

Changing profiles of cancer burden worldwide and in China: a secondary analysis of the global cancer statistics 2020

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Abstract

Background: Cancer is one of the leading causes of death globally, but its burden is not uniform. GLOBOCAN 2020 has newly updated the estimates of cancer burden. This study summarizes the most recent changing profiles of cancer burden worldwide and in China and compares the cancer data of China with those of other regions.

Methods: We conducted a descriptive secondary analysis of the GLOBOCAN 2020 data. To depict the changing global profile of the leading cancer types in 2020 compared with 2018, we extracted the numbers of cases and deaths in 2018 from GLOBOCAN 2018. We also obtained cancer incidence and mortality from the 2015 National Cancer Registry Report in China when sorting the leading cancer types by new cases and deaths. For the leading cancer types according to sex in China, we summarized the estimated numbers of incidence and mortality, and calculated China's percentage of the global new cases and deaths.

Results: Breast cancer displaced lung cancer to become the most leading diagnosed cancer worldwide in 2020. Lung, liver, stomach, breast, and colon cancers were the top five leading causes of cancer-related death, among which liver cancer changed from the third-highest cancer mortality in 2018 to the second-highest in 2020. China accounted for 24% of newly diagnosed cases and 30% of the cancer-related deaths worldwide in 2020. Among the 185 countries included in the database, China's age-standardized incidence rate (204.8 per 100,000) ranked 65th and the age-standardized mortality rate (129.4 per 100,000) ranked 13th. The two rates were above the global average. Lung cancer remained the most common cancer type and the leading cause of cancer death in China. However, breast cancer became the most frequent cancer type among women if the incidence was stratified by sex. Incidences of colorectal cancer and breast cancer increased rapidly. The leading causes of cancer death varied minimally in ranking from 2015 to 2020 in China. Gastrointestinal cancers, including stomach, colorectal, liver, and esophageal cancers, contributed to a massive burden of cancer for both sexes.

Conclusions: The burden of breast cancer is increasing globally. China is undergoing cancer transition with an increasing burden of lung cancer, gastrointestinal cancer, and breast cancers. The mortality rate of cancer in China is high. Comprehensive strategies are urgently needed to target China's changing profiles of the cancer burden.

Keywords: Cancer incidence; Cancer mortality; Changing profile; China; GLOBOCAN 2020; Worldwide

Introduction

Cancer is one of the leading causes of death globally, but its burden is not uniform.^[1] The cancer burden has grown over time in both developed and developing countries due to the complex reasons involved, which include aging and burgeoning population, accelerating socioeconomic development, and changes in the prevalence of associated risk factors.^[2,3] With the population expanding and aging worldwide, cancer is the primary cause of premature death and decreases life expectancy in many countries.^[4] However, disparities in the patterns of cancer diagnoses have been observed. Countries with varying human

development index (HDI) have different profiles of common cancer types. For example, colorectal and prostate cancers are common among men in high HDI areas, whereas cervical cancer occurs more frequently in women in low HDI areas.^[5] Moreover, standardized incidence rates for some of the leading cancer types are 200% to 300% higher in transitioned economies than in transitioning economies.^[2] Countries at the transitioning stage face a predominance of infection-related cancers and an increasing cancer burden that is associated with Western lifestyles.

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China is one of the countries in the transitioning stage of cancer.^[6] The incidence and mortality profiles of China are changing from those of developing countries to those of developed countries.^[7] Since China has a population of 1.4 billion, even minimal increases in incidence or mortality rates indicate great threats to individuals at risk and a significant economic burden. Cancer transition increases the difficulty of cancer prevention and control.^[8] Therefore, an understanding of the contemporary cancer transition and an analysis of the changing profiles of China's cancer burden are urgently needed to ensure that targeted cancer prevention and control could be tailored and implemented.

GLOBOCAN 2020 provided updated estimates of cancer incidence and mortality at the end of 2020. It is estimated that the number of new cancer cases reached 19.3 million globally, and nearly 10 million people died from cancer in 2020.^[9] Furthermore, female breast cancer displaced lung cancer and became the most substantially diagnosed cancer for the first time. The current study provides an overview of cancer incidence and mortality in 2020 based on the most recent data compiled by the International Agency for Research on Cancer (IARC), the changing profiles of leading cancer types worldwide and in China, projected cancer incidence and mortality over the next two decades, and the implications of the above factors for cancer research and control.

