

## Preplanned Studies

## The Incidence, Mortality, and DALYs Trends Associated with Esophageal Cancer — China, 1990–2019

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### Summary

#### What is already known about this topic?

Esophageal cancer (EC) is one of the most common malignant tumors in China. The new cases and deaths in China account for more than half of the world, and the disease burden of esophageal cancer is serious.

#### What is added by this report?

From 1990 to 2019, the disease burden of EC in China showed a decrease overall; it first increased between 1990 and 2004, but then decreased between 2004 and 2019. The burden of EC in men was much higher than that in women. Age was an important factor affecting the burden of EC, with disease burden rising rapidly after 40 years old.

#### What are the implications for public health practices?

The screening, early diagnosis, and treatment for EC should continue to be strengthened in China. Middle-aged and elderly men are high-risk groups of EC and should be a key population for EC prevention and control.

Esophageal cancer (EC) is one of the common malignant tumors that cause death and disability among Chinese people. According to the latest analysis of malignant tumors in China, EC is the sixth most common cancer and the fourth leading cause of death from cancer in China (1). The burden of EC in China is serious: in 2019, there were 278,121 new cases and 257,316 deaths by EC in China, accounting for more than half of the number of cases and deaths in the world (2). The standardized incidence rate (SIR) and standardized mortality rate (SMR) of EC in China were 13.90/100,000 and 13.15/100,000, respectively, which were far higher than the global levels of 6.51/100,000 and 6.11/100,000, respectively (2). The prognosis of EC is poor, and the five-year survival rate was only 30.3% (3). The data in this report were obtained from the latest estimates of the Global Burden of Disease Study 2019 (GBD 2019) (2), which

were used to analyze the burden of EC in China from 1990–2019. The results of this study showed that the burden of EC in men was much higher than that in women from 1990–2019. Age was an important factor affecting the burden of EC, with the disease burden rising rapidly after 40 years old. The screening, early diagnosis, and treatment for high-risk groups of EC should continue to be strengthened in China.

The data in this report were extracted from the GBD 2019 (2). Related indicators of incidence, mortality, and disability-adjusted life years (DALYs) in 1990, 2004, and 2019 were used to evaluate the trend of the burden of EC in China. DALYs refer to all healthy life years lost from illness to death. DALYs include the years of life lost (YLLs) caused by premature death and the years lived with disability (YLDs) caused by disability due to disease. The incidence, mortality, and DALYs of EC in China from 1990 to 2019 were described by gender. The burden of EC of different age groups in 2019 was analyzed in the 5-year-old group distance. This study aimed to update and present the incidence and deaths of EC and provide the basis for the prevention and control of EC.

From 1990 to 2019, the number of cases of EC increased from 173,687 to 278,121, an increase of 60.13%; the crude incidence rate increased from 14.67/100,000 to 19.55/100,000, an increase of 33.27%. In 2019, the SIR of EC was 13.90/100,000, a 33.71% decrease compared to the SIR of 1990 (Table 1). Similarly, from 1990 to 2019, the number of deaths caused by EC increased from 176,602 to 257,316, an increase of 45.70%; the crude mortality rate increased from 14.92/100,000 to 18.09/100,000, an increase of 21.25%. In 2019, the SMR of EC was 13.15/100,000, a decrease of 40.44% compared to the SMR of 1990 (Table 1). The overall DALYs of EC in China from 1990 to 2019 increased from 4,494,070 to 5,759,997 person years, an increase of 28.17%; the crude DALYs rate increased from 379.67/100,000 to 404.96/100,000, an increase of 6.66%. In 2019, the standardized DALYs rate of EC was 277.50/100,000,

TABLE 1. Overall incidence, deaths, and burden indicators of esophageal cancer for the years 1990, 2004, and 2019 in China.

