Received: 16 February 2021 | Revised: 24 March 2021 | Accepted: 25 March 2021

DOI: 10.1002/ijc.33588

CANCER EPIDEMIOLOGY

IJC International Journal of Cancer

Cancer statistics for the year 2020: An overview

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Abstract

Our study briefly reviews the data sources and methods used in compiling the International Agency for Research on Cancer (IARC) GLOBOCAN cancer statistics for the year 2020 and summarises the main results. National estimates were calculated based on the best available data on cancer incidence from population-based cancer registries (PBCR) and mortality from the World Health Organization mortality database. Cancer incidence and mortality rates for 2020 by sex and age groups were estimated for 38 cancer sites and 185 countries or territories worldwide. There were an estimated 19.3 million (95% uncertainty interval [UI]: 19.0-19.6 million) new cases of cancer (18.1 million excluding non-melanoma skin cancer) and almost 10.0 million (95% UI: 9.7-10.2 million) deaths from cancer (9.9 million excluding non-melanoma skin cancer) worldwide in 2020. The most commonly diagnosed cancers worldwide were female breast cancer (2.26 million cases), lung (2.21) and prostate cancers (1.41); the most common causes of cancer death were lung (1.79 million deaths), liver (830000) and stomach cancers (769000).

KEYWORDS
cancer, global estimates, GLOBOCAN, incidence, mortality

1 | INTRODUCTION

One of the remits of the Cancer Surveillance Branch (CSU) at the International Agency for Research on Cancer (IARC) is the regular provision of global estimates of the cancer burden. GLOBOCAN 2020 updates the previously published estimates of cancer incidence and mortality for the year 2018.[1] As previously, the basic units for estimation are countries, together with aggregated results globally and in 20 world regions, as defined by the United Nations (UN).[2] The estimates were developed for 38 cancer sites including other, and unspecified cancers, by sex and for 18 age groups.

The methods of estimation together with the computation of uncertainty intervals continue to rely upon the best available data on cancer incidence and mortality nationally. Interactive facilities for the tabulation and graphical visualisation of the GLOBOCAN data set of 185 countries and world regions by sex can be accessed via the Global Cancer Observatory (GCO) (https://gco.iarc.fr). A detailed description of the geographic variability observed across 20 world regions is provided elsewhere.[3] Our study aims to summarise the data sources and methods used in compiling the cancer incidence and mortality estimates for 2020 worldwide and presents a summary of the major findings.

Abbreviations: ASR, age-standardised rate; CI5, Cancer Incidence in Five Continents; CSU, Cancer Surveillance Branch; GCO, Global Cancer Observatory; GICR, Global Initiative for Cancer Registry Development; HDI, Human Development Index; IARC, International Agency for Research on Cancer; LMIC, low- and middle-income countries; NMSC, non-melanoma skin cancer; PBCR, population-based cancer registry; UI, uncertainty interval; UN, United Nations; WHO, World Health Organization.

As part of the latest International Agency for Research on Cancer (IARC) GLOBOCAN cancer statistics update, here the authors provide a comprehensive description of the data sources and methods used to compute the global incidence and mortality estimates for 38 cancers corresponding to the year 2020. The reported uncertainty intervals incorporate the major sources of error that may contribute to the uncertainty of these estimations. In addition to providing a global snapshot of the cancer burden in 2020, the estimates presented here can support the planning and prioritization of cancer control efforts at the global and national levels.

2 | METHODS

2.1 | Data

The basic sources of the estimates are the high-quality cancer registry incidence data, as compiled in the Cancer Incidence in Five Continents (CI5) series,[4] as well as new data sources most notably in sub-Saharan Africa via the expansion of the African Cancer Registry Network,[5] through targeted searches for new registry data online, and the most recent mortality data from the World Health Organization (WHO).[6] As a result, the current estimates for 2020 are more accurate for several countries and some world areas than previously and therefore not fully comparable with previous sets of estimation.

The geographical definition of the regions follows the UN country classification, except for Cyprus, which is included in Southern Europe rather than Western Asia. The source(s) of information used to develop corresponding estimates of the national burden of cancer in each country is provided in Annex A. National population estimates for 2020 were extracted from the UN website.[2]

2.2 | Methods of estimation

Cancer incidence and mortality rates for 2020 by sex and for 18 age groups (0-4, 5-9, 10-14, 15-19, ..., 75-79, 80-84, 85 and over) were estimated for the 185 countries or territories of the world with populations of more than 150 000 inhabitants in the same year.[2] Results are presented for 38 cancer sites or cancer types as defined by the 10th edition of the International Classification of Diseases (ICD-10, version 2014)[7] and for all cancers combined. These are listed in Annex B. The estimates for non-melanoma skin cancers (NMSC) exclude basal-cell carcinoma in incidence, while mortality includes deaths from all types of NMSC. The major difference with previous editions of GLOBOCAN estimates with respect to the rubrics is that gallbladder cancer (ICD-10 C23) now excludes neoplasms of extra hepatic ducts (ICD-10 C24).

The methods of incidence and mortality estimation and the computation of uncertainty intervals are similar to those used in the previous estimates.[1] These are reproduced in Annex A and summarised later.

2.2.1 | Estimates of cancer incidence by country

The methods used to estimate the sex- and age-specific incidence rates of cancer in a specific country in 2020 fall into the following broad categories, in order of priority:

1. Observed national incidence rates were projected to 2020 (45 countries).
2. The most recently observed incidence rates (national (2a) or subnational (2b)) were used as proxy for 2020 (54 countries).
3. Rates were estimated from national mortality data by modelling, using mortality-to-incidence ratios derived from:
   - Cancer registries in that country (14 countries).
   - Cancer registries in neighbouring countries (37 countries). These comprised one model for Africa; one for Caribbean; two for Asia; two for Europe and one for Oceania (see Annex C).
4. Age- and sex-specific national incidence rates for all cancers combined were obtained by averaging overall rates from neighbouring countries. These rates were then partitioned to obtain the national incidence for specific sites using available cancer-specific relative frequency data in the country (five countries).
5. Rates were estimated as an average of those from selected neighbouring countries (30 countries).

