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# Global Disparities of Cancer and Its Projected Burden in 2050

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## Abstract

**IMPORTANCE** Cancer prevention and care efforts have been challenged by the COVID-19 pandemic and armed conflicts, resulting in a decline in the global Human Development Index (HDI), particularly in low- and middle-income countries. These challenges and subsequent shifts in health care priorities underscore the need to continuously monitor cancer outcome disparities and statistics globally to ensure delivery of equitable and optimal cancer prevention and care in uncertain times.

**OBJECTIVE** To measure the global burden of 36 cancers in 2022 by sex, age, and geographic location and to project future trends by 2050.

**DESIGN, SETTING, AND PARTICIPANTS** This cross-sectional study used population-based data from 2022 in 185 countries and territories were obtained from the Global Cancer Observatory database. Data extraction and analysis were carried out in April 2024.

**MAIN OUTCOMES AND MEASURES** Counts, rates, prevalence, mortality to incidence ratios (MIRs), and demography-based projections were used to characterize current and future cancer burden.

**RESULTS** This population-based study included 36 cancer types from 185 countries and territories. By 2050, 35.3 million cancer cases worldwide are expected, a 76.6% increase from the 2022 estimate of 20 million. Similarly, 18.5 million cancer deaths are projected by 2050, an 89.7% increase from the 2022 estimate of 9.7 million. Cancer cases and deaths are projected to nearly triple in low-HDI countries by 2050, compared to a moderate increase in very high–HDI countries (142.1% vs 41.7% for cancer cases and 146.1% vs 56.8% for cancer deaths). Males had a higher incidence and greater number of deaths in 2022 than females, with this disparity projected to widen by up to 16.0% in 2050. In 2022, the MIR for all cancers was 46.6%, with higher MIRs observed for pancreatic cancer (89.4%), among males (51.7%), among those aged 75 years or older (64.3%), in low-HDI countries (69.9%), and in the African region (67.2%).

**CONCLUSIONS AND RELEVANCE** In this cross-sectional study based on data from 2022, cancer disparities were evident across HDI, geographic regions, age, and sex, with further widening projected by 2050. These findings suggest that strengthening access to and quality of health care, including universal health insurance coverage, is key to providing evidence-based cancer prevention, diagnostics, and care.

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## Key Points

**Question** What were the global disparities in cancer burden by cancer type, sex, age, Human Development Index (HDI), regions, and countries and territories in 2022, and how are these epidemiological patterns projected to change by 2050?

**Findings** In this cross-sectional study of data for 36 cancer types from 185 countries and territories, cancer disparities were evident across HDI, region, age, and sex in 2022 and are projected to widen by 2050. Cancer cases and deaths are expected to rise by 77% and 90% in 2050, respectively, with a 3-fold increase in low-HDI countries compared with a modest increase in very high–HDI countries (142% vs 42% for cancer cases and 146% vs 57% for cancer deaths).

**Meaning** These findings suggest that enhancing health care systems for cancer prevention, early diagnosis, management, and treatment is vital to better address existing disparities in cancer outcomes and slow projected trends.

+ Supplemental content

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## Introduction

Global cancer prevention and care efforts underwent major disruptions after 2020, driven by the ongoing effects of the COVID-19 pandemic and further exacerbated by persistent armed conflicts, changing health care funding priorities, and a cost-of-living crisis.[1,2] Between 2020 and 2022, the global Human Development Index (HDI), a composite measure of critical human development indicators such as life expectancy, education, and gross national income per capita, declined substantially for 2 consecutive years.[1] The consequences of these ongoing disruptions may disproportionately affect cancer care in certain regions and for individuals based on certain sociodemographic characteristics such as sex and age, resulting in disparities that can be assessed through the mortality to incidence ratio (MIR).[3-7] The MIR, for which higher values indicate higher case fatality and poor survival, has been used in the literature[3-7] and in government reports[8,9] in Australia[9] and the US[8] to assess cancer outcome equity.

Previous studies focused on the MIR were conducted using data collected prior to 2020[3-7] and data on selected cancer types, such as lung,[5] liver,[6] and gastric cancer.[3,4] As already noted, global disruptions and shifts in health priorities[1,2] underscore the need to continuously monitor cancer statistics globally to ensure delivery of equitable and optimal cancer prevention and care in uncertain times. To support evidence-based decision-making with respect to health care resource allocation, we sought to analyze the MIR for 36 cancers and to assess disparities by geographic region, sex, and age using the latest Global Cancer Observatory (GLOBOCAN) data released in 2024.[10,11] In addition, this study analyzed cancer rates, prevalence, and projections for 2050 by age, sex, and region, providing a more comprehensive assessment of global cancer burden.

