Received: 12 February 2024 | Accepted: 12 February 2024

DOI: 10.3322/caac.21834

ARTICLE

Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries

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Funding information
International Agency for Research on Cancer/ World Health Organization

Abstract

This article presents global cancer statistics by world region for the year 2022 based on updated estimates from the International Agency for Research on Cancer (IARC). There were close to 20 million new cases of cancer in the year 2022 (including nonmelanoma skin cancers [NMSCs]) alongside 9.7 million deaths from cancer (including NMSC). The estimates suggest that approximately one in five men or women develop cancer in a lifetime, whereas around one in nine men and one in 12 women die from it. Lung cancer was the most frequently diagnosed cancer in 2022, responsible for almost 2.5 million new cases, or one in eight cancers worldwide (12.4% of all cancers globally), followed by cancers of the female breast (11.6%), colorectum (9.6%), prostate (7.3%), and stomach (4.9%). Lung cancer was also the leading cause of cancer death, with an estimated 1.8 million deaths (18.7%), followed by colorectal (9.3%), liver (7.8%), female breast (6.9%), and stomach (6.8%) cancers. Breast cancer and lung cancer were the most frequent cancers in women and men, respectively (both cases and deaths). Incidence rates (including NMSC) varied from four-fold to five-fold across world regions, from over 500 in Australia/New Zealand (507.9 per 100,000) to under 100 in Western Africa (97.1 per 100,000) among men, and from over 400 in Australia/New Zealand (410.5 per 100,000) to close to 100 in South-Central Asia (103.3 per 100,000) among women. The authors examine the geographic variability across 20 world regions for the 10 leading cancer types, discussing recent trends, the underlying determinants, and the prospects for global cancer prevention and control. With demographics-based predictions indicating that the number of new cases of cancer will reach 35 million by 2050, investments in prevention, including the targeting of key risk factors for cancer (including smoking, overweight and obesity, and infection), could avert millions of future cancer diagnoses and save many lives worldwide, bringing huge economic as well as societal dividends to countries over the forthcoming decades.

KEYWORDS
cancer burden, cancer control, epidemiology, incidence, mortality

INTRODUCTION

Cancer is a major societal, public health, and economic problem in the 21st century, responsible for almost one in six deaths (16.8%) and one in four deaths (22.8%) from noncommunicable diseases (NCDs) worldwide. The disease causes three in 10 global premature deaths from NCDs (30.3% in those aged 30–69 years), and it is among the three leading causes of death in this age group in 177 of 183 countries.[1] In addition to being an important barrier to increasing life expectancy, cancer is associated with substantial societal and macroeconomic costs that vary in degree across cancer types, geography, and gender.[2] One recent study illustrated the profound impact of disproportional cancer mortality in women: an estimated one million children became maternal orphans in 2020 because their mother died from cancer in that year, with close to one half of these orphans the result of maternal deaths from either female breast or cervical cancer.[3]

In this article, we explore the cancer burden worldwide in 2022 based on the latest *GLOBOCAN* estimates produced by the International Agency for Research on Cancer (IARC) and disseminated as *Cancer Today* on the Global Cancer Observatory.[4] As with previous reports,[5–8] our lines of inquiry are threefold: (1) the description of the cancer incidence and mortality burden at the global level, (2) the geographic variability observed across 20 predefined world regions, and (3) a prediction of the future magnitude of the incidence burden (in the year 2050) based on global demographic projections. With a focus on the 10 major cancer types, we briefly link these observations to the underlying determinants and the prospects for cancer prevention and control on a global scale.

DATA SOURCES AND METHODS

The sources and methods used in compiling the *GLOBOCAN* estimates have been documented[9] and are described online at the Global Cancer Observatory (GCO) (https://gco.iarc.who.int). The GCO website includes facilities for the tabulation and graphic visualization of the *GLOBOCAN* database at the global, world region, and national level by cancer type, sex, and age. In brief, the national estimates are built up from the best available sources of cancer incidence and mortality data within each country, and their validity depends on the degree of representativeness and quality of the source information. The methods used to compile the 2022 estimates are largely based on those developed previously with an emphasis on the use of short-term predictions and the use of modeled mortality-to-incidence ratios, where applicable.[10] The estimates are available in the GCO for 36 cancer types, including nonmelanoma skin cancer (NMSC) (*International Classification of Diseases, Tenth Edition* [ICD-10] code C44, excluding basal-cell carcinomas). Together with all cancers combined, cancer-specific estimates are provided for 185 countries or territories worldwide by sex and 18 age groups (ages birth to 4 years, 5–9 years, …, 80–84 years, 85 years and older).

The number of new cancer cases and cancer deaths were extracted from the *GLOBOCAN* 2022 database for all cancers combined (ICD-10 codes C00–C97) and for 36 cancer types: lip, oral cavity (C00–C06), salivary glands (C07–C08), oropharynx (C09–C10), nasopharynx (C11), hypopharynx (C12–C13), esophagus (C15), stomach (C16), colon (C18), rectum (C19–C20), anus (C21), liver (C22, including intrahepatic bile ducts), gallbladder (C23), pancreas (C25), larynx (C32), lung (C33–C34, including trachea and bronchus), melanoma of skin (C43), NMSC (C44, excluding basal cell carcinoma for incidence), mesothelioma (C45), Kaposi sarcoma (C46), female breast (C50), vulva (C51), vagina (C52), cervix uteri (C53), corpus uteri (C54), ovary (C56), penis (C60), prostate (C61), testis (C62), kidney (including renal pelvis, C64–C65), bladder (C67), brain, central nervous system (C70–C72), thyroid (C73), Hodgkin lymphoma (C81), non-Hodgkin lymphoma (C82–C86, C96), multiple myeloma (C88 and C90, including immunoproliferative diseases), and leukemia (C91–C95). For consistency with previous reports,[4] we combine colon, rectum, and anus as colorectal cancer (ICD-10 codes C18–C21), whereas NMSC (C44, excluding basal cell carcinoma) is included in the overall estimation of the total cancer burden (unless otherwise stated) and is included within the *other* category when making comparisons of the relative magnitude of different cancers types.

For the 10 leading cancer types—which collectively comprise around two thirds of the global burden—we present indicators of the incidence and mortality burden across 20 aggregated regions defined by the United Nations Population Division (Figure 1A). In addition to the number of new cases and deaths, two measures of direct standardization that allow comparisons between populations adjusted for differences in their age structures are used: age-standardized (incidence and mortality) rates (ASRs) per 100,000 person-years based on the 1966 Segi–Doll World standard population[11] and the cumulative risk of (developing or dying from) cancer before age 75 years, assuming the absence of competing causes of death, expressed as a percentage. We also characterize the burden according to the Human Development Index (HDI; Figure 1B) based on the United Nations Development Program's *Human Development Report 2021–22*[12], using the predefined four-tier (low, medium, high, and very high HDI) and binary proxies of human development (low and medium HDI vs. high and very high HDI). Given their large population sizes, the cancer profiles in China and India are also shown separately. Finally, we provide a

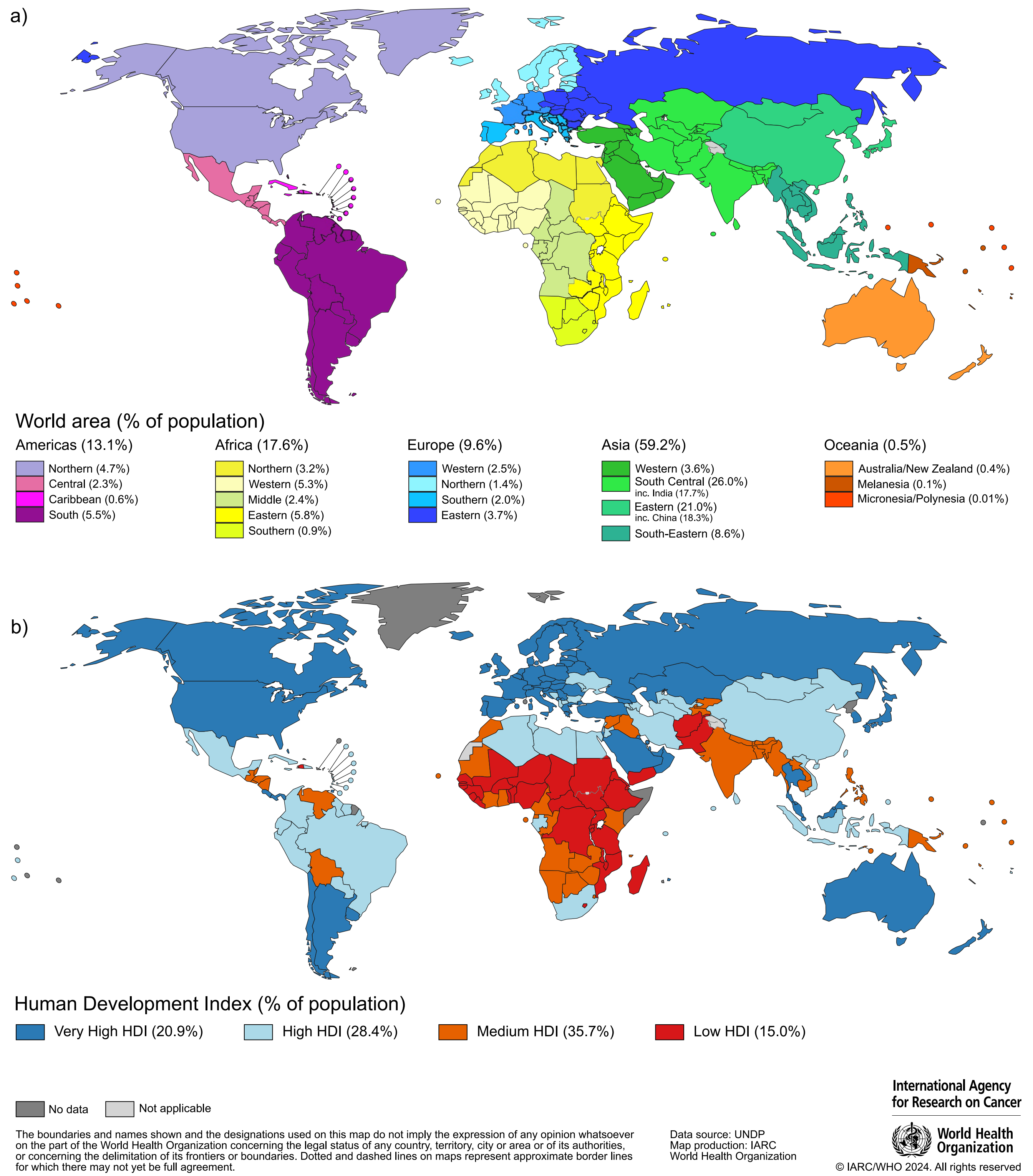

FIGURE 1 Global maps present (A) 20 areas of the world and (B) the four-tier Human Development Index. The sizes of the respective populations are included in the legend. Source: United Nations Procurement Division/United Nations Development Program. HDI indicates Human Development Index.

prediction of the future burden of cancer in the year 2050 based on demographic projections assuming constant rates. Throughout, we use the terms *transitioning*, *emerging*, and *lower HDI countries/economies* as synonyms for nations classified as low and medium HDI, and the terms *transitioned* and *higher HDI countries/economies* are used for those classified as high and very high HDI.

RESULTS

Distribution of cases and deaths by world region and cancer types

Figure 2 presents the distribution of new cases and deaths according to world region for both sexes combined and for men and women separately. For both sexes combined, there were an estimated 20.0 million new cases worldwide (19.96 million including NMSC and 18.73 million excluding NMSC) and 9.7 million cancer deaths (9.74 million including NMSC and 9.67 million excluding NMSC) in 2022 (Table 1). Almost one half of all cases (49.2%) and the majority (56.1%) of cancer deaths globally were estimated to occur in Asia in 2022 (Figure 2A), where 59.2% of the world's population resides (Figure 1B). The cancer mortality burden in the African and Asian regions is disproportionately greater than the corresponding incidence burden. This reflects the respective distribution of cancer types alongside comparatively higher case fatality rates on these continents in part because of late-stage diagnoses. Europe has a disproportionately higher cancer incidence and mortality burden, given that the continent has one fifth of the global cancer cases (22.4%) and cancer deaths (20.4%) yet less than 10% of the global population (9.6%).

Table 2 lists the number of newly diagnosed cancer cases and deaths, the incidence and mortality ASR, and the cumulative risk of developing and dying from cancer overall and for the 36 cancer types in men and women, separately. Approximately one in five men or women develop cancer in a lifetime, whereas around one in nine men and one in 12 women die from it.

As illustrated in Figure 3A (with NMSC included in the *other* category), the top 10 cancer types in both sexes account for over 60% of newly diagnosed cancer cases and cancer deaths. Lung cancer is the most commonly diagnosed cancer worldwide (12.4% of the total cases), followed by cancers of the female breast (11.6%), colorectum (9.6%), prostate (7.3%), and stomach (4.9%). Lung cancer is also the leading cause of cancer death (18.7% of the total cancer deaths), followed by colorectal (9.3%), liver (7.8%), female breast (6.9%), and stomach (6.8%) cancers. In women, breast cancer is the most commonly diagnosed cancer and the leading cause of cancer death, followed by lung and colorectal cancer for both cancer cases and deaths; whereas lung cancer is most frequent cancer in men (both cases and deaths), followed by prostate and colorectal cancer for new cases and liver and colorectal cancer for deaths (Figure 3B,C).

Global cancer patterns

Figures 4 and 5 present global maps of the most commonly diagnosed cancers and leading causes of cancer death, respectively, by sex in 185 countries. The maps illustrate the diversity of leading cancer types across nations, notably in terms of new cases and deaths in men (eight different leading cancers) and deaths in women (seven different leading cancers). In men, prostate cancer ranks as the most frequently diagnosed cancer in 118 countries, followed by lung cancer in 33 countries, with liver, colorectal, and stomach cancer ranking in first place in 11, nine, and eight countries, respectively (Figure 4A). In terms of cancer deaths, lung cancer leads in men in 89 countries (Figure 5A), followed by cancers of the prostate (52 countries) and liver (24 countries). In contrast, two cancer types dominate as the most commonly diagnosed cancers in women, namely, breast cancer (157 countries) and cervical cancer (25 of 28 remaining countries; Figure 4B). The mortality profile in women is more heterogeneous than that of incidence, however, with breast and cervical cancer as the leading causes of cancer death in 112 and 37 countries, respectively, followed by lung cancer in 23 countries (Figure 5B).

Cancer incidence and mortality patterns by four-tier HDI, China and India

Figure 6 shows the most frequent five cancers in terms of incidence and mortality for very high, high (excluding China), medium (excluding India), and low HDI levels, as well as for China and India. Although lung cancer is the most frequent cancer type worldwide and in China, female breast cancer is the most common form of incidence at each level of HDI and in India. Colorectal cancer is among the top five leading cancers for both incidence and mortality across HDI levels (also in China but not India), as is liver cancer (although only for mortality). Cervical cancer ranks in the top five cancers for both incidence and mortality in low and medium HDI regions and India. The five most common cancers tend to explain 40%–50% of the incidence and mortality burden across the four-tier HDI, China, and India, although five cancers are responsible for over two thirds of the cancer mortality burden in China.

From a global perspective, the risk of developing cancer tends to increase with increasing HDI level. For example, the cumulative risk of men developing cancer before age of 75 years in 2022 ranged from approximately 10% in low HDI settings to over 30% in very high HDI settings (Table 3). The risk of cancer death varies less by HDI level, although the cumulative risk in men in high and very high HDI settings is still about 60% higher than that of low and medium HDI settings (around 12.5% vs. 8%, respectively). In contrast, there is little variation across HDI levels in the cumulative risk of cancer death in women, with the risk higher in low HDI compared with very high HDI settings (8.8% vs. 8.2%, respectively).