| Gender | Year              | Incidence |        |           |         |           |        | Deaths    |        |           |           |           |        | DALYs  |        |           |   |           |    | YLLs  |   |           |   |           |    | YLDs  |   |           |   |           |    |  |  |  |
|--------|-------------------|-----------|--------|-----------|---------|-----------|--------|-----------|--------|-----------|-----------|-----------|--------|--------|--------|-----------|---|-----------|----|-------|---|-----------|---|-----------|----|-------|---|-----------|---|-----------|----|--|--|--|
|        |                   | Cases     |        | 1/100,000 |         | 1/100,000 |        | Cases     |        | 1/100,000 |           | 1/100,000 |        | Cases  |        | 1/100,000 |   | 1/100,000 |    | Cases |   | 1/100,000 |   | 1/100,000 |    | Cases |   | 1/100,000 |   | 1/100,000 |    |  |  |  |
|        |                   | N         | P      | P*        | N       | P         | P*     | N         | P      | P*        | N         | P         | P*     | N      | P      | P*        | N | P         | P* | N     | P | P*        | N | P         | P* | N     | P | P*        | N | P         | P* |  |  |  |
|        | 1990              | 115,475   | 18.92  | 28.70     | 117,085 | 19.19     | 30.53  | 3,127,519 | 512.55 | 707.12    | 3,097,716 | 507.67    | 699.98 | 29,803 | 4.88   | 7.14      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2004              | 199,091   | 29.15  | 33.08     | 199,078 | 29.15     | 34.49  | 5,129,816 | 751.13 | 782.60    | 5,078,004 | 743.54    | 774.28 | 51,811 | 7.59   | 8.33      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2019              | 207,924   | 28.69  | 21.94     | 197,716 | 27.28     | 21.69  | 4,622,298 | 637.72 | 458.55    | 4,566,573 | 630.03    | 452.83 | 55,725 | 7.69   | 5.72      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
| Men    | 2019 vs. 1990 (%) | 80.06     | 51.64  | -23.55    | 68.87   | 42.16     | -28.96 | 47.79     | 24.42  | -35.15    | 47.42     | 24.10     | -35.31 | 86.98  | 57.58  | -19.89    |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2004 vs. 1990 (%) | 72.41     | 54.07  | 15.26     | 70.03   | 51.90     | 12.97  | 64.02     | 46.55  | 10.67     | 63.93     | 46.46     | 10.61  | 73.84  | 55.33  | 16.67     |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2019 vs. 2004 (%) | 4.44      | -1.58  | -33.68    | -0.68   | -6.42     | -37.11 | -9.89     | -15.10 | -41.41    | -10.07    | -15.27    | -41.52 | 7.55   | 1.32   | -31.33    |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 1990              | 58,212    | 10.15  | 13.94     | 59,517  | 10.38     | 14.69  | 1,366,551 | 238.28 | 311.63    | 1,351,838 | 235.72    | 308.19 | 14,713 | 2.57   | 3.45      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2004              | 90,571    | 14.00  | 14.73     | 86,299  | 13.34     | 14.44  | 1,888,217 | 291.83 | 296.22    | 1,864,158 | 288.11    | 292.40 | 24,059 | 3.72   | 3.83      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
| Women  | 2019              | 70,197    | 10.06  | 6.83      | 59,600  | 8.54      | 5.92   | 1,137,699 | 163.10 | 108.46    | 1,117,181 | 160.16    | 106.48 | 20,518 | 2.94   | 1.97      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2019 vs. 1990 (%) | 20.59     | -0.89  | -51.00    | 0.14    | -17.73    | -59.70 | -16.75    | -31.55 | -65.20    | -17.36    | -32.05    | -65.45 | 39.45  | 14.40  | -42.90    |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2004 vs. 1990 (%) | 55.59     | 37.93  | 5.67      | 45.00   | 28.52     | -1.70  | 38.17     | 22.47  | -4.94     | 37.90     | 22.23     | -5.12  | 63.52  | 44.75  | 11.01     |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2019 vs. 2004 (%) | -22.50    | -28.14 | -53.63    | -30.94  | -35.98    | -59.00 | -39.75    | -44.11 | -63.39    | -40.07    | -44.41    | -63.58 | -14.72 | -20.97 | -48.56    |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 1990              | 173,687   | 14.67  | 20.97     | 176,602 | 14.92     | 22.08  | 4,494,070 | 379.67 | 506.98    | 4,449,555 | 375.91    | 501.75 | 44,516 | 3.76   | 5.23      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2004              | 289,663   | 21.78  | 23.54     | 285,377 | 21.46     | 23.91  | 7,018,033 | 527.68 | 537.02    | 6,942,162 | 521.98    | 531.01 | 75,871 | 5.70   | 6.01      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2019              | 278,121   | 19.55  | 13.90     | 257,316 | 18.09     | 13.15  | 5,759,997 | 404.96 | 277.50    | 5,683,755 | 399.60    | 273.75 | 76,243 | 5.36   | 3.75      |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
| Total  | 2019 vs. 1990 (%) | 60.13     | 33.27  | -33.71    | 45.70   | 21.25     | -40.44 | 28.17     | 6.66   | -45.26    | 27.74     | 6.30      | -45.44 | 71.27  | 42.55  | -28.30    |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2004 vs. 1990 (%) | 66.77     | 48.47  | 12.26     | 61.59   | 43.83     | 8.29   | 56.16     | 38.98  | 5.92      | 56.02     | 38.86     | 5.83   | 70.44  | 51.60  | 14.91     |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |
|        | 2019 vs. 2004 (%) | -3.98     | -10.24 | -40.95    | -9.83   | -15.70    | -45.00 | -17.93    | -23.26 | -48.33    | -18.13    | -23.45    | -48.45 | 0.49   | -5.96  | -37.60    |   |           |    |       |   |           |   |           |    |       |   |           |   |           |    |  |  |  |