## Methods

### Data Sources

This cross-sectional study used population-based cancer data from GLOBOCAN 2022, curated by the International Agency for Research on Cancer (IARC).[11-13] The GLOBOCAN repository aggregates publicly available global cancer-related data, encompassing data from each country or territory. At the national level, GLOBOCAN estimates cancer cases, deaths, rates, and prevalence using population-based administrative data sources such as cancer registries, civil and vital statistics registration systems, or modeling, applying robust methodologies tailored to the specific context of each country or territory.[11,12,14,15] This study followed the relevant portions of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline. As the GLOBOCAN project solely uses publicly accessible and secondary data, the IARC Ethics Committee deemed that ethical approval was not required for this study.

### Measures

This study included all cancer types available in the GLOBOCAN database, totaling 36 types. Specific cancer types were identified by referencing *International Statistical Classification of Diseases, Tenth Revision* diagnosis codes (eTable 1 in Supplement 1).[12,16] The dataset was further stratified by sex, age, country or territory, region, and HDI.[1,12,16] Age was grouped as 0 to 19, 20 to 39, 40 to 64, 65 to 74, and 75 years or older based on importance for epidemiology, policy, public health, and clinical practice.[17,18] In line with the 2022 United Nations Development Programme classification, HDI was reported in 4 tiers (ie, low, medium, high, and very high).[1] Countries and territories were assigned to 1 of 6 regions: Africa, Asia, Europe, Latin America and the Caribbean, North America, and Oceania.

### Statistical Analysis

In this study, we report various measures of burden, including counts, rates, prevalence, and MIR. Incidence and mortality rates were determined by dividing the number of cases and deaths, respectively, in 2022 by the total population in the same year, with age-standardized incidence rates



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(ASIRs) and age-standardized mortality rates (ASMRs) calculated by adjusting their crude rates with the Segi-Doll World Standard Population, as computed in 1966.[10,12,19] To estimate the MIR, the ASMR was divided by the ASIR and multiplied by 100 to obtain a percentage, with a higher MIR indicating poorer survival after a cancer diagnosis.[4,20,21] Cancer prevalence was calculated by dividing the number of persons diagnosed with cancer and known to be alive in a specific period by the total population during that period.[10,11] To project future cancer cases and deaths, demographic projections were used, assuming that the 2022 cancer rates remain stable.[13,22,23] Hence, the 2050 cancer estimates were generated by applying the 2022 standardized rates to the 2050 population predicted by the United Nations Development Programme.[1] Further methodological details are provided in the eMethods in Supplement 1.

Data analysis was carried out using R, version 4.3.1 (R Project for Statistical Computing), Excel (Microsoft Corp), and the GLOBOCAN online tabulation and visualization tools (IARC). Data extraction and analysis was carried out in April 2024.

## Results

### Cancer Counts, Rate, Prevalence, and Projections

This study assessed cancer burden disparity and projections for 36 cancers based on population-based data from 185 countries and territories. By 2050, the total number of cancer cases is projected to increase to 35.3 million, an increase of 76.6% from the 2022 estimate of 20 million (**Table 1**). Similarly, cancer deaths are estimated to reach 18.5 million, an increase of 89.7% from the 2022 estimate of 9.7 million. In 2022, the prevalence of cancer was 178.9 cases per 100 000 persons (Table 1). The 5-year period prevalence (2018-2022) was 678.6 cases per 100 000 persons (eTable 2 in Supplement 1). Breast cancer was the most prevalent cancer, accounting for 13.3% of patients with cancer who were diagnosed and alive in 2022. The next most prevalent cancers were prostate, colorectum, lung, and nonmelanoma skin cancer (eTable 3 in Supplement 1). In 2022, lung cancer was the leading incident cancer (accounting for 12.4% of new cases) and cancer deaths (accounting for 18.7% of cancer deaths). In 2050, lung cancer is projected to be the leading cause of cancer (accounting for 13.1% of new cases) and cancer deaths (accounting for 19.2% of cancer deaths). The top 10 most prevalent cancers are presented in eTable 3 in Supplement 1.

Between 2022 and 2050, an upward trend in cancer cases and deaths for both males and females is expected (**Figure 1**). However, a slightly higher increase in cancer cases (15.8% higher) and deaths (8.0% higher) in 2050 is projected among males compared with females. Among males, 19.0 million cancer cases are anticipated in 2050, an increase of 84.3% from 10.3 million in 2022 (Table 1). The projected number of cases among females in 2050 is 16.3 million, an increase of 68.5% from 9.7 million cases in 2022. Cancer deaths among males are projected to reach 10.5 million in 2050, a 93.2% increase from the 2022 estimate of 5.4 million. The projected number of deaths for females is 8.0 million, an 85.2% increase from the 2022 estimate of 4.3 million.