Methods

Data sources

A descriptive secondary analysis was conducted using data extracted from the GLOBOCAN 2020 database, as visualized in CANCER TODAY (<https://gco.iarc.fr/to-day/home>). The IARC newly released the estimates of the global cancer burden for the year 2020, including incidence, mortality, and prevalence in 185 countries or territories for 36 types of cancer. The methods for estimating the cancer burden in GLOBOCAN 2020 are country-specific and have been described in detail in a previous study.^[10] The quality of the national estimates is largely determined by the coverage and accuracy of the recorded cancer data for each country. The database is accessible online at the IARC Global Cancer Observatory, where a comprehensive assessment of global cancer statistics is systematically quantified to inform cancer research and control via an interactive web-based platform (<https://gco.iarc.fr/>). We extracted the number of new cases and cancer deaths from the GLOBOCAN 2018^[2] and 2020 databases for the most common cancer types and all cancers combined. Cancer profiles, both worldwide and by continent (as well as by specific countries on each continent), are also available in the GLOBOCAN database, which uses the best available cancer data within each country. We obtained cancer incidence and mortality data explicitly for China from the 2015 National Cancer Registry Report published in China^[3] and GLOBOCAN 2020, when sorting the leading cancer types by new cases and deaths for the years 2015 and 2020. The country-specific data for China in the GLOBOCAN 2020 were built on the recent local data from 91 cancer registries in

China.^[10] To assess the future cancer burden, we referred to the predicted incidence and mortality, as shown in CANCER TOMORROW (<https://gco.iarc.fr/tomorrow/en>), for six continents and China through 2040. The projected number of new cancer cases and deaths in a country for a specific year is calculated by multiplying the age-standardized incidence rate (ASIR) or age-standardized mortality rate (ASMR) estimated in 2020 with the corresponding expected population size for that specific year.^[11] The important assumption of the prediction is that the rates in 2020 remain consistent during the prediction period.^[9] For ethical considerations, the authors are accountable for all aspects of the work for ensuring the accuracy or integrity of any part of the work.

Data analysis

First, we described the 14 leading cancer types globally for new cases and deaths, respectively, with rank changes from 2018 to 2020. We then characterized the cancer incidence and mortality on six continents and in certain countries with a maximum number of cases within each continent. The cancer burdens of the countries mentioned above were ranked by the crude and ASIRs, as well as the crude and ASMRs. Next, the estimated numbers of new cases and deaths for the common cancer types were compiled explicitly for China in 2015 and 2020. For the top ten leading cancer types according to sex in China, we summarized the incidence and mortality, and calculated China's percentage of the new cases and deaths in the world. Finally, the projected data of cancer incidence and mortality from 2020 to 2040 were utilized to analyze the future burden of cancer.

Results

Changing global profiles of leading cancer types

Figure 1 illustrates that for both sexes combined, female breast cancer was the most frequent cancer in 2020, surpassing lung cancer. Prostate cancer, non melanoma of the skin, and colon cancer ranked third, fourth, and fifth, respectively, followed by stomach, liver, and rectal cancers. Cervical cancer remained the ninth most common type of cancer, surpassing esophageal cancer. Overall, the top 14 cancer types accounted for nearly 75% of newly diagnosed cases in 2020 (69% when non-melanoma of skin cancer was excluded). After sorting by cancer deaths in both sexes in 2020, lung, liver, stomach, breast, and colon cancers were the top five leading causes of death, closely followed by esophageal, pancreatic, and prostate cancers. Notably, stomach cancer deaths decreased by nearly 14,000 cases in 2020. Liver cancer changed from the third-highest cancer mortality in 2018 to the second-highest in 2020. Among the 14 most common cancers, deaths due to breast cancer increased the most.

Cases and deaths by continents and countries

Table 1 indicates the distribution of 19.3 million new cancer cases and Table 2 indicates the distribution of an estimated 10 million cancer deaths in the year 2020. Approximately half of the new cancer cases and 58% of