Abbreviation: DALYs=disability adjusted of life years, YLLs=years of life lost, YLDs=years lived with disability, N=number of cases for incidence and deaths / number of person years for DALYs, YLLs, and YLDs; P=crude rate, expressed as 1/100,000; P\*=standardized rate, expressed as 1/100,000.

which was 45.26% lower than the DALYs rate in 1990 (Table 1). DALYs of EC were mainly caused by early death of YLLs, and the proportion of YLLs in DALYs was about 99% (Table 1).

From 1990 to 2019, the crude incidence rate, crude mortality rate, and crude DALYs rate of EC in China showed an overall increasing trend. The rates first increased, reaching a peak in 2004 but then decreased in the years following (Figure 1). The SIR, SMR, and standardized DALYs rate also showed an increase at first followed by a decline, but the decline was faster, and the overall trend was declining compared to the crude rate (Figure 1). From 1990 to 2019, the incidence, mortality, and DALYs rate of EC in men were much higher than those in women. The SIR of EC in men was about 2–3 times that of women (Figure 1). From 1990 to 2019, the crude incidence rate, crude mortality rate, and crude DALYs rate of EC in men increased by 51.64%, 42.16%, and 24.42%, respectively, and those in women decreased by 0.89%, 17.73%, and 31.55%, respectively. From 1990 to 2019, the SIR, SMR, and standardized DALYs rate of EC in men decreased by 23.55%, 28.96%, and 35.15%, respectively, and those in women decreased by 51.00%, 59.70%, and 65.20%, respectively. All these indicators of the burden of EC decreased significantly in women than in men (Figure 1 & Table 1).

The age distributions of EC incidence rate, mortality rate, and DALYs rate were similar. The incidence rate, mortality rate, and DALYs rate among people under 20 years old were all 0. Those indicators in people under 40 years old were at a relatively low level but rose after the age of 40. The incidence rate and mortality rate of EC increased monotonously with the increase of age groups and reached the highest in the age group over 85 years old. The highest DALYs rate was found in 75–79 year-old population. Among these, the incidence, mortality, and DALYs rate of all age groups in men were much higher than those in women (Figure 2).