Figure 7 presents cancer incidence and mortality ASRs in higher versus lower HDI countries in men and women, respectively, in 2022. In men, the three cancer sites with the highest ASRs in descending order were lung, prostate, and colorectal cancer (40.1, 35.5, and 27.3 per 100,000, respectively) in higher HDI countries and prostate, lung, and lip and oral cavity cancer (12.6, 10.5, and 10.0 per 100,000, respectively) in lower HDI countries. In women (Figure 7B), incidence rates for breast cancer far exceed those of other cancers in both transitioned (54.1 per 100,000) and transitioning (30.8 per 100,000) countries, followed by lung cancer (20.7 per 100,000) in transitioned countries and cervical cancer (19.3 per 100,000) in transitioning

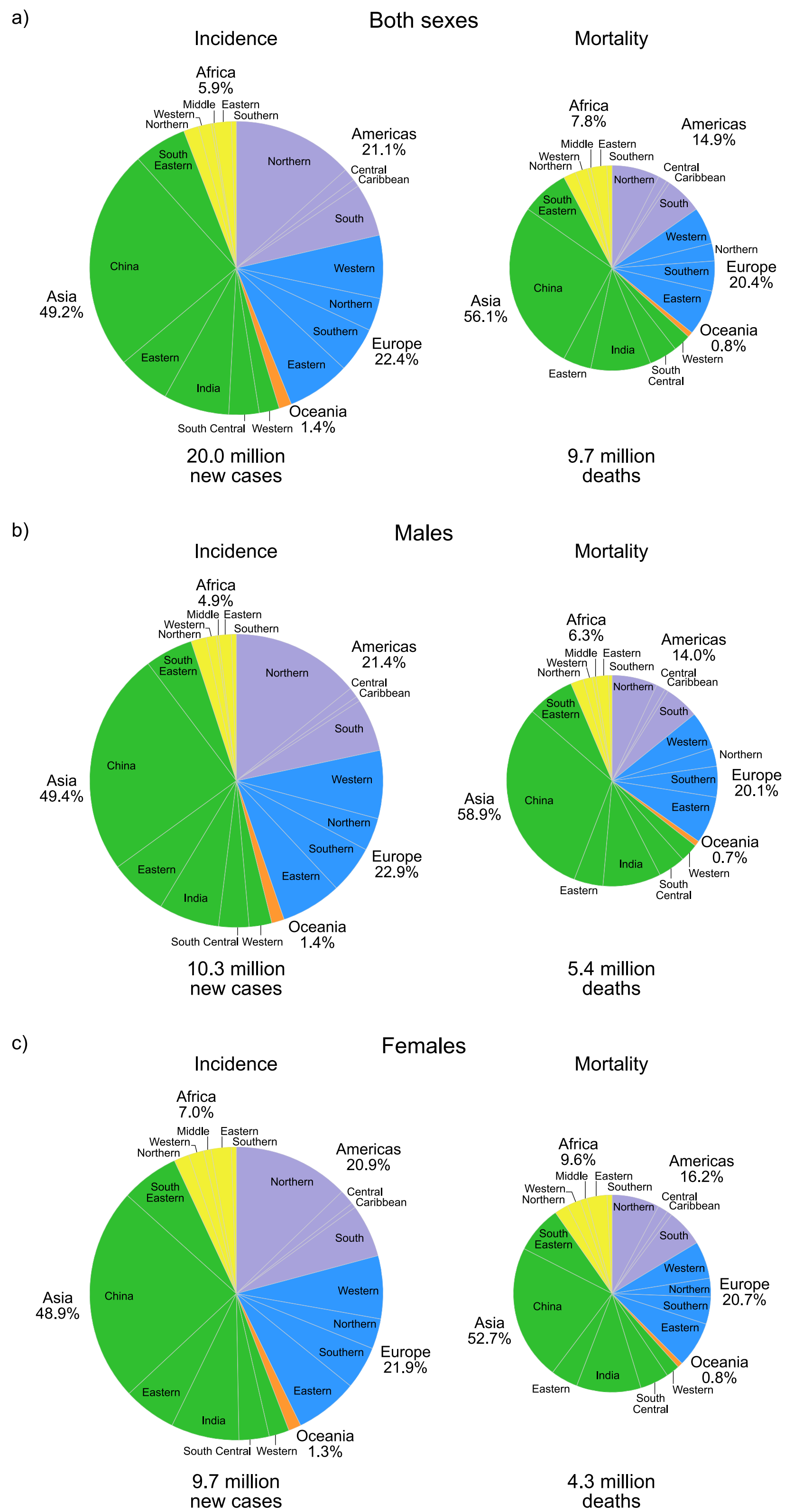

FIGURE 2 Pie charts present the distribution of cases and deaths (incidence and mortality) by world area in 2022 for (A) both sexes, (B) males, and (C) females. For each sex, the area of the pie chart reflects the proportion of the total number of cases or deaths. Source: GLOBOCAN 2022.

countries. In terms of mortality, lung cancer rates rank in first place among men and women in transitioned countries, and among men in transitioning countries. Among women in transitioning countrires, however, mortality rates from cancers of the female breast, cervix, and ovary are of greater magnitude than those from cancers of the lung. Rates tend to be higher in transitioned compared with

TABLE 1 New cases and deaths for 36 cancers and all cancers combined in 2022.

	Incidence			Mortality		
Cancer site	Rank	New cases	% of all sites	Rank	Deaths	% of all sites
Lung	1	2,480,301	12.4	1	1,817,172	18.7
Female breast	2	2,308,897	11.6	4	665,684	6.9
Colorectum	3	1,926,118	9.6	2	903,859	9.3
Prostate	4	1,466,680	7.3	8	396,792	4.1
Stomach	5	968,350	4.9	5	659,853	6.8
Liver	6	865,269	4.3	3	757,948	7.8
Thyroid	7	821,173	4.1	24	47,485	0.5
Cervix uteri	8	661,021	3.3	9	348,189	3.6
Bladder	9	613,791	3.1	13	220,349	2.3
Non-Hodgkin lymphoma	10	553,010	2.8	11	250,475	2.6
Esophagus	11	510,716	2.6	7	445,129	4.6
Pancreas	12	510,566	2.6	6	467,005	4.8
Leukemia	13	486,777	2.4	10	305,033	3.1
Kidney	14	434,419	2.2	16	155,702	1.6
Corpus uteri	15	420,242	2.1	19	97,704	1
Lip, oral cavity	16	389,485	2	15	188,230	1.9
Melanoma of skin	17	331,647	1.7	22	58,645	0.6
Ovary	18	324,398	1.6	14	206,839	2.1
Brain, central nervous system	19	321,476	1.6	12	248,305	2.6
Larynx	20	188,960	0.9	18	103,216	1.1
Multiple myeloma	21	187,774	0.9	17	121,252	1.2
Gallbladder	22	122,462	0.6	20	89,031	0.9
Nasopharynx	23	120,416	0.6	21	73,476	0.8
Oropharynx	24	106,316	0.5	23	52,268	0.5
Hypopharynx	25	86,276	0.4	25	40,917	0.4
Hodgkin lymphoma	26	82,409	0.4	28	22,701	0.2
Testis	27	72,031	0.4	32	9056	0.1
Salivary glands	28	55,003	0.3	27	23,894	0.2
Vulva	29	47,342	0.2	29	18,579	0.2
Penis	30	37,699	0.2	31	13,729	0.1
Kaposi sarcoma	31	35,359	0.2	30	15,911	0.2
Mesothelioma	32	30,618	0.2	26	25,372	0.3
Vagina	33	18,800	0.1	33	8238	0.1
All cancers excl. C44		18,730,216			9,667,298	
All cancers		19,964,811			9,736,779	

Note: Nonmelanoma skin cancer excludes basal cell carcinoma.

Abbreviation: excl. C44, excluding nonmelanoma skin cancer.

Source: GLOBOCAN 2022.

TABLE 2 Incidence (cases, age-standardized rate, cumulative risk) and mortality (deaths, age-standardized rate, cumulative risk) for 36 cancers and all cancers combined (including nonmelanoma skin cancer except basal cell carcinoma) by sex in 2022.

	Incidence						Mortality					
	Males			Females			Males			Females		
Cancer site	Cases	Age-standardized rate (world), %	Cumulative risk: Birth to age 74 years, %	No. of cases	Age-standardized rate (world), %	Cumulative risk: Birth to age 74 years, %	No. of cases	Age-standardized rate (world), %	Cumulative risk: Birth to age 74 years, %	No. of cases	Age-standardized rate (world), %	Cumulative risk: Birth to age 74 years, %
Lip, oral cavity	268,759	5.8	0.67	120,726	2.3	0.26	130,668	2.8	0.32	57,562	1.1	0.12
Salivary glands	30,942	0.7	0.07	24,061	0.5	0.05	13,982	0.3	0.03	9912	0.2	0.02
Oropharynx	86,269	1.9	0.23	20,047	0.4	0.05	42,792	0.9	0.11	9476	0.2	0.02
Nasopharynx	86,257	1.9	0.21	34,159	0.7	0.08	54,090	1.2	0.14	19,386	0.4	0.04
Hypopharynx	72,079	1.5	0.19	14,197	0.3	0.03	34,565	0.7	0.09	6352	0.1	0.01
Esophagus	364,999	7.6	0.93	145,717	2.6	0.31	318,284	6.5	0.78	126,845	2.2	0.25
Stomach	627,229	12.8	1.53	341,121	6.0	0.67	427,421	8.6	0.98	232,432	3.9	0.42
Colon	609,216	12.4	1.43	533,006	9.2	1.03	283,797	5.5	0.57	254,341	4.0	0.39
Rectum	436,081	9.1	1.10	293,621	5.4	0.62	205,062	4.1	0.45	138,699	2.3	0.25
Anus	23,999	0.5	0.06	30,195	0.6	0.07	10,856	0.2	0.02	11,104	0.2	0.02
Liver and intrahepatic bile ducts	600,243	12.7	1.49	265,026	4.8	0.55	521,433	10.9	1.26	236,515	4.1	0.46
Gallbladder	43,531	0.9	0.10	78,931	1.4	0.16	31,400	0.6	0.07	57,631	1.0	0.11
Pancreas	269,583	5.5	0.64	240,983	4.0	0.44	247,466	5.0	0.56	219,539	3.5	0.38
Larynx	165,598	3.5	0.44	23,362	0.4	0.05	90,256	1.9	0.23	12,960	0.2	0.03
Trachea, bronchus and lung	1,571,868	32.1	3.88	908,433	16.2	1.95	1,233,109	24.8	2.91	584,063	9.8	1.11
Melanoma of skin	179,916	3.7	0.40	151,731	2.9	0.31	33,149	0.7	0.07	25,496	0.4	0.04
NMSC	744,792	14.0	1.29	489,803	7.5	0.70	39,703	0.8	0.07	29,778	0.4	0.04
Mesothelioma	21,411	0.4	0.05	9207	0.2	0.02	18,083	0.3	0.03	7289	0.1	0.01
Kaposi sarcoma	24,290	0.6	0.05	11,069	0.3	0.02	10,455	0.2	0.02	5456	0.1	0.01
Breast	.	.	.	2,295,686	46.8	5.05	.	.	.	665,684	12.6	1.36
Vulva	.	.	.	47,342	0.8	0.09	.	.	.	18,579	0.3	0.03

(Continues)

TABLE 2 (Continued)

	Incidence						Mortality					
	Males			Females			Males			Females		
Cancer site	Cases	Age-standardized rate (world), %	Cumulative risk: Birth to age 74 years, %	No. of cases	Age-standardized rate (world), %	Cumulative risk: Birth to age 74 years, %	No. of cases	Age-standardized rate (world), %	Cumulative risk: Birth to age 74 years, %	No. of cases	Age-standardized rate (world), %	Cumulative risk: Birth to age 74 years, %
Vagina	.	.	.	18,800	0.4	0.04	.	.	.	8238	0.2	0.02
Cervix uteri	.	.	.	661,021	14.1	1.50	.	.	.	348,189	7.1	0.79
Corpus uteri	.	.	.	420,242	8.4	1.01	.	.	.	97,704	1.7	0.20
Ovary	.	.	.	324,398	6.6	0.73	.	.	.	206,839	4.0	0.46
Penis	37699	0.8	0.09	.	.	.	13,729	0.3	0.03	.	.	.
Prostate	1,466,680	29.4	3.68	.	.	.	396,792	7.3	0.61	.	.	.
Testis	72,031	1.7	0.13	.	.	.	9056	0.2	0.02	.	.	.
Kidney	277,574	5.9	0.69	156,845	3.0	0.34	100,209	2.0	0.22	55,493	0.9	0.10
Bladder	471,072	9.3	1.05	142,719	2.4	0.26	165,541	3.1	0.28	54,808	0.8	0.07
Brain, CNS	173,591	3.9	0.39	147,885	3.1	0.32	139,737	3.0	0.33	108,568	2.2	0.23
Thyroid	206,487	4.6	0.46	614,686	13.6	1.35	17,244	0.3	0.04	30,241	0.5	0.06
Hodgkin lymphoma	48,753	1.1	0.10	33,656	0.8	0.07	13,668	0.3	0.03	9033	0.2	0.02
Non-Hodgkin lymphoma	311,157	6.6	0.72	241,853	4.6	0.49	143,624	2.9	0.30	106,851	1.9	0.19
Multiple myeloma	103,767	2.1	0.25	84,007	1.5	0.18	66,938	1.3	0.15	54,314	0.9	0.10
Leukemia	277,824	6.2	0.59	208,953	4.4	0.41	173,063	3.7	0.35	131,970	2.5	0.24
All cancers excluding NMSC	9,561,663	198.5	20.77	9,168,553	178.7	17.93	538,7340	108.9	11.33	4,279,958	76.3	7.93
All cancers	10,306,455	212.5	21.79	9,658,356	186.2	18.51	5,427,043	109.7	11.39	4,309,736	76.8	7.97

Abbreviations: CNS, central nervous system; NMSC, Nonmelanoma skin cancer.
Source: GLOBOCAN 2022.

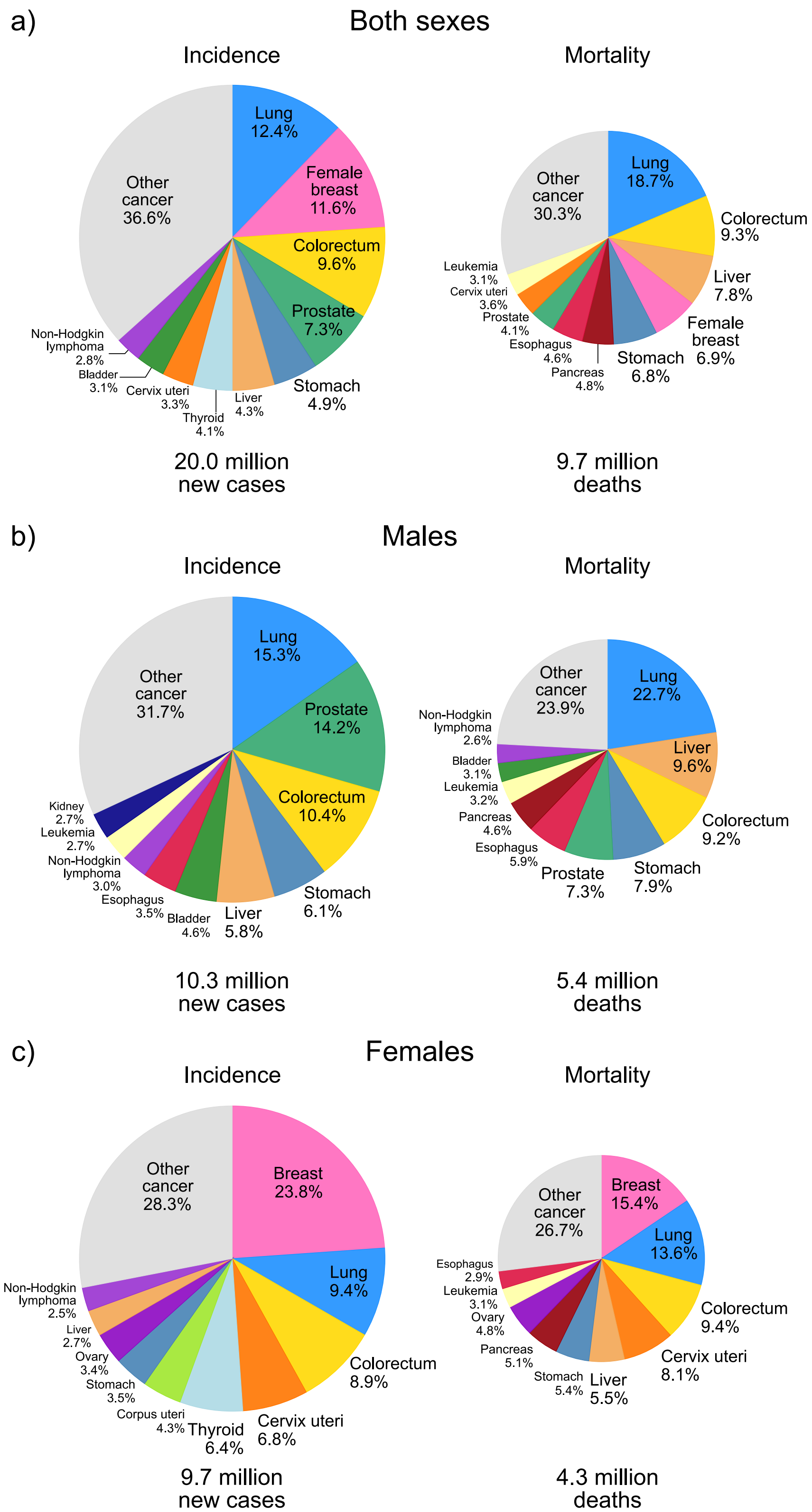

FIGURE 3 Pie charts present the distribution of cases and deaths for the top five cancers in 2022 for (A) both sexes, (B) males, and (C) females. For each sex, the area of the pie chart reflects the proportion of the total number of cases or deaths; nonmelanoma skin cancers (excluding basal cell carcinoma) are included in the *other* category. Source: GLOBOCAN 2022.

