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RESEARCH PAPER

Cancer profiles in China and comparisons with the USA: a comprehensive analysis in the incidence, mortality, survival, staging, and attribution to risk factors

Siyi He, Changfa Xia, He Li, Maomao Cao, Fan Yang, Xinxin Yan, Shaoli Zhang, Yi Teng, Qianru Li & Wanqing Chen*

Office of Cancer Screening, National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing 100021, China

*Corresponding author (email: chenwq@cicams.ac.cn)

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China faces a disproportionate cancer burden to the population size and is undergoing a transition in the cancer spectrum. We extracted data in five aspects of cancer incidence, mortality, survival, staging distributions, and attribution to risk factors in China, the USA and worldwide from open-source databases. We conducted a comprehensive secondary analysis of cancer profiles in China in the above aspects, and compared cancer statistics between China and the USA. A total of 4,546,400 new cancer cases and 2,992,600 deaths occurred in China in 2020, accounting for 25.1% and 30.2% of global cases, respectively. Lifestyle-related cancers including lung cancer, colorectal cancer, and breast cancer showed an upward trend and have been the leading cancer types in China. 41.6% of new cancer cases and 49.3% of cancer deaths occurred in digestive-system cancers in China, and the cancers of esophagus, nasopharynx, liver, and stomach in China accounted for over 40% of global cases. Infection-related cancers showed the highest population-attributable fractions among Chinese adults, and most cancers could be attributed to behavioral and metabolic factors. The proportions of stage I for most cancer types were much higher in the USA than in China, except for esophageal cancer (78.2% *vs.* 41.1%). The 5-year relative survival rates in China have improved substantially during 2000–2014, whereas survival for most cancer types in the USA was significantly higher than in China, except for upper gastrointestinal cancers. Our findings suggest that although substantial progress has been made in cancer control, especially in digestive system cancers in China, there was still a considerable disparity in cancer burden between China and the USA. More robust policies on risk factors and standardized screening practices are urgently warranted to curb the cancer growth and improve the prognosis for cancer patients.

cancer burden | survival rate | neoplasm staging | risk factors | China

INTRODUCTION

According to estimates of GLOBOCAN 2020, there were 19,292,789 newly-diagnosed cancer cases and 9,958,133 cancer deaths worldwide in 2020 (Ferlay et al., 2020). It ranked the first or second leading cause of death among population below age 70 years in 112 of 183 countries (Sung et al., 2021), and remains a prominent threat to public health in China (Sun et al., 2020; Wu et al., 2019). With the growth of population size and the population aging, the cancer burden in China presented a steadily upward trend in recent decades (Cao et al., 2021c; Xia et al., 2022). Cancer has been the primary cause of death among males and the top three causes of death among female residents in both urban and rural China since 2005, accounting for around one-quarter and one-fifth of overall male and female deaths, respectively (National Health Commission, 2023). Total expenses for Chinese cancer patients reached 304.84 billion Chinese Yuan in 2017, accounting for 5.8% of the total health expenses (Cai et al., 2021). In addition, China's cancer spectrums have been facing a dramatic transition in the past 30 years, from the mode in developing countries to that of developed countries, with a reduction in upper gastrointestinal cancers and an increase in cancers of colorectum, prostate, thyroid, and breast (Wang et al., 2023; Wei et al., 2020).

Considering the large population scale, the cancer burden in China may strongly influence global cancer statistics (Bray et al., 2012; Wei et al., 2020) and the affordability of healthcare for the Chinese government and individuals (Cai et al., 2021; Mao et al., 2017; Zhao et al., 2016). In order to reduce the cancer burden, the Chinese government has issued policy documents such as the *Health China 2030* to guide cancer control actions (Jia et al., 2019; National Health Commission, 2019), which has achieved initial progress in terms of cancer literacy, survival and incidence of certain cancer types (He et al., 2023; Wei et al., 2020; Zeng et al., 2018). To the best of our knowledge, a comprehensive analysis of the current cancer profiles in China is still urgently warranted to provide references for further formulation and adjustments of cancer prevention strategies. In this study, we applied open-source and published data, conducted a secondary analysis of incidence, mortality, survival, staging distributions, and attribution to risk factors in China, and systematically compared them with cancer profiles in the USA.

RESULTS

Cancer incidence in China, by sex and age group

It is estimated that there were 4,546,400 new cancer cases in China in 2020, accounting for 25.1% of global new cases. As shown in Table 1, the five leading cancer types in China were lung, colorectal, stomach, breast, and liver cancers, and 41.6% of newly-diagnosed cases were cancers of the digestive system (colorectum, stomach, liver, esophagus, and pancreas). In addition, new cases of four cancer types in China accounted for almost half of the global new diagnoses, which were esophagus (53.7%), nasopharynx (46.8%), liver (45.3%), and stomach cancer (43.9%), respectively (Table 1).

Cancer incidence in 2020 in Chinese males was considerably higher than in females, with an age-standardized incidence rate (ASIR) of 224.3 per 100,000 and 187.3 per 100,000, respectively. The most common cancers diagnosed among Chinese males and females were lung cancer and breast cancer, with an ASIR of 47.8 per 100,000 and 39.1 per 100,000, respectively (Figure 1). Cancer spectrums varied among age groups in China. The overall cancer incidence increased with age, and the ASIR of the childhood group, young adults, middle-aged adults, and older population was 10.9 per 100,000, 103.2 per 100,000, 558.8 per 100,000, and 1222.1 per 100,000, respectively. Leukaemia was the predominant cancer type among the childhood group, and cancers of breast, thyroid, and cervix uteri were the primary early-onset cancer types. Older population showed much higher cancer incidence, with the lung (274.3 per 100,000), colorectal (180.1 per 100,000), and stomach cancer (149.0 per 100,000) ranking in the top 3 (Figure 1).