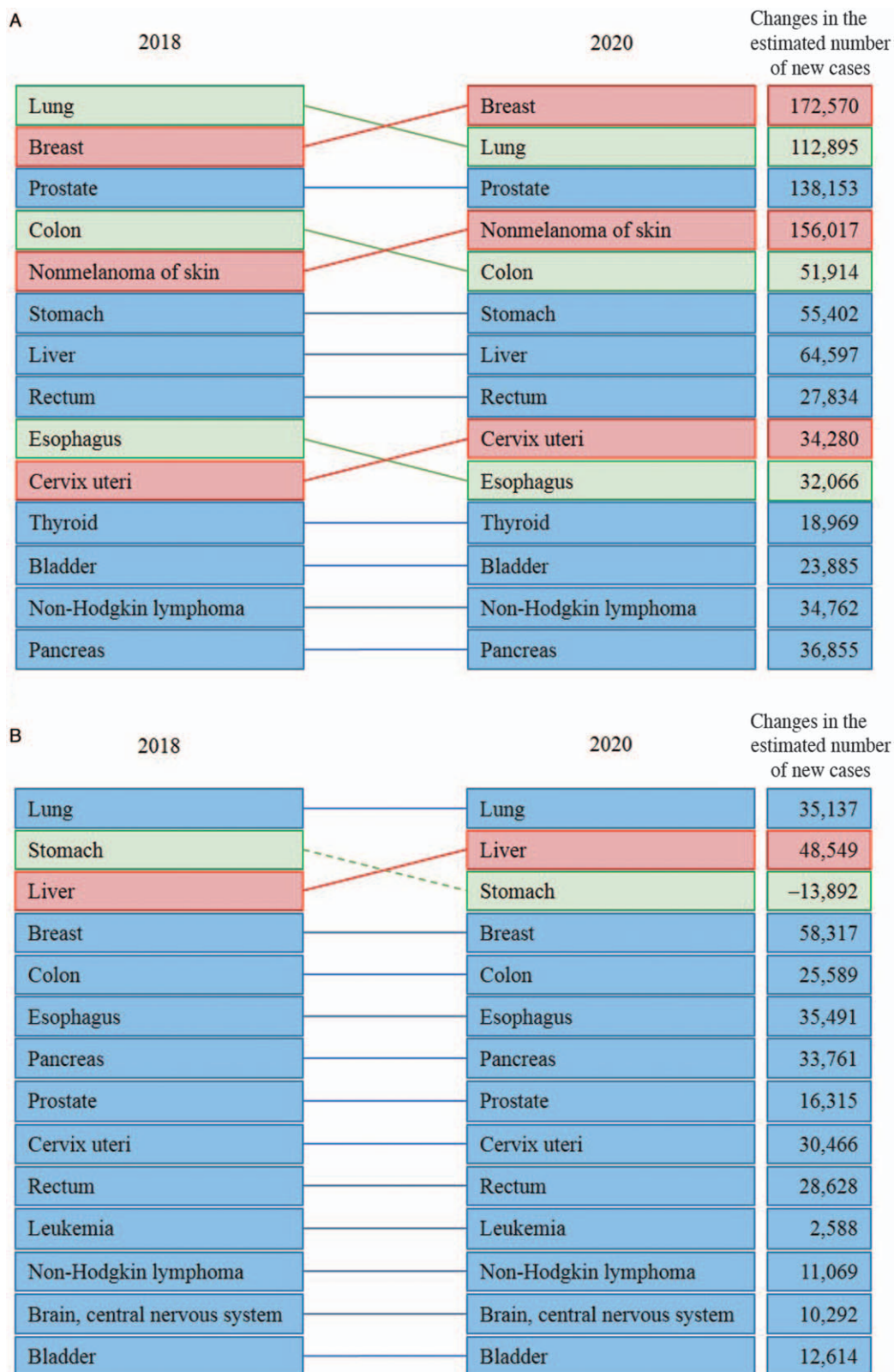


Figure 1: Rank changes in the most common cancer types (A) and leading causes of cancer-related death (B) based on the estimation of new cases and deaths worldwide, 2018–2020. Blue represents no change, red represents rank increase, and green represents rank decrease.

Table 1: Estimated incidence of all cancer types for six continents in 2020.

