Cancer statistics in China and United States, 2022: profiles, trends, and determinants

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Abstract

Background: The cancer burden in the United States of America (USA) has decreased gradually. However, China is experiencing a transition in its cancer profiles, with greater incidence of cancers that were previously more common in the USA. This study compared the latest cancer profiles, trends, and determinants between China and USA.

Methods: This was a comparative study using open-source data. Cancer cases and deaths in 2022 were calculated using cancer estimates from GLOBOCAN 2020 and population estimates from the United Nations. Trends in cancer incidence and mortality rates in the USA used data from the Surveillance, Epidemiology, and End Results program and National Center for Health Statistics. Chinese data were obtained from cancer registry reports. Data from the Global Burden of Disease 2019 and a decomposition method were used to express cancer deaths as the product of four determinant factors.

Results: In 2022, there will be approximately 4,820,000 and 2,370,000 new cancer cases, and 3,210,000 and 640,000 cancer deaths in China and the USA, respectively. The most common cancers are lung cancer in China and breast cancer in the USA, and lung cancer is the leading cause of cancer death in both. Age-standardized incidence and mortality rates for lung cancer and colorectal cancer in the USA have decreased significantly recently, but rates of liver cancer have increased slightly. Rates of stomach, liver, and esophageal cancer decreased gradually in China, but rates have increased for colorectal cancer in the whole population, prostate cancer in men, and other seven cancer types in women. Increases in adult population size and population aging were major determinants for incremental cancer deaths, and case-fatality rates contributed to reduced cancer deaths in both countries.

Conclusions: The decreasing cancer burden in liver, stomach, and esophagus, and increasing burden in lung, colorectum, breast, and prostate, mean that cancer profiles in China and the USA are converging. Population aging is a growing determinant of incremental cancer burden. Progress in cancer prevention and care in the USA, and measures to actively respond to population aging, may help China to reduce the cancer burden.

Keywords: Cancer; Incidence; Mortality; Trends; Aging; China; USA

Introduction

Cancer is the leading cause of deaths in China and developed countries.[1,2] GLOBOCAN 2020 estimated that there were 19,292,789 cancer cases and 9,958,133 cancer deaths globally in 2020.[2] The number of cancer cases and deaths, as well as crude incidence and mortality of cancer in China have increased gradually since 2000.[3,4] In the United States of America (USA), however, age-standardized rates of cancer incidence in men and cancer mortality in the whole population have generally decreased since the early 1990s.[5] Long-term trends in cancer burden and rates reflect both patterns in behaviors associated with cancer risk and changes in medical practice, such as the use of cancer screening tests. The relatively successful progress in cancer research, prevention, and care in the USA may provide lessons for other countries.[6]

China is making efforts to confront its rapidly increasing cancer burden.[7] However, rapid population aging and accumulated effects of risk factor exposure mean that it faces many new challenges for cancer prevention. A comparison of cancer profiles, trends, and determinants between China and the USA may inform activities and policy making around cancer prevention in China. We therefore carried out a comparative study to report cancer burden, long-term trends in cancer incidence and mortality

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rates, and the contributions of four determinant factors to incremental cancer deaths.

Methods

Data sources

We used open-source data from GLOBOCAN 2020 released by the International Agency for Research on Cancer,[8] the 2019 revision of World Population Prospects released by the United Nations (UN),[9] the Surveillance, Epidemiology, and End Results (SEER) program released by the National Cancer Institute,[5] the USA mortality files released by the National Center for Health Statistics,[5] cancer registry data released by the National Cancer Center (NCC) of China,[10] and the Global Burden of Disease (GBD 2019) released by the Institute for Health Metrics and Evaluation.[11] Cancer data from GLOBOCAN 2020 and population estimates from UN were used to estimate the cancer profiles in China and the USA in 2022. Longitudinal cancer data from SEER and China NCC were used in the trend analyses. Data from GBD 2019 were used to analyze the determinant factors of cancer deaths.