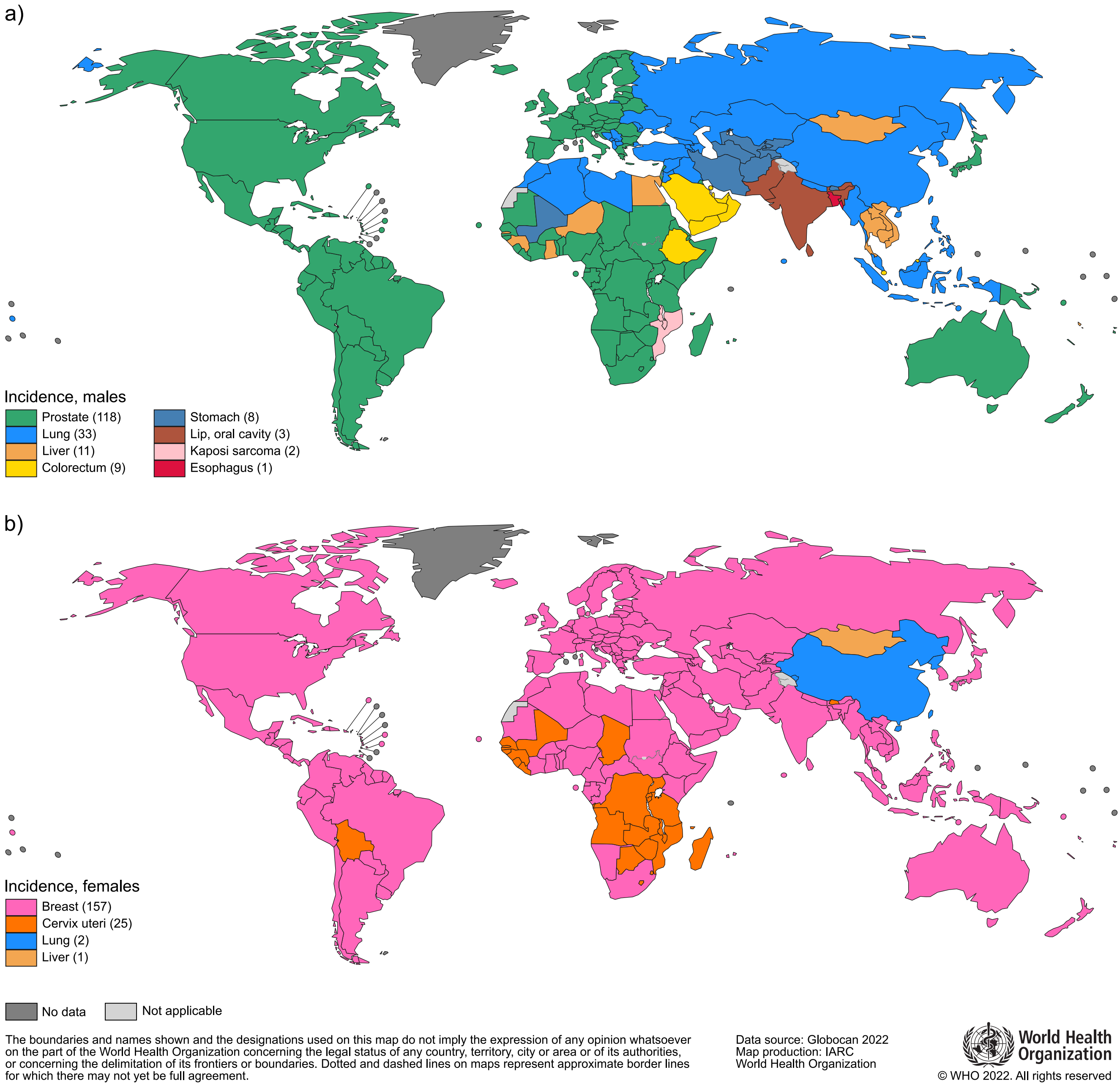

FIGURE 4 Global maps present the most common type of cancer incidence in 2022 in each country among (A) men and (B) women. The numbers of countries represented in each ranking group are included in the legend. Nonmelanoma skin cancer (excluding basal cell carcinoma) is the most common type of cancer in Australia and New Zealand among men and women and in the United States among men; however, it is excluded when making global maps. Source: GLOBOCAN 2022.

transitioning countries site-for-site in both men and women, although the cancer profiles in part reflect the large incidence burden of specific cancer types in highly populated countries, including China (e.g., lung), India (oral cavity), and the United States (prostate).

Cancer incidence and mortality rates by sex and world region

The incidence rate for all cancers combined (including NMSC) was slightly higher in men (212.5 per 100,000) than in women (186.2 per 100,000) in 2022, although rates varied four-fold to five-fold across world regions (Table 3). Among men, incidence rates ranged from over 500 in Australia/New Zealand (507.9 per 100,000) to under 100 in Western Africa (97.1 per 100,000) and, among women, rates ranged from over 400 in Australia/New Zealand (410.5 per 100,000) to close to 100 in South-Central Asia (103.3 per 100,000). Sex-specific differences in mortality rates were less pronounced than for incidence (Table 3), with mortality rates per 100,000 persons ranging from 68.9 in Central America to 159.6 in Eastern Europe among men and from around 63 in Central America and South-Central Asia to 115.7 in Melanesia among women. The

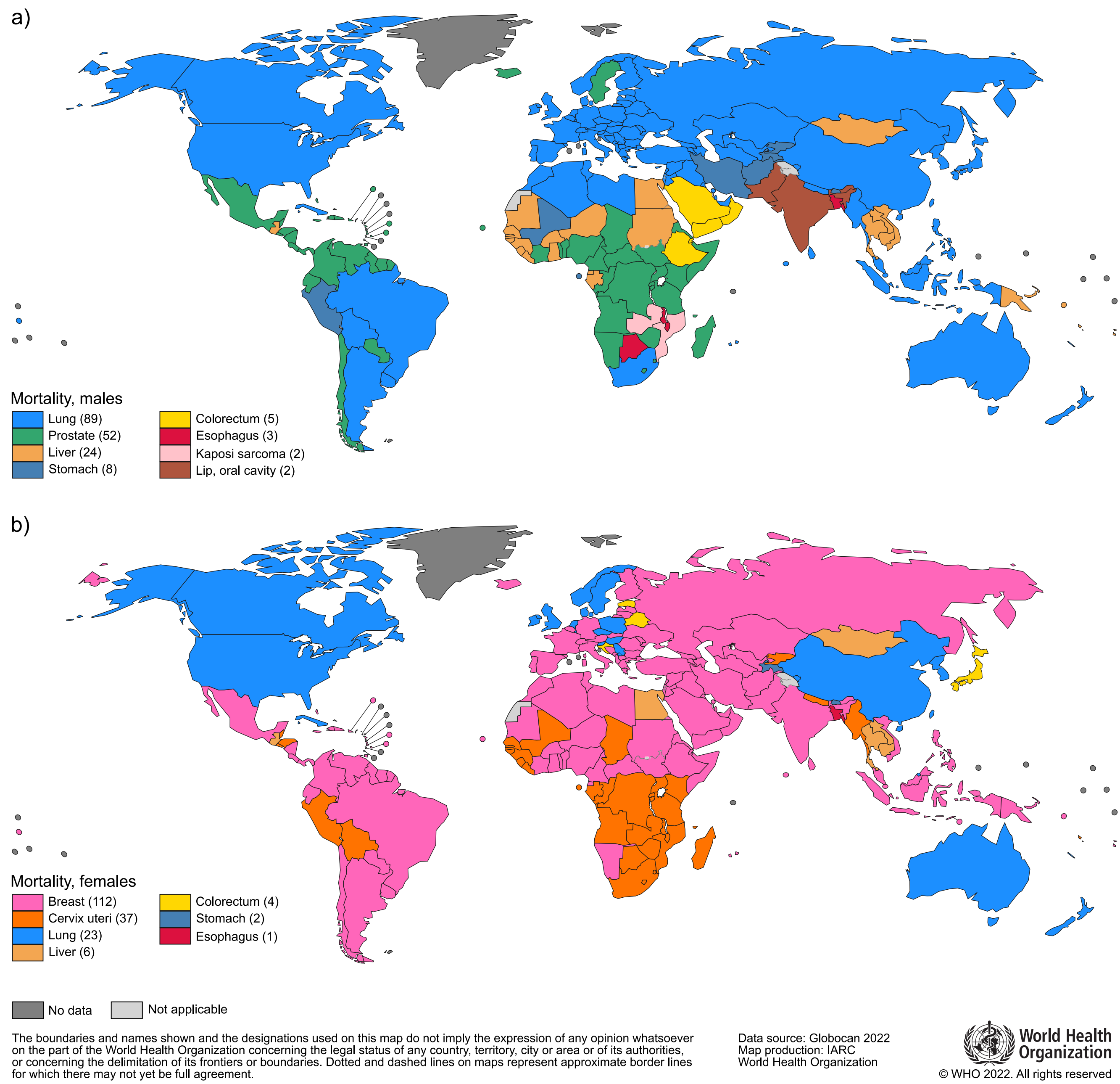

FIGURE 5 Global maps present the most common type of cancer mortality by country in 2022 among (A) men and (B) women. The numbers of countries represented in each ranking group are included in the legend. Source: GLOBOCAN 2022.

cumulative risk of dying from cancer among women in 2022 tends to be highest in several regions where many transitioning countries are located, including Melanesia and Micronesia/Polynesia (11.8% and 10.5%, respectively) and Eastern and Southern Africa (10.7% and 10.4%, respectively). In contrast, the estimated cumulative risks of cancer death are less than 10 in North America (7.9%), Southern Europe (8.0%), and Australia/New Zealand (7.5%).

Such regional variations in cancer incidence and mortality largely reflect differences in underlying exposure to the dominant risk factors for the major cancers, the distribution of associated cancer types, and barriers to effective prevention, early detection, and curative treatment. Below, we examine and discuss the variations by world region in more depth, assessing the incidence and mortality patterns for the 10 most frequent cancer types (Figures 8–20). A focus is on the four leading incident cancers (lung, female breast, colorectal, and prostate) that, in combination, are responsible for close to two fifths of the overall incidence and mortality burden.

Lung cancer

With almost 2.5 million new cases and over 1.8 million deaths worldwide, lung cancer is the leading cause of cancer morbidity

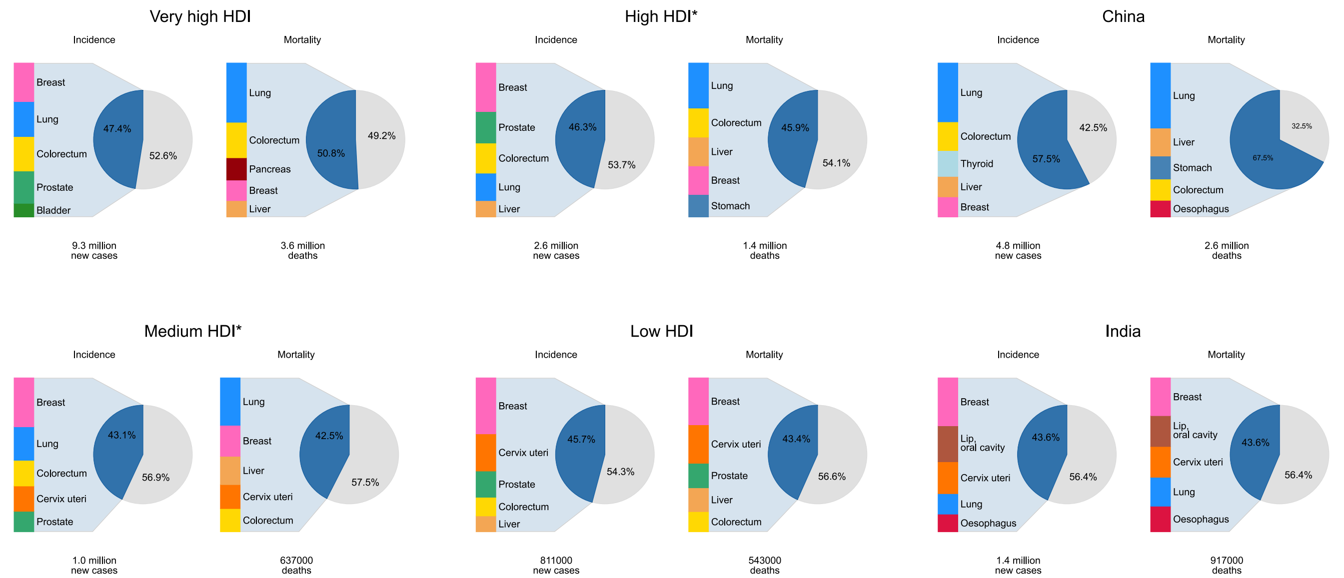

FIGURE 6 Pie charts present the distribution of cases and deaths (incidence and mortality) for the top 10 most common cancers in 2022 by the four tiers of the Human Development Index (HDI) (excluding China and India in high and medium HDI, respectively), and for China and India, for both sexes. Nonmelanoma skin cancers (excluding basal cell carcinoma) are included in the *other* category. Source: GLOBOCAN 2022.

and mortality in 2022, responsible for close to one in eight (12.4%) cancers diagnosed globally and one in five (18.7%) cancer deaths (Table 1, Figure 3). The disease ranks first among men and second among women for both incidence and mortality, with male-to-female lung cancer incidence and mortality ratios of around 2. These, however, vary widely by region, from close to unity in North America and Northern Europe to four-fold to five-fold in Northern Africa and Eastern Europe (Figure 8).

Among men, lung cancer is the most commonly diagnosed cancer in 33 countries (Figure 4A) and the leading cause of cancer death in 89 countries (Figure 5A). The highest incidence rates are observed in the Eastern Asian region in men, followed by Micronesia/Polynesia, and Eastern Europe, with the highest national rate among men worldwide estimated in Türkiye. Among women, lung cancer is the leading cause of cancer death in 23 countries, including China and the United States (Figure 5B). By world region, elevated incidence rates are seen in Northern America, Eastern Asia, and Northern Europe, with the highest national rate estimated in Hungary.

Given the poor survival, the marked geographic and temporal patterns in both incidence and mortality largely reflect the stage of the tobacco epidemic in countries where the habit has been adopted[13,14] as well as differentials in the historic patterns of tobacco exposure: the intensity and duration of smoking, the type of cigarettes, and the degree of inhalation. Among men, a diminution in smoking prevalence, followed by a peak and decline in lung cancer rates in the same generations, was first reported in several high-income countries where smoking was first established (e.g., the United Kingdom and the United States), with steep increase, peak, and subsequent decline in the lung cancer rates mirroring those of smoking prevalence albeit a 20–25 years lag.[15,16]

In general, the tobacco epidemic among women remains at a less advanced phase than among men, and the extent to which smoking trends in women mimic those seen earlier in men varies considerably by region.[13,17] In most transitioned countries, lung cancer rates in women are still rising,[18] with only a few countries (e.g., in the United States) showing signs of a stabilization or decline in rates.[18,19] The net result is that incidence rates in women are approaching or surpassing those in men in several countries at younger or middle ages and in recent generations in Europe and Northern America,[18,20,21] forewarning of a relatively higher overall lung cancer burden among women in future decades.