Continents	Number of new cases	Crude incidence rates (per 100,000)	Rank	Age-standardized incidence rates (per 100,000)	Rank
Worldwide	19,292,789	247.5	–	201.0	–
Asia	9,503,710	204.8	–	169.1	–
China	4,568,754	315.6	57	204.8	65
India	1,324,413	96.0	121	97.1	172
Japan	1,028,658	813.3	1	285.1	27
Indonesia	396,914	145.1	100	141.1	110
Turkey	233,834	277.3	64	231.5	50
Republic of Korea	230,317	449.2	42	242.7	44
Thailand	190,636	273.1	65	164.0	88
Viet Nam	182,563	187.6	81	159.7	91
Europe	4,398,443	587.4	–	285.2	–
Germany	628,519	750.2	4	313.2	15
Russian Federation	591,371	405.2	48	234.3	48
France	467,965	716.9	9	341.9	9
UK	457,960	674.6	15	319.9	12
Italy	415,269	686.8	13	292.6	21
North America	2,556,862	693.2	–	360.7	–
United States of America	2,281,658	689.3	12	362.2	4
Canada	274,364	726.9	7	348.0	8
Latin America and the Caribbean	1,470,274	224.8	–	186.5	–
Brazil	592,212	278.6	63	215.4	61
Mexico	195,499	151.6	95	140.4	111
Argentina	130,878	289.6	60	218.2	57
Colombia	113,221	222.5	75	182.3	76
Peru	69,849	211.8	76	176.3	81
Africa	1,109,209	82.7	–	132.1	–
Egypt	134,632	131.6	107	159.4	92
Nigeria	124,815	60.5	168	110.4	152
South Africa	108,168	182.4	83	209.5	64
Ethiopia	77,352	67.3	158	106.7	162
Morocco	59,370	160.8	93	148.3	105
Oceania	254,291	595.8	–	404.6	–
Australia	200,021	784.4	2	452.4	1
New Zealand	35,934	745.2	5	422.9	2

the world's deaths occurred in Asia, followed by Europe which accounted for 23% and 20% of the world's new cases and deaths, respectively. North America accounted for 13% of all new cases. Latin America and the Caribbean, Africa, and North America shared roughly the same proportion (7%) of the total deaths. Oceania had the highest ASIR (404.6 per 100,000), followed by North America (360.7 per 100,000) and Europe (285.2 per 100,000). The highest ASMRs were seen in Europe, Asia, and Oceania, with the rates of 108.7, 101.6, and 93.2 per 100,000, respectively.

With respect to cancer incidence and mortality in specific countries, China accounted for 24% of all newly diagnosed cases and 30% of the cancer deaths worldwide, in part due to China's large population. Among 185 countries or territories in the GLOBOCAN 2020 database, China ranked 65th with an ASIR of 204.8 per 100,000 and 13th with an ASMR of 129.4 per 100,000. These two rates were above the global average. Both the Republic of Korea and Japan, which are geographically adjacent to China, had higher ASIRs but lower ASMRs than China. High

ASIR and relatively low ASMR were also found in some parts of Europe (eg, in Germany, France, and the UK), North America (the USA and Canada), and Oceania (Australia and New Zealand).

Changing profiles of leading cancer types in China

As shown in Figure 2, the distribution of new cases and deaths related to China's most common cancer types is depicted for 2015 and 2020. Lung cancer remained the most common cancer, followed by colorectal and gastric cancer, and had an estimated 0.82 million new cases in 2020 in China. Breast cancer, replacing liver cancer, was estimated to be the fourth most common cancer diagnosed, with the number of new cases increasing from 0.3 million in 2015 to 0.42 million in 2020. Liver cancer and esophageal cancer ranked as the fifth and sixth leading types of cancer, respectively, with an estimated 0.41 million and 0.32 million new cases, respectively. In terms of cancer mortality in China, lung cancer was the leading cause of death, responsible for 0.72 million deaths in 2020. According to the number of deaths, the top five most common cancers

Table 2: Estimated mortality of all cancer types for six continents in 2020.

Continents	Number of deaths	Crude mortality rates (per 100,000)	Rank	Age-standardized mortality rates (per 100,000)	Rank
Worldwide	9,958,133	127.8	–	100.7	–
Asia	5,809,431	125.2	–	101.6	–
China	3,002,899	207.5	42	129.4	13
India	851,678	61.7	122	63.1	178
Japan	420,124	332.2	3	81.5	124
Indonesia	234,511	85.7	97	85.1	110
Turkey	126,335	149.8	66	120.4	21
Thailand	124,866	178.9	55	100.5	65
Viet Nam	122,690	126.0	71	106.0	50
Republic of Korea	88,597	172.8	56	75.5	144
Europe	1,955,231	261.1	–	108.7	–
Russian Federation	312,122	213.9	39	113.7	32
Germany	252,065	300.9	10	102.3	61
France	185,621	284.4	17	107.9	42
UK	179,648	264.6	22	100.5	64
Italy	174,759	289.0	15	91.1	86
North America	699,274	189.6	–	87.1	–
United States of America	612,390	185.0	54	86.3	106
Canada	86,684	229.7	33	93.5	82
Latin America and the Caribbean	713,414	109.1	–	86.5	–
Brazil	259,949	122.3	72	91.2	85
Mexico	90,222	70.0	115	63.2	176
Argentina	70,074	155.0	63	106.1	49
Colombia	54,987	108.1	81	84.7	111
Peru	34,976	106.1	82	85.5	108
Africa	711,429	53.1	–	88.8	–
Egypt	89,042	87.0	96	108.6	41
Nigeria	78,899	38.3	176	74.8	150
South Africa	56,802	95.8	87	111.7	38
Ethiopia	51,865	45.1	155	75.3	146
Morocco	35,265	95.5	88	87.9	96
Oceania	69,354	162.5	–	93.2	–
Australia	48,236	189.2	51	83.3	119
New Zealand	10,508	217.9	38	99.0	70

