

## ORIGINAL RESEARCH

# Esophageal cancer: trends in incidence and mortality in China from 2005 to 2015

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**Abstract****Background:** The long-term trend analysis of esophageal cancer is rarely reported in China. Our purpose is to analyze the incidence and mortality trends of esophageal cancer in China from 2005 to 2015.**Method:** Based on *the data in the annual report of the China Cancer Registry*, a comprehensive analysis of esophageal cancer cases and deaths from 2005 to 2015 was carried out. The incidence and mortality of esophageal cancer are stratified by gender and region (urban or rural). Long-term trend analysis was conducted using Joinpoint regression model.**Result:** In China, the age-standardized incidence rates by the world population declined from 13.84/10<sup>5</sup> in 2005 to 11.64/10<sup>5</sup> in 2015. Annual percent changes were 3.4% (95% CI: 0.6%, 6.3%) in the period 2005-2011, -7.4% (95% CI: -10.1%, -4.7%) in the period 2011-2015, respectively. The age-standardized mortality rates declined from 10.86/10<sup>5</sup> in 2005 to 8.57/10<sup>5</sup> in 2015. And the average annual percent change was -4.1% (95% CI: -6.7%, -1.5%). The incidence and mortality of esophageal cancer in men are higher than those in women, and the incidence and mortality of esophageal cancer in rural areas are much higher than those in urban areas.**Conclusion:** In China, the incidence of esophageal cancer first increased and then decreased during 2005-2015, while the mortality rate has been declining.**KEY WORDS**

China, Esophageal cancer, incidence or morbidity, mortality, trend

## 1 | INTRODUCTION

Globally, esophageal cancer is one of the most frequently reported cancer types and a common cause of death.<sup>1</sup> In China, the incidence of esophageal cancer in 2015 ranked sixth and the mortality rate ranked fourth.<sup>2</sup> According to the

GLOBOCAN 2018 report of the International Agency for Research on Cancer (IARC), the number of global esophageal cancer cases is 572,034, accounting for 3.2% of the total number of new cases; the death toll is 508,585, accounting for 5.3% of all cancer deaths. The age-standardized incidence rate (ASIR) of men is higher than that of women,

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with a ratio of approximately 2.7:1. When assessing the age-standardized mortality rate (ASMR), gender differences were also observed.<sup>3</sup>

Some studies on the incidence and mortality of esophageal cancer have been conducted worldwide. According to data from the Japan Cancer Control and Information Service Center, Lin Yingsong's research shows that the ASIR for esophageal cancer increased from  $8.3/10^5$  in 1975 to  $11.7/10^5$  in 2006.<sup>4</sup> On the contrary, a decline in esophageal cancer has been found in Korea. ASIR dropped from  $4.06/10^5$  in 1999 to  $2.91/10^5$  in 2013, with an annual percent change (APC) of  $-2.2%$  ( $p < 0.001$ ).<sup>5</sup> A similar trend in esophageal cancer has been found in American women; from 2001 to 2015, the APC was  $-1.41%$ .<sup>6</sup> In addition, using data from the Korean Statistical Information Service (KOSIS) database, a time trend analysis in South Korea shows that the trends in esophageal cancer mortality are similar in men and women. For men, the mortality rate increased from 1983 to 1993, the APC was  $4.14%$ , and it decreased from 1993 to 2002, the APC was  $-2.34%$ , and then, with a sharp decline from 2002 to 2012, it was  $-5.12%$ . For women, there was no significant trend from 1983 to 1995. Since then, the mortality rate has decreased, with APC of  $-6.30%$ .<sup>7</sup>

However, in China, there are few epidemiological studies on the long-term trend of esophageal cancer. Most existing morbidity and mortality studies are limited to one year or a short period of time or in specific areas. Based on data from the *annual report of the China Cancer Registry*, our study describes the incidence and mortality of esophageal cancer in China from 2005 to 2015. The number of new cancer cases and deaths, corresponding morbidity, mortality, and age-standardized rate (ASR) are reported. In addition, we analyzed the incidence and mortality trends of esophageal cancer during the entire study period, as well as gender and regional diversity.