From the GLOBOCAN 2020 database, we extracted sex- and age-specific estimates of cancer cases and deaths for 35 cancer types (including all cancers combined) in China and the USA in 2020. The corresponding population estimates for 2020 and projections to 2022 were downloaded from the UN website by sex and age. For the 14 cancer types included in the trend analyses (top 10 cancer types for cancer cases and deaths among men and women in China in 2000),[10] we collected age-standardized cancer incidence rate from 1975 to 2018 and age-standardized cancer mortality rate from 1975 to 2019 in the USA from the SEER interactive website. Age-standardized cancer incidence and mortality in China between 2000 and 2015 were extracted from the previous published cancer registry report.[10] From the GBD 2019 database, we collected year-, sex-, and age-specific estimates of cancer cases and deaths for 29 cancer types in China and the USA between 1990 and 2019, accompanied by the corresponding population estimates.

Statistical analysis

Using the same methodology as GLOBOCAN 2020,[12] we linked cancer cases and deaths to the corresponding population estimates released by the UN. Age-specific cancer incidence and mortality rate in 2020 were calculated for 35 cancer types and by sex. We assumed that the age-specific rate in 2022 would remain constant at the rates estimated in 2020.[13] Cancer cases and deaths in 2022 in China and the USA were calculated by multiplying the age-specific rate by population estimates in 2022, and then aggregated by 35 cancer types (including all cancers combined) and sex. Cancer profiles in China in 2022 were estimated for Chinese mainland, Hong Kong, and Macau. Taiwan province was not included because of lack of data in GLOBOCAN 2020. Cancer profiles in the USA in 2022 were estimated for 50 states and the District of Columbia, but not the dependencies.

Trends in cancer incidence and mortality rates were reported separately by sex. Rates for USA cancer incidence (1975–2018) and mortality (1975–2019) were adjusted by 2000 USA standard population. Rates for cancer incidence and mortality (2000–2015) in China were adjusted by Segi's world standard population. A total of 14 cancer types were included in the trends analysis, including the top 10 cancer types in China in 2000 by incidence (lung, stomach, liver, esophagus, colorectum, bladder, pancreas, brain and central nervous system [CNS], leukemia, and prostate) and mortality (lung, liver, stomach, esophagus, colorectum, pancreas, brain and CNS, leukemia, bladder, and prostate) in males, and by incidence (breast, lung, stomach, colorectal, esophagus, liver, uterus, brain and CNS, thyroid, and cervix) and mortality (lung, stomach, liver, esophagus, colorectum, breast, brain and CNS, uterus, cervix, and thyroid) in females.[4,10]

Using the cancer deaths in 1990 as a reference, we used a decomposition method to express cancer deaths as the product of four determinant factors (ie, population aging, population size, age-specific cancer incidence rate, and case-fatality rate) among men and women aged 25 years and older from 1991 to 2019.[14,15] The four determinants corresponded to the four terms shown in the sum below:[14-16]

$$Death_y = \sum_{a,c} Pop\ size_y \cdot \frac{Pop\ age_{a,y}}{Pop\ size_y} \cdot \frac{Case_{a,c,y}}{Pop\ age_{a,y}} \cdot \frac{Death_{a,c,y}}{Case_{a,c,y}}$$

where a represents the 5-year age groups of men and women aged 25 years and older (up to 90 years and older), c represents the cancer type, and y represents the year. Cancer deaths attributable to the four determinant factors were calculated for 29 cancer types by sex, and then summed to give the total attributable cancer deaths in that year. The proportions of attributable cancer deaths among total cancer deaths in that year were calculated and the time trends between 1991 and 2019 were assessed.

Results

Profiles of cancer cases and deaths in 2022

The estimated numbers of new cancer cases and deaths in China (Taiwan province were not included) and the USA (excluding dependencies) in 2022 by sex and cancer type are shown in Table 1. In total, it is expected that there will be approximately 4,820,000 and 2,370,000 people newly diagnosed with cancer, and 3,210,000 and 640,000 people dying from cancer in China and the USA, respectively.

Estimates suggest that the leading five cancer types diagnosed in 2022 will be cancers of the lung, colorectum, stomach, liver, and breast in China, and cancers of the breast, lung, prostate, colorectum, and melanoma of skin in the USA. The leading five causes of cancer death will be cancers of the lung, liver, stomach, esophagus, and colorectum in China, and cancers of the lung, colorectum, pancreas, breast, and prostate in the USA [Table 1]. The most common cancers diagnosed in males will be lung cancer in China and prostate cancer in the USA. Breast cancer will be the most common cancer in females in both

Table 1: Estimated new cancer cases and deaths by sex in China and the United States, 2022.*