## DISCUSSION

The results of this study showed that the crude incidence rate, crude mortality rate, and crude DALYs rate of EC in China increased overall from 1990 to 2019, which indicated that the burden of EC in China was still heavy. Different from the increasing trend of crude rate, the SIR, SMR, and standardized DALYs rate showed an overall decreasing trend, which is

consistent with the previous research results reported in China (4). This phenomenon is related to the change in population structure caused by aging.

The burden of EC first increased and then decreased. The “Outline of China Cancer Prevention and Control Program (2004–2010)” issued by the Ministry of Health is a programmatic document on cancer prevention and treatment (5), which has played an important role in promoting cancer prevention and treatment in China. In 2005, China carried out cancer screening and early diagnosis and treatment (including esophageal, stomach, liver, nasopharyngeal, female breast, and cervical cancers) in rural high-risk areas in the form of central fiscal transfer payments (3,6). Screening has found a considerable number of precancerous lesions and esophageal cancer patients, urged them to seek medical treatment as early as possible and inhibited the progression of the disease to advanced esophageal cancer, and also reduced the death of EC. Thereby the incidence and mortality rate of EC decreased. This may be an important reason for the decrease in the burden of EC after 2004. It shows that screening and early diagnosis of esophageal EC have achieved certain preventive effects (7). YLLs account for about 99% of DALYs, indicating that the life loss caused by early death of esophageal cancer is still at a high level. China should continue to strengthen early screening for EC.

From 1990 to 2019, the incidence, mortality, and DALYs rate of EC in men were much higher than those in women, and the crude incidence rate, crude death rate, and crude DALYs rate of men increased, while those of women decreased. This may be closely related to the drinking and smoking habits of the male population (8), so the male population should be the key intervention group. Women’s burden of EC decreased more than men’s, which may be related to women’s high fruit intake (9), low drinking and smoking rates and other habits (8). The estrogen in women can also affect the disease as it has been shown to have a preventive and therapeutic effect (10).

The results of the analysis of EC burden among different age groups in China in 2019 showed that the incidence, mortality, and DALYs rate of EC in people under 40 years old were at a relatively low level, but rose rapidly after the age of 40. Age was an important factor influencing the burden of EC, and it increased with age. In all age groups, the burden of EC in men was significantly higher than that in women. It is suggested that middle-aged and elderly men are high-risk populations for EC and should be regarded as a