Cancer mortality in China, by sex and age group

A total of 2,992,600 deaths from cancer were estimated to occur in China in 2020, accounting for 30.2% of global cancer deaths. Table 2 depicts the leading causes of cancer deaths in China and worldwide. The five predominant causes of cancer deaths in 2020 were lung, liver, stomach, esophagus, and colorectal cancer. For each of the above types, cancer deaths in China accounted for nearly 40% of the global cancer deaths, respectively. Moreover, almost half of the cancer deaths occurred in cancers of the digestive system (49.3%) in 2020 (Table 2).

Chinese males faced significantly higher cancer mortality than females, with an age-standardized mortality rate (ASMR) of 163.3 per 100,000 and 97.7 per 100,000, respectively. For both males and females, the primary cause of cancer deaths in China was lung cancer, with an ASMR of 41.8 per 100,000 and 19.7 per 100,000, respectively (Figure 1). Consistent with cancer incidence in China, the overall cancer mortality increased with age, and the ASMR of childhood group, young adults, middle-aged adults, and older population was 4.2 per 100,000, 35.0 per 100,000, 326.7 per 100,000, and 1,012.0 per 100,000, respectively. Leukaemia was the leading cause of cancer deaths

Table 1. Estimated new cancer cases and incidence rates of the top 20 cancer types in China and worldwide, 2020[a)]

Cancer site	China					Global			
	New cases	Proportion of cancer cases in China (%)	Proportion of corresponding cases worldwide (%)	ASIR[b)], per 100,000	Rank[c)]	New cases	Proportion of cancer cases worldwide (%)	ASIR[b)], per 100,000	Rank[c)]
Lung	815,563	17.9	37.0	34.8	2	2,206,771	12.2	22.4	3
Colorectum	555,477	12.2	28.8	23.9	3	1,931,590	10.7	19.5	4
Stomach	478,508	10.5	43.9	20.6	4	1,089,103	6.0	11.1	6
Breast	416,371	9.2	18.4	39.1	1	2,261,419	12.5	47.8	1
Liver	410,038	9.0	45.3	18.2	5	905,677	5.0	9.5	7
Esophagus	324,422	7.1	53.7	13.8	6	604,100	3.3	6.3	11
Thyroid	221,093	4.9	37.7	11.3	7	586,202	3.2	6.6	9
Pancreas	124,994	2.7	25.2	5.3	11	495,773	2.7	4.9	15
Prostate	115,426	2.5	8.2	10.2	9	1,414,259	7.8	30.7	2
Cervix uteri	109,741	2.4	18.2	10.7	8	604,127	3.3	13.3	5
Non-Hodgkin lymphoma	92,834	2.0	17.1	4.3	14	544,352	3.0	5.8	12
Bladder	85,694	1.9	14.9	3.6	16	573,278	3.2	5.6	13
Leukaemia	85,404	1.9	18.0	5.1	13	474,519	2.6	5.4	14
Corpusuteri	81,964	1.8	19.6	7.6	10	417,367	2.3	8.7	8
Brain, central nervous system	79,575	1.8	25.8	4.1	15	308,102	1.7	3.5	18
Kidney	73,587	1.6	17.1	3.3	17	431,288	2.4	4.6	16
Nasopharynx	62,444	1.4	46.8	3	18	133,354	0.7	1.5	23
Ovary	55,342	1.2	17.6	5.3	12	313,959	1.7	6.6	10
Lip, oral cavity	30,117	0.7	8.0	1.3	19	377,713	2.1	4.1	17
Larynx	29,135	0.6	15.8	1.3	20	184,615	1.0	2	20

a) Excluding non-melanoma skin cancer. b) Adjusted by Segi's world standard population. c) Ranked by the ASIR. ASIR, age-standardized incidence rate. The incidence data were obtained from the Global Cancer Observatory Platform released by the Cancer Surveillance Branch of International Agency for Research on Cancer (https://gco.iarc.fr/today/home) (Ferlay et al., 2020).