What's new?

As part of the latest International Agency for Research on Cancer (IARC) GLOBOCAN cancer statistics update, here the authors provide a comprehensive description of the data sources and methods used to compute the global incidence and mortality estimates for 38 cancers corresponding to the year 2020. The reported uncertainty intervals incorporate the major sources of error that may contribute to the uncertainty of these estimations. In addition to providing a global snapshot of the cancer burden in 2020, the estimates presented here can support the planning and prioritization of cancer control efforts at the global and national levels.

2.2.2 | Estimates of cancer mortality by country

Depending on the coverage, completeness and degree of detail of the mortality data available, four methods were utilised to estimate the sex- and age-specific mortality rates of cancer in a country:

1. Observed national mortality rates were projected to 2020 (80 countries).
2. The most recently observed mortality rates (national [2a] or subnational [2b]) were used as proxy for 2020 (21 countries).
3. Rates were estimated from the corresponding national incidence estimates by modelling, using incidence-to-mortality ratios derived from cancer registries in neighbouring countries (81 countries). These comprised two models for Africa; three for Asia and one for Oceania (see Annex C).
4. Rates were estimated as an average of those from selected neighbouring countries (three countries).

Random fluctuations in the predicted age-specific incidence and mortality rates were smoothed using a *lowess* function, a locally weighted regression, by country, sex and cancer site. Estimates for the 20 world

TABLE 1 Estimated new cancer cases and uncertainty intervals (95% UI, all ages, in thousands), age-standardised rates (ASRs, per 100 000) and cumulative risk to age 75 (percent) by sex and cancer type worldwide, 2020

	Both sexes				Males				Females			
Cancer	Numbers	95% UI	ASR (World)	Cum. risk (0-74)	Numbers	95% UI	ASR (World)	Cum. risk (0-74)	Numbers	95% UI	ASR (World)	Cum. risk (0–74)
Lip, oral cavity	377.7	(362.4-393.7)	4.1	0.46	264.2	(251.2-277.9)	6.0	0.68	113.5	(105.6-122.0)	2.3	0.26
Salivary glands	53.6	(48.2-59.5)	0.6	0.06	29.7	(25.9-34.1)	0.7	0.07	23.9	(20.3-28.1)	0.5	0.05
Oropharynx	98.4	(91.3-106.1)	1.1	0.13	79.0	(72.8-85.9)	1.8	0.22	19.4	(16.3-23.0)	0.4	0.05
Nasopharynx	133.4	(124.7-142.6)	1.5	0.16	96.4	(89.1-104.3)	2.2	0.24	37.0	(32.6-42.0)	0.8	0.09
Hypopharynx	84.3	(76.7-92.6)	0.9	0.11	70.3	(63.5-77.8)	1.6	0.19	14.0	(10.8-18.1)	0.3	0.03
Oesophagus	604.1	(587.1-621.6)	6.3	0.78	418.4	(404.5-432.6)	9.3	1.15	185.8	(176.0-196.0)	3.6	0.44
Stomach	1089.1	(1066.6-1112.1)	11.1	1.31	719.5	(701.4-738.2)	15.8	1.87	369.6	(356.4-383.2)	7.0	0.79
Colon	1148.5	(1138.3-1158.8)	11.4	1.30	600.9	(593.6-608.3)	13.1	1.49	547.6	(540.5-554.8)	10.0	1.12
Rectum	732.2	(724.7-739.8)	7.6	0.91	443.4	(437.7-449.1)	9.8	1.18	288.9	(284.0-293.8)	5.6	0.65
Anus	50.9	(46.0-56.3)	0.5	0.06	21.7	(18.4-25.6)	0.5	0.06	29.2	(25.7-33.1)	0.6	0.07
Liver	905.7	(884.7-927.2)	9.5	1.11	632.3	(615.0-650.1)	14.1	1.65	273.4	(261.7-285.6)	5.2	0.60
Gallbladder	115.9	(108.3-124.1)	1.2	0.13	41.1	(36.6-46.0)	0.9	0.10	74.9	(68.8-81.6)	1.4	0.16
Pancreas	495.8	(489.0-502.7)	4.9	0.55	262.9	(258.0-267.8)	5.7	0.66	232.9	(228.1-237.8)	4.1	0.45
Larynx	184.6	(174.3-195.6)	2.0	0.25	160.3	(150.6-170.5)	3.6	0.45	24.4	(20.8-28.4)	0.5	0.06
Lung	2206.8	(2176.5-2237.4)	22.4	2.74	1435.9	(1410.9-1461.5)	31.5	3.78	770.8	(753.9-788.1)	14.6	1.77
Melanoma of skin	324.6	(314.2-335.4)	3.4	0.37	173.8	(166.4-181.6)	3.8	0.42	150.8	(143.5-158.4)	3.0	0.33
Non-melanoma skin	1198.1	(1056.5-1358.6)	11.0	1.06	722.3	(605.2-862.1)	15.1	1.40	475.7	(397.8-568.9)	7.9	0.75
Mesothelioma	30.9	(27.0-35.3)	0.3	0.03	21.6	(18.4-25.2)	0.5	0.05	9.3	(7.2-12.1)	0.2	0.02
Kaposi sarcoma	34.3	(26.0-45.2)	0.4	0.03	23.4	(17.1-32.0)	0.5	0.05	10.9	(6.0-19.6)	0.3	0.02
Breast	2261.4	(2244.3-2278.7)	47.8	5.20		—			2261.4	(2244.3–2278.7)	47.8	5.20
Vulva	45.2	(40.7-50.3)	0.9	0.09		—			45.2	(40.7–50.3)	0.9	0.09
Vagina	17.9	(14.7-21.8)	0.4	0.04		—			17.9	(14.7-21.8)	0.4	0.04
Cervix uteri	604.1	(582.0-627.1)	13.3	1.39		—			604.1	(582.0–627.1)	13.3	1.39
Corpus uteri	417.4	(410.4-424.4)	8.7	1.05		—			417.4	(410.4–424.4)	8.7	1.05
Ovary	314.0	(300.8-327.6)	6.6	0.73		—			314.0	(300.8–327.6)	6.6	0.73
Penis	36.1	(31.0-42.0)	0.8	0.09	36.1	(31.0–42.0)	0.8	0.09		—		
Prostate	1414.3	(1395.3-1433.5)	30.7	3.86	1414.3	(1395.3–1433.5)	30.7	3.86		—		
Testis	74.5	(68.2-81.3)	1.8	0.14	74.5	(68.2–81.3)	1.8	0.14		—		
Kidney	431.3	(418.1-444.8)	4.6	0.52	271.2	(260.8-282.1)	6.1	0.70	160.0	(152.2-168.3)	3.2	0.36
Bladder	573.3	(557.2-589.8)	5.6	0.64	440.9	(426.8-455.4)	9.5	1.05	132.4	(124.9-140.4)	2.4	0.26