were lung, liver, gastric, esophageal, and colorectal cancers, accounting for almost 70% of all cancer-related deaths. The mortality distribution of the leading cancer types varied minimally from 2015 to 2020 in China.

Table 3 illustrates that the leading cancer type in men is lung cancer ($n=0.54$ million, 38% of the global lung cancer cases in men), whereas that in women is breast cancer ($n=0.42$ million, 18% of the global breast cancer cases). Lung cancer, the leading cause of cancer death for both sexes in China, accounted for 40% of global lung cancer deaths. Gastrointestinal cancers, including stomach, colorectal, liver, and esophageal cancers, created a massive burden of cancer incidence and mortality among males and ranked as the top five cancer types following lung cancer (totally accounting for 41% and 47% of global gastrointestinal cancer cases and deaths in men, respectively). Prostate cancer ranked sixth in incidence ($n=115,426$, 8.16%) and seventh in mortality ($n=51,094$, 13.61%) in China. Notably, thyroid cancer was the ninth and the fourth most common type of cancer in men and women, accounting for 38% of global new cases of thyroid cancer. Female breast cancer in China represented approximately

18% of the global breast cancer deaths. The same proportion applied to that of cervical cancer, which had the sixth-highest incidence and seventh-highest death cases in China. Gastrointestinal cancers contributed an estimate of 591,688 cases (35%) and 435,860 deaths (39%) in women.

Projections of future incidence and mortality

Figures 3 reveal that an estimated 49% increase in new cases and a 62% increase in deaths will occur on six continents in 2040 compared with 2020. China is expected to experience 6.85 million new cancer cases and 5.07 million deaths in 2040. Asia, Latin America and the Caribbean, and Africa are projected to undergo a striking relative magnitude of increased incidence and mortality. Moreover, the absolute cancer burden will continue to increase over the next 20 years.

Discussion

With the increasing incidence and mortality, cancer remains a primary public health problem. The changing