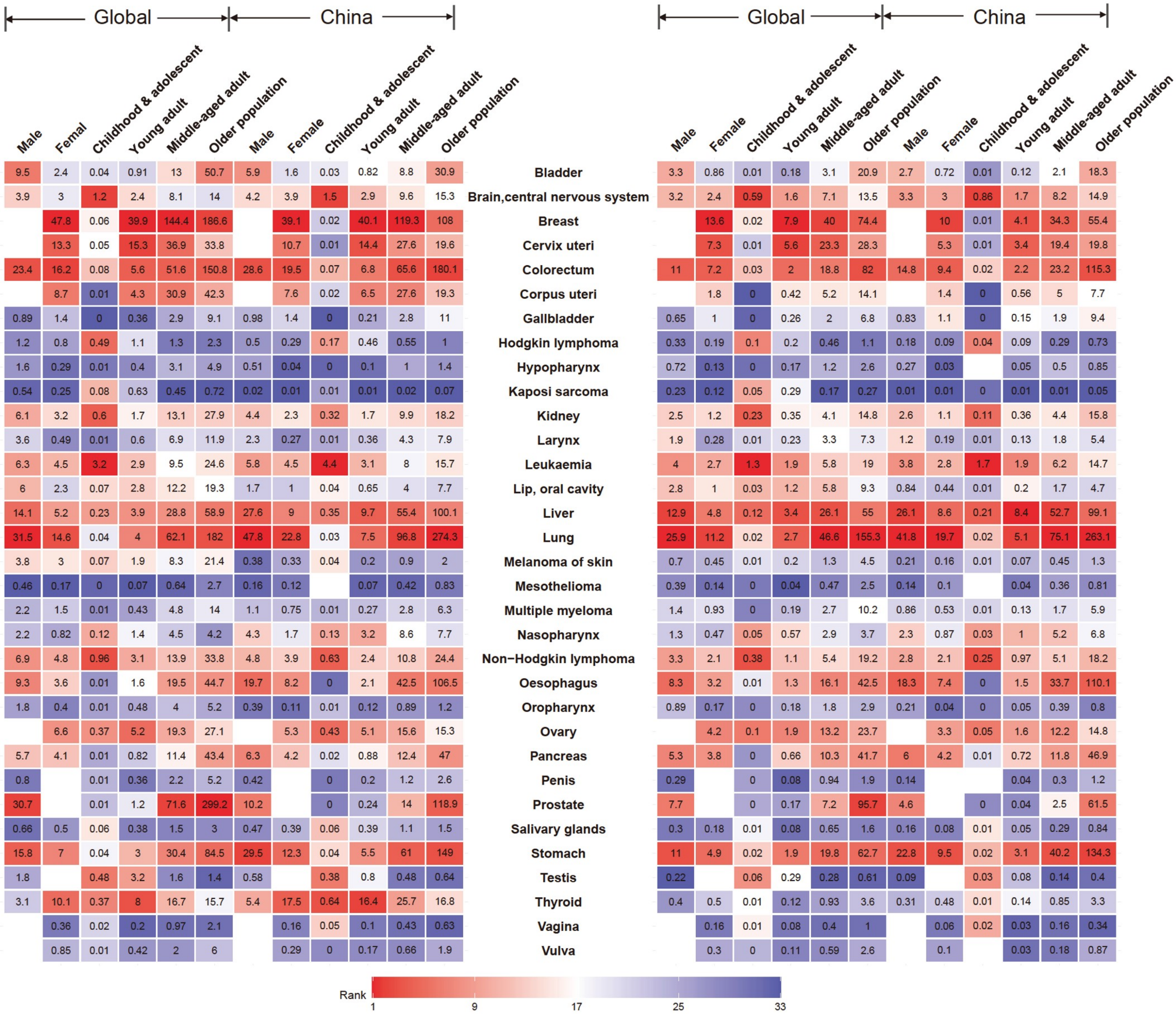

Figure 1. The age-standardized incidence rates (left) and mortality rates (right) of 33 cancer types in China and worldwide in 2020, by sex and age group. The numbers shown in each cell represent the age-standardized incidence/mortality rates (per 100,000). The color of each cell shows the rankings of rates in each column. All data in this figure were obtained from the Global Cancer Observatory Platform released by the Cancer Surveillance Branch of International Agency for Research on Cancer (https://gco.iarc.fr/today/home) (Ferlay et al., 2020).

among the childhood group, whereas the highest ASMRs were observed for cancers of liver, lung, and breast among young adults. Besides, deaths from lung cancer contributed to the greatest cancer deaths in the middle-aged and older population, with an ASMR of 75.1 per 100,000 and 263.1 per 100,000, respectively (Figure 1).

Cancer staging and age-standardized 5-year net survival in China

There was significant heterogeneity in the distributions of cancer staging in China during 2016–2017 (Table 3). Patients diagnosed with female breast cancer showed the highest proportion of stage I–II (78.3%), whilst patients with lung cancer and stomach cancer had the highest proportion of advanced stages (67.5% and 64.7 % of stage III–IV, respectively). In addition, the proportion of stage I–II cases was substantially higher in females than in males for lung cancer, esophagus cancer, and all cancers combined, although no significant differences were observed in the staging distributions of colorectal cancer and stomach cancer (Table 3).

Figure 2 illustrates the age-standardized 5-year net survival rates of 18 cancers in China. Age-standardized 5-year survival varied by cancer type, ranging from 9.9% (95% confidence interval (CI): 9.1–10.7) for pancreas cancer to 83.2% (95%CI: 82.1–84.3) for breast cancer in 2010–2014. Sex-specific cancers tended to have high 5-year survival (over 60%) in 2010–2014, including cancers of the breast, cervix, and prostate, whereas half of cancer types had low survival (below 40%), mainly cancers of lung, brain, myeloid, and upper gastrointestinal tract (Figure 2). For the majority of cancer types in China, improvements have been observed in the 5-year relative survival rates, except for

Table 2. Estimated new cancer deaths and mortality rates of the top 20 cancer types in China and worldwide, 2020[a)]