## 2 | MATERIALS AND METHODS

The National Central Cancer Registry of China (NCCR) is responsible for the collection, evaluation and release of cancer data according to the local population cancer registry. Cancer data was collected from clinics in rural areas, local hospitals, health insurance databases, death monitoring databases and cooperative medical insurance databases. Then, checking the data according to the "Chinese Cancer Registry Guidelines" and the "Five Continent Stage IX Cancer Incidence Rate" standards of the International Agency for Research on Cancer (IARC)/International Association of Cancer Registry (IACR). From 2005 to 2015, the number of cancer registries increased from 45 to 501, the population covered increased from 69 to 388 million, and the proportion of the national population increased from 5.31% to 28.22%. After quality

assessment, the number of cancer registries included in the database has increased from 34 to 388, the population covered has increased from 55 to 321 million, and the proportion of the total population of the country has increased from 4.20% to 23.35%. In 2015, all 31 provinces, autonomous regions, municipalities directly under the Central Government and Xinjiang Production and Construction Corps in mainland China established a cancer registration framework, and comprehensively reported cancer incidence and mortality.<sup>2</sup>

The data on esophageal cancer includes new cases, deaths, morbidity, mortality and ASR from 2005 to 2015, extracted from the *annual report of the Chinese Cancer Registry*. The cases of esophageal cancer (C15) were determined by the tenth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10). Included data between January 1 and December 31 of the year, all cases were diagnosed with esophageal cancer or died of esophageal cancer.

The incidence and mortality of esophageal cancer are stratified by gender (male or female) and region (urban or rural). The ASIR and ASMR of the Chinese population are standardized by the Chinese population structure of 1982 (2005-2009) or 2000 (2010-2015). Segi's world population structure standardizes the ASIR and ASMR of the world population. All rates are expressed per 100,000 person-years. Connection point regression analysis, by linking several different linear segments on the logarithmic scale of the connection point to describe the change of the result trend.<sup>8</sup> The morbidity and mortality trends of esophageal cancer from 2005 to 2015 were described. Using the joint point regression program (version 4.7.0.0) to calculate the average annual rate of change (AAPC), APC and its 95% confidence interval (95% CI). In addition, the number and location of the connection points and the corresponding  $P$  value are determined by permutation tests. The significance level  $\alpha$  of both sides is taken as 0.05.

## 3 | RESULTS

### 3.1 | Incidence and mortality of esophageal cancer

By 2015, China newly diagnosed cases of esophageal cancer was 61 732 (44,067 for males and 17,667 for females), the crude incidence rate of  $19.24 / 10^5$ , new cancer cases accounted for 6.69%. The ASIRs of the Chinese population and the world population are  $11.50/10^5$  and  $11.64/10^5$  respectively, ranking sixth in the incidence of all cancers. Among them, the rough hair rate of men is  $27.07/10^5$ , accounting for 8.64% of new cancer cases in men. The ASIRs of the Chinese population and the world population are  $16.96/10^5$  and  $17.19/10^5$  respectively. The incidence of brutality among

women is  $11.17/10^5$ , accounting for 4.28% of new cancer cases in women. The ASIRs of the Chinese population and the world population are  $6.21/10^5$  and  $6.24/10^5$  respectively. From 2005 to 2015, the incidence of esophageal cancer first increased, and then declined by gender in the general population and subgroups, reaching a peak in 2010. In addition, the number of new cases in men in 2015 was significantly higher than that in women, with a ratio of approximately 2.5:1 (Table 1).