The 2022 ASIR and ASMR varied by HDI, with the ASIR more than twice as high in very high–HDI countries (285.7 cases per 100 000 persons) compared with low-HDI countries (110.6 cases per 100 000 persons) (**Table 2**). The ASMR ranged from 73.1 deaths per 100 000 persons in medium-HDI countries to 96.0 deaths per 100 000 persons in very high–HDI countries (**Table 3**). In 2050, a 3-fold increase in cancer cases is projected in low-HDI countries (increase of 142.1%) compared with a projected increase of 41.7% in very high–HDI countries (Table 2). Cancer deaths in low-HDI countries are expected to increase by 146.1% compared with an increase of 56.8% in very high–HDI countries (Table 3).

In 2022, the global ASIR and ASMR per 100 000 persons were 196.9 cases and 91.7 deaths, respectively, with variations observed across regions. The highest and lowest ASIRs were observed in Oceania (409.0 cases per 100 000 persons) and Africa (132.3 cases per 100 000 persons), respectively. The ASMR ranged from 106.3 deaths per 100 000 in Europe to 83.9 deaths per 100 000 in North America. In 2050, cancer cases and deaths are projected to increase in all regions,



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Table 1. Prevalence and MIR of Cancer in 2022 and Projection of Cancer Cases and Deaths in 2050 by Cancer Type