Cancer site	China					Global			
	Cancer deaths	Proportion of cancer deaths in China (%)	Proportion of corresponding deaths worldwide (%)	ASMR[b)], per 100,000	Rank[c)]	Cancer deaths	Proportion of cancer deaths worldwide (%)	ASMR[b)], per 100,000	Rank[c)]
Lung	714,699	23.9	39.8	30.2	1	1,796,144	18.2	18	1
Liver	391,152	13.1	41.8	17.2	2	935,173	9.5	9	3
Stomach	373,789	12.5	45.0	15.9	3	830,180	8.4	8.7	4
Esophagus	301,135	10.1	39.2	12.7	4	768,793	7.8	7.7	5
Colorectum	286,162	9.6	41.8	12	5	684,996	6.9	13.6	2
Pancreas	121,853	4.1	22.4	5.1	8	544,076	5.5	5.6	8
Breast	117,174	3.9	25.1	10	6	466,003	4.7	4.5	9
Brain, central nervous system	65,204	2.2	17.4	3.2	12	375,304	3.8	7.7	6
Leukaemia	61,694	2.1	18.0	3.3	10	341,831	3.5	7.3	7
Cervixuteri	59,060	2.0	19.0	5.3	7	311,594	3.1	3.3	11
Non-Hodgkin lymphoma	54,351	1.8	20.9	2.4	13	259,793	2.6	2.6	13
Prostate	51,094	1.7	20.3	4.6	9	251,329	2.5	2.8	12
Kidney	43,196	1.4	20.3	1.9	14	212,536	2.1	1.9	14
Bladder	39,393	1.3	19.0	1.6	15	207,252	2.1	4.2	10
Ovary	37,519	1.3	20.9	3.3	11	179,368	1.8	1.8	16
Nasopharynx	34,810	1.2	19.6	1.6	16	177,757	1.8	1.9	15
Gallbladder	23,297	0.8	19.9	0.97	18	117,077	1.2	1.1	18
Corpus uteri	16,607	0.6	16.6	1.4	17	99,840	1.0	1	19
Multiple myeloma	16,182	0.5	16.6	0.69	19	97,370	1.0	1.8	17
Larynx	15,814	0.5	18.7	0.67	20	84,695	0.9	0.84	21

a) Excluding non-melanoma skin cancer. b) Adjusted by Segi's world standard population. c) Ranked by the ASMR. ASMR, age-standardized mortality rate. The mortality data were obtained from the Global Cancer Observatory Platform released by the Cancer Surveillance Branch of International Agency for Research on Cancer (https://gco.iarc.fr/today/home) (Ferlay et al., 2020).

acute lymphoblastic leukaemia, pancreas cancer, and ovary cancer. For example, an absolute increase of over 10% has been seen in the age-standardized 5-year relative survival of cancers lymphoma, melanoma of skin, brain, prostate, and cervix. The age-standardized 5-year survival of several cancers of the digestive system (colon, rectum, stomach, and esophagus) also improved substantially, with an absolute increase of over 5% (Figure 2).

Cancer burden attributable to modifiable risk factors in China, by sex

Substantial variations were seen in males and females in the aspects of cancer deaths attributable to modifiable risk factors in China in 2014 (Figure 3). Specifically, the highest proportions of cancer deaths attributable to all risk factors combined were observed in cancers of Kaposi sarcoma (100%), nasopharynx (96.8%), anus (88.0%), oral cavity, pharynx (79.8%), and liver (75.7%) among males, and in cancers of Kaposi sarcoma (100%), cervix (97.4%), nasopharynx (95.0%), anus (88.0%), and vagina (78.0%) among females. In general, population-attributable fractions (PAFs) were considerably higher among males, especially for acute myeloid leukaemia, bladder cancer, lung cancer, and esophagus cancer.

In terms of separate risk factors, deaths from most cancer types could be attributed to smoking, excess body weight, and alcohol drinking, regardless of sex. Cancer-specific PAFs for infectious agents remain consistent in males and females, such as human papillomavirus, Epstein-Barr virus, human herpes virus type 8, and Clonorchis sinensis. Instead, substantial heterogeneity was seen in cancer-specific PAFs for other factors across sexes, with much higher PAFs for smoking and alcohol drinking among males, whereas higher PAFs for second-hand smoking, physical inactivity, diabetes, and ultraviolet radiation among females (Figure 3).

Comparisons with current cancer profiles in the USA

The rankings of cancer incidence and mortality varied in China and the USA, but the overall cancer burden was much lower in the USA. The overall ASIR and ASMR in the USA in 2020 were 297.3 per 100,000 and 85.7 per 100,000, respectively. The estimated newly diagnosed cancer cases and deaths were 1,756,921 and 607,636 in the USA, accounting for 18.8% and 6.1% of global cases. The top 3 leading causes of cancer deaths were cancers of prostate, lung, and colorectum in males, and cancers of breast, lung, and colorectum in females, accounted for nearly half of all incident males (45.8%) and female cases (50.6%), respectively. Cancer mortality in the USA among males was substantially higher than among females, with an ASMR of 97.1 per 100,000 and 76.6 per 100,000, respectively.

For the distributions of cancer staging, early-diagnosed cases took up more cases in females than males in the USA, which was

Table 3. Stage distribution for main cancer types by sex in China and in the USA, 2016–2017[a)]

Cancer site	Sex	USA				China			
		Stage I	Stage II	Stage III	Stage IV	Stage I	Stage II	Stage III	Stage IV
Overall	Male	23.3	15.1	23.1	38.5	15.4	21.4	34.7	28.5
	Female	41.3	25.4	14.9	18.4	24.9	34.1	22.6	18.3
	Combined	35.4	22.0	17.6	25.0	19.7	27.2	29.2	23.9
Colorectum	Male	23.9	23.6	28.4	24.1	14.9	33.3	33.2	18.6
	Female	24.3	24.4	28.4	22.9	15.7	32.4	34.1	17.9
	Combined	24.1	24.1	28.4	23.4	15.2	32.9	33.5	18.3
Lung	Male	22.3	7.8	19.6	50.3	11.6	15.7	27.9	44.8
	Female	28.4	7.4	18.3	45.9	28.0	14.3	16.2	41.5
	Combined	25.3	7.6	18.9	48.2	17.3	15.2	23.8	43.7
Stomach	Male	20.7	14.7	20.3	44.2	20.5	14.2	44.4	20.9
	Female	27.4	15.0	17.4	40.3	22.9	14.2	40.3	22.6
	Combined	23.2	14.8	19.3	42.7	21.1	14.2	43.3	21.4
Esophagus	Male	13.5	15.8	29.0	41.7	16.9	27.7	44.0	11.4
	Female	15.1	20.3	31.5	33.1	24.3	35.9	32.3	7.5
	Combined	13.8	16.7	29.5	39.9	18.7	29.6	41.2	10.5
Liver	Male	32.6	21.1	21.0	25.3	18.2	26.9	29.5	25.4
	Female	34.9	21.5	15.9	27.7	14.6	20.3	28.7	36.4
	Combined	33.2	21.2	19.7	25.9	17.5	25.6	29.3	27.6
Breast	Female	51.2	32.8	10.1	5.9	27.6	50.7	16.9	4.7