2015, esophageal cancer deaths was 47 373 (34,262 for males and 13,111 for females), the crude mortality rate of  $14.76 / 10^5$ , accounting for 8.39 percent of the total cancer deaths. The ASMR of the Chinese population and the world population are  $8.54/10^5$  and  $8.57/10^5$  respectively, ranking fourth among all cancer death rates. Among them, the crude death rate for men was  $21.05/10^5$ , accounting for 8.64% of the total deaths from cancer in men. The ASMRs of the Chinese population and the world population are  $12.92/10^5$

**TABLE 1** The incidence of esophageal cancer in registered areas in China from 2005 to 2015

Year	Gender	Number of cases	Crude oil rate (1/10 <sup>5</sup> )	Proportion(%)	ASIR China (1/10 <sup>5</sup> )	ASIR World (1/10 <sup>5</sup> )
2005	All	10 738	19.55	7.57	10.24	13.84
	male	7321	26.31	9.19	14.55	19.65
	Female	3417	12.61	5.49	6.13	8.39
2006	All	11 195	18.79	6.87	9.68	13.11
	male	7653	25.50	8.39	13.83	18.77
	Female	3542	11.99	4.93	5.75	7.83
2007	All	11 877	19.86	7.19	10.14	13.71
	male	8115	26.85	8.80	14.39	19.46
	Female	3762	12.72	5.16	6.05	8.26
2008	All	13 792	20.85	6.97	9.88	13.54
	male	9556	28.66	8.68	14.26	19.55
	Female	4236	12.92	4.83	5.69	7.87
2009	All	18 924	22.14	7.74	10.88	14.81
	male	13 161	30.44	9.57	15.62	21.27
	Female	5763	13.64	5.39	6.27	8.59
2010	All	30 364	24.36	8.69	16.19	16.48
	male	21 082	33.42	10.62	23.23	23.68
	Female	9282	15.07	6.15	9.44	9.57
2011	All	33 339	22.87	8.07	14.95	15.19
	male	23 549	31.98	10.10	21.79	22.18
	Female	9790	13.58	5.45	8.37	8.46
2012	All	44 967	22.70	8.09	14.66	14.86
	male	31 733	31.62	10.16	21.35	21.66
	Female	13 234	13.55	5.43	8.23	8.30
2013	All	50 197	22.16	7.79	13.92	14.09
	male	35 414	30.83	9.82	20.25	20.55
	Female	14 783	13.24	5.21	7.79	7.84
2014	All	58 396	20.26	7.08	12.49	12.64
	male	41 755	28.56	9.11	18.41	18.69
	Female	16 641	11.72	4.54	6.74	6.77
2015	All	61 734	19.24	6.69	11.50	11.64
	male	44 067	27.07	8.64	16.94	17.19
	Female	17 667	11.17	4.28	6.21	6.24

Note: The data comes from the *annual report of the China Cancer Registry*.

Abbreviations: ASIR China, age-standardized incidence rate by Chinese population; ASIR World, age-standardized incidence rate by world population.

and 13.00/10<sup>5</sup> respectively. The crude death rate for women is 8.29/10<sup>5</sup>, accounting for 6.34% of the total deaths from cancer in women. The ASMRs of the Chinese population and the world population are 4.34/10<sup>5</sup> and 4.31/10<sup>5</sup> respectively. During the period 2005-2015, the mortality rate gradually declined. Similar to the morbidity rate, the mortality rate of men is also higher than that of women, with a mortality rate of approximately 2.6:1 (Table 2).

Grouped by gender and region, the ASIR order of esophageal cancer from high to low is rural males, rural females, urban males, and urban females. Unlike other subgroups, the incidence of rural males is decreasing year by year. As mentioned above, the incidence of men is higher than that of women. In addition, the incidence of patients in rural areas is higher than that in urban areas. In recent years, the incidence in rural areas has shown a downward trend, while