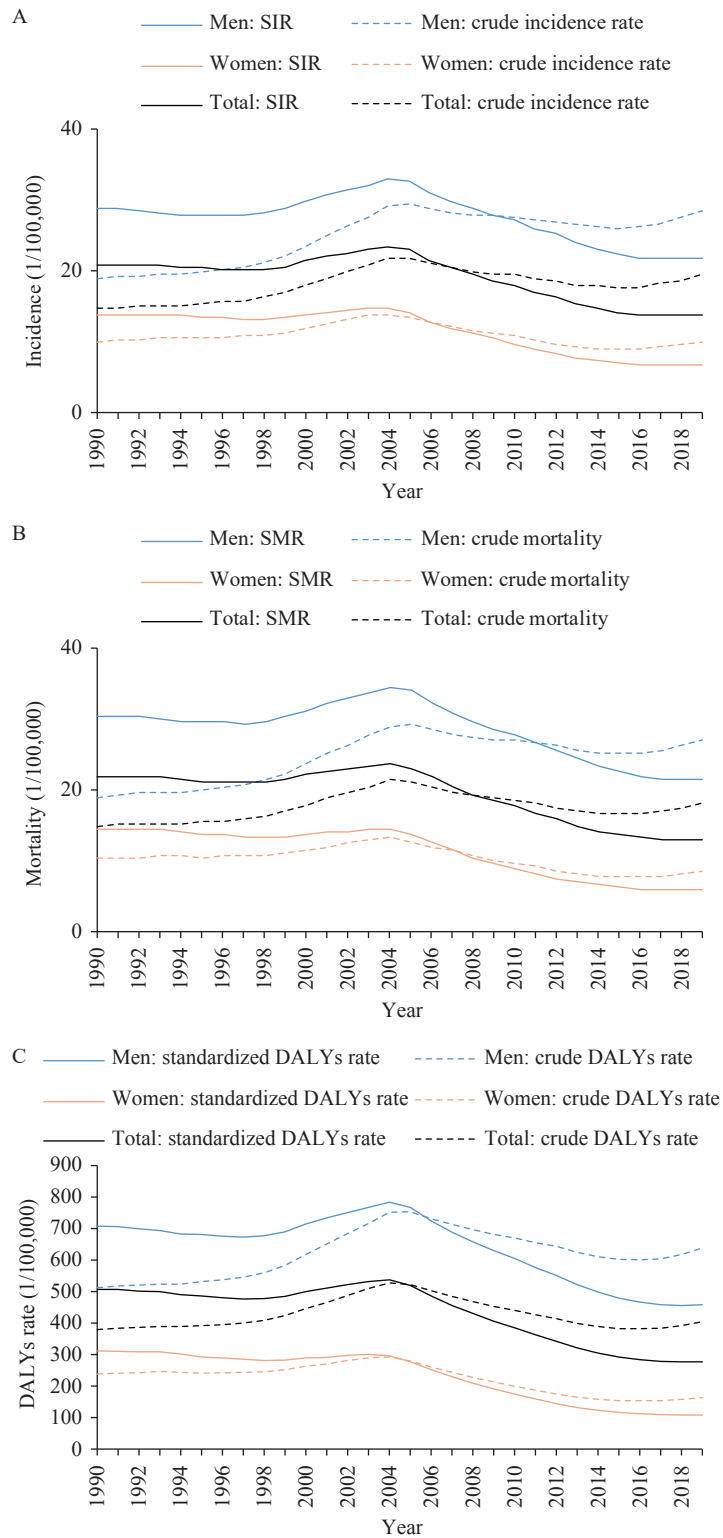


FIGURE 1. The incidence, mortality, and DALYs rate of esophageal cancer from 1990 to 2019 in China. (A) The incidence of esophageal cancer from 1990 to 2019 in China; (B) The mortality of esophageal cancer from 1990 to 2019 in China; (C) The DALYs rate of esophageal cancer from 1990 to 2019 in China. Abbreviation: SIR=standardized incidence rate; SMR=standardized mortality rate; DALYs=disability adjusted of life years.

key population for EC prevention and control and regular screening measures should be taken.

After analysis, we observed the EC data collected from GBD 2019 were close to reports on EC incidence