a) Excluding patients with unknown stage at diagnosis. Not all percentages add up to 100% due to rounding. The data of stage distributions in China and in the USA were extracted from Zeng et al. (2021), Shan et al. (2023), and calculated based on the Surveillance, Epidemiology, and End Results program (SEER, 2019), respectively.

similar to China. However, Table 3 illustrates that the proportion of stage I diagnoses in the USA was higher than in China for cancers of colorectum (24.1% *vs*. 15.2%), lung (25.3% *vs*. 17.3%), breast (51.2% *vs*. 27.6%), liver (33.2% *vs*. 17.5%), and all cancers combined (35.5% *vs*. 19.9%), while Chinese patients with esophagus cancer showed a higher proportion of stage I than patients in the USA (78.2% *vs*. 41.1%). This trend occurred in both sexes (Table 3).

Age-standardized 5-year survival in the USA ranged from 11.5% (95%CI: 11.3–11.7) for pancreas cancer to 97.4% (95% CI: 97.3–97.5) for prostate cancer in 2010–2014. It was considerably higher than in China, except for stomach cancer (33.1% *vs*. 35.9%) and esophagus cancer (20.0% *vs*. 29.7%) (Figure 2). The largest survival gap between China and the USA during 2010–2014 was for melanoma of the skin (90.8% *vs*. 49.6%), brain cancer (78.2% *vs*. 41.1%), and lymphoma cancer (94.3% *vs*. 61.1%). Compared with survival in period 2000–2004, although for most cancers the improvements of survival in period 2010–2014 in the USA were not distinct, the survival of several lethal cancer types increased substantially, including pancreas cancer, lung cancer, and ovary cancer.

Figure S1 in Supporting Information illustrates the estimated proportion of cancer deaths attributable to 17 well-established risk factors in adults aged 30 years and over in the USA in 2014 by sex. Compared with China, higher PAFs for smoking, human immunodeficiency virus (HIV) infection, processed meat, physical inactivity, excess bodyweight, and ultraviolet radiation of cancer mortality were observed in the USA population (Figure 3; Figure S1 in Supporting Information). American women showed larger proportions of alcohol-associated cancer deaths than Chinese women, and we found higher PAFs for *Helicobacter pylori* (Hp) infection of death from stomach cancer among Chinese men. In addition, significantly larger proportions of hepatitis B virus (HBV)-associated deaths from liver cancer were seen among Chinese men than American men (55.6% *vs*. 5.4%), whereas American men showed 2.4-fold proportions of alcohol-associated deaths from liver cancer (24.0% *vs*. 10.3%).

DISCUSSION

In our study, a secondary analysis was conducted in five aspects of incidence, mortality, survival, staging distributions, and attribution to risk factors, which provides a systematic summary of the current cancer profiles in China and comparisons with the USA. Chinese population accounted for 18% of the world's total population (United Nations, Department of Economic and Social Affairs, Population Division, 2022), whereas over a quarter of global cancer cases and deaths occurred in China, which indicates a disproportionate cancer burden to the population at present. Infection-related cancers showed the highest PAFs, whilst the majority of cancer types could be attributed to behavioral and metabolic factors, mainly smoking, excess body weight, and alcohol drinking. Moreover, the proportions of stage I diagnosis and 5-year relative survival for most cancer types were much higher in the USA than in China, except for upper gastrointestinal cancers.

Cancer spectrum in China is undergoing a transition with a complex composition (Cao et al., 2021c; Xia et al., 2022). The age-standardized incidence rates, mortality rates, and the disability-adjusted life years (DALYs) among cancers of stomach,