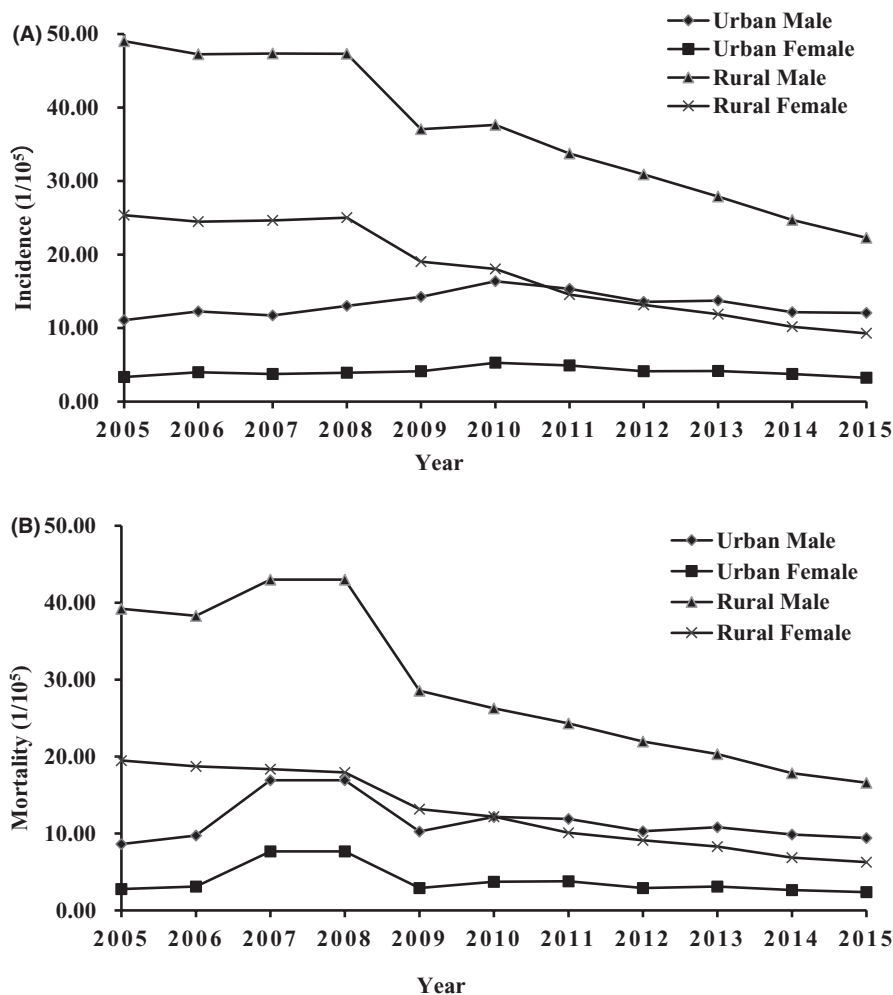
**TABLE 2** 2005-2015 Mortality of Esophageal Cancer in Registered Areas of China

Year	Gender	Number of cases	Crude oil rate (1/10 <sup>5</sup> )	Proportion(%)	ASMR China (1/10 <sup>5</sup> )	ASMR World (1/10 <sup>5</sup> )
2005	All	8669	15.78	9.34	7.91	10.86
	Male	5843	21.00	10.15	11.27	15.46
	Female	2826	10.43	8.02	4.77	6.61
2006	All	9092	15.26	8.69	7.46	10.30
	Male	6216	20.71	9.52	10.82	14.97
	Female	2876	9.73	7.30	4.33	6.04
2007	All	9450	15.80	8.92	7.58	10.47
	Male	6522	21.58	9.84	11.10	15.32
	Female	2928	9.90	7.38	4.25	5.96
2008	All	10 741	16.24	8.79	7.34	10.11
	Male	7482	22.44	9.84	10.84	14.90
	Female	3259	9.94	7.07	4.02	5.63
2009	All	14 337	16.77	9.29	7.75	10.76
	Male	10 067	23.29	10.39	11.42	15.86
	Female	4270	10.11	7.44	4.22	5.96
2010	All	22 292	17.88	10.05	11.51	11.59
	Male	15 422	24.45	11.08	16.76	16.93
	Female	6870	11.16	8.33	6.56	6.56
2011	All	25 282	17.35	9.72	11.03	11.13
	Male	17 836	24.22	10.86	16.29	16.48
	Female	7446	10.33	7.75	6.06	6.09
2012	All	33 258	16.79	9.63	10.54	10.59
	Male	23 433	23.35	10.78	15.56	15.69
	Female	9825	10.06	7.67	5.77	5.74
2013	All	37 690	16.64	9.44	10.15	10.18
	Male	26 457	23.03	10.52	14.93	15.02
	Female	11 233	10.06	7.61	5.59	5.55
2014	All	43 383	15.05	8.67	9.01	9.05
	Male	31 261	21.38	9.89	13.57	13.65
	Female	12 122	8.53	6.58	4.65	4.62
2015	All	47 373	14.76	8.39	8.54	8.57
	Male	34 262	21.05	9.57	12.92	13.00
	Female	13 111	8.29	6.34	4.34	4.31

Note: The data comes from the annual report of the China Cancer Registry .