| Cancer type | Females | | | | | | Males | | | | | | Both sexes | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Prevalence in 2022[a] | MIR in 2022 | No. of cases in 2050 | Change, % | No. of deaths in 2050 | Change, % | Prevalence in 2022[a] | MIR in 2022 | No. of cases in 2050 | Change, % | No. of deaths in 2050 | Change, % | Prevalence in 2022[a] | MIR in 2022 | No. of cases in 2050 | Change, % | No. of deaths in 2050 | Change, % |
| All cancers | 179.0 | 41.3 | 16 280 527 | 68.5 | 7 989 377 | 85.2 | 178.8 | 51.7 | 19 000 529 | 84.3 | 10 490 923 | 93.2 | 178.9 | 46.6 | 35 281 056 | 76.6 | 18 480 300 | 89.7 |
| All cancers, excluding NMSC | 168.0 | 42.7 | 15 232 802 | 66.0 | 7 924 506 | 85.0 | 162.6 | 54.9 | 17 350 353 | 81.4 | 10 405 366 | 93.0 | 165.3 | 48.9 | 32 583 155 | 73.9 | 18 329 871 | 89.5 |
| Lip, oral cavity | 2.2 | 47.8 | 208 183 | 72.3 | 102 329 | 77.6 | 4.7 | 48.3 | 433 380 | 61.1 | 213 557 | 63.3 | 3.5 | 47.5 | 641 563 | 64.6 | 315 886 | 67.6 |
| Salivary glands | 0.47 | 36.7 | 38 527 | 59.7 | 17 802 | 78.9 | 0.59 | 43.9 | 52 858 | 70.7 | 25 750 | 84.1 | 0.53 | 41.1 | 91 385 | 65.9 | 43 552 | 81.9 |
| Oropharynx | 0.39 | 46.2 | 32 933 | 64.2 | 16 827 | 77.4 | 1.6 | 47.9 | 141 181 | 63.5 | 72 633 | 69.6 | 1 | 48.2 | 174 114 | 63.6 | 89 460 | 71.0 |
| Nasopharynx | 0.63 | 53.4 | 49 771 | 45.8 | 31 027 | 60.1 | 1.6 | 63.2 | 126 542 | 46.7 | 85 600 | 58.2 | 1.1 | 59.2 | 176 313 | 46.4 | 116 627 | 58.7 |
| Hypopharynx | 0.22 | 41.4 | 22 223 | 56.7 | 10 567 | 66.7 | 1.1 | 45.6 | 119 433 | 65.7 | 59 698 | 72.7 | 0.67 | 46.1 | 141 656 | 64.2 | 70 265 | 71.8 |
| Esophagus | 2.2 | 84.6 | 265 446 | 82.0 | 238 831 | 88.1 | 5.6 | 85.5 | 657 192 | 79.9 | 586 747 | 84.3 | 3.9 | 86.0 | 922 638 | 80.5 | 825 578 | 85.4 |
| Stomach | 4.8 | 65.0 | 637 677 | 86.8 | 452 907 | 94.7 | 8.9 | 67.2 | 1 178 681 | 87.9 | 832 310 | 94.7 | 6.9 | 66.3 | 1 816 357 | 87.5 | 1 285 217 | 94.7 |
| Colorectum | 16.8 | 42.8 | 1 593 471 | 85.9 | 826 029 | 104.3 | 20.7 | 45.2 | 1 980 340 | 85.2 | 1 009 371 | 102.0 | 18.7 | 44.0 | 3 573 811 | 85.5 | 1 835 400 | 103.0 |
| Liver | 3.6 | 85.4 | 487 751 | 83.7 | 447 916 | 89.1 | 8.2 | 85.8 | 1 036 750 | 72.6 | 923 551 | 77.0 | 5.9 | 86.1 | 1 524 501 | 76.0 | 1 371 467 | 80.8 |
| Gallbladder | 1.2 | 71.4 | 144 782 | 83.4 | 107 617 | 86.7 | 0.64 | 71.6 | 83 878 | 92.7 | 61 722 | 96.5 | 0.89 | 69.2 | 228 660 | 86.7 | 169 339 | 90.2 |
| Pancreas | 2.8 | 87.5 | 482 093 | 99.8 | 450 072 | 104.8 | 3.1 | 90.9 | 516 570 | 91.5 | 485 966 | 96.3 | 3 | 89.4 | 998 663 | 95.4 | 936 038 | 100.3 |
| Larynx | 0.43 | 51.1 | 39 726 | 69.8 | 23 786 | 83.3 | 3.1 | 54.3 | 286 039 | 72.5 | 163 895 | 81.3 | 1.8 | 52.6 | 325 765 | 72.2 | 187 681 | 81.6 |
| Lung | 12.6 | 60.5 | 1 665 164 | 83.3 | 1 146 109 | 96.2 | 19.7 | 77.3 | 2 954 902 | 88.0 | 2 401 765 | 94.8 | 16.2 | 71.2 | 4 620 066 | 86.2 | 3 547 874 | 95.2 |
| Melanoma of skin | 3.6 | 14.8 | 260 785 | 71.8 | 50 158 | 96.6 | 4.1 | 17.6 | 338 780 | 88.3 | 67 063 | 102.2 | 3.8 | 16.6 | 599 565 | 80.7 | 117 222 | 99.8 |
| NMSC | 11.0 | 6.0 | 1 047 724 | 113.9 | 64 871 | 118.2 | 16.2 | 5.5 | 1 650 176 | 121.6 | 85 557 | 115.6 | 13.6 | 5.7 | 2 697 901 | 118.5 | 150 429 | 116.7 |
| Mesothelioma | 0.14 | 81.3 | 17 028 | 84.6 | 14 069 | 93.0 | 0.3 | 83.3 | 44 002 | 105.5 | 38 890 | 115.1 | 0.22 | 78.6 | 61 030 | 99.2 | 52 959 | 108.7 |
| Kaposi sarcoma | 0.16 | 50.0 | 14 597 | 30.4 | 7135 | 28.8 | 0.37 | 44.6 | 33 537 | 36.2 | 13 908 | 30.9 | 0.27 | 46.3 | 48 134 | 34.4 | 21 043 | 30.1 |
| Breast | 47.9 | 27.1 | 3 553 037 | 54.7 | 1 138 155 | 70.9 | NA | NA | NA | NA | NA | NA | 47.9 | 27.0 | 3 553 037 | 54.7 | 1 138 155 | 70.9 |
| Vulva | 0.94 | 36.1 | 88 369 | 86.7 | 37 263 | 100.6 | NA | NA | NA | NA | NA | NA | 0.94 | 36.1 | 88 369 | 86.7 | 37 263 | 100.6 |
| Vagina | 0.33 | 41.7 | 31 938 | 69.7 | 14 777 | 79.3 | NA | NA | NA | NA | NA | NA | 0.33 | 41.7 | 31 938 | 69.7 | 14 777 | 79.3 |
| Cervix uteri | 11.9 | 50.4 | 948 116 | 43.2 | 542 825 | 55.6 | NA | NA | NA | NA | NA | NA | 11.9 | 50.4 | 948 116 | 43.2 | 542 825 | 55.6 |
| Corpus uteri | 9.0 | 20.2 | 676 296 | 60.9 | 183 093 | 87.4 | NA | NA | NA | NA | NA | NA | 9 | 20.2 | 676 296 | 60.9 | 183 093 | 87.4 |
| Ovary | 6.1 | 59.7 | 503 790 | 55.2 | 351 164 | 69.7 | NA | NA | NA | NA | NA | NA | 6.1 | 59.7 | 503 790 | 55.2 | 351 164 | 69.7 |
| Penis | NA | NA | NA | NA | NA | NA | 0.69 | 35.4 | 67 002 | 77.7 | 25 361 | 84.6 | 0.69 | 35.4 | 67 002 | 77.7 | 25 361 | 84.6 |
| Prostate | NA | NA | NA | NA | NA | NA | 30.5 | 24.8 | 2 879 501 | 96.2 | 939 534 | 136.4 | 30.5 | 24.8 | 2 879 501 | 96.2 | 939 534 | 136.4 |
| Testis | NA | NA | NA | NA | NA | NA | 1.6 | 12.4 | 88 362 | 22.7 | 12 697 | 40.0 | 1.6 | 12.4 | 88 362 | 22.7 | 12 697 | 40.0 |
| Kidney | 3.1 | 31.7 | 269 210 | 71.4 | 109 731 | 97.3 | 5.4 | 33.9 | 476 581 | 71.6 | 195 131 | 94.5 | 4.3 | 34.1 | 745 791 | 71.5 | 304 861 | 95.5 |
| Bladder | 2.8 | 33.3 | 282 673 | 97.7 | 121 651 | 121.5 | 9.6 | 33.3 | 946 705 | 100.9 | 372 719 | 125.0 | 6.2 | 32.1 | 1 229 377 | 100.1 | 494 370 | 124.1 |
| Brain, central nervous system | 2.9 | 71.0 | 232 925 | 57.4 | 180 912 | 66.5 | 3.4 | 79.5 | 270 984 | 56.0 | 228 738 | 63.6 | 3.2 | 74.3 | 503 910 | 56.6 | 409 650 | 64.9 |
| Thyroid | 12.6 | 3.9 | 819 021 | 33.2 | 57 356 | 89.5 | 4.1 | 7.6 | 284 794 | 37.9 | 33 360 | 93.5 | 8.3 | 4.8 | 1 103 816 | 34.4 | 90 715 | 91.0 |
| Hodgkin lymphoma | 0.67 | 23.4 | 46 849 | 39.0 | 14 784 | 63.2 | 0.96 | 28.2 | 67 226 | 37.8 | 21 444 | 56.8 | 0.82 | 25.3 | 114 075 | 38.3 | 36 229 | 59.4 |
| Non-Hodgkin lymphoma | 4.7 | 41.3 | 423 663 | 75.1 | 203 349 | 90.2 | 5.9 | 45.5 | 536 509 | 72.3 | 271 565 | 88.9 | 5.3 | 42.9 | 960 173 | 73.5 | 474 914 | 89.5 |
| Multiple myeloma | 1.7 | 61.3 | 154 282 | 83.4 | 106 368 | 95.5 | 2.0 | 61.9 | 194 362 | 87.2 | 133 209 | 98.9 | 1.8 | 61.1 | 348 644 | 85.5 | 239 577 | 97.4 |
| Leukemia | 3.8 | 59.1 | 341 267 | 63.2 | 232 413 | 75.9 | 5.1 | 59.7 | 459 432 | 65.2 | 309 616 | 78.7 | 4.5 | 58.5 | 800 698 | 64.3 | 542 029 | 77.5 |