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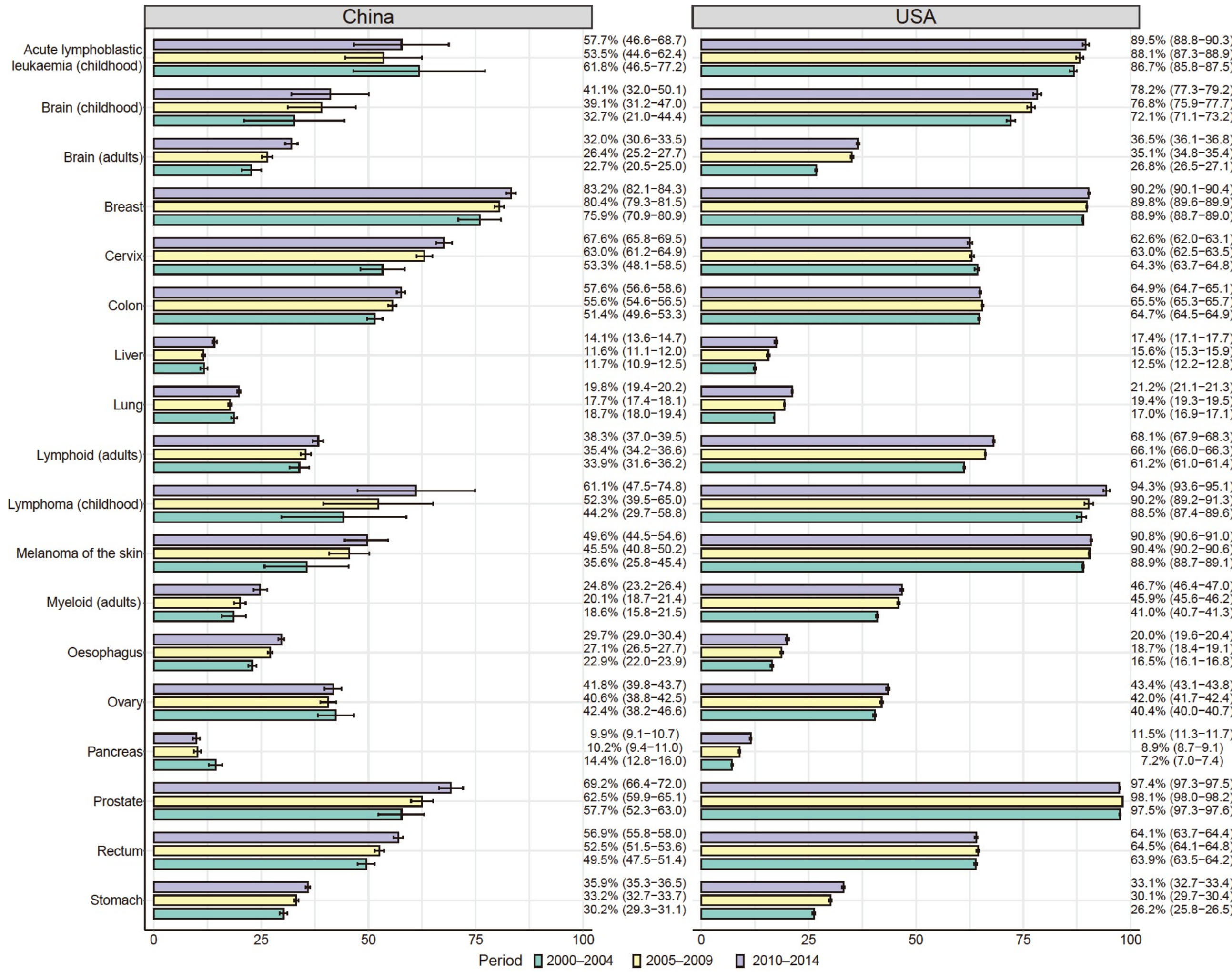

Figure 2. Age-standardized 5-year net survival (%) and corresponding 95%CI of 18 cancer types during period 2000–2014 in China and the USA. The data used in this figure were extracted from the Global surveillance of trends in cancer survival 2000–2014 (CONCORD-3) program released by the CONCORD Working Group (Allemani et al., 2018).

esophagus, and liver showed significant decreasing trends in the past three decades (Chen, 2008; Global Burden of Disease Collaborative Network, 2018; Su et al., 2023; Sun et al., 2020). The Chinese government has made considerable efforts on cancer control and has gained many achievements. As for primary prevention, a downward trend has been observed in the Hp infection rate in China over the past decades, possibly due to the improvements in cancer literacy, economic level, and sanitary conditions (He et al., 2023; Hooi et al., 2017; Li et al., 2020; Zhou et al., 2023). The widespread HBV vaccination and declined aflatoxin exposure primarily contributed to the reductions of liver cancer (Sun et al., 2013; Tanaka et al., 2011). Besides, government-funded cancer screening programs have made substantial contributions to the early detection and intervention of cancer in China (Cao et al., 2021b), reflecting the favorable trends in the survival and staging distribution of esophagus cancer (An et al., 2023).

Nevertheless, the corresponding burden of the digestive system cancers remains heavy in China, which could be partly explained as follows. First, it remains a critical challenge to control Hp infection in China, with an average rate of 40.66% for individual-based infection (Zhou et al., 2023). Second, HBV infection still contributed to the majority of deaths from liver cancer among both sexes (Cao et al., 2021a; Chen et al., 2019), and its prevalence was classified as higher intermediate prevalence (5%–7.99%) in this stage (Shi et al., 2021; Wang et al., 2019). On the contrary, only 0.2% of cancer deaths are attributable to HBV infection in adults aged 30 years and over in the USA (Islami et al., 2018), with the prevalence of persons living with chronic hepatitis B in the USA remaining unchanged at 0.3% since 1999 (Roberts et al., 2021). It suggests persistent efforts are needed to improve vaccination coverage and develop curative therapies for the achievements of "eliminating HBV infection" goal by 2030 (Jeng et al., 2023). Third, a population-based survey in the USA reported an over 76% recognition rate of each cancer symptom (Sarma et al., 2020), while the cancer literacy level of early detection in China was below 70% (He et al., 2023). Hence, cancer literacy in terms of secondary prevention and the participation rate of cancer screening still warranted improvements for Chinese population (Cao et al., 2021b; Chen et al., 2020; He et al., 2023; Li et al., 2021). Significant variations were also observed in the professional level of primary care physicians, which might lead to uneven endoscopy quality and biased proportions of early-stage diagnosis (Xin et al., 2022). In terms of