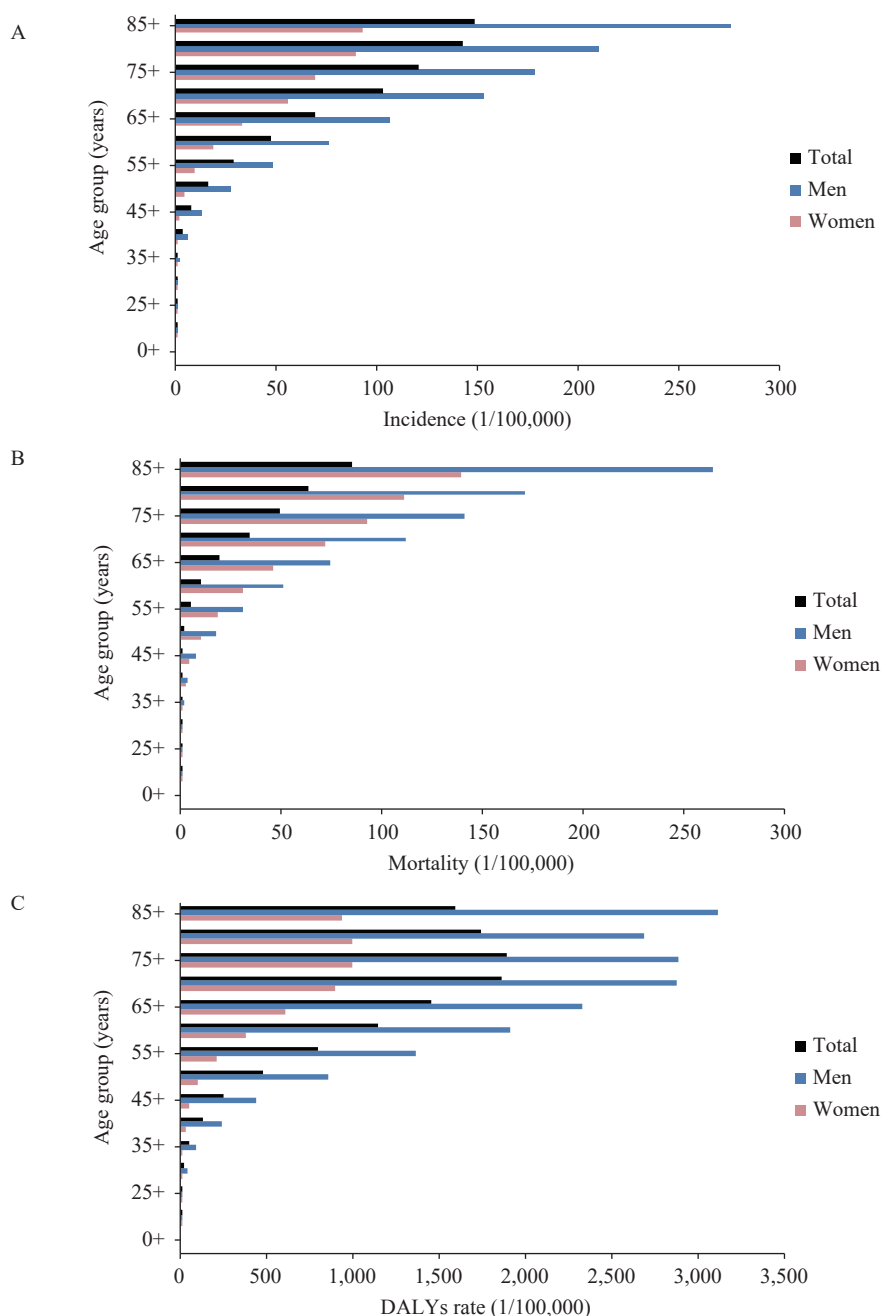


FIGURE 2. The incidence, mortality, and DALYs rate of esophageal cancer among different age groups in 2019. (A) The incidence of esophageal cancer among different age groups in 2019; (B) The mortality of esophageal cancer among different age groups in 2019; (C) The DALYs rate of esophageal cancer among different age groups in 2019. Abbreviation: DALYs=disability adjusted of life years.

and mortality data in Chinese cancer registration areas as the ratio of incidence was between 0.88 and 1.24 and the ratio of mortality was between 1.12 and 1.52 (11–12). The two different sources provided comparable data.

This study still has certain limitations. First, EC includes two main histological subtypes:

adenocarcinoma (AC) and squamous cell carcinoma (SCC) (13), which were not classified in the analysis. Second, this study did not differentiate between urban and rural areas and different regions in detail.

In summary, the SIR and SMR of EC in China from 1990 to 2019 showed decreases, but the burden of EC in China was still severe due to the large aging

population. EC is a great hazard to the health of the population, especially in men over 40 years of age. It is necessary to increase the detection rate and early diagnosis and treatment for high-risk groups of EC, which is the basis for greatly reducing the incidence and mortality.

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