In transitioning countries where the epidemic is at an earlier stage, among men, smoking has either peaked recently or continues to increase,[22] and hence lung cancer rates will likely increase for at least the next few decades barring tobacco mitigation interventions to accelerate smoking cessation or reduce initiation.[23] The potential for a rapid rise in global lung cancer mortality is of pressing concern given some of the most populous countries have among the highest daily smoking prevalence among men, such as Indonesia (54.4%) and China (41.5%).[24]

In contrast, smoking prevalence varies markedly among women in transitioning countries. For example, only a small percentage of women estimated to be daily smokers (<5%) in Indonesia, China, and most African countries.[25] About one-quarter of lung cancer cases globally are attributable to causes other than tobacco smoking. However, the proportion may be higher in some populations, such as women from Eastern Asia, where smoking prevalence is low and nonsmoker lung cancer constitutes a significant proportion of the overall disease burden. Environmental exposures—for example, biomass fuels, occupation, and pollution[26]—may partially explain

TABLE 3 Incidence and mortality rates (age-standardized rate per 100,000, cumulative risk) for 24 world areas and by sex for all cancers combined (including nonmelanoma skin cancer except basal cell carcinoma) in 2022.

	Incidence				Mortality			
	Males		Females		Males		Females	
	Age-standardized rate (world)	Cumulative risk: Birth to age 74 years, %	Age-standardized rate (world)	Cumulative risk: Birth to age 74 years, %	Age-standardized rate (world)	Cumulative risk: Birth to age 74 years, %	Age-standardized rate (world)	Cumulative risk: Birth to age 74 years, %
Eastern Africa	111.8	11.83	145.8	14.76	81.9	8.63	101.3	10.74
Middle Africa	103.3	11.09	107.8	11.2	75.5	7.94	77.0	8.31
Northern Africa	147.6	15.65	145.8	14.67	103.2	10.62	78.5	8.24
Southern Africa	224.1	22.36	186.2	18.31	141.2	13.23	108.4	10.43
Western Africa	97.1	10.55	127.2	13.11	72.1	7.65	82.9	8.85
Caribbean	217.5	22.51	175.0	17.39	115.4	11.53	87.1	8.97
Central America	140.6	14.64	140.4	14.04	68.9	7.06	64.0	6.81
South America	217.9	22.17	190.5	18.64	103.7	10.51	81.2	8.43
Northern America	397.7	36.73	340.7	31.63	95.1	9.74	74.9	7.85
Eastern Asia	224.3	22.93	202.6	19.59	126.0	13.1	67.6	6.93
All but China	289.8	28.99	225.0	21.3	109.9	10.6	63.5	6.03
China	209.6	21.79	197.0	19.29	127.5	13.5	67.8	7.1
South-Eastern Asia	155.1	16.3	148.9	15	110.0	11.6	80.1	8.6
South-Central Asia	104.1	11.32	103.3	10.88	71.6	7.91	64.1	7.06
All but India	122.2	13.18	109.1	11.37	84.9	9.07	67.9	7.34
India	97.1	10.62	100.8	10.68	66.4	7.48	62.6	6.95
Western Asia	188.9	19.62	160.9	16.12	119.4	12.56	74.7	7.78
Eastern Europe	295.9	31.02	226.3	22.83	159.6	17.83	87.5	9.77
Northern Europe	338.0	32.57	293.1	27.92	111.7	11.05	85.9	8.89
Southern Europe	311.0	31.06	247.6	23.93	124.0	12.81	77.0	8.04
Western Europe	338.2	33.12	277.1	26.64	121.7	12.64	82.8	8.75
Australia/New Zealand	507.9	45.03	410.5	36.62	102.2	9.87	74.3	7.51

(Continues)

TABLE 3 (Continued)

	Incidence				Mortality			
	Males		Females		Males		Females	
	Age-standardized rate (world)	Cumulative risk: Birth to age 74 years, %	Age-standardized rate (world)	Cumulative risk: Birth to age 74 years, %	Age-standardized rate (world)	Cumulative risk: Birth to age 74 years, %	Age-standardized rate (world)	Cumulative risk: Birth to age 74 years, %
Melanesia	179.2	18.39	196.0	18.94	110.8	11.21	115.9	11.82
Micronesia/ Polynesia	228.6	24.29	203.4	20.59	142.7	15.02	95.1	10.5
Very High HDI	320.6	31.49	261.9	25.25	118.3	12.21	78.5	8.21
High HDI	198.0	20.64	181.0	17.92	119.9	12.62	72.4	7.58
Medium HDI	111.1	12	113.7	11.83	76.7	8.44	69.5	7.58
Low HDI	98.7	10.52	122.5	12.55	72.0	7.7	82.6	8.82
World	212.5	21.79	186.2	18.5	109.7	11.39	76.8	7.97

Note: Nonmelanoma skin cancer excludes basal cell carcinoma.

Abbreviation: HDI, Human Development Index.

Source: GLOBOCAN 2022.

these patterns. For example, the high lung cancer rates among Chinese women are postulated in part to reflect increased outdoor ambient air pollution and exposures to household burning of solid fuels for heating and cooking.[21,27,28]

A recent study estimated that adenocarcinoma was the most common subtype of lung cancer worldwide in 2020, with incidence rates exceeding those of squamous cell carcinoma in most countries among men and in all 185 countries among women.[29] Although considerable regional heterogeneity remains, incidence rates of adenocarcinoma were highest in Eastern Asia (including China) in both sexes. Previous epidemiological studies have linked the high burden of adenocarcinoma to long-term exposure to outdoor air pollution in transitioned countries[30–32]; and, recently, a novel mechanism has been proposed on the underlying means by which air pollution causes adenocarcinoma.[33] Thus the high levels of air pollution recorded in several urban areas worldwide may be among the important underlying reasons for the observed patterns of lung cancer.

However, tobacco remains the principal cause of lung cancer, and the disease can largely be prevented through effective tobacco control policies and regulations. To assist in national implementation of effective interventions to reduce the demand for tobacco, the World Health Organization (WHO) Framework Convention on Tobacco Control introduced the MPOWER package, consisting of six policy intervention strategies. Progress in the implementation of these interventions remains variable across countries. An increase in the average tobacco tax, one of the most effective interventions to reduce the demand for tobacco, has been highlighted in four WHO regions,[34] although only the European region reaches the 75% tax benchmark suggested by the WHO. Gredner et al. have illustrated the great potential of comprehensive implementation of tobacco control policies in reducing the disease burden in greater Europe, with over 1.6 million lung cancer cases preventable over a 20-year period through the highest level implementation of tobacco control policies.[35]

Five-year survival from lung cancer tends to be below 20% in most countries[36], with little difference according to human development.[37] A study of survival differences by stage, histologic subtype, and sex in high-income countries suggested that factors related to treatment, health care systems, and the extent of comorbidity likely play important roles.[38] Because most lung cancers are diagnosed at a later stage when curative treatment is not possible, there has been a longstanding focus on the screening of high-risk individuals (smokers and ex-smokers), with randomized controlled trials (e.g., the US National Lung Screening Trial [ClinicalTrials.gov identifier NCT00047385][39] and the NELSON study [International Standard Randomized Controlled Trial Number 63545820][40]) demonstrating that low-dose computed tomography substantially reduces deaths from lung cancer. The translation of mortality benefits to the general population has proven challenging, however, given the well documented issues around false positives, overdiagnosis, and complication rates, while ensuring attendance and coverage given the prohibitive costs and infrastructure required.[41] The US Preventive Services Task Force currently recommends annual lung cancer screening with low-dose computed tomography in those aged 50–80 years with a 20-pack-year smoking history who currently smoke cigarettes or who quit within the past 15 years; a recent guideline update by the American Cancer Society relaxed the years since quitting criteria to include former smokers who have exceeded 15 years since quitting.[42] Australia is planning to introduce a national lung cancer screening program by July 2025 for smokers and former smokers

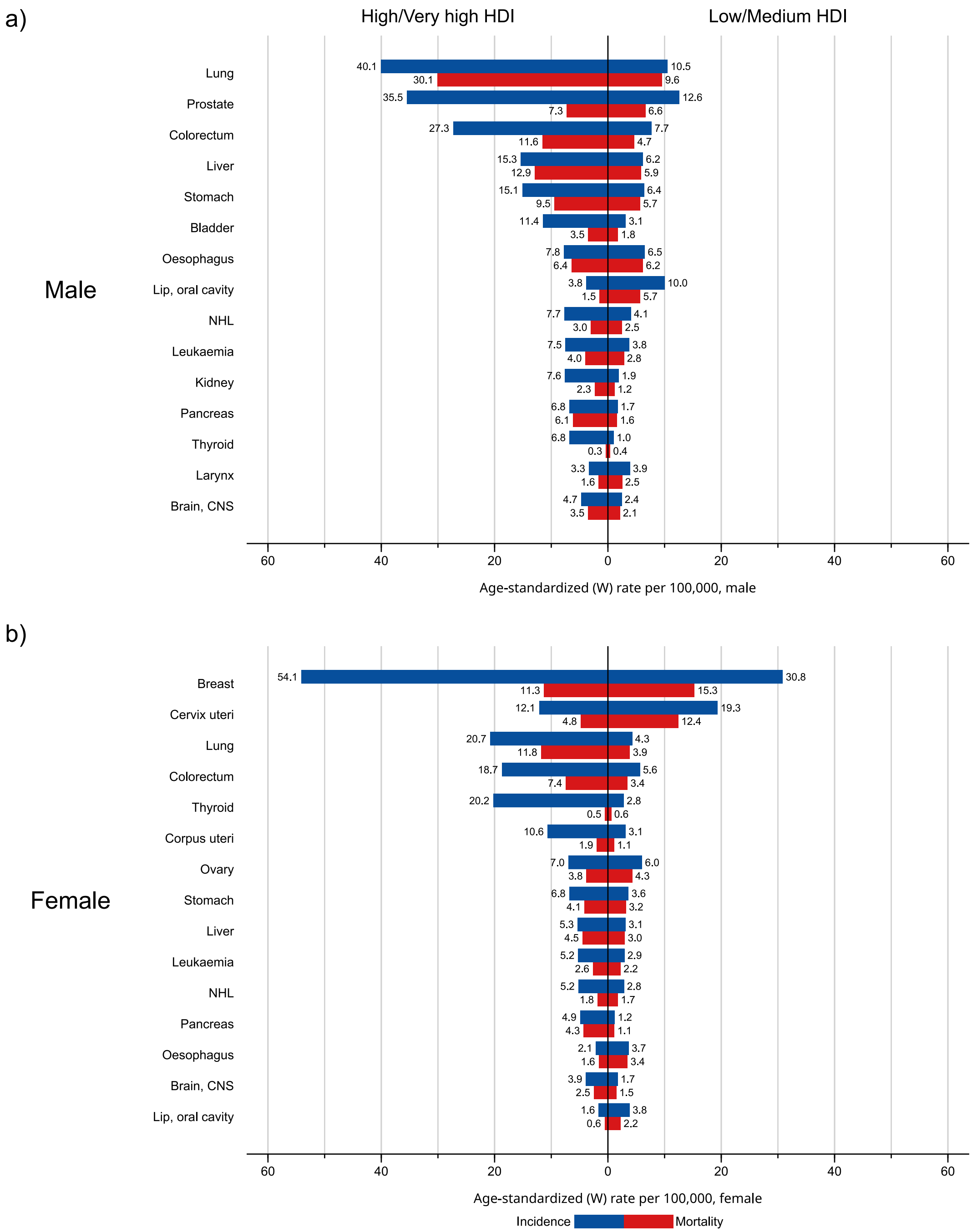

FIGURE 7 Bar charts of the incidence and mortality age-standardized rates in high/very high Human Development Index (HDI) countries versus low/medium HDI countries among (A) males and (B) females in 2020. The 15 most common cancers world (W) are shown in descending order of the overall age-standardized rate for both sexes combined. CNS indicates central nervous system; NHL, non-Hodgkin lymphoma. Source: GLOBOCAN 2022.

at high risk[43]), and, through its *Europe's Beating Cancer Plan*, the European Commission is also proposing the introduction of lung cancer screening to its 27 member states.[44]

Female breast cancer

Female breast cancer is the second leading cause of global cancer incidence in 2022, with an estimated 2.3 million new cases, comprising 11.6% of all cancer cases (Table 1, Figure 3). The disease is the fourth leading cause of cancer mortality worldwide, with 666,000 deaths (6.9% of all cancer deaths). Among women, breast cancer is the most commonly diagnosed cancer, and it is the leading cause of cancer deaths globally and in 157 countries for incidence (Figure 4B) and in 112 countries for mortality (Figure 5B).

Breast cancer accounts for close to one in four cancer cases and one in six cancer deaths in women worldwide, with the highest incidence rates seen in France, and in Australia/New Zealand,

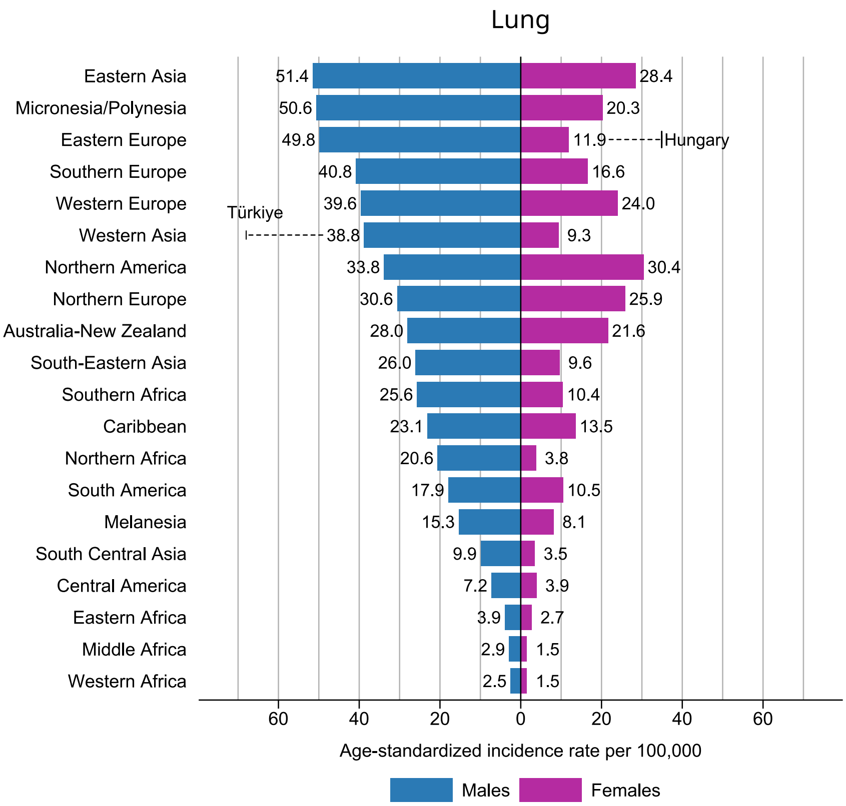

FIGURE 8 Bar chart of the region-specific incidence age-standardized rate by sex for lung cancer among 2022. Rates are shown in descending order of the world (W) age-standardized rate in males, and the highest national rates among males and females are superimposed. Source: GLOBOCAN 2022.

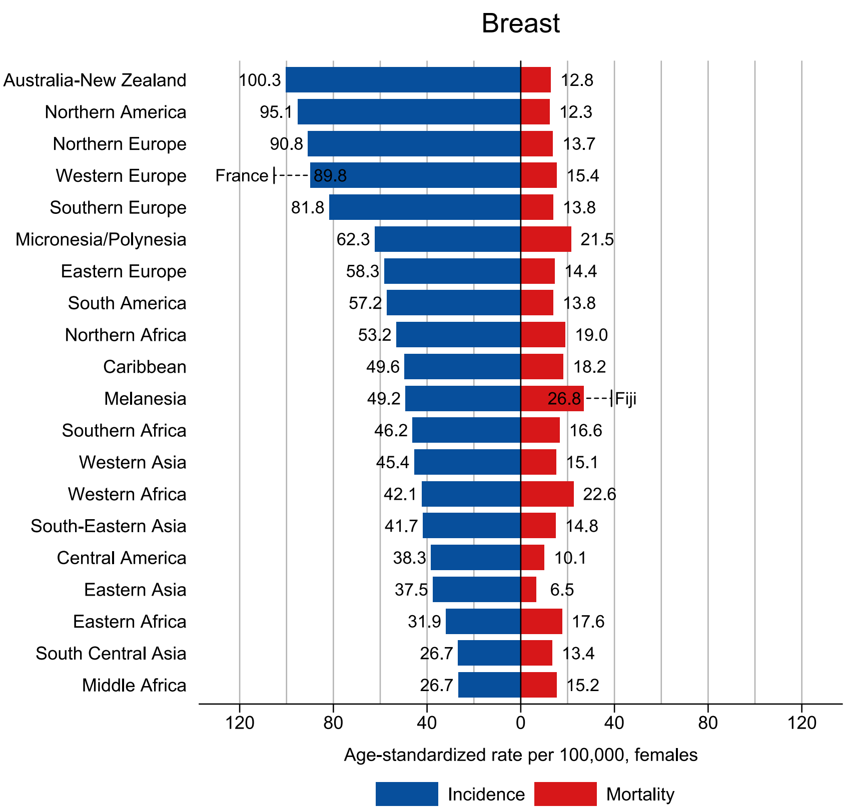

FIGURE 9 Bar chart of the region-specific incidence and mortality age-standardized rates for female breast cancer in 2022. Rates are shown in descending order of the world age-standardized rate, and the highest national age-standardized rates for incidence and mortality are superimposed. Source: GLOBOCAN 2022.