		Estimated new cases						Estimated deaths					
		China†			USA‡			China†			USA‡		
ICD-10	Cancer site	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
C00-97	All sites	4,820,834	2,625,070	2,195,764	2,372,145	1,282,341	1,089,804	3,208,516	1,943,763	1,264,753	640,724	338,601	302,123
C00-97, but C44	All sites excluding nonmelanoma skin	4,796,996	2,612,375	2,184,621	1,817,871	925,496	892,375	3,193,744	1,935,833	1,257,911	633,795	333,898	299,897
C00-06	Lip, oral cavity	31,733	19,484	12,249	25,210	16,914	8296	15,745	9913	5832	4452	2886	1566
C07-08	Salivary glands	9165	5078	4087	5109	3033	2076	2912	1898	1014	1003	667	336
C09-10	Oropharynx	5875	4575	1300	13,019	10,698	2321	3074	2516	558	3313	2601	712
C11	Nasopharynx	64,165	46,570	17,595	1933	1385	548	36,315	26,168	10,147	945	665	280
C12-13	Hypopharynx	6574	6079	495	2314	1892	422	3569	3235	334	572	475	97
C15	Oesophagus	346,633	237,543	109,090	19,042	14,975	4067	323,600	221,524	102,076	16,916	13,617	3299
C16	Stomach	509,421	352,955	156,466	27,294	16,612	10,682	400,415	274,691	125,724	11,898	7160	4738
C18-21	Colorectum	592,232	340,257	251,975	160,248	84,579	75,669	309,114	177,921	131,193	56,693	30,164	26,529
C22	Liver	431,383	316,979	114,404	43,732	30,712	13,020	412,216	302,327	109,889	32,332	21,415	10,917
C23	Gallbladder	31,114	11,876	19,238	4874	1705	3169	25,143	10,086	15,057	2409	795	1614
C25	Pancreas	134,374	75,178	59,196	59,143	31,227	27,916	131,203	72,680	58,523	49,920	26,166	23,754
C32	Larynx	30,832	27,335	3497	12,954	10,295	2659	16,939	14,404	2535	3995	3173	822
C33-34	Lung	870,982	575,302	295,680	238,032	121,953	116,079	766,898	505,618	261,280	144,913	76,828	68,085
C43	Melanoma of skin	8114	4292	3822	99,935	59,435	40,500	4369	2396	1973	7530	4920	2610
C44§	Nonmelanoma skin§	23,838	12,695	11,143	554,274	356,845	197,429	11,181	6156	5025	5002	3626	1376
C45	Mesothelioma	3381	1904	1477	3601	2677	924	2942	1731	1211	2695	2056	639
C46	Kaposi sarcoma	282	154	128	1107	980	127	171	97	74	95	79	16
C50	Breast	429,105	–	429,105	259,827	–	259,827	124,002	–	124,002	44,094	–	44,094
C51	Vulva	3516	–	3516	6317	–	6317	1319	–	1319	1551	–	1551
C52	Vagina	1711	–	1711	1496	–	1496	720	–	720	431	–	431
C53	Cervix uteri	111,820	–	111,820	13,740	–	13,740	61,579	–	61,579	5830	–	5830
C54	Corpus uteri	84,520	–	84,520	63,246	–	63,246	17,543	–	17,543	11,909	–	11,909
C56	Ovary	57,090	–	57,090	24,494	–	24,494	39,306	–	39,306	14,914	–	14,914
C60	Penis	4882	4882	–	1583	1583	–	1678	1678	–	435	435	–
C61	Prostate	125,646	125,646	–	216,900	216,900	–	56,239	56,239	–	34,611	34,611	–
C62	Testis	4509	4509	–	9500	9500	–	884	884	–	457	457	–
C64-65	Kidney	77,410	50,088	27,322	71,676	45,128	26,548	46,345	31,172	15,173	15,259	9950	5309
C67	Bladder	91,893	71,002	20,891	84,825	65,181	19,644	42,973	32,391	10,582	19,223	13,904	5319
C70-72	Brain, central nervous system	82,673	42,474	40,199	25,177	14,136	11,041	68,283	35,204	33,079	18,752	10,590	8162
C73	Thyroid	224,023	54,252	169,771	53,815	14,674	39,141	9915	3640	6275	2262	1084	1178
C81	Hodgkin lymphoma	6984	4624	2360	8240	4676	3564	2948	1958	990	984	586	398
C82-86, C96	Non-Hodgkin lymphoma	97,788	52,767	45,021	76,510	42,426	34,084	57,929	31,625	26,304	21,974	12,766	9208
C88, C90	Multiple myeloma	22,450	12,989	9461	33,463	18,899	14,564	17,360	10,376	6984	14,145	8024	6121
C91-95	Leukaemia	88,249	50,213	38,036	63,469	37,028	26,441	64,489	37,328	27,161	25,017	14,679	10,338