TABLE 1 (Continued)

Cancer	Both sexes				Males				Females			
	Numbers	95% UI	ASR (World)	Cum. risk (0–74)	Numbers	95% UI	ASR (World)	Cum. risk (0–74)	Numbers	95% UI	ASR (World)	Cum. risk (0–74)
Brain, central nervous system	308.1	(295.7-321.0)	3.5	0.35	168.3	(159.2-178.1)	3.9	0.40	139.8	(131.6-148.5)	3.0	0.31
Thyroid	586.2	(579.1-593.4)	6.6	0.68	137.3	(134.0-140.7)	3.1	0.33	448.9	(442.7-455.3)	10.1	1.02
Hodgkin lymphoma	83.1	(78.8-87.6)	1.0	0.09	49.0	(45.8-52.3)	1.2	0.10	34.1	(31.2-37.3)	0.8	0.07
Non-Hodgkin lymphoma	544.4	(536.0-552.8)	5.8	0.62	304.2	(297.9-310.6)	6.9	0.73	240.2	(234.8-245.8)	4.8	0.52
Multiple myeloma	176.4	(167.9-185.3)	1.8	0.21	98.6	(92.3-105.3)	2.2	0.25	77.8	(72.3-83.7)	1.5	0.17
Leukaemia	474.5	(459.8-489.7)	5.4	0.50	269.5	(258.5-281.0)	6.3	0.59	205.0	(195.5-215.0)	4.5	0.41
Other specified cancers	643.3	(625.2-661.8)	7.0	0.72	357.1	(343.6-371.1)	8.2	0.85	286.2	(274.4-298.5)	6.0	0.61
Unspecified cancers	418.7	(403.1-434.9)	4.3	0.47	227.4	(215.9-239.5)	5.1	0.56	191.3	(181.0-202.3)	3.7	0.39
All cancers	19 292.8	(18 993.0-19 597.3)	201.0	20.44	10 065.3	(9832.4-10 303.7)	222.0	22.60	9227.5	(9035.1-9424.0)	186.0	18.55
All cancers excl. non-melanoma skin cancer	18 094.7	(17 812.8-18 381.1)	190.0	19.59	9343.0	(9126.0-9565.0)	206.9	21.50	8751.8	(8568.9-8938.6)	178.1	17.94

regions were obtained by the population-weighted average of the incidence and mortality rates of the component countries. These rates were applied to the corresponding population estimate for the region for 2020 to obtain the estimated numbers of new cancer cases and deaths in 2020. The rates were age-standardised rates (ASRs per 100 000 person-years) using the direct method and the World standard population as proposed by Segi[8] and modified by Doll.[9] The cumulative risk of developing or dying from cancer before the age of 75 in the absence of competing causes of death was also calculated using the age-specific rates and expressed as a percentage.[4]

2.2.3 | Uncertainty intervals

Uncertainty intervals (95% UI) of the estimated sex- and site-specific number of new cancer cases and cancer deaths for all ages were computed using the SE of the crude incidence or mortality rate used in the estimation. The SE is corrected for three major causes of uncertainty in the final estimate:

1. *Coverage*: the catchment population used in the computations only covers part of the national population (not the entire country/subnational).
2. The *lag time*: the most recent data are available prior to the year 2020.
3. The *quality* of the data: the extent to which the data are considered complete and accurate.

Penalties were used to correct the SE for each factor above in the UI calculation. The formulae used to compute the corrected SE are provided in Annex D. The values of the penalties are given by country in Annex E.

3 | RESULTS

Tables 1 and 2 show the estimated number of cases and deaths for all cancers combined and for 38 specific cancers in males, females and both sexes, with the corresponding 95% uncertainty intervals, ASRs and the cumulative risk. We estimated that there were 19.3 million (95% UI: 19.0-19.6 million) new cancer cases (18.1 million excluding NMSC) and 10.0 million (95% UI: 9.7-10.2 million) cancer deaths (9.9 million excluding NMSC) in 2020 worldwide. There is about a 20% risk of getting a cancer in a lifetime (before the age of 75), and a 10% risk of dying from the cancer; one in five persons will get cancer in their lifetimes and one in 10 will die from the disease. With 2.26 million (95% UI: 2.24-2.28) new cases estimated in 2020, female breast cancer has now become the most commonly diagnosed cancer worldwide, followed closely by lung cancer (2.21 million, 95% UI: 2.18-2.24). The most common cause of cancer death remains by far lung cancer (1.80 million deaths, 95% UI: 1.77-1.82), followed by liver (0.83 million, 95% UI 0.81-0.85) and stomach cancer (0.77 million, 95% UI: 0.75-0.79).