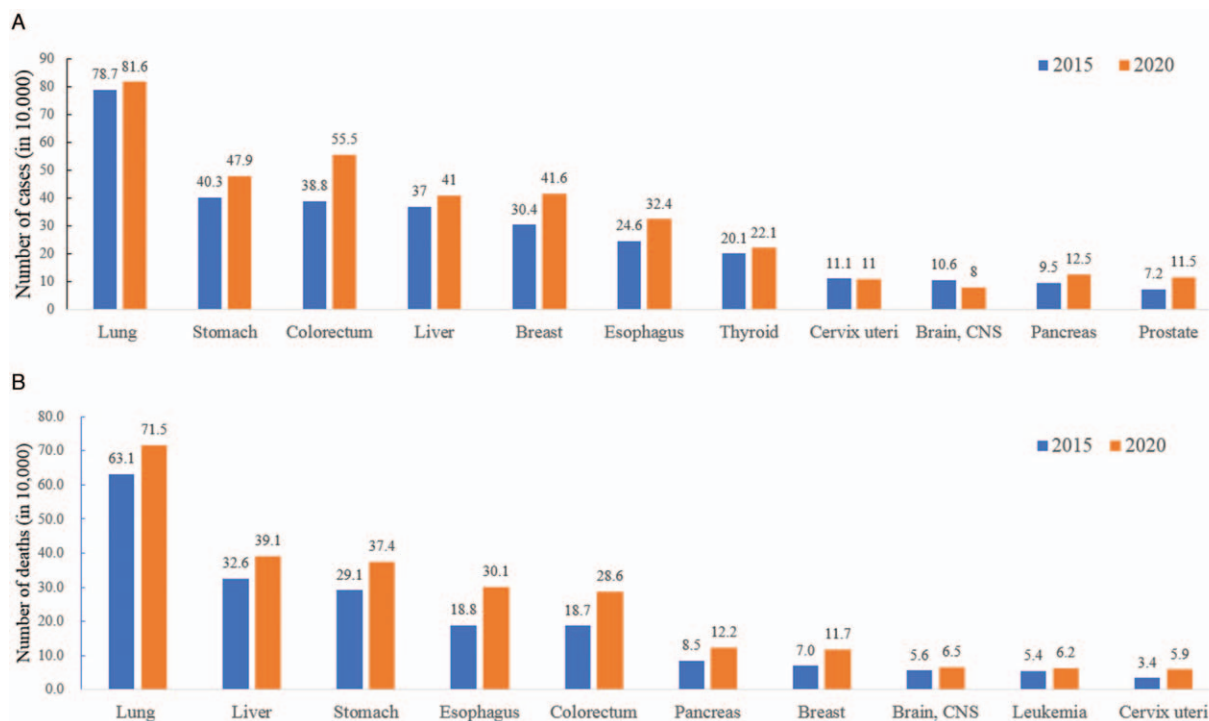


Figure 2: Estimated number of new cases (A) and cancer-related deaths (B) from of the common cancer types in 2015 and 2020, China. CNS: Central nervous system.

Table 3: Estimated numbers of new cases and deaths of the top ten cancer types in China in 2020 according to sex.

Rank	Types	Incidence				Mortality						
		Male		Female		Male		Female				
		N	Percentage (%)*	Types	N	Percentage (%)*	Types	N	Percentage (%)*			
1	All cancers	2,475,945	24.60	All cancers	2,092,809	22.68	All cancers	1,820,002	32.92	All cancers	1,182,897	26.71
2	Lung	539,181	37.55	Breast	416,371	18.41	Lung	471,546	39.67	Lung	243,153	40.03
3	Stomach	331,629	46.09	Lung	276,382	35.86	Liver	288,127	49.89	Colorectum	121,203	28.89
4	Colorectum	319,486	29.97	Colorectum	235,991	27.26	Stomach	256,512	51.02	Stomach	117,277	44.09
5	Liver	302,598	47.86	Thyroid	167,704	37.36	Esophagus	206,780	55.24	Breast	117,174	17.11
6	Esophagus	223,044	53.32	Stomach	146,879	39.74	Colorectum	164,959	31.99	Liver	103,025	40.78
7	Prostate	115,426	8.16	Cervix uteri	109,741	18.17	Pancreas	67,882	27.50	Esophagus	94,355	55.58
8	Pancreas	70,383	26.78	Liver	107,440	39.30	Prostate	51,094	13.61	Cervix uteri	59,060	17.28
9	Bladder	66,242	15.03	Esophagus	101,378	54.58	Leukemia	35,664	20.06	Pancreas	53,971	24.63
10	Thyroid	53,389	38.89	Corpus uteri	81,964	19.64	Brain	33,658	24.34	Ovary	37,519	18.10
	Non-Hodgkin lymphoma	50,125	16.48	Ovary	55,342	17.63	Non-Hodgkin lymphoma	29,721	20.19	Brain	31,546	27.90

* Percentages represent the incidence/mortality in China accounting for the global incidence/mortality in corresponding cancer types.

profiles of the most common cancer types revealed that breast cancer replaced lung cancer as the most diagnosed cancer globally in 2020. The incidence of breast cancer has increased in both high-HDI and low-HDI countries, and the ASIR in more developed regions is 2 to 4 times that in less developed regions.^[1,9] Potential reasons for this increase may be ongoing changes in reproductive practices, including declining fertility rates, postponement of the first childbearing, and breastfeeding for shorter durations.^[12] Excess body weight and a high body mass index are also associated with increased breast cancer risk among older women, especially after menopause.^[13,14] Moreover, variations in breast cancer incidence also reflect disparities in the prevalence and distribution of risk factors in different areas. Countries undergoing rapid societal and

economic development are more likely to experience changes in the breast cancer profiles of their population.^[15]

We also observed rank changes in the mortality attributable to liver cancer, which is currently the second leading cause of cancer-related deaths globally. Etiologically, hepatitis B/C virus infections and alcohol use are responsible for more than 80% of liver cancer deaths.^[16] Previous studies illustrated that liver cancer mortality varies considerably depending on the patient's age groups, sex, ethnicity, educational attainment, and geographic area.^[17,18] Targeted interventions, including vaccination, disruption of hepatitis virus transmission, antiviral treatment, and reduced alcohol consumption, are urgently needed to halt the growing burden of liver cancer.