* Estimates based on data released by the International Agency for Research on Cancer for GLOBOCAN 2020 and the WHO for World Population Prospects (2019 revision). † Including Chinese mainland, Hong Kong, and Macau. Taiwan province was not included because of lack of data in GLOBOCAN 2020. ‡ USA dependencies were not included. § New cases exclude basal cell carcinoma, whereas deaths include all types of nonmelanoma skin cancer. ICD: International Classification of Diseases.

countries. Lung cancer is expected to be the biggest cause of death in 2022 in both males and females, and in both countries [Table 1].

Trends in cancer incidence and mortality

Long-term trends in incidence and mortality rates of 10 major cancer types are shown in Figure 1. Among male population, the incidence and mortality rates of lung and colorectal cancer in the USA, and of stomach, liver, and esophageal cancer in China have decreased gradually in recent years. However, the rates have significantly increased for liver cancer in the USA, and colorectal and prostate cancer in China. There was a spike in incidence of prostate cancer in the USA during the early 1990s because of widespread screening using prostate-specific antigen testing. From 2007 to 2014, the prostate cancer incidence rate decreased rapidly. Mortality rate for prostate cancer in the USA increased slightly during the early 1990s, and has since decreased almost continuously.

Among female population, the incidence and mortality rates of lung and colorectal cancer in the USA, and of stomach, liver, and esophageal cancer in China have decreased gradually in recent years. However, the incidence rates for the other seven most common cancer types in Chinese women have all increased since 2000. Noticeably, the incidence rate of thyroid cancer has sharply increased since 2000 in both China and the USA, although the mortality rates were very stable during the same period [Figure 1].

Determinants of cancer deaths

The incremental deaths between 1991 and 2019 were expressed by four determinant factors, using cancer deaths in 1990 as a baseline. The proportions of all cancer deaths attributable to the four determinant factors in each year are shown in Figure 2. The increase in the population size of adults aged 25 years and older was the leading determinant of incremental cancer deaths in both countries. Population aging was the second determinant of incremental cancer deaths since 2005, and in future may overtake population size. Except for males in the USA, age-specific cancer incidence rates contributed to increased cancer deaths. However, the proportion of deaths associated with age-specific incidence