TABLE 2 Estimated cancer deaths and uncertainty intervals (95% UI, all ages, in thousands), age-standardised rates (ASRs, per 100 000) and cumulative risk to age 75 (percent) by sex and cancer type worldwide, 2020

	Both sexes				Males				Females			
Cancer	Numbers	95% UI	ASR (World)	Cum. Risk (0–74)	Numbers	95% UI	ASR (World)	Cum. Risk (0–74)	Numbers	95% UI	ASR (World)	Cum. Risk (0–74)
Lip, oral cavity	177.8	(167.8-188.3)	1.9	0.22	125.0	(116.6-134.1)	2.8	0.32	52.7	(47.7-58.3)	1.0	0.12
Salivary glands	22.8	(19.1-27.1)	0.2	0.03	13.4	(10.7-16.7)	0.3	0.03	9.4	(7.1-12.5)	0.2	0.02
Oropharynx	48.1	(43.3-53.5)	0.5	0.06	39.6	(35.3-44.5)	0.9	0.11	8.6	(6.7-10.9)	0.2	0.02
Nasopharynx	80.0	(72.8-87.9)	0.9	0.10	58.1	(52.1-64.8)	1.3	0.16	21.9	(18.3-26.3)	0.5	0.05
Hypopharynx	38.6	(34.2-43.5)	0.4	0.05	32.3	(28.4-36.8)	0.7	0.09	6.3	(4.7-8.5)	0.1	0.01
Oesophagus	544.1	(526.2-562.5)	5.6	0.68	374.3	(359.9-389.3)	8.3	1.01	169.8	(159.3-180.9)	3.2	0.38
Stomach	768.8	(748.6-789.5)	7.7	0.90	502.8	(486.5-519.6)	11.0	1.29	266.0	(254.3-278.3)	4.9	0.55
Colon	576.9	(569.8-584.0)	5.4	0.55	302.1	(297.1-307.2)	6.4	0.66	274.7	(269.8-279.7)	4.6	0.45
Rectum	339.0	(333.0-345.1)	3.3	0.37	204.1	(200.4-207.9)	4.4	0.50	134.9	(127.1-143.2)	2.4	0.26
Anus	19.3	(16.2-23.0)	0.2	0.02	9.4	(7.3-12.2)	0.2	0.02	9.9	(7.8-12.5)	0.2	0.02
Liver	830.2	(807.1-853.9)	8.7	1.01	577.5	(558.3-597.4)	12.9	1.49	252.7	(240.2-265.8)	4.8	0.55
Gallbladder	84.7	(79.0-90.8)	0.8	0.09	30.3	(27.1-33.8)	0.7	0.07	54.4	(49.8-59.5)	1.0	0.11
Pancreas	466.0	(459.5-472.6)	4.5	0.51	246.8	(242.2-251.5)	5.3	0.62	219.2	(214.6-223.8)	3.8	0.41
Larynx	99.8	(92.8-107.4)	1.0	0.13	85.4	(78.9-92.3)	1.9	0.23	14.5	(11.9-17.6)	0.3	0.03
Lung	1796.1	(1767.6-1825.2)	18.0	2.18	1188.7	(1164.9-1212.9)	25.9	3.08	607.5	(591.6-623.7)	11.2	1.34
Melanoma of skin	57.0	(52.2-62.4)	0.6	0.06	32.4	(28.8-36.4)	0.7	0.07	24.7	(21.5-28.3)	0.4	0.05
Non-melanoma skin	63.7	(58.3-69.7)	0.6	0.05	37.6	(33.5-42.2)	0.8	0.07	26.1	(22.7-30.1)	0.4	0.04
Mesothelioma	26.3	(22.8-30.3)	0.3	0.03	18.7	(15.8-22.1)	0.4	0.04	7.6	(5.8-10.0)	0.1	0.02
Kaposi sarcoma	15.1	(10.2-22.3)	0.2	0.01	9.9	(6.2-16.0)	0.2	0.02	5.2	(2.6-10.2)	0.1	0.01
Breast	685.0	(675.5-694.6)	13.6	1.49		—			685.0	(675.5–694.6)	13.6	1.49
Vulva	17.4	(14.5-20.9)	0.3	0.03		—			17.4	(14.5–20.9)	0.3	0.03
Vagina	8.0	(6.0-10.7)	0.2	0.02		—			8.0	(6.0–10.7)	0.2	0.02
Cervix uteri	341.8	(324.2-360.4)	7.3	0.82		—			341.8	(324.2–360.4)	7.3	0.82
Corpus uteri	97.4	(91.0-104.2)	1.8	0.22		—			97.4	(91.0–104.2)	1.8	0.22
Ovary	207.3	(197.0-218.1)	4.2	0.49		—			207.3	(197.0–218.1)	4.2	0.49
Penis	13.2	(10.7-16.3)	0.3	0.03	13.2	(10.7–16.3)	0.3	0.03		—		
Prostate	375.3	(367.8-382.9)	7.7	0.63	375.3	(367.8–382.9)	7.7	0.63		—		
Testis	9.3	(7.5-11.7)	0.2	0.02	9.3	(7.5–11.7)	0.2	0.02		—		
Kidney	179.4	(175.2-183.7)	1.8	0.20	115.6	(112.3-119.0)	2.5	0.28	63.8	(61.2-66.5)	1.2	0.12
Bladder	212.5	(204.9-220.4)	1.9	0.18	158.8	(150.2-167.9)	3.3	0.30	53.8	(51.2-56.4)	0.9	0.08

TABLE 2 (Continued)