Abbreviations: MIR, mortality to incidence ratio; NA, not applicable; NMSC, nonmelanoma skin cancer.

[a] The number of cases diagnosed in 2022 and survived in the same year, as well as the 5-year period prevalence, is presented in eTable 2 in Supplement 1.

yet Africa is expected to have a more than 5-fold increase compared with Europe (the region with the lowest increase): 139.4% vs 24.6% for cases (Table 2) and 146.7% vs 36.4% for deaths (Table 3).

Across 185 countries and territories globally, ASIRs were not uniformly distributed, ranging from 35.9 cases per 100 000 persons in Sierra Leone to 462.5 cases per 100 000 persons in Australia (eFigure 1A and eTable 4 in Supplement 1). The highest and lowest ASMRs were in Mongolia (181.5 deaths per 100 000 persons) and Saudi Arabia and Qatar (46.2 deaths per 100 000 persons), respectively (eFigure 1B and eTable 5 in Supplement 1). Between 2022 and 2050, cancer cases and deaths are projected to increase in 181 of 185 countries and territories (97.8%), with decreases expected in the remaining countries (eg, both cases and deaths are expected to decline in Moldova and Serbia) (eTables 4 and 5 in Supplement 1). The prevalence of cancer per 100 000 persons in 2022 ranged from 18.4 cases in Niger to 711.0 cases in Australia (eTable 6 in Supplement 1). In about half of countries and territories, increases greater than 2-fold in cancer cases (44.9%) and deaths (56.8%) are expected, with the highest increase projected in Kuwait at 338.2% for cases and 544.4% for deaths (eTables 4 and 5 in Supplement 1).