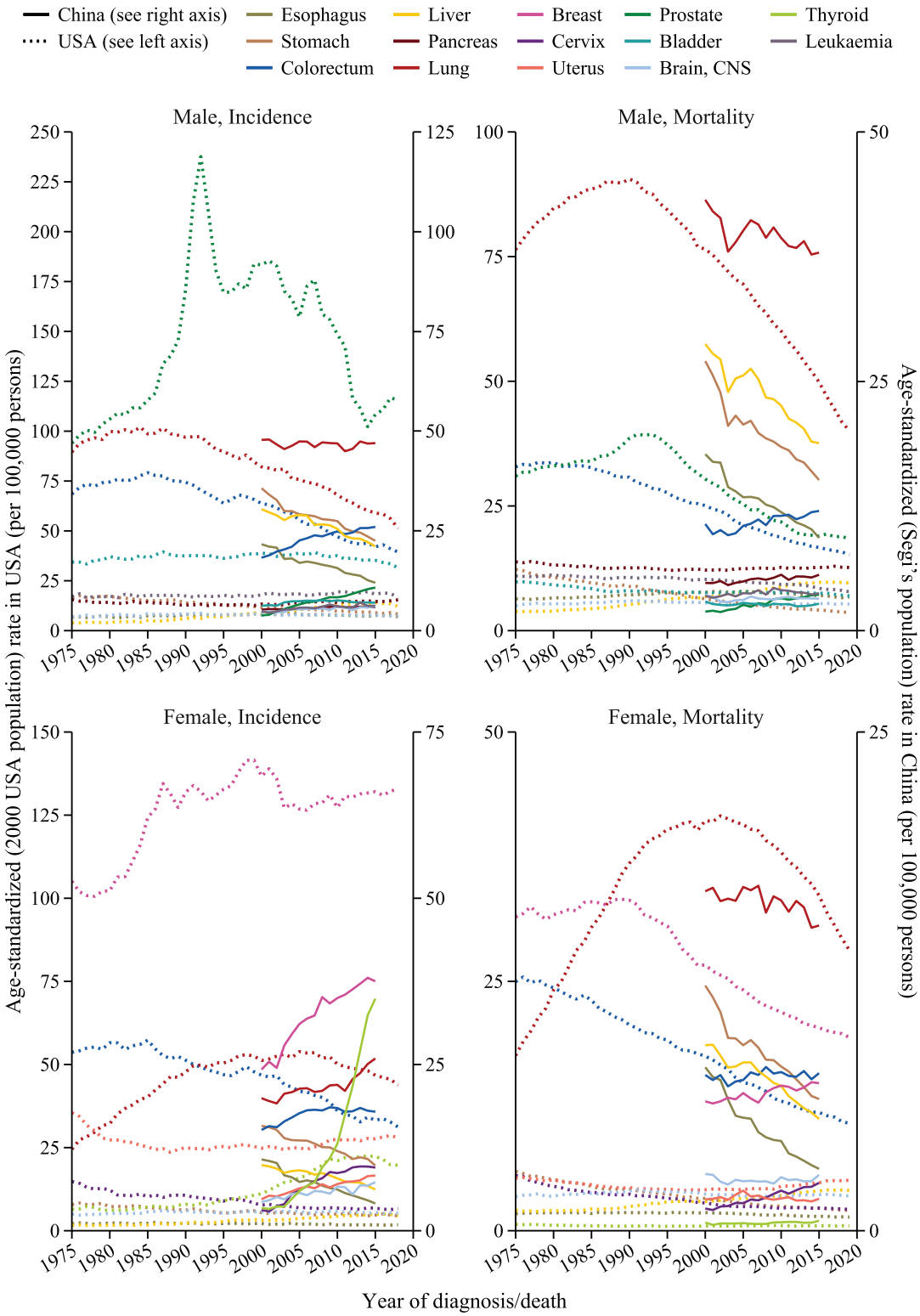

Figure 1: Trends in cancer incidence and mortality rates by sex for China and the United States of America. Analyses were based on data released by the USA Surveillance, Epidemiology, and End Results program and the China National Cancer Center. Rates for USA cancer incidence (1975–2018) and mortality (1975–2019) were standardized by 2000 USA standard population. Rates for cancer incidence and mortality in China (2000–2015) were standardized by Segi's world standard population. CNS: Central nervous system.