Cancer	Both sexes				Males				Females			
	Numbers	95% UI	ASR (World)	Cum. Risk (0–74)	Numbers	95% UI	ASR (World)	Cum. Risk (0–74)	Numbers	95% UI	ASR (World)	Cum. Risk (0–74)
Brain, central nervous system	251.3	(244.4-258.4)	2.8	0.30	138.3	(129.5-147.7)	3.2	0.34	113.1	(109.7-116.5)	2.4	0.26
Thyroid	43.6	(40.0-47.6)	0.4	0.05	15.9	(13.6-18.6)	0.3	0.04	27.7	(25.0-30.8)	0.5	0.05
Hodgkin lymphoma	23.4	(20.2-27.1)	0.3	0.02	14.3	(11.9-17.2)	0.3	0.03	9.1	(7.1-11.6)	0.2	0.02
Non-Hodgkin lymphoma	259.8	(254.4-265.2)	2.6	0.27	147.2	(143.2-151.4)	3.3	0.33	112.6	(109.1-116.1)	2.1	0.21
Multiple myeloma	117.1	(109.9-124.7)	1.1	0.13	65.2	(59.9-71.0)	1.4	0.15	51.9	(47.2-57.0)	0.9	0.10
Leukaemia	311.6	(304.3-319.1)	3.3	0.32	177.8	(173.3-182.4)	4.0	0.38	133.8	(125.8-142.2)	2.7	0.26
Other specified cancers	367.3	(353.4-381.7)	3.9	0.39	200.2	(189.8-211.1)	4.5	0.46	167.1	(158.0-176.7)	3.3	0.33
Unspecified cancers	383.1	(370.3-396.4)	3.8	0.40	209.3	(199.8-219.3)	4.6	0.49	173.8	(165.3-182.7)	3.2	0.33
All cancers	9958.1	(9721.1-10 200.9)	100.7	10.65	5528.8	(5351.7-5711.8)	120.8	12.59	4429.3	(4273.6-4590.8)	84.2	8.86
All cancers excl. non-melanoma skin cancer	9894.4	(9658.5-10 136.0)	100.1	10.61	5491.2	(5315.0-5673.3)	120.0	12.53	4403.2	(4248.1-4563.9)	83.7	8.83

Table 3 shows the most common types of cancer in terms of new cases and deaths in each of the 20 world regions in 2020. Prostate cancer was the most frequently diagnosed cancer in males in 12 regions of the world, followed by lung cancer (four regions), NMSC (two regions), lip and oral cavity, and liver cancer in one region. Lung cancer was the most frequent cause of death from cancer in 13 regions of the world, followed by prostate and liver cancer in five and two areas, respectively. In females, breast cancer was the most frequently diagnosed cancer in all regions of the world, except in Eastern Africa and in Australia/New Zealand where cervical cancer and NMSC dominated, respectively. Breast cancer was also the most frequent cause of death from cancer in 12 regions of the world, lung cancer in five regions (including Eastern Asia) and cervical cancer in three sub-Saharan Africa regions. These seven cancers represent almost half of the global incidence and mortality burden in 2020.

Figure 1A,B summarises the estimated numbers of new cancer cases and cancer deaths worldwide in 2020 by type of cancer and by sex, while Figure 2 shows the distribution of the global cancer cases and deaths (all cancers combined) by world region. Most cases (6.0 million, 31.1% of the total) and deaths (3.6 million, 36.3%) occurred in Eastern Asia with its vast population (1.7 billion, 22% of the global population in 2020). Northern America ranks second in terms of number of new cases (2.6 million, 13.3%) but third (699 000, 7.0%) in terms of cancer deaths after South-Central Asia (1.3 million, 12.6%). Almost a quarter of the new cases (4.4 million) and one fifth of the deaths (1.9 million) occurred in Europe, despite containing only one-tenth of the global population

4 | DISCUSSION

The main aim of our study is to document the data sources and methods used to compile the global and region-specific estimates of the cancer burden. Although IARC's estimation methods have been refined in the last decades to account for the increasing availability and quality of data, the underlying methodological principles have remained unchanged: wherever possible, national estimates are based upon local sources of cancer incidence (from population-based cancer registries) and cancer mortality (mainly from vital registration systems). These methods are objective and easy to reproduce and have been adopted by the Joint Research Centre (JRC) of the European Commission[10] for their estimates of the cancer burden in Europe in 2020.

The uncertainty intervals (95% UI) that accompany the estimates aim to capture, alongside inherent random variation, the uncertainty in the source information, taking into account three important sources of errors of the final estimate: coverage, lag time (timeliness) and the quality of the data. Penalties are used to correct the SE for each bias in the UI calculation, and the interval thus widens when the recorded incidence or mortality data cover a relatively low proportion of the total population, is less timely or of poorer quality. The estimation of the UI was modified on a cancer type-specific basis, given local cancer registration processes and data availability can vary by cancer type.

TABLE 3 Leading types of cancer in terms of new cases (incidence) and deaths (mortality) by sex in each of the 20 world regions in 2020 [Color table can be viewed at wileyonlinelibrary.com]

