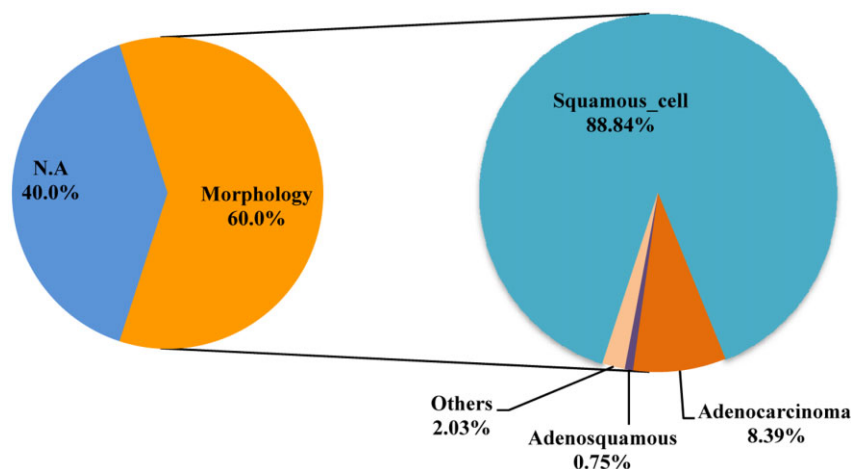


**Figure 1** (a) 2011 age-specific esophageal cancer incidence in China. (b) 2011 age-specific esophageal cancer mortality in China. —△—, Urban male; ---□---, Urban female; —●—, Rural male; ---◇---, Rural female.

**Table 4** Estimated esophageal cancer mortality in China in 2011

Areas	Gender	Number of cases	Crude rate (1/10 <sup>5</sup> )	ASR <sub>cn</sub> (1/10 <sup>5</sup> )	ASR <sub>wld</sub> (1/10 <sup>5</sup> )	Cumulative rate 0–74 (%)	TASR 35–64 (1/10 <sup>5</sup> )
All	Both	218 957	16.25	11.51	11.62	1.40	14.26
	Male	154 587	22.38	16.86	17.05	2.06	22.02
	Female	64 371	9.80	6.38	6.42	0.75	6.26
Urban	Both	73 724	10.67	7.46	7.53	0.89	9.36
	Male	54 618	15.49	11.46	11.62	1.39	15.48
	Female	19 106	5.65	3.63	3.63	0.40	3.04
Rural	Both	145 233	22.12	15.85	15.98	1.94	19.58
	Male	99 969	29.57	22.65	22.84	2.74	29.14
	Female	45 264	14.21	9.35	9.41	1.12	9.77

ASR<sub>cn</sub>, age-standardized rate (using China standard population, 2000); ASR<sub>wld</sub>, age-standardized rate (using world standard population); TASR, truncated age-standardized rate (using world standard population).



**Figure 2** Pathological types of esophageal cancer in China.

incidence and mortality rates for esophageal cancer were 21.62/100 000 and 16.25/100 000, respectively. The age-standardized incidence and mortality rates by world population were 15.83/100 000 and 11.62/100 000, respectively. Our results indicated that both incidence and mortality rates of esophageal cancer were higher in rural than in urban areas. Age-specific esophageal cancer incidence and mortality rates increased with age. ESCC was the most common pathological type of esophageal cancer in China. With 291 238 cases and 218 957 new cancer deaths in 2011, esophageal cancer remains a common disease in China, especially in rural areas and in men.

The geographical variations of incidence and mortality rates of esophageal cancer in China shown in our study were similar to previous reports.<sup>6</sup> Both incidence and mortality rates of esophageal cancer in rural areas were about twice the rate in urban areas. Such disparities may be a result of different socioeconomic status and lifestyle. The two major histological types of esophageal cancer include EAC and ESCC. Both ESCC and EAC share common risk factors, such as cigarette smoking. The risk factors of ESCC include diets low in fruit and vegetables, high in meat, moldy food, smoking, and drinking.<sup>7</sup> Population-attributable risks of smoking, obesity, history of gastroesophageal reflux, and low fruit and vegetable consumption accounted for about 79% of EAC cases. In China, ESCC was the predominant histological type of the disease, which differed from the situation in the United States.<sup>8,9</sup> Differences in the rates of subtypes of esophageal cancer may reflect different lifestyles and genetic backgrounds.<sup>10,11</sup> Our previous results showed that esophageal cancer incidence rates have recently declined in China, mainly resulting from changes in dietary patterns and food preservation methods.<sup>4</sup>

The prognosis for esophageal cancer is dismal in China; the relative survival rates are about 20%.<sup>12</sup> The earlier esophageal

cancer is detected, the better chance a person has of surviving five years after diagnosis. Five-year survival of localized esophageal cancer reaches 40% in the United States, whereas for distant disease, five-year survival is only 3.8%.<sup>13</sup> Population screening with endoscopy and biopsy is effective in the early detection of cancer, and has been conducted in areas of China with a high-risk of esophageal cancer incidence, such as Cixian and Linzhou.<sup>14</sup>

Our study provided estimated esophageal cancer statistics using updated population-based data from 177 qualified cancer registries. This data may be useful for basic, clinical, and translational research on esophageal cancer. With the increasing emphasis on cancer surveillance from the Chinese government, the quality of cancer registration data in China will continue to improve.

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### Disclosure

No authors report any conflict of interest.

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