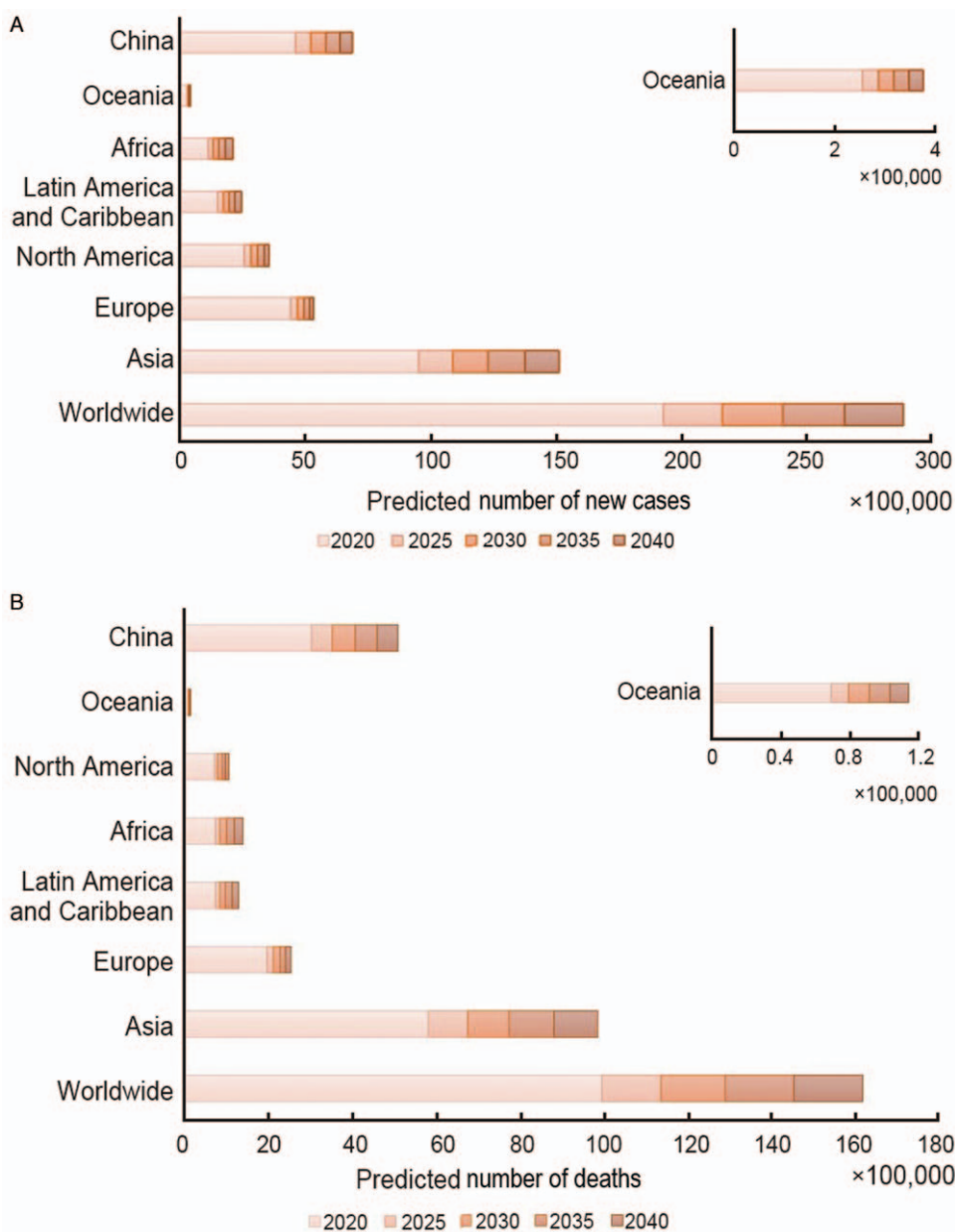


Figure 3: Estimated increase in the number of new cases (A) and deaths (B) of all cancer types on the basis of 2020 worldwide and in China.