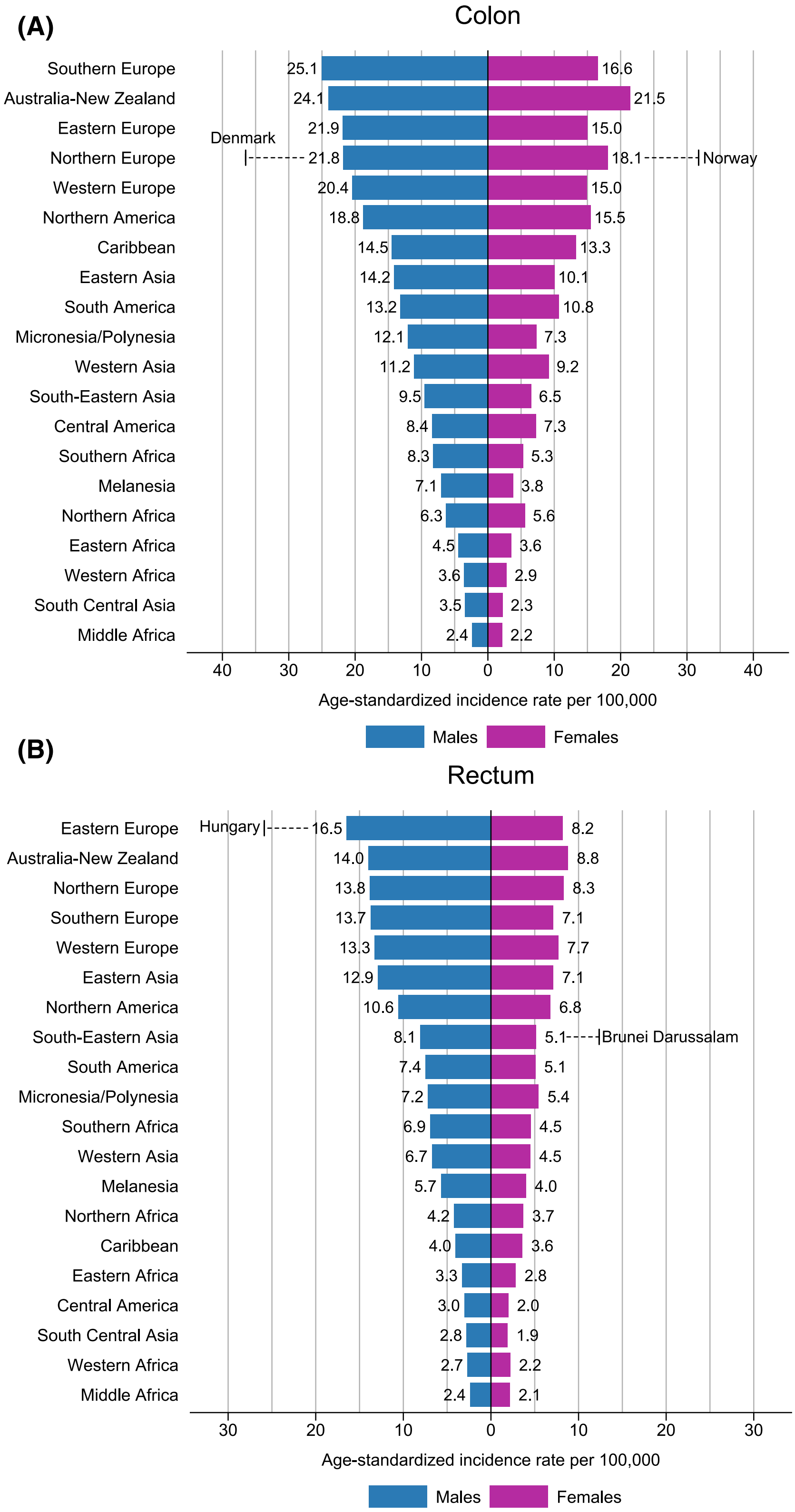

FIGURE 10 Bar charts of the region-specific incidence age-standardized rate by sex for cancers of the (A) colon and (B) rectum (including anus) in 2022. Rates are shown in descending order of the world age-standardized rate among men, and the highest national rates among men and women are superimposed. Source: GLOBOCAN 2022.

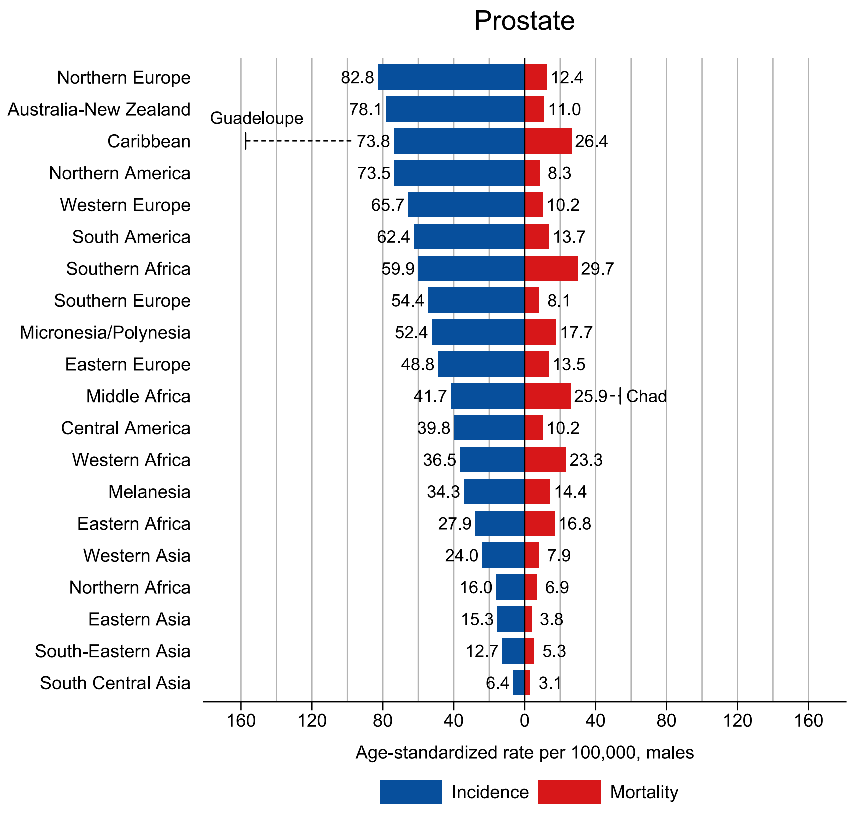

FIGURE 11 Bar chart of the region-specific incidence and mortality age-standardized rates for prostate cancer in 2022. Rates are shown in descending order of the world age-standardized rate, and the highest national age-standardized rate for incidence and mortality is superimposed. Source: GLOBOCAN 2022.

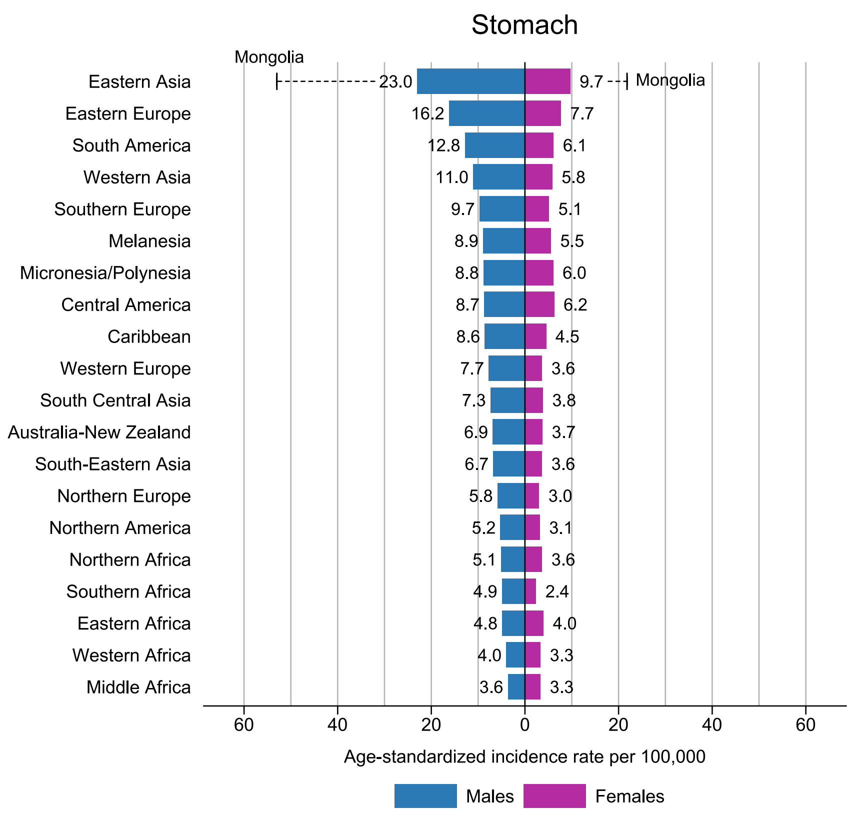

FIGURE 12 Bar chart of the region-specific incidence age-standardized rate by sex for stomach cancer in 2022. Rates are shown in descending order of the world age-standardized rate among males, and the highest national rates among males and females are superimposed. Source: GLOBOCAN 2022.

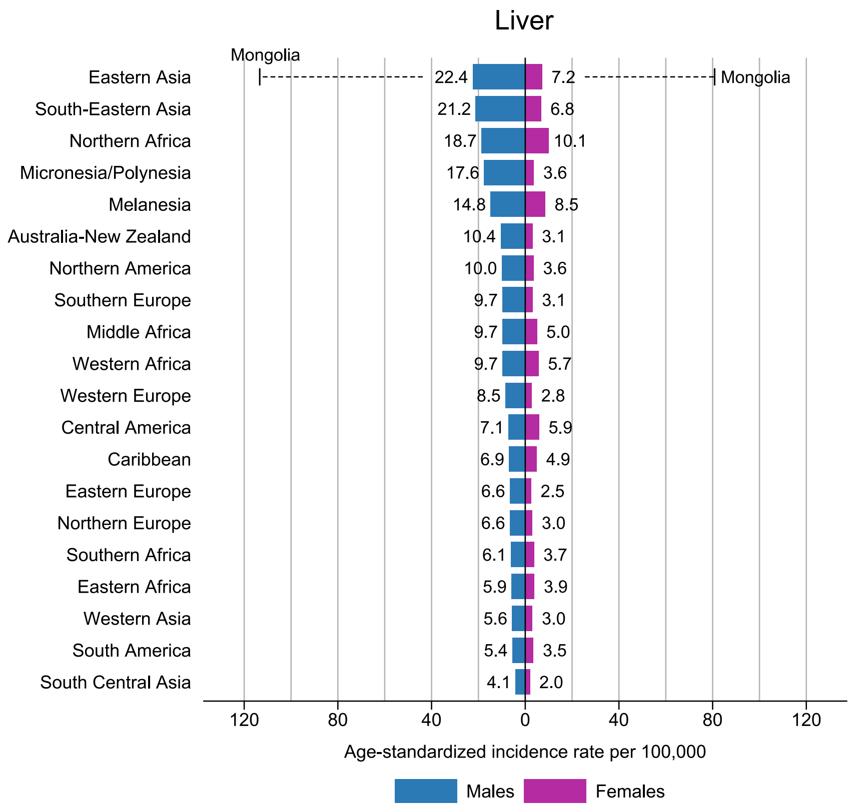

FIGURE 13 Bar chart of the region-specific incidence age-standardized rate by sex for liver cancer in 2022. Rates are shown in descending order of the world age-standardized rate among males, and the highest national rates among males and females are superimposed. Source: GLOBOCAN 2022.

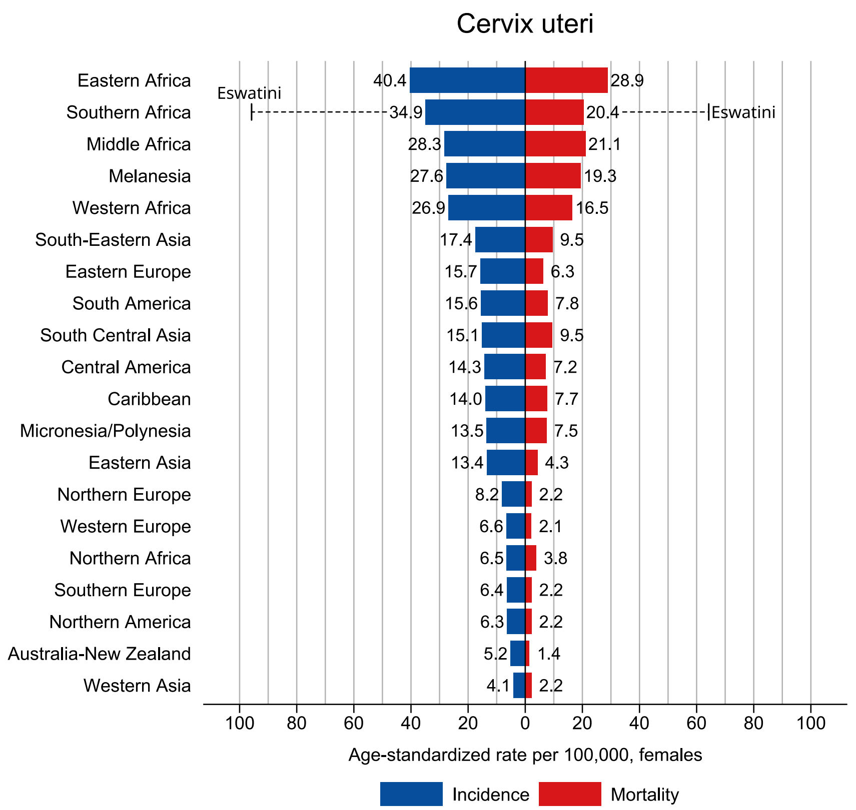

FIGURE 14 Bar chart of the region-specific incidence and mortality age-standardized rates for cervical cancer in 2022. Rates are shown in descending order of the world age-standardized rate, and the highest national age-standardized rate for incidence and mortality is superimposed. Source: GLOBOCAN 2022.

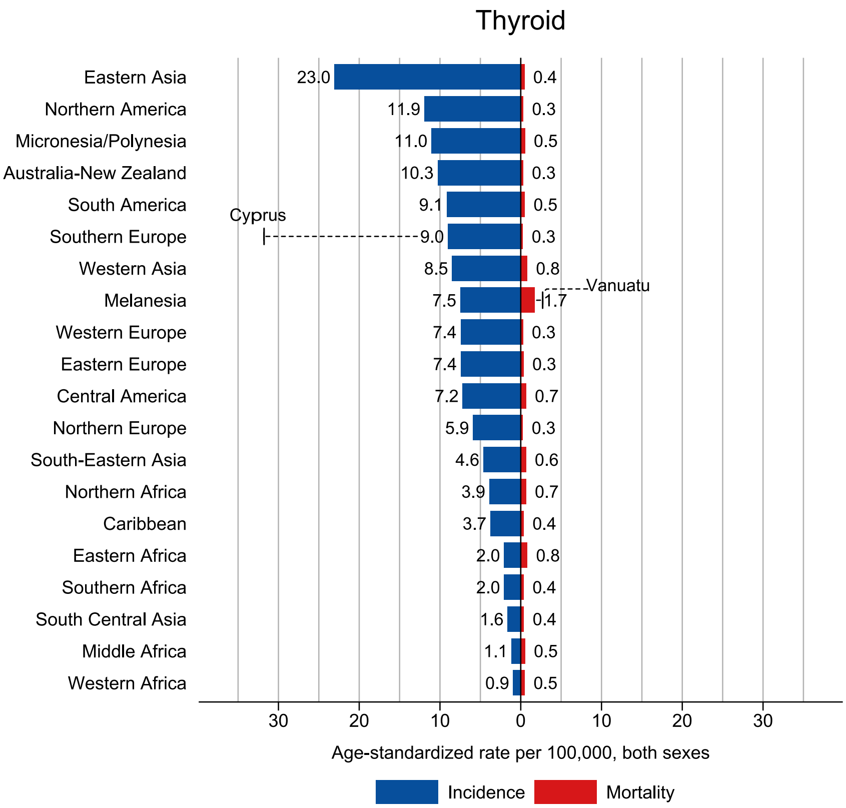

FIGURE 15 Bar chart of the region-specific incidence age-standardized rate by sex for thyroid cancer in 2022. Rates are shown in descending order of the world age-standardized rate among males, and the highest national rates among males and females are superimposed. Source: GLOBOCAN 2022.