Abbreviations: ASMR China, age-standardized incidence rate by Chinese population; ASMR World, age-standardized incidence rate by world population.

**FIGURE 1** The ASIR world (A) and ASMR world (B) of esophageal cancer in urban and rural areas by gender from 2005 to 2015.



urban areas have remained unchanged (Figure 1A). When assessing ASMR, a similar shift was observed (Figure 1B).

### 3.2 | Time trend of esophageal cancer incidence and mortality

From 2005 to 2011, the incidence of esophageal cancer gradually increased when the APC was 3.4% (95% CI: 0.6%, 6.3%), but sharply decreased at an APC of  $-7.4%$  (95% CI:  $-10.1%$ ,  $-4.7%$ ) during 2011-2015. In addition to the different connection points, similar esophageal cancer trends have also been observed in men and women. From 2005 to 2011, the incidence of men increased, APC was 3.8% (95% CI: 1.1%, 6.6%); from 2011 to 2015, the incidence decreased, APC was  $-7.0%$  (95% CI:  $-9.4%$ ,  $-4.4%$ ). For women, this connection point appeared in 2010, and there was no statistically significant trend from 2005 to 2010. Since then, the incidence of APC has decreased by  $-7.5%$  (95% CI:  $-9.8%$ ,  $-5.0%$ ). After stratified by region, the incidence rate in urban areas increased with an APC of 8.4% from 2005 to 2010 (95% CI: 4.0%, 13.0%). From 2010 to 2015, the incidence rate decreased at an APC of  $-5.7%$  (95% CI:  $-8.0%$ ,  $-3.3%$ ). In rural areas, the incidence rate decreased

throughout the study period, AAPC was  $-8.2%$  (95% CI:  $-10.0%$ ,  $-6.3%$ ) (Table 3, Figure 2A).

For mortality, Joinpoint regression analysis showed that the AAPC of the total population from 2005 to 2015 was  $-4.1%$  (95% CI:  $-6.7%$ ,  $-1.5%$ ). In terms of subgroups, males (AAPC:  $-3.5%$ , 95% CI:  $-5.9%$ ,  $-1.1%$ ), females (AAPC:  $-6.2%$ , 95% CI:  $-9.3%$ ,  $-3.0%$ ) and rural areas (AAPC:  $-10.1%$ , 95% CI:  $-11.2%$ ,  $-9.0%$ ). However, the AAPC in urban areas was not statistically significant (Table 3, Figure 2B).

## 4 | DISCUSSION

From 2005 to 2015, the incidence of esophageal cancer in China increased first (2005-2011: APC: 3.4%) and then decreased (2011-2015: APC:  $-7.4%$ ), while the mortality rate decreased year by year. Unlike our results, in other countries, both morbidity and mortality are on the rise. In Brazil, the incidence of esophageal cancer from 2005 9.1 / 10<sup>5</sup> increased to 2015 years of 12.1 / 10<sup>5</sup>.<sup>9</sup> In Serbia, during the 1991-2015 study period, the APC of male esophageal cancer mortality was 0.9% (95% CI: 0.3%, 1.4%) and 0.4% (95% CI:  $-0.6%$ ,

TABLE 3 Trends in the incidence and mortality of esophageal cancer in China from 2005 to 2015 by gender.