In China, comparing new cases and deaths by cancer type between 2015 and 2020 exhibits the changing profiles of the cancer burden. Lung cancer remains the most common cancer type and the leading cause of cancer-related deaths. Tobacco consumption, air pollution, and occupational exposure are the primary carcinogens that contribute to lung cancer incidence.^[19] China is experiencing cancer transitioning stage with substantial increases in the new cases of colorectal cancer and female breast cancers. In high-HDI countries, lung, colorectal, and female breast cancers, possibly associated with a Westernized lifestyle, are responsible for nearly one-half of the total cancer incidence.^[5] China’s cancer incidence profile is becoming similar to that of high-HDI countries. However, the leading causes of cancer-related mortality remained consistent between 2015 and 2020. The cancer mortality

rate is higher in China than in developed countries. In addition to lung cancer, gastrointestinal cancers account for 45% of the cancer-related deaths in China, whereas the corresponding figure is much lower in developed countries (eg, the USA and the UK).^[7] A possible explanation for this finding is that gastrointestinal cancers may have poorer prognoses, and late-stage presentation may be more common in China. An updated overview of cancer epidemiology would improve our understanding of the cancer patterns and possibly help tackle cancer burden more efficiently in China.

The analysis of projected incidence and mortality indicated that the cancer burden will continue to increase over the next 20 years. Much is still required to fight against cancer. However, a “one-size-fits-all” strategy for cancer preven-

tion and control does not seem to be effective. Consider China as an example, the level of cancer awareness is inversely associated with cancer risk in rural China.^[20] Health promotion and education that disseminate cancer knowledge and improve cancer development perceptions are crucial in real practice.^[21] As potentially modifiable risk factors have been identified across all provinces in China,^[22] tailored healthier lifestyles should be persistently recommended across different areas. Organized cancer screening programs funded by the Chinese government have been implemented for several years in rural and urban China to explore appropriate strategies for early cancer detection.^[23,24] Comprehensive strategies, including vaccination programs and tobacco control policies, also need to be developed.^[25]

The estimated incidence and mortality vary substantially across continents and countries. In addition to several socioeconomic and lifestyle factors, it is noteworthy that the coverage and data quality of the cancer registry play a critical role in cancer surveillance.^[26] Currently, high-quality registry data are not extensively available in most low- and middle-income countries. For instance, cancer registries cover only small proportions of the population (less than 10%) in Latin America and Asia, whereas the corresponding figure is 98% in the USA.^[27,28] China's national cancer registry has made remarkable improvements in data representativeness and quality since its establishment in 2002.^[29] The total number of local population-based cancer registries has increased significantly from 501 in 2015 to 1152 in 2020, presently covering up to 598 million people in China.^[3,30] However, the data quality in these registries is inconsistent. Persistent efforts should be devoted to improving and achieving more reliable national cancer data, laying a solid foundation for precise burden estimates and evidence-based cancer control programs.

GLOBOCAN 2020 has shown that it is vital for global cancer control to deliver cancer prevention and care in transitioning countries.^[9] China, a transitioning country, bears a massive burden of cancer incidence and mortality. This study depicts the most recent changing profile of the cancer burden, particularly in China, and compares the cancer data of China with those of other regions. Future implications for tailored policies and targeted practices on cancer control in China may be drawn from the findings of this study. However, potential limitations should be noted when interpreting the findings. Although GLOBOCAN 2020 provides reasonably accurate estimates of recent cancer data, caution should be exercised when evaluating the real burden under the impact of the global COVID-19 pandemic on decreased access to health care and delayed cancer diagnosis. Second, the cancer burden varies considerably according to sex, age group, race/ethnicity, and geographic location.^[31] Cancer disparities should be addressed explicitly in research to enable customized targeted cancer control programs. Additionally, by performing our analysis of the future cancer burden using only five years of data, we did not account for other data sources and variables, which could have improved our understanding of the burden and related trends in the near future.

Conclusions

The burden of breast cancer is increasing globally. China is undergoing cancer transitioning with an increasing burden of lung cancer, colorectal cancer, and female breast cancer. In China, cancer mortality is high, and gastrointestinal cancers account for 45% of all cancer deaths in 2020. An overview of the updated cancer epidemiology would renew our understanding of the recent cancer burden. Comprehensive strategies, including health education, dissemination of essential cancer knowledge, advocacy of healthy lifestyle, effective cancer screening, vaccination programs, and tobacco-control policies, need to be tailored to target China's cancer pattern.

Conflicts of interest

None.

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