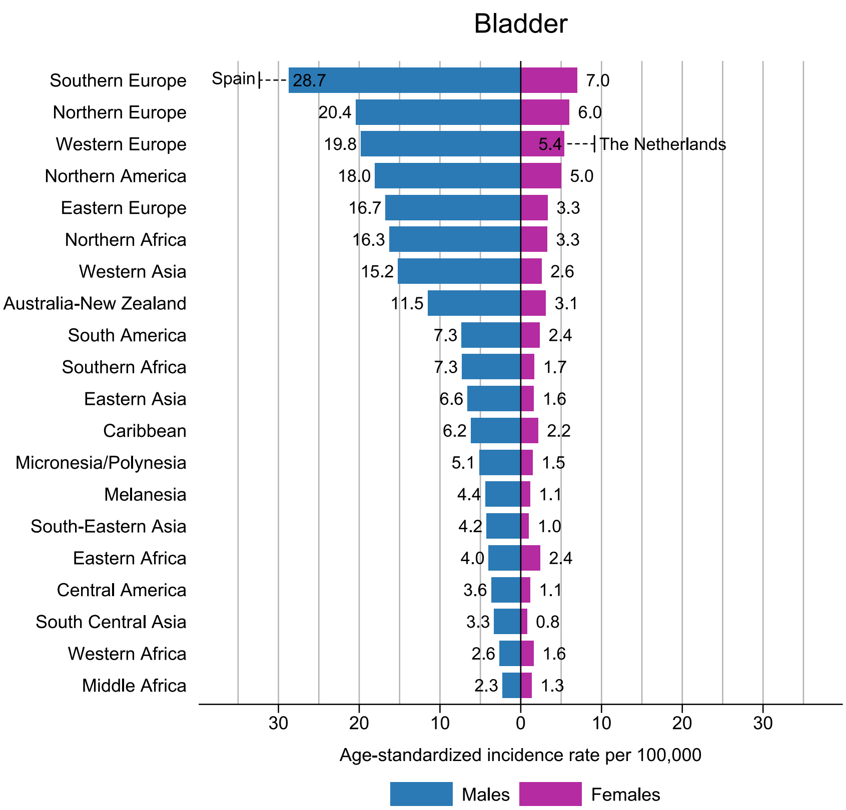

FIGURE 16 Bar chart of the region-specific incidence age-standardized rate by sex for bladder cancer in 2022. Rates are shown in descending order of the world age-standardized rate among males, and the highest national rates among males and females are superimposed. Source: GLOBOCAN 2022.

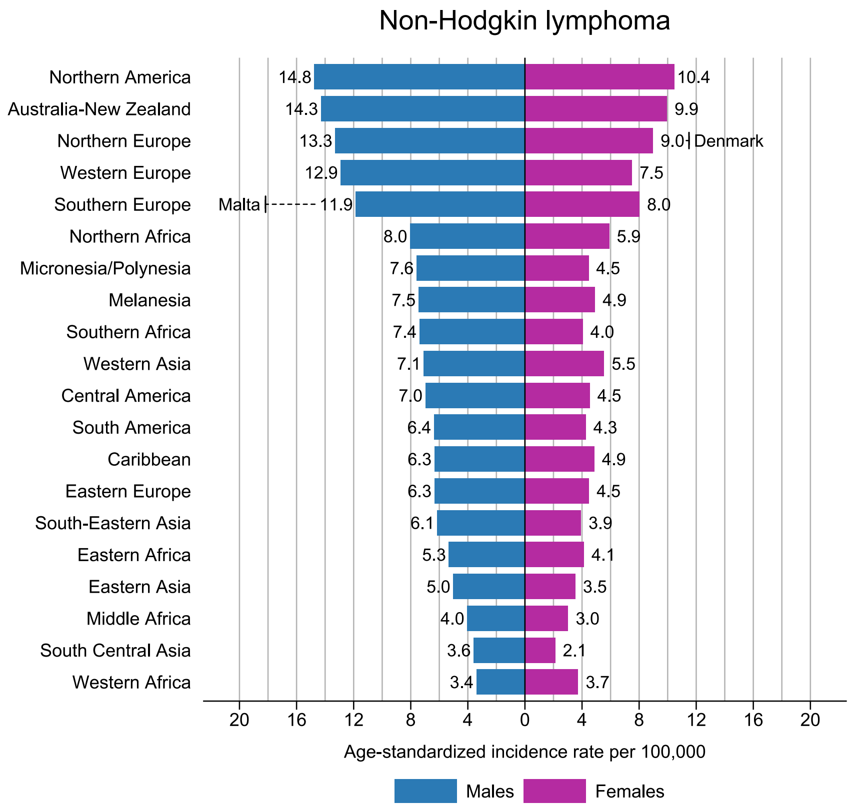

FIGURE 17 Bar chart of the region-specific incidence age-standardized rate by sex for non-Hodgkin lymphoma in 2022. Rates are shown in descending order of the world age-standardized rate among males, and the highest national rates among males and females are superimposed. Source: GLOBOCAN 2022.

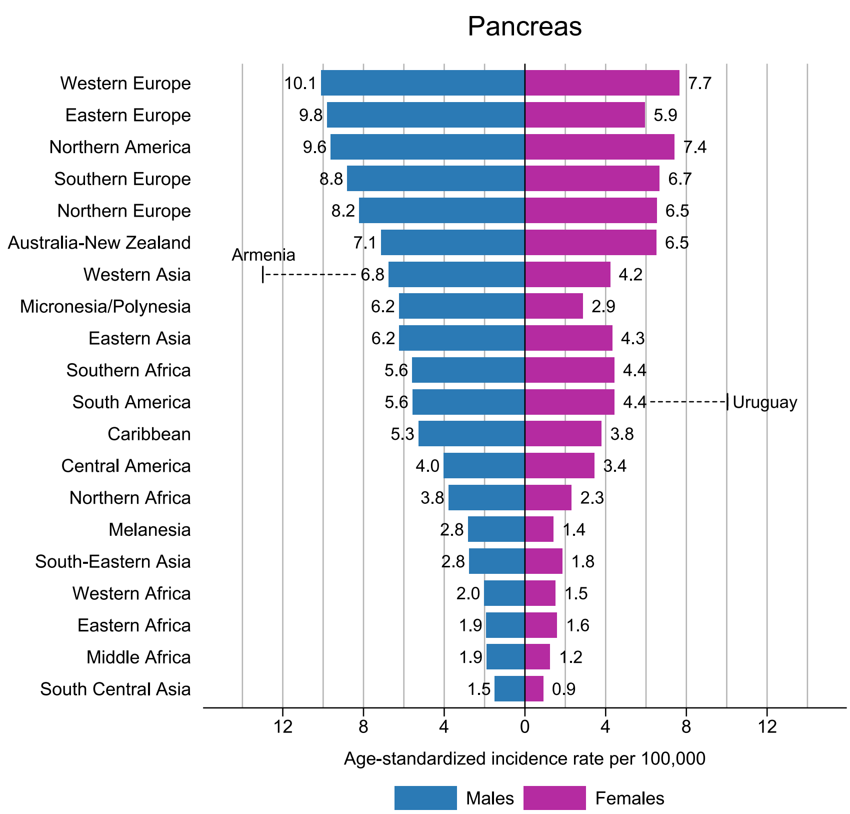

FIGURE 18 Bar chart of the region-specific incidence age-standardized rate by sex for pancreatic cancer in 2022. Rates are shown in descending order of the world age-standardized rate among males, and the highest national rates among males and females are superimposed. Source: GLOBOCAN 2022.

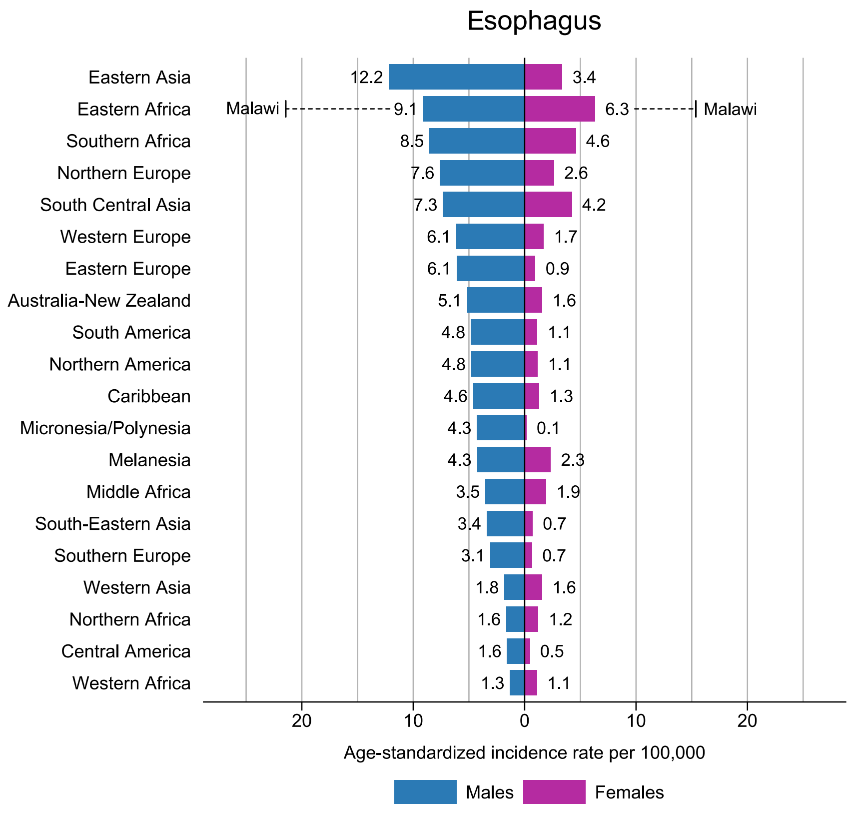

FIGURE 19 Bar chart of the region-specific incidence age-standardized rate by sex for esophageal cancer in 2022. Rates are shown in descending order of the world age-standardized rate among males, and the highest national rates among males and females are superimposed. Source: GLOBOCAN 2022.

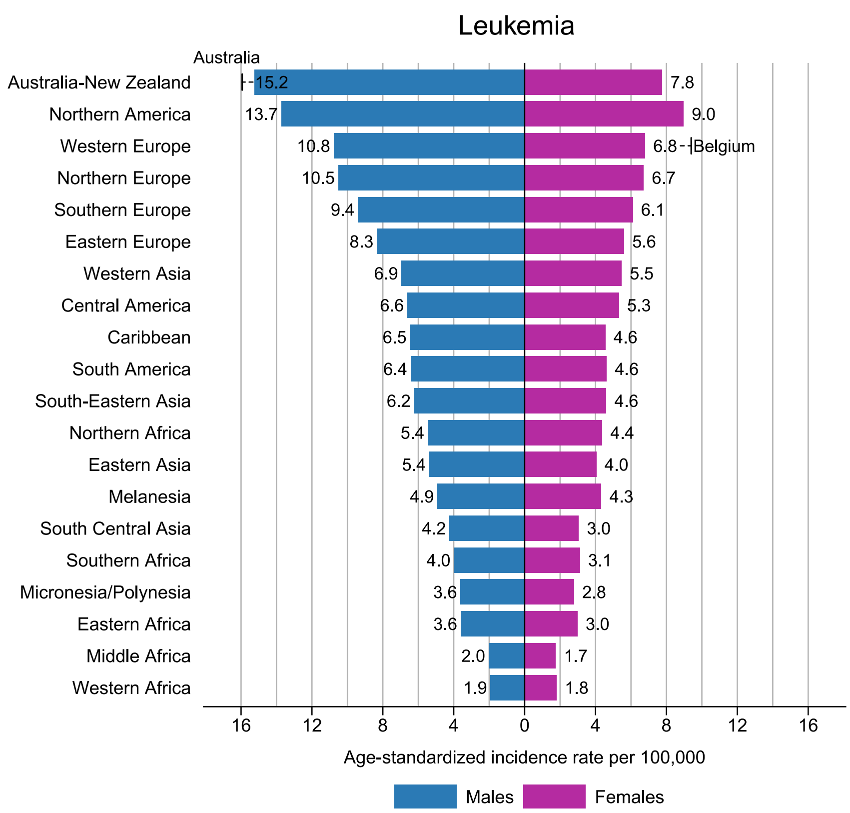

FIGURE 20 Bar chart of the region-specific incidence age-standardized rate by sex for leukemia in 2022. Rates are shown in descending order of the world age-standardized rate among males, and the highest national rates among males and women are superimposed. Source: GLOBOCAN 2022.

Northern America, and Northern Europe, where incidence rates are four times higher than in South-Central Asia and Middle Africa (Figure 9). Although women living in transitioned countries have considerably higher incidence rates compared with those in transitioning countries (54.1 vs. 30.8 per 100,000, respectively; Figure 7B), they have considerably lower mortality rates (11.3 vs. 15.3 per 100,000, respectively; Figure 7B). The highest mortality rates are found in Melanesia. Fiji has the world's highest mortality rate, alongside Western Africa and Micronesia/Polynesia (Figure 9).

The higher incidence rates in transitioned versus transitioning countries reflect a higher prevalence of numerous reproductive and lifestyle risk factors, including early age at menarche, later age at menopause, advanced age at first birth, fewer number of children, less breastfeeding, hormone-replacement therapy, oral contraceptive, alcohol intake, excess body weight, and physical inactivity.[45] Time trends in breast cancer incidence mainly reflect changes in these determinants as well as increased detection through mammographic screening. The generally uniform rises in rates over the period from 1980 to 2000 in high-income regions—in Northern America, Oceania, and Europe—have been followed by stable or declining trends by the early 2000s[46] linked to a reduced prevalence of menopausal hormone-replacement therapy and possibly a plateauing in screening participation.[47,48] Nevertheless, rising incidence rates have been reported in several high-income countries in North America, Europe, and Oceania since 2007 for premenopausal and postmenopausal breast cancer. In many high-income countries where breast cancer incidence rates are historically high, mortality rates decreased since around the early 1990s,[49] reflecting progress because of numerous treatment breakthroughs and improvements in early detection by screening and heightened breast cancer awareness. In contrast, rapid increases in breast cancer incidence and mortality are seen in transitioning countries in South America, Africa, and Asia[50–54] as well as in high-income Asian countries (Japan and the Republic of Korea).[55] There remain substantial geographic and temporal variations in breast cancer mortality in different regions[54,56] that appear to be linked to the level of coverage of essential health services.[57] Many sub-Saharan African countries are among the countries with the highest breast cancer mortality worldwide, reflecting weak health infrastructure and subsequently poor survival outcomes because of late presentation.[37]

In terms of primary prevention, a reduction in excess body weight and alcohol consumption and increasing physical activity and breastfeeding may have an impact in reducing breast cancer incidence.[58] However, with few established modifiable risk factors for the disease, the focus of breast cancer control has been increasing access to early diagnosis/screening and timely, comprehensive cancer management. The WHO recommends organized, population-based mammography screening every 2 years for women at average risk for breast cancer aged 50–69 years in well resourced settings.[59] However, in limited resource settings, where women are often diagnosed at a late stage and mammography screening is not cost-effective or feasible, the focus is on early diagnosis by ensuring prompt and effective diagnosis and treatment of women with symptomatic lesions. In response, the WHO established the Global Breast Cancer Initiative in 2021 to galvanize stakeholders from around the world and across sectors with the shared goal of reducing breast cancer mortality by 2.5% per annum, which translates to the saving of 2.5 million lives within 2 decades. The Global Breast Cancer Initiative has three key pillars as an operational approach to achieve these objectives, centered on health promotion and early detection; timely diagnosis; and comprehensive breast cancer management.[60]

Colorectal cancer

More than 1.9 million new cases of colorectal cancer (including anal cancers) and 904,000 deaths were estimated to occur in 2022, representing close to one in 10 cancer cases and deaths (Table 1). Overall, colorectal cancer ranks in third place in terms of incidence but second in terms of mortality (Figure 3). Incidence rates are three to four times higher in transitioned relative to transitioning countries, although less variation is seen for mortality given a relatively higher case fatality in the latter countries (Figure 7). There is an approximately 10-fold variation in colon cancer incidence rates by world region in men and women, respectively, with the highest rates in Europe, Australia/New Zealand, and Northern America, with Denmark and Norway ranking first in men and women, respectively (Figure 10A). Rectal cancer incidence rates have a similar regional distribution, although rates in Eastern Asia rank among the regions with the highest regional rates, exceeding those of Northern America (Figure 10B). Both colon and rectal cancer incidence rates are relatively low in most parts of Africa and South and Central Asia.