Variable	Incidence			Mortality	
	Year	Armored personnel carrier	IAEA	IAEA	
Total	2005–2011	3.4 <sup>A kind</sup> (0.6, 6.3)	–1.1 (–2.7, 0.6)	–4.1 <sup>A kind</sup> (–6.7, –1.5)	
	2011–2015	–7.4 <sup>A kind</sup> (–10.1, –4.7)			
Gender					
	Male	2005–2011	3.8 <sup>A kind</sup> (1.1, 6.6)	–0.6 (–2.2, 0.9)	–3.5 <sup>A kind</sup> (–5.9, –1.1)
		2011–2015	–7.0 <sup>A kind</sup> (–9.4, –4.4)		
Female	2005–2010	4.1 (–0.6, 8.9)	–1.9 (–3.9, 0.2)	–6.2 <sup>A kind</sup> (–9.3, –3.0)	
	2010–2015	–7.5 <sup>A kind</sup> (–9.8, –5.0)			
Area					
	Urban area	2005–2010	8.4 <sup>A kind</sup> (4.0, 13.0)	1.1 (–0.8, 3.1)	–4.6 (–9.1, 0.1)
		2010–2015	–5.7 <sup>A kind</sup> (–8.0, –3.3)		
Rural	2005–2008	–2.8 (–10.1, 5.1)	–8.2 <sup>A kind</sup> (–10.0, –6.3)	–10.1 <sup>A kind</sup> (–11.2, –9.0)	
	2008–2015	–10.4 <sup>A kind</sup> (–11.4, –9.3)			

Abbreviations: AAPC, average annual percentage change; APC, annual percentage change.

1.4%) for women.<sup>10</sup> Smoking is one of the established risk factors for esophageal cancer.<sup>11</sup> At the same time, China has a relatively widespread smoking epidemic and second-hand smoke exposure.<sup>12</sup> The obvious trend of esophageal cancer may be attributed to the long-term efforts of national public health measures to ban indoor smoking in the past few decades. On November 10, 2003, China officially became the 77th country to sign the *Framework Convention on Tobacco Control*. In 2006, the Seventeenth Meeting of the Standing Committee of the Tenth National People's Congress formally approved the above convention, prohibiting the use of vending machines to control tobacco.<sup>13</sup> In 2011, the Chinese government passed the "Detailed Rules for the Implementation of the Regulations on Sanitation Administration in Public Places." And bansmoking took effect on May 1 of the same year. It is clearly prohibited to smoke in indoor public places.<sup>14</sup> The relevant data show that compared with 2010, the proportion of smoking and second-hand smoke exposure in public places such as restaurants and government buildings has dropped significantly in 2015.<sup>15</sup> In addition, in 2008, the Chinese government invested approximately RMB 400 billion in health, culture and education.<sup>16</sup> This has improved the Chinese people's awareness of disease prevention and medical care, and further reduced the incidence of esophageal cancer. There is no doubt that stratified analysis based on some other important variables, such as histological type, tumor stage and tumor size, will help us better understand the current results. However, the inability to obtain detailed information about the clinicopathological characteristics of esophageal cancer is also a limitation of our study, which is inherent in the reported registration data.