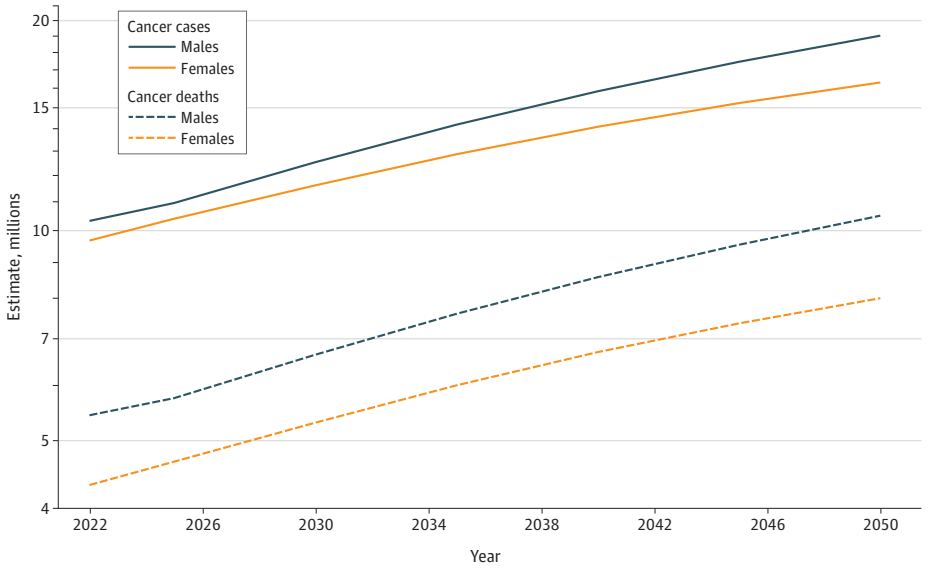
## MIR in 2022

The global MIR in 2022 was 46.6%, with the highest MIR observed for pancreatic cancer (89.4%) and the lowest for thyroid cancer (4.8%). Of the 36 cancer types studied, 8 (22.2%) had an MIR lower than 30.0%, whereas the rest fell into 2 categories: those with an MIR ranging from 30.0% to 50.0% (13 types [36.1%]) and those with an MIR exceeding 50.0% (14 types [38.9%]) (Table 1). The 5 cancer types with the highest MIR were pancreatic, liver, esophageal, mesothelioma, and brain and central nervous system cancers (eTable 3 in Supplement 1). The MIR was 10.4% higher in males than females (51.7% vs 41.3%) (Table 1).

The MIR was higher in the extreme age groups: 38.3% among individuals aged 19 years or younger and 64.3% among those 75 years or older, with the lowest MIR observed among the group aged 20 to 39 years (28.2%). Across age groups, males had a slightly higher MIR than females, with the largest gap observed among the groups aged 20 to 39 years (36.3% vs 24.0%) and 40 to 64 years (48.2% vs 35.4%) (Table 3).

There was an inverse association between MIR and HDI, with low-HDI countries experiencing an MIR (69.9%) nearly double that of very high–HDI countries (33.6%). Africa recorded the highest MIR at 67.2%, whereas Oceania had the lowest at 22.8% (Table 3).

Figure 1. Worldwide Projected Number of Cancer Cases and Deaths by Sex, 2022-2050






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Table 2. Distribution of Cancer Cases, Rates, and Prevalence in 2022 and Projected Cases by 2050 Across Age, HDI, and Region