As a pointer to socioeconomic development, colorectal cancer incidence rates have been steadily rising in countries undergoing major transition,[61,62] including countries in Eastern Europe, South-Eastern and South-Central Asia, and South America.[63,64] Behavioral and dietary changes are considered the main explanatory factors for the increases in such settings, including a relatively greater intake of animal-source foods and an increasingly sedentary lifestyle, leading to an upsurge in the prevalence of overweight and obesity. There is strong evidence that alcohol consumption, smoking, consumption of red or processed meat, and body fatness increase the disease risk overall, whereas calcium supplements and consumption of whole grains, fiber, and dairy products, as well as physical activity, are considered protective, particularly for colon cancer.[65] Although screening in transitioning countries currently is generally not considered feasible given the prohibitive costs of colonoscopy and challenges in ensuring the necessary infrastructure to deliver diagnostic and treatment services,[66] there is increasing evidence that colorectal cancer screening with noninvasive procedures, such as the fecal immunochemical test, given its high specificity, good sensitivity, and ease of use, may be cost-effective in many transitioning regions.[67–69]

The declines in colorectal cancer incidence in many high-incidence countries over the last decades have been considered the result of population-level shifts toward a healthier lifestyle (e.g., increased access to sources of fiber, such as fruits and vegetables) and the introduction of screening,[63,70] with the uptake of colonoscopy screening and the removal of precursor lesions attributed to the specific downturns in incidence rates from the late 1990s where implemented.[71–73] In contrast to the recent stabilizing or declining trends for all ages combined, there are numerous recent reports documenting a rise in colorectal cancer among younger adults (younger than 50 years at diagnosis) in many high-income countries, including the United States, Canada, and Australia, with incidence rising by 1%–4% per year.[74–81]

Reasons for the rising incidence in successive recent generations are unknown but point to a profound influence of risk factors during early life or/and young adulthood. Suspected risk factors include a rise in the prevalence of obesity, physical inactivity, and antibiotics affecting the gut microbiome.[82] To mitigate the rising burden of early onset colorectal cancer, the USPSTF has updated its 2016 guidelines to align them with those of the American Cancer Society, with lowering the age for initiation of screening to 45 years.[83]

Prostate cancer

With an estimated 1.5 million new cases and 397,000 deaths worldwide (Table 1), prostate cancer is the world's second most frequent cancer and the fifth leading cause of cancer death among men in 2022 (Figure 3B). Incidence rates are almost three times higher in transitioned than in transitioning countries (35.5 and 12.6 per 100,000, respectively), whereas the difference in mortality rates is much smaller (7.3 and 6.6 per 100,000, respectively; Figure 7). Prostate cancer is the most frequently diagnosed cancer among men in almost two thirds (118 of 185) of the world's countries (Figure 4A). Incidence varies markedly by region, and rates range from 6.4 to 82.8 per 100,000, with the highest rates seen in Northern Europe, Australia/New Zealand, the Caribbean, and Northern America and the lowest rates seen in several Asian and African regions (Figure 11). The regional patterns of mortality rates do not follow those of incidence, with the highest mortality rates found in the Caribbean and sub-Saharan Africa, indicative of disparities in early detection and treatment. Still, prostate cancer is the leading cause of cancer death among men in 52 countries, including many countries in the Caribbean and sub-Saharan Africa, in Central and South America (e.g., Ecuador, Chile, and Venezuela), as well as Sweden in Europe (Figure 5A).

Despite its prominence as a commonly diagnosed cancer and a leading cause of cancer death, few lifestyle and environmental factors have been identified for prostate cancer. Advancing age, family history, and certain genetic mutations and conditions are the only established risk factors, although there are speculative roles for smoking, excess body weight, and some nutritional factors in modulating risk.[84] Of note, elevated incidence of prostate cancer in the Caribbean and sub-Saharan African countries may reflect in part increased genetic susceptibility, given that multiple genetic variants associated with disease risk are more frequent in men with Western African ancestry.[85,86]

Differences in diagnostic practices at the national level are a driving factor explaining much of the marked variations in prostate cancer incidence worldwide.[87] In North America, selected Nordic countries, and Australia, there were rapid increases in incidence rates from the late 1980s to the early 1990s as a result of the widespread introduction of prostate-specific antigen (PSA) testing.[88] The increases were followed by equally pointed reductions within a few years, likely reflecting a depletion of prevalent cancers, with declines thereafter largely attributed to a reduction in the use of PSA testing,[87–91] reflecting changes in PSA–based screening guidelines.[92–95]

After about 2 decades of declining incidence in the United States, however, a 3% per annum average increase in incidence (notably at later stages of diagnosis) was reported from 2014 to 2019, in parallel with the stabilization of prostate cancer mortality.[96] The USPSTF has since upgraded screening recommendation to informed decision for men aged 55–69 years to discuss the benefits and harms of PSA screening with their health care provider to make an individualized decision on whether or not to get screened.[97] In greater Europe, Southern and Central America, and Asia, later, less emphatic trends have been reported, reflecting a more recent and moderate adoption of PSA testing.[86–88,98] In contrast, incidence rates continue to increase in China and countries in the Baltic and Eastern Europe.[86] Rapidly increasing trends have been also found in sub-Saharan Africa, with annual increases reported in Southern and Eastern African countries from 1995 to 2018.[99] These may primarily reflect increased awareness and improvements in the respective health care systems that have permitted greater use of PSA testing and transurethral resections.[99]

There is little in the way of geographic or temporal correlation between the incidence and mortality rates of prostate cancer. Mortality rates have decreased in most high-income countries since the mid-1990s, including those in Northern America, Oceania, and Northern and Western Europe,[88,98,100] likely reflecting advancements in effective treatment and earlier detection through increased testing of asymptomatic men.[101,102] During the same period, rates increased in many countries in Central and Eastern Europe, Asia, and Africa[88] and continued until recently in some countries[86], partly reflecting a concomitant increase in incidence rates alongside lesser access to PSA testing and curative treatment. Recent mortality trends in transitioned countries indicate that the trends continue to decline in greater Europe outside of the Baltic countries and Eastern Europe.[86] In the United States, mortality rates have stabilized during the most recent period after declining for several decades, in part because of the increase in advanced-stage disease.[103,104]

Common infection-related cancers

Cancers of the stomach, liver, and cervix combine to represent 2.5 million new cases of cancer worldwide in 2022, equivalent to one in eight new cancers diagnosed and close to one in five cancer deaths (Figure 3). The main oncogenic agents responsible for stomach cancer (*Helicobacter pylori*), cervical cancer (human papillomavirus [HPV]), and liver cancer (hepatitis B virus [HBV] and hepatitis C virus [HCV]) are all either preventable (HPV, HBV) or treatable (*H. pylori*, HCV).

There were over 968,000 new cases of *stomach cancer* in 2022 and close to 660,000 deaths, ranking the disease as fifth in terms of both incidence and mortality worldwide (Table 1, Figure 3A). In men, it is the most frequent cancer and the leading cause of cancer death in several South-Central Asian countries (Figures 4A and 5A), including Afghanistan, Iran, Kyrgyzstan, and Tajikistan. In Tajikistan, it is also the leading cause of cancer death in women. Incidence rates are highest in Eastern Asia (with Mongolia having the highest incidence rates in both sexes) alongside Eastern Europe, with rates lowest across the African continent (Figure 12).

Although stomach cancer is often reported as a single entity, it can generally be classified topographically as two epidemiologically distinct entities of the cardia (upper stomach) and noncardia (lower stomach). Chronic *H. pylori* infection is considered the principal cause of noncardia gastric cancer, with approximately nine in 10 cases attributable to this bacterium.[105,106] Yet only a small fraction of infected hosts will develop cancer, likely because of differences in bacterial genetics, host genetics, age of infection acquisition, and environmental factors.[107] Other risk factors for noncardia gastric cancer include alcohol consumption, tobacco smoking, and foods preserved by salting, with low consumption of fruit intake and high consumption of processed meat, grilled or barbecued meat, and fish possibly also increasing risk.[65] Fewer cancers of the gastric cardia—about one in five cases globally—are attributable to *H. pylori* infection, although a recent study from China put that proportion at over 60%[108]. A dual etiology is implicated, with some cancers associated with excess body weight and gastroesophageal reflux disease, similar to the epidemiologic profile of esophageal adenocarcinoma.[109]

Overall trends in stomach cancer rates have been steadily declining over the last half century in most populations—hypothesized to be mainly attributable to decline in noncardia gastric cancer—an *unplanned triumph* of prevention that includes better preservation and storage of foods as well as a decreased prevalence of *H. pylori*.[110] Yet recent studies have pointed to rising trends among younger age groups, particularly in low-incidence populations,[111,112] with concomitant increases in autoimmune gastritis and dysbiosis of the gastric microbiome postulated to be underlying factors for the shift toward tumors occurring close to the esophagogastric junction.[113] Incidence rates in cancers of the gastric cardia rose from the 1960s in the United Kingdom[114] and the United States[115] but appear to have leveled off in recent decades in the United States,[116] Sweden,[117] and the Netherlands.[118]

There were over three quarters of a million *liver cancer* deaths worldwide in 2022, positioning liver cancer as the third leading cause of cancer death after lung and colorectum and the sixth most frequently diagnosed, with an estimated 865,000 new cases and 757,948 deaths in 2022 (Table 1, Figure 3). The disease ranks in second place among men in terms of mortality (Figure 3B), with both incidence and mortality rates two to three times higher in men than in women across most world regions (Figure 13). Rates tend to be higher in transitioning countries, with the disease the most common form of cancer death among men in 24 geographically diverse countries in Eastern Asia (Mongolia), South-Eastern Asia (e.g., Cambodia, Laos, Thailand, and Vietnam), Northern and Western Africa (e.g., Egypt, Senegal, and Ghana), and Central America (Guatemala Figures 5A and 13).

Primary liver cancer comprises mainly hepatocellular carcinoma (HCC) (75%–85% of cases) and intrahepatic cholangiocarcinoma (10%–15% of cases), with HBV or HCV chronic infection responsible for 21% to 55% of HCC worldwide.[105,119] Other risk factors for HCC include aflatoxin exposure, heavy alcohol consumption, excess body weight, type 2 diabetes, and smoking,[120] although the key determinants vary across regions. In most high-risk HCC areas (e.g., China and Eastern Africa), chronic HBV infection and aflatoxin exposure predominate as risk factors, whereas HCV infection is the predominant cause in a diverse set of countries (e.g., Egypt, Italy, and Japan). In Mongolia, HBV and HCV, co-infections of HBV carriers with HCV or hepatitis D virus, as well as alcohol consumption all contribute to the highest ranking national rates in men and women, respectively, seen worldwide. Major risk factors for cholangiocarcinoma also vary by region and include liver flukes (e.g., in the northeast region of Thailand, where *Opisthorchis viverrini*, is endemic)[121] and metabolic conditions (including obesity, diabetes, and nonalcoholic fatty liver disease), alongside heavy alcohol consumption and HBV and HCV infections.[122–124]

With declines in the population seroprevalence of HBV and HCV, as well as a reduction in aflatoxin exposure, liver cancer rates have been declining steadily in many high-risk countries in East and South-Eastern Asia since the late 1970s and in Japan and China since the 1990s.[63,125,126] Vaccination against HBV has markedly reduced the prevalence of HBV infection and the incidence of HCC in high-risk countries in East Asia, where it was first introduced in the early 1980s.[127] In contrast, in countries like Thailand, where HCC represents less than 30% of liver cancer, liver cancer incidence rates continue to rise despite the decline in HCC rates.[125] Likewise, incidence rates in formerly low-risk countries, most countries across Europe, North America, Australia/New Zealand, and South America have increased or stabilized at a higher level in recent years,[125,128] possibly in part because of increasing prevalence of metabolic risk factors, such as excess body weight, diabetes, nonalcoholic fatty liver disease, and alcohol consumption.

The WHO's global hepatitis strategy aims to reduce new hepatitis infections by 90% and deaths by 65% by 2030. By the end of 2022, the HBV vaccine had been introduced nationally in 190 member states, with global coverage of 84% for three doses of hepatitis B vaccine administration.[129] Yet vaccination schedules differ between countries, with the first dose often given at 6 weeks instead of within 24 hours after birth, failing to protect infants against mother-to-child transmission.[130] One hundred thirteen member states have introduced nationwide a single dose of hepatitis B vaccine to newborns within the first 24 hours of life, with global coverage at 45% but varying from 80% in the WHO Western Pacific Region to 18% in the WHO African Region.[129]

Cervical cancer is the fourth most common cancer in terms of both incidence and mortality in women (Figure 3C), with an estimated 660,000 new cases and 350,000 deaths worldwide in 2022 (Table 1). The disease is the most common cancer type in 25 countries (Figure 4B) and the leading cause of cancer death in 37 countries (Figure 5B), mainly in sub-Saharan Africa as well as South America and South-Eastern Asia. Incidence and mortality rates vary at least 10-fold, with the highest regional incidence and mortality rates found in sub-Saharan Africa and Melanesia (Figure 14) and the lowest rates found in Northern America, Australia/New Zealand, and Western Asia.

HPV is a necessary, but not sufficient, cause of cervical cancer,[131] with 12 of the 448 known HPV types classified as group 1 carcinogens by the IARC Monographs.[132] Other important cofactors include some sexually transmittable infections (human deficiency virus [HIV] and *Chlamydia trachomatis*), smoking, a higher number of childbirths, and long-term use of oral contraceptives.[133] Rates remain disproportionately high in transitioning versus transitioned countries (19.3 vs. 12.1 per 100,000 for incidence, respectively; 12.4 vs. 4.8 per 100,000 for mortality, respectively; Figure 7B), in part reflecting the higher prevalence of chronic HPV infection also with limited access to screening and vaccination in transitioning countries.