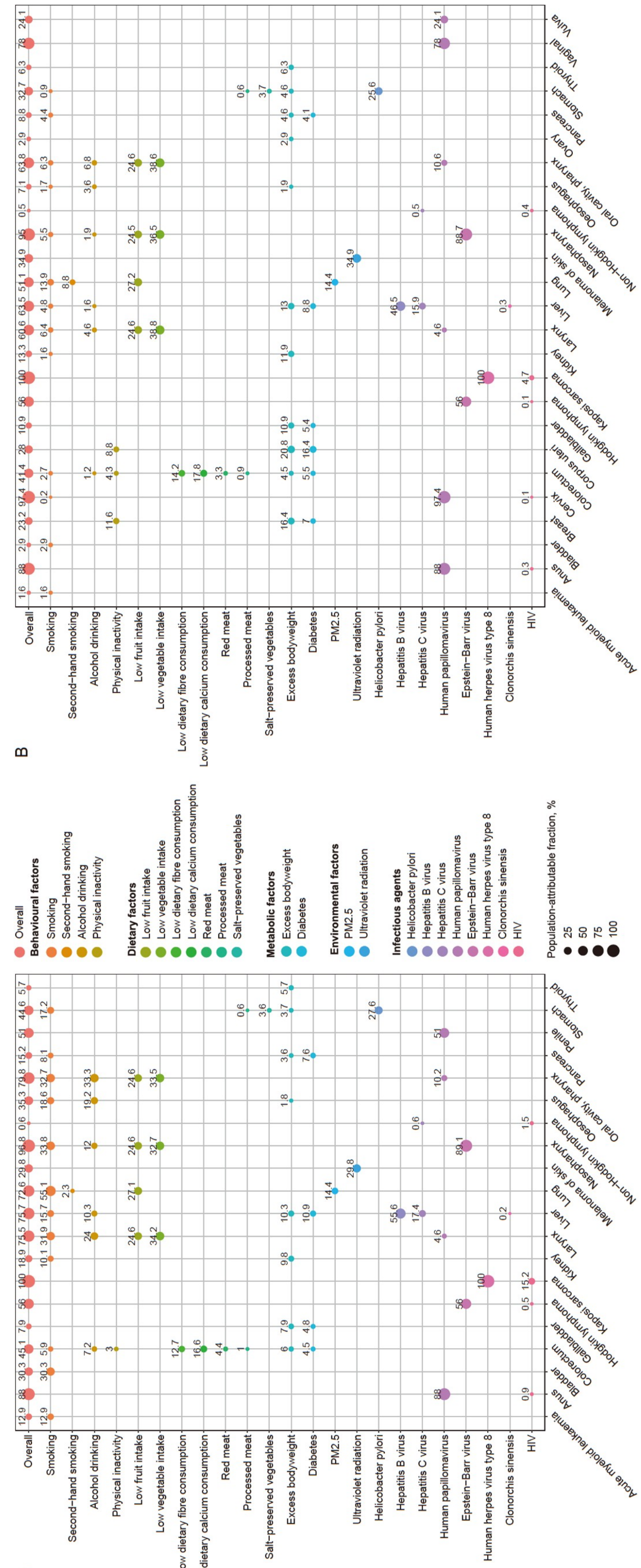

Figure 3. Population-attributable fractions (%) of 26 cancer types and related risk factors in Chinese residents aged 20 years and over, by sex. The data were extracted from Chen et al. (2019).

the quality of screening colonoscopy, the rate of adequate bowel preparation before colonoscopy (86.0% *vs.* 90.7%) and the detection rate of adenoma (16.7%–18.6% *vs.* 26.6%) were lower in Chinese tertiary hospitals than in rural and underserved areas of the USA during 2017–2019, indicating great clinical significance to coping with physician scarcity and promoting the quality of screening practices (Brajcich et al., 2022; Xin et al., 2022). In addition, China faced a heavy burden of certain cancer types, such as nasopharynx cancer. Although the ASMR of nasopharynx cancer has decreased by 51.7% since 1990, the ASIR has increased by 72.7% and was predicted to be on the rise in all age groups till 2049 (Bai et al., 2022; Su et al., 2023; Zhang et al., 2023).

In both China and the USA, smoking and low fruit intake ranked the top five modifiable risk factors with high PAFs of cancer deaths. Besides, the highest PAFs of overall cancer deaths were also for behavioral and metabolic factors (alcohol drinking and excess bodyweight) in the USA, while for infection-associated factors in China (HBV and HPV infection) (Chen et al., 2019; Islami et al., 2018). In the past decades, considerably increasing trends were observed in westernized lifestyle-related cancers, including colorectal, breast, prostate, and thyroid cancer (Chen, 2008; Global Burden of Disease Collaborative Network, 2018; Su et al., 2023; Sun et al., 2020; Wang et al., 2023). Similar trends could also be seen in the total expenses for cancer in Chinese patients during 2008–2017 (Cai et al., 2021). Such trends might be driven by the changes of socioeconomic levels and lifestyles. Based on the recent reports in China, the vegetable consumption (http://www.Chinanutri.cn/sjnj/) has decreased gradually, whereas the intake of red meat, processed food (Li et al., 2017), and alcohol (Jiang et al., 2015) increased steadily. In addition, rapid increases were seen in the physical activity levels (Zang and Ng, 2016; Zou et al., 2020) and obesity rate (Mi et al., 2015) among Chinese residents, along with the prevalence of type 2 diabetes (Wang et al., 2017). Although the smoking prevalence showed a favorable decline over the last 30 years, both the positive and passive smoking rates remained consistently high (Sun et al., 2020; World Health Organization, 2018). Since the above risk factors have been proven to be closely associated with most cancer types and showed relatively high PAFs (Cogliano et al., 2011; World Cancer Research Fund/American Institute for Cancer Research, 2018), the newly-diagnosed cancer cases and deaths were projected to keep on the rise (Cao et al., 2021c). Although improvements in the cancer survival of these cancer types have been observed with the development of therapeutic techniques (Chen et al., 2023; Gong et al., 2022), strengthened health education, regulation, and related policies are warranted for the government to create a supportive social environment for the positive adoption of healthy lifestyles and cancer prevention (Brawley, 2017). In addition, a recent study based on the National Central Cancer Registry of China (NCCR) found higher cancer mortality among Chinese older people than those in the USA, implying a priority to meeting the growing demands for cancer diagnosis and care services for the elderly (Ju et al., 2023).