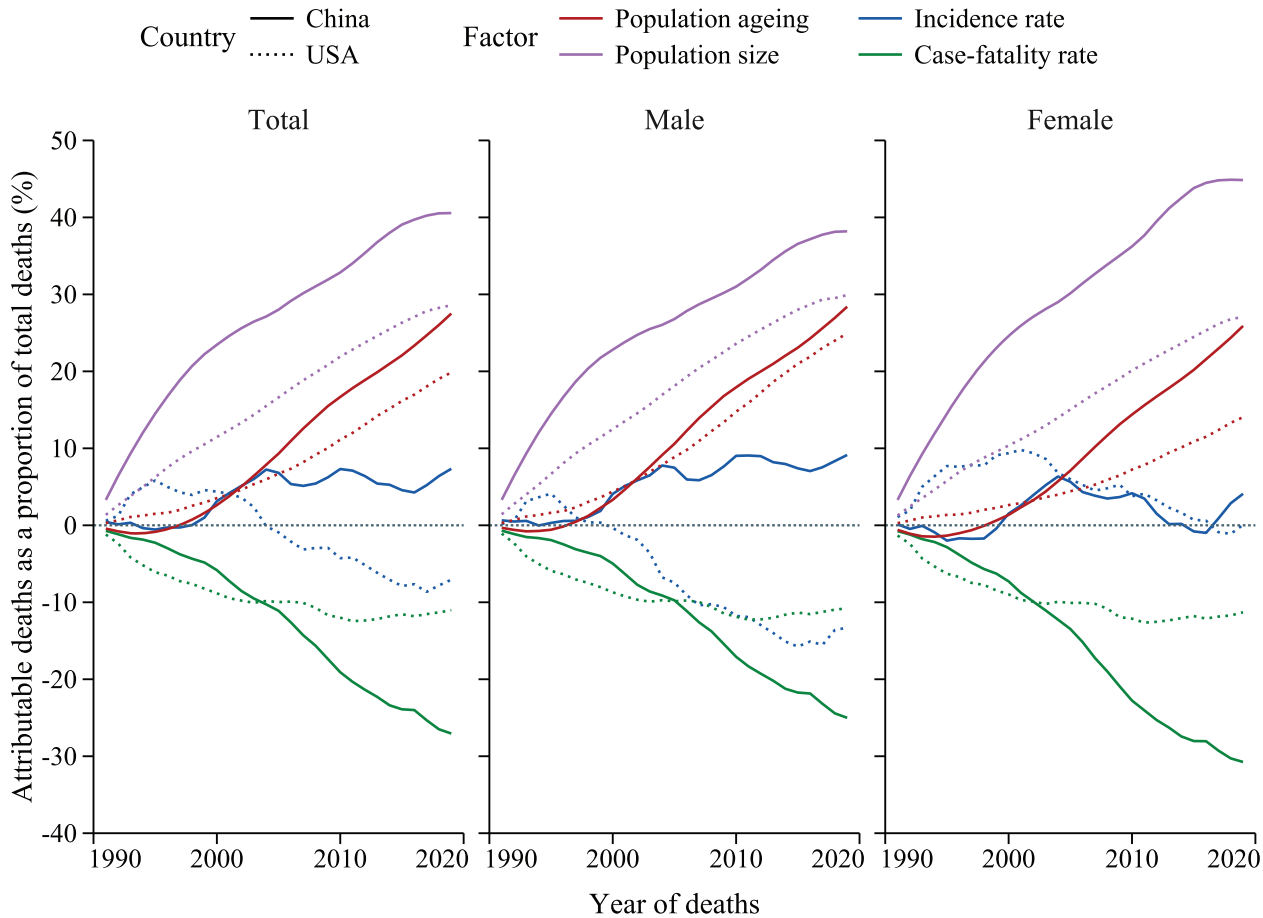

Figure 2: Trends in determinant factors influencing cancer deaths by sex in China and the United States of America. Analyses were based on data released by the Institute for Health Metrics and Evaluation for Global Burden of Disease 2019. Cancer deaths were expressed as the product of four factors: (1) population aging, (2) population size, (3) age-specific cancer incidence rate, and (4) cancer case-fatality rate.

rate was much lower than that associated with population size and population aging, and the gaps were rapidly widening. Case-fatality rates contributed to reduced cancer deaths in both countries, with a more dramatic contribution in China in recent years than in the USA.

Discussion

In this comparative study, we reported estimated cancer statistics and profiles for 2022, long-term trends in cancer incidence and mortality rates, and determinant factors for incremental cancer deaths in China and USA. Lung cancer is expected to be the most common cancer in China and the leading cause of cancer death in both countries, with breast cancer the most common cancer in the USA in 2022. With the decreases in incidence and mortality rates for cancers of the stomach, liver, and esophagus, and increases in rates for cancers of the lung, colorectum, breast, and prostate, China's cancer profile is becoming similar to that of the USA. Increases in adult population size and population aging were major determinants of incremental cancer deaths. Some achievements in cancer prevention in the USA may inform the development of cancer control strategies in China.

The estimated cancer cases and deaths in the USA in our study were higher than projections reported by the American Cancer Society (ACS).[5] Cancer statistics in 2022 published by ACS projected 1,918,030 new cancer cases and 609,360 cancer deaths in the USA,[5] giving a gap of about 454,000 cancer cases and 31,000 cancer deaths between the two estimates. Similar differences were observed in reports of cancer statistics in 2020 and GLOBOCAN 2020, resulting in approximately 475,068 cancer cases and 5870 cancer deaths fewer than estimates in the USA in 2020.[8,17] The gaps between our estimates based on GLOBOCAN 2020 and cancer statistics published by ACS may be explained by the different measurements of non-melanoma cancer of the skin. We included non-melanomas of the skin in total cancer cases and deaths [Table 1], but the ACS did not.[2,5,8,17]