| Characteristic | Females | | | | | Males | | | | | Both sexes | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. of cases in 2022 | ASIR[a] | Prevalence[b] | No. of cases in 2050 | Change, % | No. of cases in 2022 | ASIR[a] | Prevalence[b] | No. of cases in 2050 | Change, % | No. of cases in 2022 | ASIR[a] | Prevalence[b] | No. of cases in 2050 | Change, % |
| Age group, y | | | | | | | | | | | | | | | |
| 0-19 | 121 659 | 9.7 | 6.9 | 126 803 | 4.2 | 154 054 | 11.6 | 8.3 | 156 508 | 1.6 | 275 713 | 10.7 | 7.6 | 283 311 | 2.8 |
| 20-39 | 819 008 | 67.1 | 55.1 | 923 980 | 12.8 | 429 222 | 34.2 | 26.6 | 483 853 | 12.7 | 1 248 230 | 50.3 | 40.5 | 1 407 834 | 12.8 |
| 40-64 | 4 194 578 | 381.0 | 240.2 | 5 627 751 | 34.2 | 3 674 832 | 338.9 | 293.9 | 5 238 037 | 42.5 | 7 869 410 | 359.3 | 267.1 | 10 865 788 | 38.1 |
| 65-74 | 2 220 224 | 850.1 | 624.2 | 3 703 685 | 66.8 | 3 200 612 | 1369.1 | 962.5 | 5 508 950 | 72.1 | 5 420 836 | 1094.7 | 784.0 | 9 212 636 | 70.0 |
| ≥75 | 2 309 420 | 1294.7 | 845.1 | 5 898 306 | 112.0 | 2 852 890 | 2262 | 1458.3 | 7 613 180 | 166.9 | 5 162 310 | 1697.6 | 1101.7 | 13 511 487 | 161.7 |
| Region | | | | | | | | | | | | | | | |
| Africa | 679 184 | 140.7 | 55.6 | 1 592 426 | 134.5 | 506 032 | 125.7 | 40.3 | 1 244 910 | 146.0 | 1 185 216 | 132.3 | 48.0 | 2 837 336 | 139.4 |
| Asia | 4 732 544 | 157.7 | 141.6 | 7 946 498 | 67.9 | 5 093 995 | 174.3 | 133.9 | 9 427 687 | 85.1 | 9 826 539 | 164.4 | 137.7 | 17 374 185 | 76.8 |
| Europe | 2 112 119 | 253.4 | 437.1 | 2 450 585 | 16.0 | 2 359 303 | 319.6 | 504.3 | 3 118 658 | 32.2 | 4 471 422 | 280.0 | 469.6 | 5 569 243 | 24.6 |
| Latin America and the Caribbean | 782 217 | 177.4 | 164.3 | 1 365 053 | 74.5 | 768 843 | 199.9 | 158.5 | 1 506 210 | 95.9 | 1 551 060 | 186.0 | 161.4 | 2 871 263 | 85.1 |
| Northern America | 1 235 140 | 340.7 | 553.4 | 1 735 508 | 40.5 | 1 438 034 | 397.7 | 637.8 | 2 243 908 | 56.0 | 2 673 174 | 364.7 | 595.2 | 3 979 416 | 48.9 |
| Oceania | 123 685 | 371.3 | 479.6 | 210 456 | 70.2 | 145 403 | 451.2 | 559.6 | 248 959 | 71.2 | 269 088 | 409.0 | 519.6 | 459 415 | 70.7 |
| HDI of countries and territories | | | | | | | | | | | | | | | |
| Low | 474 370 | 122.7 | 40.6 | 1 160 337 | 144.6 | 337 841 | 98.9 | 28.0 | 806 151 | 138.6 | 812 211 | 110.6 | 34.3 | 1 966 488 | 142.1 |
| Medium | 1 261 351 | 114.2 | 70.8 | 2 445 324 | 93.9 | 1 162 894 | 111.6 | 58.5 | 2 383 754 | 105.0 | 2 424 245 | 112.3 | 64.5 | 4 829 078 | 99.2 |
| High | 3 612 996 | 181.0 | 181.9 | 5 546 725 | 53.5 | 3 823 126 | 198 | 170.9 | 6 652 363 | 74.0 | 7 436 122 | 187.5 | 176.3 | 12 199 088 | 64.1 |
| Very high | 4 312 457 | 261.9 | 419.7 | 5 681 725 | 31.8 | 4 983 714 | 320.6 | 478.2 | 7 487 212 | 50.2 | 9 296 171 | 285.7 | 448.6 | 13 168 937 | 41.7 |

Abbreviations: ASIR, age-standardized incidence rate; HDI, Human Development Index.

[a] Estimates for ASIR are per 100 000 persons and were adjusted using the World Standard Population.

[b] The number of cases diagnosed in 2022 and survived in the same year, as well as the 5-year period prevalence, is presented in eTable 2 in Supplement 1.