The observation of a broad decline in cervical cancer incidence rates in most areas of the world over the last few decades has been attributed to continuous rises in human development levels, possibly as a marker of diminishing risk of persistent infection with high-risk HPV resulting from factors such as improving genital hygiene, parity declines, and a downturn in the prevalence of sexually transmitted diseases.[134] Cervical cancer screening programs hastened the declines in the incidence and mortality rates in many countries in Europe, Oceania, and Northern America, despite the observations of increasing risk among younger generations of women in some of these countries,[135–137] which in part may reflect changing sexual behavior and increased transmission of HPV that is insufficiently compensated by uptake in screening.[138,139] A recent analysis of incidence trends from 1988 to 2017 indicated continuous declines in rates in Oceania (Australia and New Zealand), Northern America (Canada and the United States), and Western Europe up to the mid-2000s, with incidence tending to stabilize thereafter.[140] Major declines in incidence were also observed in Latin American countries (e.g., Brazil, Colombia, and Costa Rica) and in Asia (e.g., India, Thailand, and South Korea), with small increases in incidence rates in Japan and China from 2007 to 2017. In Europe, incidence rates increased in the Baltic countries of Latvia, Lithuania, and Bulgaria, whereas they decreased in Eastern Europe (in Poland, Slovenia, and Czechia). In contrast, a recent African study pointed to increasing incidence trends over 10–25 years in eight countries in Eastern and Southern regions, including Malawi, South Africa, and Kenya.[141]

The global strategy of the WHO's Cervical Cancer Elimination Initiative is to reduce incidence rates to a threshold of below 4 per 100,000 women-years in this century, thereby eliminating the disease as a public health problem.[142] According to our estimates, only 10 countries—all in the Eastern Mediterranean—have incidence rates in 2022 below the threshold. Given the relatively high incidence rates and unfavorable trends in many transitioning countries, modeling studies indicate that the elimination goal may not be achieved before the end of the century in these countries without significantly scaling-up preventive and curative interventions, including HPV screening and vaccination.[143] The Cervical Cancer Elimination Initiative has set national *90–70–90* targets for countries to be on the path toward cervical cancer elimination by 2030. The targets require that 90% of girls are fully vaccinated with HPV vaccine by the age of 15 years, 70% of women are screened with a high-performance test at ages 35 and 45 years, and 90% of women with precancerous lesions or invasive cancer receive treatment.[142] Encouragingly, there is promising evidence supporting the potential of a self-sampling approach to increase screening participation in under-screened and never-screened women and the efficacy of a single-dose vaccine to facilitate straightforward implementation of the programs.[144–146]

Other common cancer types

With over 821,000 cases worldwide in 2022, *thyroid cancer* ranks as the seventh most common cancer in terms of incidence overall and fifth in women. The incidence rate is three times higher in women than in men (Tables 1 and 3). Mortality from the disease is much lower than incidence, with an estimated 44,000 deaths for both sexes combined in 2022 and ranking 24th. Incidence rates are about seven times higher in transitioned versus transitioning countries, whereas the difference in mortality rates by comparison is much smaller (Figure 7). The highest incidence rates in both sexes are found in Eastern Asia, where the rate is two times higher than that seen in second-ranking Northern America (Figure 15). With 466,000 new cases, China alone accounts for over one half of the incidence burden worldwide. The rapid rises in incidence rates in many countries in recent years are mainly attributed to the increasing use of imaging, ultrasonography, and biopsy.[147,148] In a study of 25 countries, the increases were mainly confined to papillary carcinomas commonly detected by intense scrutiny of the thyroid gland.[147] The vast majority of new cancers detected have been subclinical papillary tumors that otherwise would not go on to cause symptoms or death; this has been estimated at 90% in South Korea; 70%–80% in the United States, Italy, France, and Australia; and 50% in Japan, the Nordic countries, and England and Scotland for the period 2003–2007.[148] Overdiagnosis and corresponding associated treatments have a significant impact on the total costs of thyroid cancer management, as recently measured in France.[149] In recent years, there have been modifications of national and international clinical practice guidelines,[11,150,151] which recommend against screening for thyroid cancer and advocate active surveillance for microcarcinoma.[152,153] This has likely led to declines in thyroid cancer incidence rates in the Republic of Korea since 2010 as well as in the United States.[154,155] Although ionizing radiation is the only well established risk factor,[156] a recent study estimated that 16% of the cancers overall and 63% of large tumors in the United States were attributable to obesity,[157] suggesting that obesity control might reduce the thyroid cancer burden. According to the recent *IARC Handbook of Cancer Prevention* Working Group on Body Fatness and Cancer, there is sufficient evidence that the absence of excess body fatness lowers thyroid cancer risk.[158]

Worldwide, *bladder cancer* is the ninth most frequently diagnosed cancer, with approximately 614,000 new cases and 220,000 deaths occurring in 2022 (Table 1). The burden and rates are considerably higher in men than in women, in whom the disease ranks as the sixth most common cancer and the ninth leading cause of cancer death (Figure 3). Incidence rates in both men and women are highest in Southern Europe (Spain has the highest incidence rate in men globally) as well as other regions of Europe (the Netherlands has the highest rate in women) and Northern Europe (Figure 16). The epidemiology of bladder cancer varies by region, with tobacco smoking, occupational exposures (e.g., aromatic amines), and arsenic contamination of drinking water among the putative causes in industrialized countries.[159,160] Infection with *Schistosoma haematobium* has an important role in some countries in sub-Saharan Africa, where it is estimated to account for over 50% of bladder cancer cases in the region.[161] Diverging bladder cancer incidence trends have been observed by sex since the 1990s, with rates tending to decrease or stabilize in men but increase among women in certain European countries (e.g., in Spain, the Netherlands, Germany, and Belarus).[160,162,163] Almost two fifths of bladder cancer cases among women were estimated to be attributable to smoking in 2014 in the United States, compared with about one half of new cases in men.[164] Mortality rates have been in decline in higher HDI countries in part because of reductions in smoking prevalence and improvements in treatment[165], although increases in mortality rates have also been reported among men in Thailand, Israel, and Slovakia and among women in Thailand, Japan, Croatia, and Poland.[160] Of note, there may be artifactual changes in incidence because of differences in coding and registration practice concerning inclusion or otherwise of noninvasive carcinomas.[160,166,167] Because these cancers often represent a large proportion of all bladder cancers[168] and are commonly associated with reasonably favorable survival, comparing trends in bladder cancer mortality rates may be more suitable for assessing progress in disease control.[160,166]

There were 553,000 new cases of *non-Hodgkin lymphoma* and 250,000 deaths in 2022 (Table 1). It is the 10th most commonly diagnosed and the 11th leading cause of cancer death, but it is the most common hematologic malignancy. Incidence rates are approximately two times higher in transitioned versus transitioning countries, although corresponding mortality rates are close to parity (Figure 7). The highest incidence is seen across Europe, Northern America, and Australia/New Zealand, with the highest rates in men and women worldwide seen in Malta and Denmark, respectively (Figure 17). In many high-incidence countries, rates have plateaued recently after rises in incidence during the 1980s and 1990s.[169] In the United States, the incidence trend has been declining in both HIV-infected and HIV-uninfected individuals, and reasons for the temporal patterns remain elusive.[170] A recent study linked the respective mortality declines in the United States and Japan in 1997 and 2000 to the introduction of rituximab, a targeted cancer drug for the treatment of B-cell non-Hodgkin lymphoma.[171]

There were 511,000 new cases of *pancreatic cancer* and 467,000 deaths in 2022. The disease is among the poorest in terms of prognosis and hence the disease ranks as the sixth leading cause of cancer mortality in both sexes combined (Figure 4), responsible for almost 5% of all cancer deaths worldwide. Rates are around four times greater in higher versus lower HDI countries (Figure 7), with incidence rates highest in Europe, North America, and Australia/New Zealand, although the rates are highest globally in Armenia in Western Asia among men and Uruguay in South America among women (Figure 18). With mortality rates reasonably stable in many countries (such as in the European Union countries[172]) over the last decades, the disease has increased in its public health importance because of concomitant declines in mortality rates of other common cancers (e.g., lung, colorectal, prostate, breast, and stomach cancers). Pancreatic cancer incidence or mortality trends partially reflect the known risk factors: smoking, obesity, diabetes, and heavy alcohol consumption.[173] Preventative strategies to reduce exposure to some of these risk factors are key to tackling the rising importance of the disease.[174]

Esophageal cancer is the 11th most commonly diagnosed cancer and the seventh leading cause of cancer death worldwide, with an estimated 511,000 new cases and 445,000 deaths in 2022 (Figure 3, Table 1). There remains a two-fold to three-fold difference in incidence and mortality rates between the sexes (Table 2), with rates somewhat greater in transitioned versus transitioning countries among men, but the inverse among women (Figure 7). The highest rates are seen in Eastern Asia and Eastern Africa, where Malawi has the highest incidence rates worldwide in both men and women (Figure 19). The disease is the leading cause of cancer death among men and women in Bangladesh and among men in Malawi and Botswana (Figure 5B). The geographic variations in esophageal cancer incidence substantially vary between the two most common histologic subtypes (squamous cell carcinoma and adenocarcinoma), which have quite different etiologies. In higher HDI settings, smoking and alcohol are major risk factors for squamous cell carcinoma; whereas, in lower HDI settings, the risk factors are yet to be uncovered.[175] Adenocarcinoma represents around two thirds of cases in higher HDI settings and is associated with excess body weight, gastroesophageal reflux disease, and Barrett esophagus.[176] With incidence rates of adenocarcinoma rising[177,178] in many of these countries, excess body weight is likely to be a key contributor to the future burden of esophageal cancer.[177]

Leukemia is the 13th and 10th most frequently diagnosed cancer and the leading cause of cancer death worldwide, respectively, with more than 487,000 new leukemia cases and 305,000 deaths estimated in 2022 (Table 1, Figure 3). The highest incidence rates are seen in Australia/New Zealand (Australia has the highest incidence rates worldwide in men), Northern America, and the four regions of Europe in both sexes (Belgium has the highest rate in women; Figure 20). There is a two-fold to three-fold higher incidence in transitioned versus transitioning countries in both men and women, although mortality is similar, particularly among women (Figure 7). The disease comprises a heterogeneous group of hematopoietic cancers with biologically distinct subgroups, commonly categorized into four major subtypes that have heterogenous causes, including genetics, infection, as well as increased access to diagnostic technologies. Acute lymphoblastic leukemia occurs at greater frequency among children and conveys a bimodal pattern, with higher incidence seen in countries from Latin America and Asia.[179] Acute myeloid leukemia is more frequent in adults but is also common in children, with higher incidence rates in higher HDI settings.[179] Chronic lymphoid leukemia incidence rates are higher among the elderly and males and are elevated in North America, Oceania, and some European countries, whereas higher proportions of chronic myeloid leukemia are observed among adult males in higher HDI countries.[179]

The future cancer incidence burden in 2050

Based on the projected changes in population growth and aging, and assuming overall cancer rates remain unchanged, we predict over 35 million new cancer cases (including NMSC, except basal cell carcinoma) will occur in the year 2050, a 77% increase from the 20 million cases estimated in 2022 (Figure 21). The demographic transition is a key driver of the size of the cancer burden, with the global population of approximately 8 billion in 2022 reaching 9.7 billion by 2050.[180] Although the absolute differences in cancer incidence burden predicted in 2050 are greatest in high HDI countries (including China) and very high HDI countries (with an additional 4.8 and 3.9 million cases, respectively, predicted by 2050 compared with 2022), the greatest relative increases will take place in lower HDI settings. The magnitude of the increase is most striking in low HDI countries, where a 142% predicted increase will result in a more than doubling of the burden to 2 million new cases by 2050 from 0.8 million in 2022. A close to 100% rise is predicted in medium HDI countries (including India), signifying that there will be two times as many cases (4.8 million) in 2050 compared with those currently estimated (2.4 million) in 2022.

Strengths and weaknesses

It is important to note that the country-level incidence and mortality estimates, although offering a valuable global exposition of the scale and profile of cancer every 2 years, are not intended as a substitute for the continuous approaches to data collection provided by high-quality, population-based cancer registries and vital registration systems. Population-based cancer registries are key providers of statistics on cancer incidence and survival and thus are a critical resource for policymakers (as well as the compilers of global cancer estimates), providing the evidence base from which to plan, monitor, and evaluate the impact of national cancer control programs and some of the 2030 national targets of the WHO cancer initiatives. Yet incidence and mortality data of high quality remain sparse in many transitioning countries. Given the critical importance of building capacity for local data production, analysis, and dissemination within the countries themselves, the Global Initiative for Cancer Registry Development was launched by the IARC in 2012. The Initiative provides the necessary regional

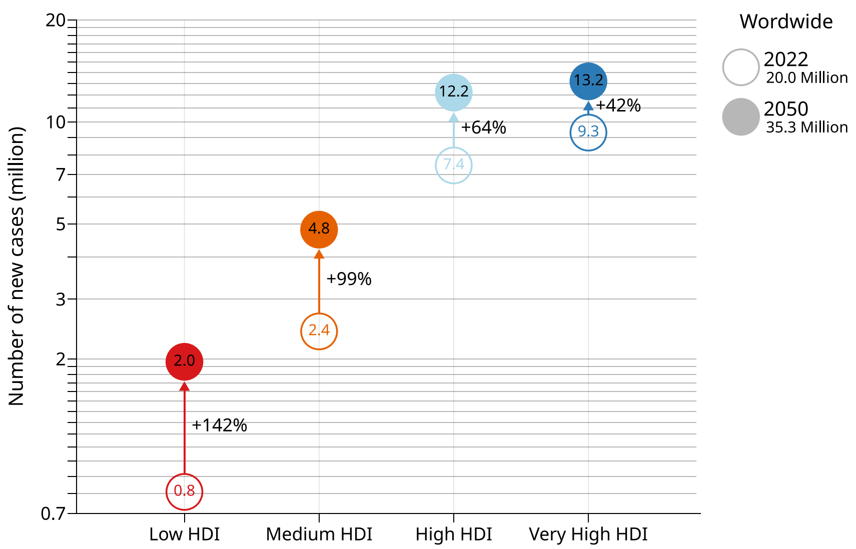

FIGURE 21 Projected number of new cases for all cancers combined (both sexes combined) in 2050 according to the four-tier Human Development Index (HDI). Source: GLOBOCAN 2022.

infrastructure through IARC hubs and designated centers of expertise to assist registries using a broad set of knowledge transfer and capacity-building activities.[181]

The coronavirus disease 2019 pandemic caused over 6 million deaths in 2020–2022 and severely affected health systems worldwide. Cancer services across the cancer continuum were significantly affected, resulting in major delays in diagnosis and treatment. Many cancer registries worldwide reported disruptions to their operations during the first wave of the pandemic,[182,183] and monthly cancer registrations were clearly reduced for common cancers as a result in many countries. The estimates provided for 2022, however, do not reflect the impact of the pandemic because they are largely based on extrapolations of cancer data collected before 2020. In any case, it is difficult to develop estimates adjusted for the pandemic while the final conclusions are still to be drawn. The subsequent impact on cancer incidence counts may turn out to be rather moderate and short-term; for example, several registries have reported that, having received relatively fewer pathology reports during earlier months was offset by increased diagnostic activity in later months.[184–186] Nevertheless, the long-term impact on cancer survival and mortality remains to be assessed, whereas modeling studies have predicted that a transient increase in diagnoses at more advanced stages could lead to future excess cancer mortality.

There were advances in compiling the 2022 cancer incidence estimates. First, the development of the estimates was coupled with the availability of incidence data from the latest published volume (Volume XII) of *Cancer Incidence in Five Continents* (CI5).[187] The CI5 series is an exposition of comparable cancer incidence data from all parts of the globe based on the high-quality data made available by population-based cancer registries. For CI5 Volume XII, 671 population-based cancer registries, covering 813 populations in 104 countries, responded to the call for data, submitting cancer incidence data sets that covered the period of diagnosis from 2013 to 2017. After a careful evaluation of the comparability, completeness, and accuracy of each data set, Volume XII compiles cancer incidence data from 456 cancer registries, covering 589 populations in 70 countries.

Second, we were able to use recent cancer registry data in collaboration with registry networks and programs worldwide. As examples, in China, our collaboration with the National Cancer Registry Office meant that 700 cancer registries were used in developing trend-based estimates in 2022. The estimates from the 40 countries that comprise the European Union-27 and greater Europe were developed in collaboration with the European Commission's Joint Research Center and the European Network of Cancer Registries. Finally, we were able to use the results of the SurvCan-3 project, which benchmarks recent survival probabilities in more than 30 transitioning countries[37] to improve the mortality estimates in some regions, where actual data on mortality from cancer were largely absent, notably in sub-Saharan Africa.

Conclusions

The current global statistics for the year 2022 indicate that there were almost 20 million new cases of cancer and close to 10 million cancer deaths. Demographics-based predictions indicate that the annual number of new cases of cancer will reach 35 million by 2050, a 77% increase from the 2022 level. The overall scale of cancer and the diversity of cancer profiles by world region and human development level reemphasize the need for a global escalation of targeted cancer control measures. Investments in prevention, including the targeting of key risk factors for cancer (including smoking, overweight and obesity, and infections), can avert millions of future cancer diagnoses and save many lives worldwide,[188] bringing huge economic as well as societal dividends to countries over the forthcoming decades.

ACKNOWLEDGMENTS

The authors thank cancer registries worldwide for their continued collaboration; without their efforts, there would be no global cancer estimates. This work was supported by the International Agency for Research on Cancer/World Health Organization.

CONFLICT OF INTEREST STATEMENT

The authors disclosed no conflicts of interest. Hyuna Sung, Rebecca L. Siegel, and Ahmedin Jemal are employed by the American Cancer Society, which receives grants from private and corporate foundations, including foundations associated with companies in the health sector, for research outside of the submitted work. The authors are not funded by or key personnel for any of these grants, and their salary is solely funded through American Cancer Society funds. Where authors are identified as personnel of the International Agency for Research on Cancer/World Health Organization, the authors alone are responsible for the views expressed in this article, and they do not necessarily represent the decisions, policy, or views of the International Agency for Research on Cancer/World Health Organization.

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How to cite this article: Bray F, Laversanne M, Sung H, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2024;74(3):229-263. doi:10.3322/caac.21834