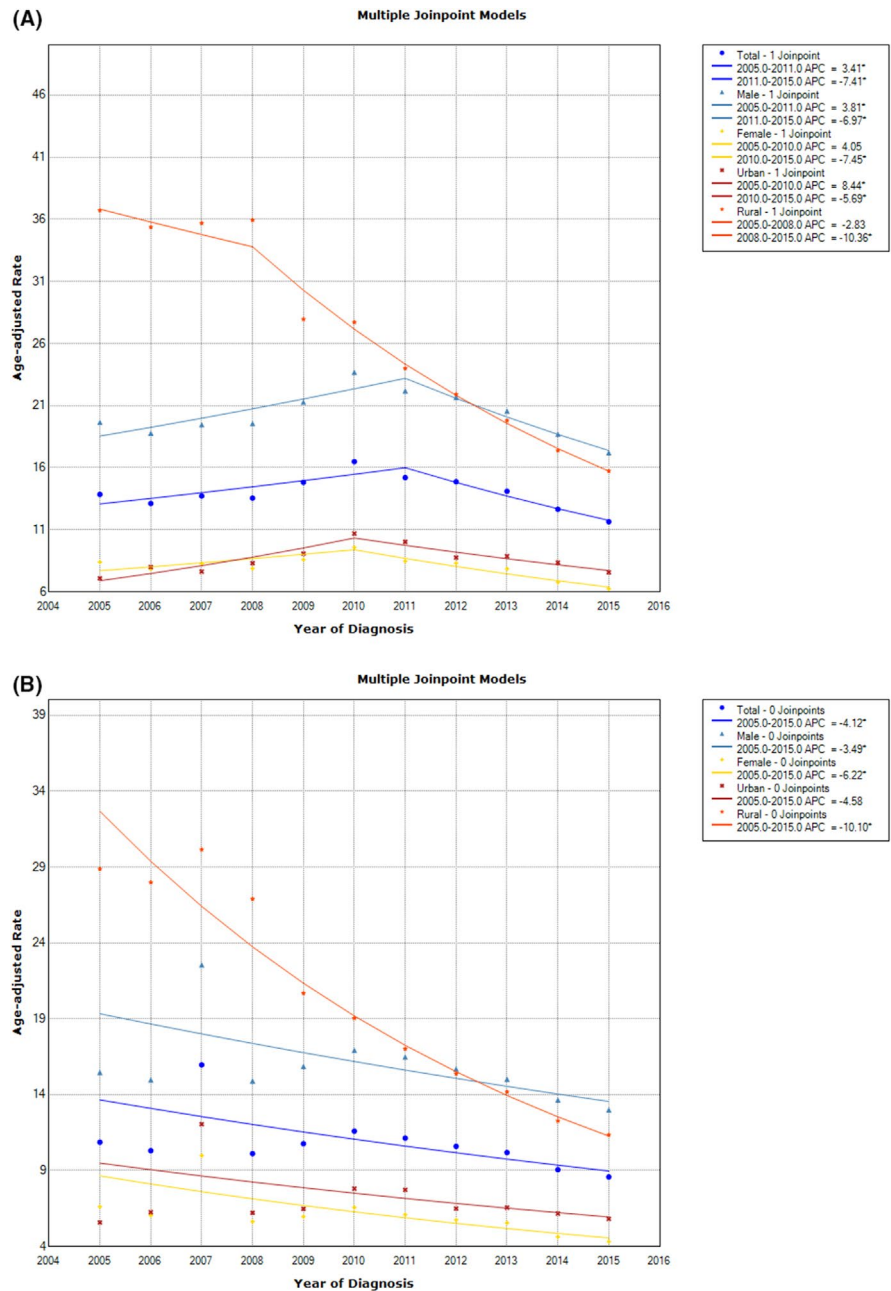
In addition, esophageal cancer screening may contribute to the uninterrupted decline in mortality (AAPC: –4.1%).

Facts have proved that endoscopic screening using iodine staining can effectively improve the 5-year survival rate and reduce mortality of patients with esophageal cancer. This is currently the best early screening method.<sup>17</sup> The central government expanded the scope of subsidies to local public health funds in 2005, including the screening, early diagnosis and treatment of esophageal cancer implemented in 2006.<sup>18</sup> The tumor stage at diagnosis was associated with the prognosis of esophagus cancer, and early detection could effectively reduce its mortality.<sup>19</sup> A long-term follow-up study on the surgical outcome of Chinese patients with esophageal cancer showed that the 5-year survival rate for early diagnosis exceeds 85%, and the 5-year survival rate for late diagnosis is less than 10%.<sup>20</sup>

In terms of gender-specific rates, as shown in Table 1 and 2, the incidence and mortality were much higher in males than in females at approximately two to three times greater. This difference was also found in other studies, which supports our results. Coincidentally, similar phenomena were found in two different subtypes of esophageal cancer. Esophageal squamous cell carcinoma (ESCC) is the main histological type in China, and males dominate, while esophageal adenocarcinoma (EAC) is common in most western countries (such as the United States, the United Kingdom and Wales) and is more common in women. For EAC, risk factors include increased body mass index and gastroesophageal reflux disease. However, smoking and drinking are the main risk factors for ESCC.<sup>1,21</sup> Therefore, research on the etiology of these unique risk factors between ESCC and EAC will help to explore the reasons for gender differences. In contrast, women (AAPC: –6.2%) have a faster decline in esophageal cancer mortality than men (AAPC: –3.5%). In recent years, the progress of neoadjuvant chemotherapy may be related to the difference in