Population aging is likely to be a major social characteristic in China for the foreseeable future. China has one of the fastest growing aging populations in the world.[18] By the end of 2020, the population in China aged 60 years and older was 260 million, with an annual increase of approximately 10 million expected from 2021 to 2025.[19] The total population size in China is expected to reach a peak around 2025, and the proportion of those aged 60 years and older is expected to exceed 30% by 2035.[18,20] If population size remains stable or decreases, but population aging continues to increase, the upward trend in cancer burden is likely to

remain unchanged in China. Healthy aging strategies would therefore need to be included in cancer prevention activities and multisectoral collaboration should be enhanced in policy development.[21]

China is undergoing a transition toward the cancer profiles in developed counties, characterized by high incidence of cancers of the lung, colorectum, breast, and prostate.[22] These changes are driving a move toward mass cancer screening and early detection for the eligible population aged 45 to 74 years old.[23] Several screening technologies and strategies have been developed to reduce the cancer burden in the USA, and might be introduced into cancer screening services in China.[5,24] Screening should target the high-risk population and cancers, such as colorectal, breast, lung, cervical, and upper gastrointestinal cancer.[24] Considering the large population, potential benefits and harms from screening, and the capacity of health services, China would probably not provide a "one size fit all" cancer screening service across each province and county.[10] Providing organized screening for high-risk areas and opportunistic screening for non-high-risk areas might be the most feasible solution in the near future.

Approximately 45.2% cancer deaths in China in adults aged 20 years or older were attributable to 23 modifiable risk factors.[25] Primary cancer prevention that is focused on controlling behavioral, dietary, metabolic and environmental factors, and infectious agents has great potential to reduce the burden of cancer in China. Compared with the USA, where smoking prevalence gradually decreased from 25% in 1997 to 15% in 2015, Chinese adults have a higher smoking prevalence (25.2% in 2013) and this is not changing.[26,27] Consequently, approximately 16.8% of all cancer deaths in adults 30 years and older in China were attributable to active and second-hand smoking, and more than 98% of these deaths in men were attributable to active smoking compared with 50% in women.[28] The tobacco epidemic remains at an earlier stage in China than in the USA, and the full impact of tobacco smoking patterns in recent decades on cancer mortality may therefore not yet have been realized.[29] If no tobacco control action is taken to immediately reduce tobacco use with implementation of targeted policies and programs, the burden of cancer will continue to grow dramatically. Comprehensive smoke-free policies should be adopted across China, instead of being largely limited to particular metropolitan areas.[28]

Cervical cancer is expected to be eliminated as a public health problem worldwide for the first time.[30] However, incidence and mortality rates of cervical cancer in China have increased significantly since 2000. Only if China adopts a comprehensive strategy, including human papillomavirus vaccination, cervical screening, and treatment of pre-invasive lesions and invasive cancer, then cervical cancer could be eliminated by the late 2040s, with potential economic benefits.[31]

The 5-year relative survival rate in cancer increased from 30.9% in 2003–2005 to 40.5% in 2012–2015 in China.[32] However, the survival rates for specific cancer types were lower in China than the USA, especially breast and colorectal cancer.[5,32] The data reported in our study also suggest that cancer prognosis in China is poorer than in the USA because the cancer-type-specific mortality to incidence ratios were generally lower in China. More efforts are needed in China to deliver effective cancer care and improve universal health coverage.[33]

Our study had several limitations. First, the estimates of cancer burden in 2022 were subject to biases within the GLOBOCAN 2020 reporting system.[12] Second, we used cancer rates in 2020 as an approximation of rates in 2022, which did not account for any potential changes from 2020 to 2022. Third, the data from GBD 2019 depended on the out-of-sample predictive validity of modeling work, particularly where data were not available.[34] Lastly, we adopted two distinct standard populations in calculating age-standardized incidence and mortality rates because long-term age-specific cancer cases, deaths and populations were not reported.[5,10]

In summary, there was a dramatic increase in incidence and mortality rates in cancers of the colorectum, female breast, and male prostate in China. However, rates of cancers of the stomach, liver, and esophagus decreased gradually. This produced a narrowing disparity between cancer profiles in China and the USA. Given the increasing contributions of population aging on the incremental cancer burden, China may benefit from adopting some of the effective prevention measures from USA, as well as actions to support healthy aging.

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Conflicts of interest

None.

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