	Male						Female					
	Incidence			Mortality			Incidence			Mortality		
	First	Second	Third	First	Second	Third	First	Second	Third	First	Second	Third
World	Lung	Prostate	Non-melanoma skin	Lung	Liver	Stomach	Breast	Lung	Cervix uteri	Breast	Lung	Cervix uteri
Africa	Prostate	Liver	Lung	Prostate	Liver	Lung	Breast	Cervix uteri	Liver	Breast	Cervix uteri	Liver
Eastern Africa	Prostate	Kaposi sarcoma	NHL	Prostate	Oesophagus	Liver	Cervix uteri	Breast	Oesophagus	Cervix uteri	Breast	Oesophagus
Middle Africa	Prostate	Liver	NHL	Prostate	Liver	NHL	Breast	Cervix uteri	NHL	Cervix uteri	Breast	Liver
Northern Africa	Liver	Lung	Prostate	Liver	Lung	Bladder	Breast	Liver	Cervix uteri	Breast	Liver	Ovary
Southern Africa	Prostate	Lung	Non-melanoma skin	Lung	Prostate	Oesophagus	Breast	Cervix uteri	Non-melanoma skin	Cervix uteri	Breast	Lung
Western Africa	Prostate	Liver	NHL	Prostate	Liver	NHL	Breast	Cervix uteri	Ovary	Breast	Cervix uteri	Liver
Americas	Prostate	Non-melanoma skin	Lung	Lung	Prostate	Colon	Breast	Non-melanoma skin	Lung	Lung	Breast	Colon
Northern America	Non-melanoma skin	Prostate	Lung	Lung	Prostate	Pancreas	Breast	Non-melanoma skin	Lung	Lung	Breast	Pancreas
Caribbean	Prostate	Lung	Colon	Prostate	Lung	Colon	Breast	Colon	Lung	Breast	Lung	Colon
Central America	Prostate	Stomach	Colon	Prostate	Stomach	Liver	Breast	Cervix uteri	Thyroid	Breast	Cervix uteri	Liver
South America	Prostate	Lung	Colon	Lung	Prostate	Stomach	Breast	Cervix uteri	Thyroid	Breast	Lung	Cervix uteri
Asia	Lung	Stomach	Liver	Lung	Liver	Stomach	Breast	Lung	Cervix uteri	Lung	Breast	Cervix uteri
Eastern Asia	Lung	Stomach	Liver	Lung	Liver	Stomach	Breast	Lung	Colon	Lung	Breast	Stomach
South-Eastern Asia	Lung	Liver	Prostate	Lung	Liver	Stomach	Breast	Cervix uteri	Lung	Breast	Cervix uteri	Lung
South-Central Asia	Lip and oral cavity	Lung	Stomach	Lung	Lip and oral cavity	Oesophagus	Breast	Cervix uteri	Ovary	Breast	Cervix uteri	Ovary
Western Asia	Lung	Prostate	Bladder	Lung	Stomach	Prostate	Breast	Thyroid	Lung	Breast	Lung	Stomach

TABLE 3 (Continued)

	Male						Female					
	Incidence			Mortality			Incidence			Mortality		
	First	Second	Third	First	Second	Third	First	Second	Third	First	Second	Third
Europe	Prostate	Lung	Non-melanoma skin	Lung	Prostate	Colon	Breast	Lung	Colon	Breast	Lung	Colon
Eastern Europe	Lung	Prostate	Colon	Lung	Prostate	Stomach	Breast	Corpus uteri	Colon	Breast	Lung	Colon
Northern Europe	Prostate	Non-melanoma skin	Lung	Lung	Prostate	Colon	Breast	Lung	Colon	Lung	Breast	Colon
Southern Europe	Prostate	Lung	Bladder	Lung	Colon	Prostate	Breast	Colon	Lung	Breast	Lung	Colon
Western Europe	Prostate	Non-melanoma skin	Lung	Lung	Prostate	Colon	Breast	Non-melanoma skin	Lung	Breast	Lung	Pancreas
Oceania	Non-melanoma skin	Prostate	Melanoma of skin	Lung	Prostate	Colon	Non-melanoma skin	Breast	Melanoma of skin	Lung	Breast	Colon
Australia/New Zealand	Non-melanoma skin	Prostate	Melanoma of skin	Lung	Prostate	Colon	Non-melanoma skin	Breast	Melanoma of skin	Lung	Breast	Colon
Melanesia	Prostate	Lip and oral cavity	Lung	Liver	Lung	Prostate	Breast	Cervix uteri	Thyroid	Breast	Cervix uteri	Liver
Micronesia/Polynesia	Prostate	Lung	Liver	Lung	Prostate	Liver	Breast	Lung	Thyroid	Lung	Breast	Ovary

Abbreviation: NHL, non-Hodgkin lymphoma.