**FIGURE 2** The trend of esophageal cancer during 2005-2015; (A) Stratification by gender and region; (B) Dividing regions by gender and mortality.



trends between men and women. Compared with men, women showed excellent pathological results after receiving preoperative neoadjuvant chemotherapy (women to men: 66.7% vs. 36.1%), but the possibility of postoperative complications was less (females vs males: 28.6% vs 52.8%).<sup>22</sup>

Compared with the urban area, as shown in Figure 1, The morbidity and mortality in rural areas are much higher. Some previous studies have reached similar conclusions.<sup>18, 23, 24</sup> It was found that the cost of health care, income level, education level, and family gathering of high-risk groups also contributed. First, patients with esophageal cancer in rural areas have always experienced delayed diagnosis and treatment. The high mortality rate may be related to poor economic capacity and insufficient medical resources.<sup>25</sup> A survey conducted in seven cities/

countries including Linzhou and Cixian showed that the annual cost of illness (ACI) for urban patients with esophageal cancer was US\$13,029, while the ACI for rural patients was only US\$3,504.<sup>26</sup> Second, there is a huge gap in income levels between urban and rural areas. The relatively low quality of life in rural areas will undoubtedly have a negative impact on the occurrence of diseases. According to the National Bureau of Statistics, from 2002 to 2014, the per capita disposable income of urban residents increased from 7702.8 yuan to 28,843.9 yuan, while the per capita disposable income of rural residents increased from 2475.6 yuan to 10 488.9 yuan.<sup>27</sup> Third, receiving a high level of education is associated with an improved survival rate of patients receiving curative treatment (HR: 0.82, 95% CI: 0.69, 0.99).<sup>28</sup> But in the past two decades, higher

education opportunities in rural areas have always lagged behind those in cities.<sup>29</sup> In addition, due to the lack of education in rural areas, insufficient awareness of disease prevention is also a reason. Fourth, among the high-risk populations in Henan Province, patients with familial esophageal cancer have some similar characteristics, that is, several generations of these family members live together in rural areas with limited mobility.<sup>30</sup> Finally, the higher smoking rate in rural areas (62% vs 44%) may also be one of the potential reasons for the higher incidence of esophageal cancer in rural areas.

Although the incidence and mortality of esophageal cancer have been declining in some areas in recent years, the survival rate of patients is still very low due to its extremely aggressive nature.<sup>1</sup> By pooling and analyzing the survival data of Chinese cancer patients from 2003 to 2015, the study found that the age-standardized 5-year relative survival rate of esophageal cancer has steadily increased in the past decade (average rate of change: 2.9%, 95% CI : 0.7%, 5.2%). However, during 2012–2015, the 5-year relative survival rate for esophageal cancer was only 30.3% (95% CI: 29.6%, 31.0%).<sup>31</sup>

## 5 | CONCLUSION

To sum up, from 2005 to 2015, the incidence of esophageal cancer in China increased first, then decreased, and the mortality rate gradually decreased. The incidence and mortality of esophageal cancer in men are higher than women, and in rural areas than in urban areas.

It suggests that the existing diagnosis and treatment methods can be maintained. On the other hand, timely intervention measures should be taken to the known risk factors of esophageal cancer. And more research should be conducted to explore the underlying reasons (such as the molecular mechanism of genetic influence) that affect the changes in the incidence and mortality of esophageal cancer.

### CONFLICT OF INTEREST

The author did not disclose.

### AUTHOR CONTRIBUTION

Ping Zhiguang conceived and designed this research. He Feifan, Qin Xiaoyue, Wan Zhanyong and Li Wei arranged and analyzed the data. He Feifan and Wang Junyi explained data and drafted manuscripts, tables and figures. Liu Li and Ping Zhiguang reviewed the manuscript.

### DATA AVAILABILITY STATEMENT

All raw data are publicly available through the China Central Cancer Registry.

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