This analysis extracted the latest open-source data or published findings using the most comprehensive databases and described the most current cancer profiles in China. The comparisons between China and the USA were based on the same data source or information during the same period, which ensured the strong comparability. However, there were also some limitations in this study. First, most findings were estimated from subnational data and had limited national representativeness, which could vary from the actual national cancer statistics and should be treated with caution. We believe with the expand of cancer registries, more abundant and accurate survival data would be available to better estimate the prognosis of Chinese cancer patients. Second, the hospital-based data source of staging information may overestimate the proportions of early-stage diagnosis for general population of cancer patients in China. Third, the province-level cancer burden and separate cancer profiles in rural and urban China were not analyzed in our study due to the data availability.

In summary, substantial progress has been made in the cancer survival and cancer burden of several digestive system cancers in China, whilst China still faces heavy disease burden from cancer. Continued health promotions and more robust policies on controlling the leading risk factors are of great significance for curbing the growth of cancer burden, given that primary prevention might be the most cost-effective strategy for developing countries with a large population. Furthermore, together with the expansion of cancer screening programs, more efforts should be paid to improve the quality of primary clinicians and optimization of screening strategies, in order to increase the proportion of early-stage cases, improve survival and maximize the effectiveness of cancer control.

MATERIALS AND METHODS

Data source

In this secondary analysis, we extracted open-source data on cancer incidence, mortality, survival, staging distributions, and PAFs from the Global Cancer Observatory Platform (https://gco.iarc.fr/today/home) released by the Cancer Surveillance Branch of International Agency for Research on Cancer (IARC) (Ferlay et al., 2020), the Global surveillance of trends in cancer survival 2000–2014 (CONCORD-3) program released by the CONCORD Working Group (Allemani et al., 2018), the distributions of the stage at diagnosis in the USA released by the Surveillance, Epidemiology, and End Results (SEER) program (SEER, 2019), the published stage information of a multicenter, hospital-based cancer registration program released by the NCCR (Shan et al., 2023; Zeng et al., 2021), and the estimated PAFs of site-specific cancer burden in China and the USA from systematic analyses (Chen et al., 2019; Islami et al., 2018), respectively.

The GLOBOCAN 2020 database presents a comprehensive assessment of global cancer statistics from 185 countries or territories for 36 cancer types by sex and age group (Sung et al., 2021). The sex- and age-specific estimates of new cancer cases, deaths, ASIR, and ASMR for 33 cancer types (combing cancers of colon, rectum, and anus and excluding non-melanoma skin cancer, C00-97/C44) in China, the USA, and worldwide in 2020 were extracted in this descriptive study. The CONCORD-3 estimated the global survival of 18 cancers during a 15-year period 2000–2014 based on data from 322 cancer registries in 71 countries and territories (Allemani et al., 2018). We extracted the site-specific, age-standardized 5-year net survival and the corresponding 95%CIs of all 18 cancers in China (21 registries) and the USA (48 registries) in three periods (2000–2004, 2005–2009, 2010–2014). The NCCR described the stage distributions for 6 main cancers by area and sex in China between 2016–2017 (Zeng et al., 2021). We extracted both the overall and sex-specific distributions of the stage at diagnosis for all six cancers of the lung, stomach, esophagus, colorectum, liver, and female breast (including all cancers combined) in China. We also calculated the corresponding staging distributions of the USA from SEER estimates using SEER*Stat (version 8.4.1) (SEER, 2019), after following the same criteria to exclude cases diagnosed at stage 0 or unknown stage. The NCCR also reported the site-, sex-, and province-specific cancer burden attributable to 23 potentially modifiable risk factors (categorized as behavioral factors, dietary factors, metabolic factors, environmental factors, and infectious agents) in China in 2014 (Chen et al., 2019). We extracted the country-level PAFs of all 26 cancers and related risk factors in men (20 cancers) and women (25 cancers) aged 20 years and over. Meanwhile, we obtained the estimated PAFs for 17 potentially modifiable exposures of 26 cancer types and overall cancer deaths (excluding nonmelanoma skin cancers) in American adults aged 30 years and older in 2014.

Statistical analysis

First, we described the 20 leading cancer types in China in 2020, calculated the cancer-specific percentage in China's cancer spectrum as well as China's cancer-specific percentage in the global new cases/deaths, and ranked by the ASIR/ASMR, respectively. We then characterized the cancer incidence and mortality by sex and age group, and ranked each group by ASIR and ASMR, respectively. In this study, the childhood age group consisted of children and adolescents and was defined as ages 0–19 years (Force et al., 2019). Young adults, middle-aged adults, and older population age groups referred as ages 20–49, 50–64 and 65 and older years, respectively. Cancer cases diagnosed in young adults were defined as incidence of early-onset cancers (Ugai et al., 2022). Next, the stage distribution and survival of main cancer types were reported and compared separately by the country. We also summarized the proportion of cancer-specific deaths attributable to modifiable risk factors in China and the USA by sex. Finally, a systematical and comprehensive analysis was conducted to compare cancer profiles between China and the USA.

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Compliance and ethics

The author(s) declare that they have no conflict of interest.

Supporting information

The supporting information is available online at https://doi.org/10.1007/s11427-023-2423-1. The supporting materials are published as submitted, without typesetting or editing. The responsibility for scientific accuracy and content remains entirely with the authors.

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