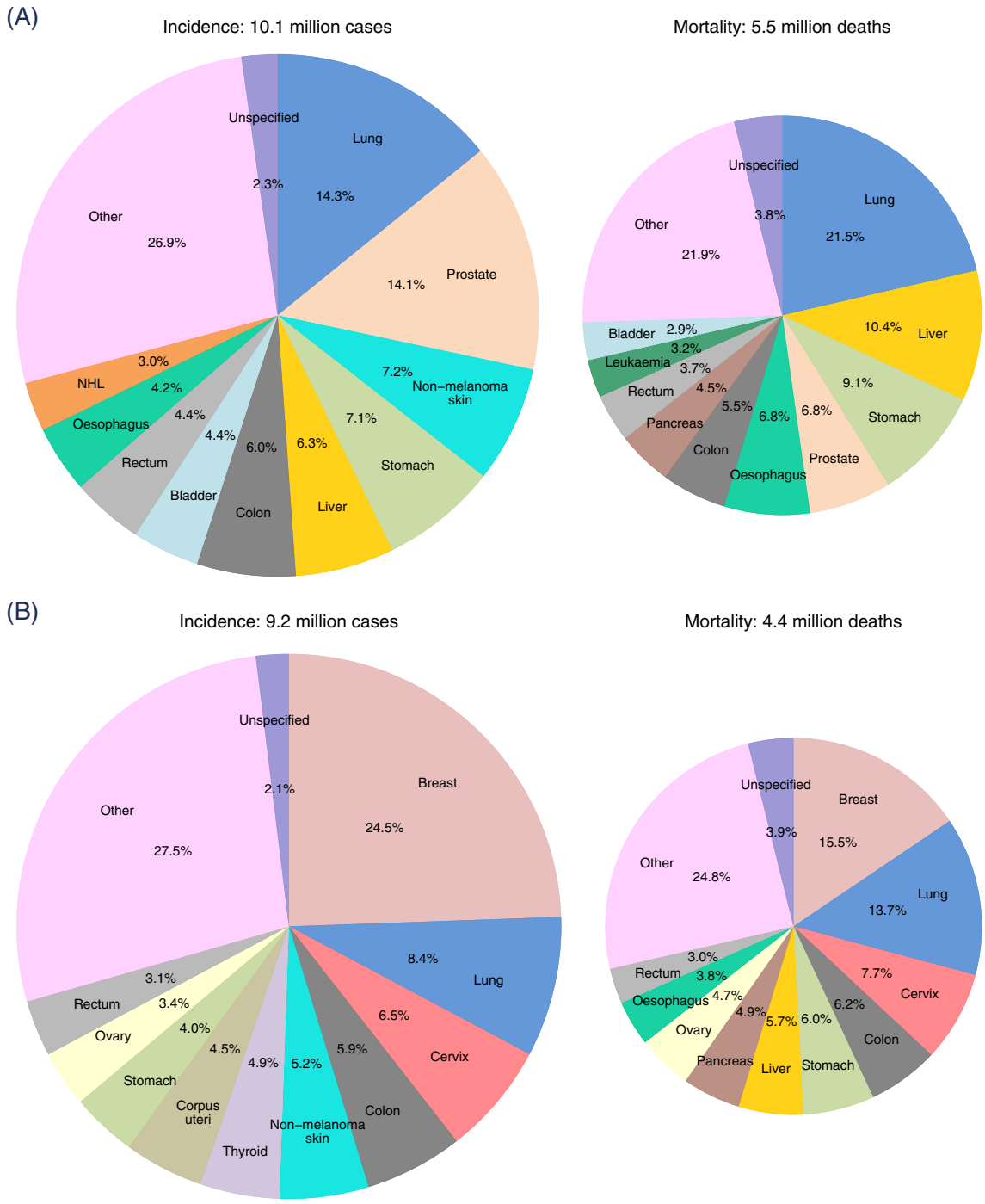

FIGURE 1 Distribution of the estimated new cases and deaths for the 10 most common cancers in 2020 in males (A) and females (B). For each sex, the area of the pie chart reflects the proportion of the total number of cases or deaths. NHL, non-Hodgkin lymphoma [Color figure can be viewed at wileyonlinelibrary.com]

The underlying incidence rates depend on the ability to diagnose cancer cases, which in turn is related to the adequacy, access and utilisation of diagnostic services, particularly for NMSC and leukaemia and for cancers of the brain, liver and pancreas. Conversely, there is the prospect of an inflation of incidence rates for certain cancers where there may have been extensive screening for asymptomatic disease, or an increased amount of accidental findings emerging from the use of high-resolution imaging techniques; this refers to cancers of the prostate and thyroid in many higher-income countries, in particular.[11] For certain countries and cancer types, national cancer mortality data were not available at the necessary level of granularity, namely mesothelioma, Kaposi sarcoma, Hodgkin lymphoma and cancers of the vulva, vagina, testis, kidney and thyroid in the countries of Albania, the Russian Federation and Ukraine. In these circumstances, the penalty was increased to inflate the SE, reflecting a higher degree of uncertainty surrounding the corresponding estimates. This

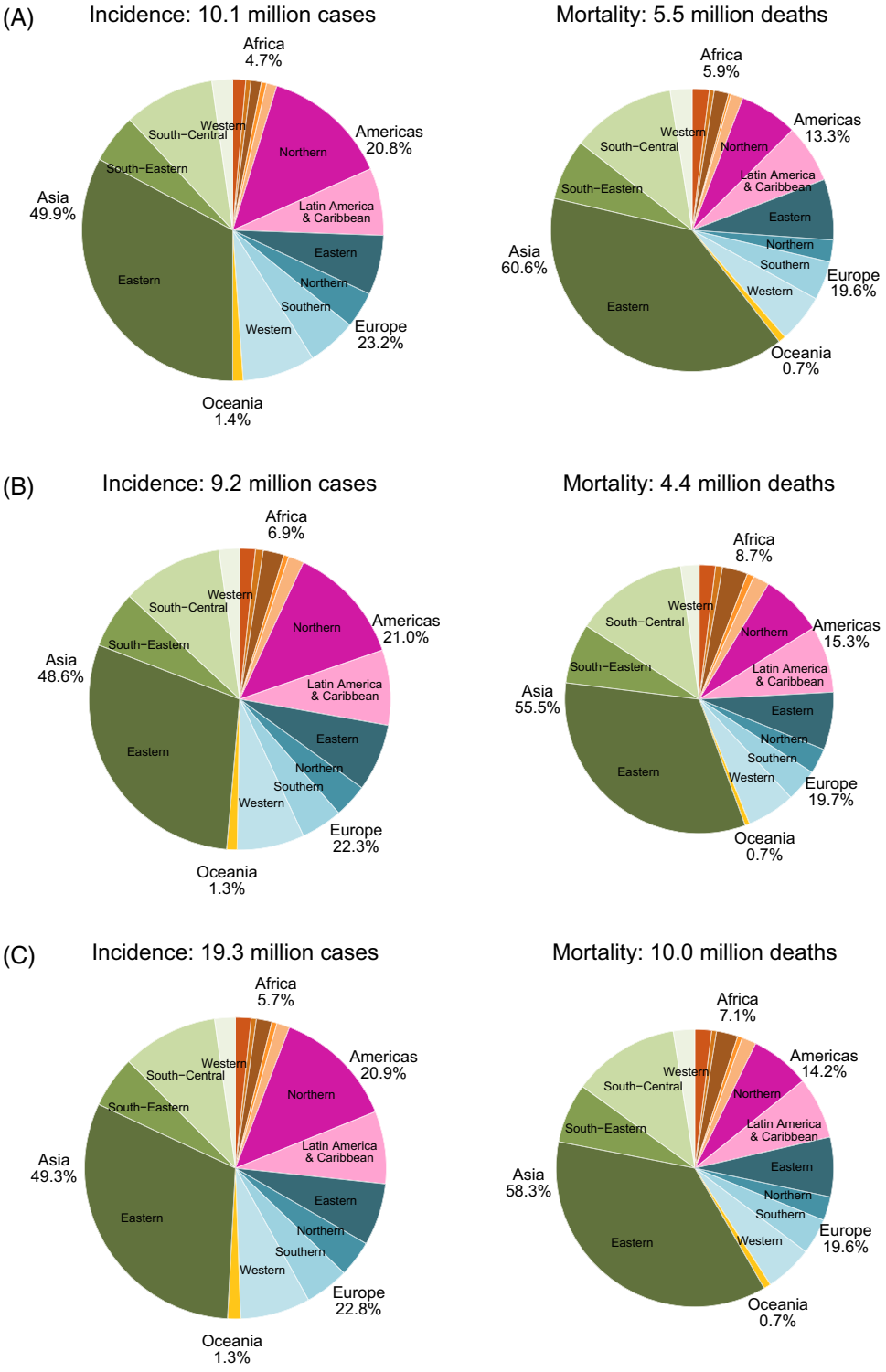

FIGURE 2 Estimated global numbers of new cases and deaths with proportions by world regions in 2020 in males (A), females (B) and both sexes (C) [Color figure can be viewed at wileyonlinelibrary.com]

approach reflects only a subset of all possible sources of bias in the collection and analysis of the data that are presently available worldwide.

Our estimates of the incidence of NMSC are based exclusively on cancer registry data that report the first occurrence of the cancer,[4] and therefore may differ widely from reports published elsewhere. NMSCs are particularly common in fair-skinned populations of European descent, with high incidence rates found in Australia/New Zealand, North America, South Africa and Northern Europe. Given that the completeness of registration of NMSC varies widely, the results should be interpreted with considerable caution, particularly in Australia/New Zealand and North America, where the estimates are based on a single registry in Australia (Tasmania, likely to have the lowest rate in the country as the lowest solar exposure) and Canada (Manitoba). As NMSC incidence is difficult to assess and cases rarely fatal, the surveillance of NMSC has been somewhat

neglected at the global level. However, it is noteworthy that the estimated mortality rates of all types of NMSC worldwide are higher than the corresponding rates of melanoma, oropharynx, thyroid cancer and mesothelioma (NMSC ASR of 0.60 vs 0.56, 0.51, 0.43 and 0.25, respectively).

The use of site-, sex- and age-specific M:I ratios from cancer registries to estimate national incidence rates from national mortality has been validated and applied extensively over several decades, and the possible sources of bias have been described in detail elsewhere.[1,12,13] Due to the lack of recent data on survival statistics in lower-income settings, we did not model survival to derive mortality from incidence,[1] but rather fitted site-, sex- regional models of I:M ratios as proxies of survival, scaled to a given country according to HDI level[14] (see also Annex C). As previously, we caution against comparisons of estimates compiled in this and previous versions of GLOBOCAN; the changes in the incidence and mortality counts or rates are in part due to an increasing availability and quality of the incidence data from cancer registries worldwide, which is the basis for the more robust set of methods and estimates described herein.

From a global perspective, it is unknown how the COVID-19 pandemic will affect the burden of cancer. Important delays in cancer diagnoses have been reported in the United States[15] and Belgium,[16] suggesting that patients will be registered but with a delay and possibly at a more advanced stage. Unfortunately, this extraordinary situation cannot be reflected in the present 2020 estimates, which are based on incidence and mortality trends from past years. As a result, we might observe a possible overestimation of the true 2020 incidence rates (as they will be reported) in some countries. The COVID-19 pandemic also affected the registration process in PBCR, particularly in low- and middle-income countries (LMIC) and may lead to delays in reporting that affect corresponding incidence rates in the years prior to 2020.

In addition to providing a global snapshot of the cancer burden in 2020, the GLOBOCAN estimates highlight the need for regional and national prioritisation of cancer control efforts given the cancer patterns observed today. There are many critical observations among these results that can serve to provide the evidence base and impetus for developing strategies to reduce the cancer burden worldwide in the decades to follow. However, such national estimates at a single point in time are not designed nor intended to be a substitute for the continuous collection of data undertaken by population-based cancer registries that are critical in the local monitoring and evaluating of cancer control plans. Indeed, the present GLOBOCAN estimates of cancer would not be possible without the underlying recorded data from PBCR. Yet many LMICs have limited or no such surveillance systems in place, and to counter this, IARC leads the Global Initiative for Cancer Registry Development (GICR, https://gicr.iarc.fr) as a partnership of leading cancer organisations attempting to address these inequities in cancer registration. The GICR provides the necessary technical assistance and advocacy to ensure a step-change in quantity, quality, comparability and use of registry data in the next few years.

The sustainable development of cancer registries is a global issue, however. The rising demand for population-based cancer registry data is at variance with the fact that many registries confront significant operational challenges, including insufficient funding and a shortage of qualified staff. This has been amplified in the COVID-19 era, where most registries, most markedly in LMIC, have seen major disruptions to their operations during the early phase of the COVID-19 pandemic.[17] Finally, registries are increasingly hampered by data protection regulations and may be reluctant to transfer data across national borders for fear of penalties by national authorities, thus threatening the future of international collaborations in cancer research.[18]

ACKNOWLEDGEMENTS

The authors gratefully acknowledge cancer registries worldwide and their staff for their willingness to contribute their data to this exercise, and particularly the members of the African Cancer Registry Network. We also thank the staff of CSU at IARC for their careful review of the estimates.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DISCLAIMER

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.

DATA AVAILABILITY STATEMENT

The list of the datasets used to develop the country-specific estimates of the burden of cancer is provided in Annex. These data sets are either in the public domain or available upon request to their owners. The full results of the study are available at the Global Cancer Observatory (GCO) (https://gco.iarc.fr).

ETHICS STATEMENT

As all data utilised in our study are completely anonymised, ethical approval was not required.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Ferlay J, Colombet M, Soerjomataram I, et al. Cancer statistics for the year 2020: An overview. *Int. J. Cancer*. 2021;149:778–789. https://doi.org/10.1002/ijc.33588