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Table 3. Distribution of Cancer Deaths, Rates, and MIR in 2022 and Projected Deaths by 2050 Across Age, HDI, and Region

| Characteristic | Females | | | | | Males | | | | | Both sexes | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. of deaths in 2022 | ASMR[a] | MIR[b] | No. of deaths in 2050 | Change, % | No. of deaths in 2022 | ASMR[a] | MIR[b] | No. of deaths in 2050 | Change, % | No. of deaths in 2022 | ASMR[a] | MIR[b] | No. of deaths in 2050 | Change, % |
| Age group, y | | | | | | | | | | | | | | | |
| 0-19 | 44 650 | 3.6 | 37.1 | 46 502 | 4.2 | 60 695 | 4.6 | 39.7 | 61 689 | 1.6 | 105 345 | 4.1 | 38.3 | 108 191 | 2.7 |
| 20-39 | 195 992 | 16.1 | 24.0 | 221 406 | 13.0 | 155 118 | 12.4 | 36.3 | 175 010 | 12.8 | 351 110 | 14.2 | 28.2 | 396 416 | 12.9 |
| 40-64 | 1 489 485 | 134.9 | 35.4 | 2 026 682 | 36.1 | 1 773 090 | 163.3 | 48.2 | 2 527 742 | 42.6 | 3 262 575 | 148.8 | 41.4 | 4 554 423 | 39.6 |
| 65-74 | 1 072 140 | 409.1 | 48.1 | 1 792 872 | 67.2 | 1 616 008 | 690.8 | 50.5 | 2 783 908 | 72.3 | 2 688 148 | 542.0 | 49.5 | 4 576 780 | 70.3 |
| ≥75 | 1 511 281 | 837.4 | 64.7 | 5 694 788 | 120.4 | 1 825 373 | 1454.4 | 64.3 | 7 726 482 | 124.5 | 3 336 654 | 1090.9 | 64.3 | 13 421 270 | 122.8 |
| Region | | | | | | | | | | | | | | | |
| Africa | 416 898 | 89.8 | 63.8 | 1 010 342 | 142.4 | 346 945 | 89.9 | 71.5 | 873 980 | 151.9 | 763 843 | 88.9 | 67.2 | 1 884 322 | 146.7 |
| Asia | 2 270 297 | 70.5 | 44.7 | 4 448 116 | 95.9 | 3 194 154 | 107.7 | 61.8 | 6 320 955 | 97.9 | 5 464 451 | 88.0 | 53.5 | 10 769 071 | 97.1 |
| Europe | 894 222 | 84.4 | 33.3 | 1 150 917 | 28.7 | 1 091 871 | 135.3 | 42.3 | 1 558 850 | 42.8 | 1 986 093 | 106.3 | 38.0 | 2 709 767 | 36.4 |
| Latin America and the Caribbean | 365 838 | 77.6 | 43.7 | 709 467 | 93.9 | 383 404 | 96.5 | 48.3 | 794 801 | 107.3 | 749 242 | 85.5 | 46.0 | 1 504 267 | 100.8 |
| Northern America | 332 967 | 74.9 | 22.0 | 524 789 | 57.6 | 373 460 | 95.1 | 23.9 | 641 750 | 71.8 | 706 427 | 83.9 | 23.0 | 1 166 539 | 65.1 |
| Oceania | 33 326 | 82.9 | 22.3 | 64 063 | 92.2 | 40 450 | 106.0 | 23.5 | 80 026 | 97.8 | 73 776 | 93.4 | 22.8 | 144 089 | 95.3 |
| HDI of countries and territories | | | | | | | | | | | | | | | |
| Low | 306 630 | 82.8 | 67.5 | 764 968 | 149.5 | 237 970 | 72.2 | 73.0 | 575 001 | 141.6 | 544 600 | 77.3 | 69.9 | 1 339 969 | 146.1 |
| Medium | 764 722 | 69.9 | 61.2 | 1 588 698 | 107.8 | 795 332 | 77.0 | 69.0 | 1 678 918 | 111.1 | 1 560 054 | 73.1 | 65.1 | 3 267 616 | 109.5 |
| High | 1 605 339 | 72.4 | 40.0 | 3 067 344 | 91.1 | 2 385 933 | 119.9 | 60.6 | 4 570 114 | 91.5 | 3 991 272 | 94.5 | 50.4 | 7 637 458 | 91.4 |
| Very high | 1 634 910 | 78.6 | 30.0 | 2 420 685 | 48.1 | 2 008 592 | 118.3 | 36.9 | 3 292 383 | 63.9 | 3 643 502 | 96.0 | 33.6 | 5 713 068 | 56.8 |

Abbreviations: ASMR, age-standardized mortality rate; HDI, Human Development Index; MIR, mortality to incidence ratio.

[a] Estimates for ASMR are per 100 000 persons and were adjusted using the World Standard Population.

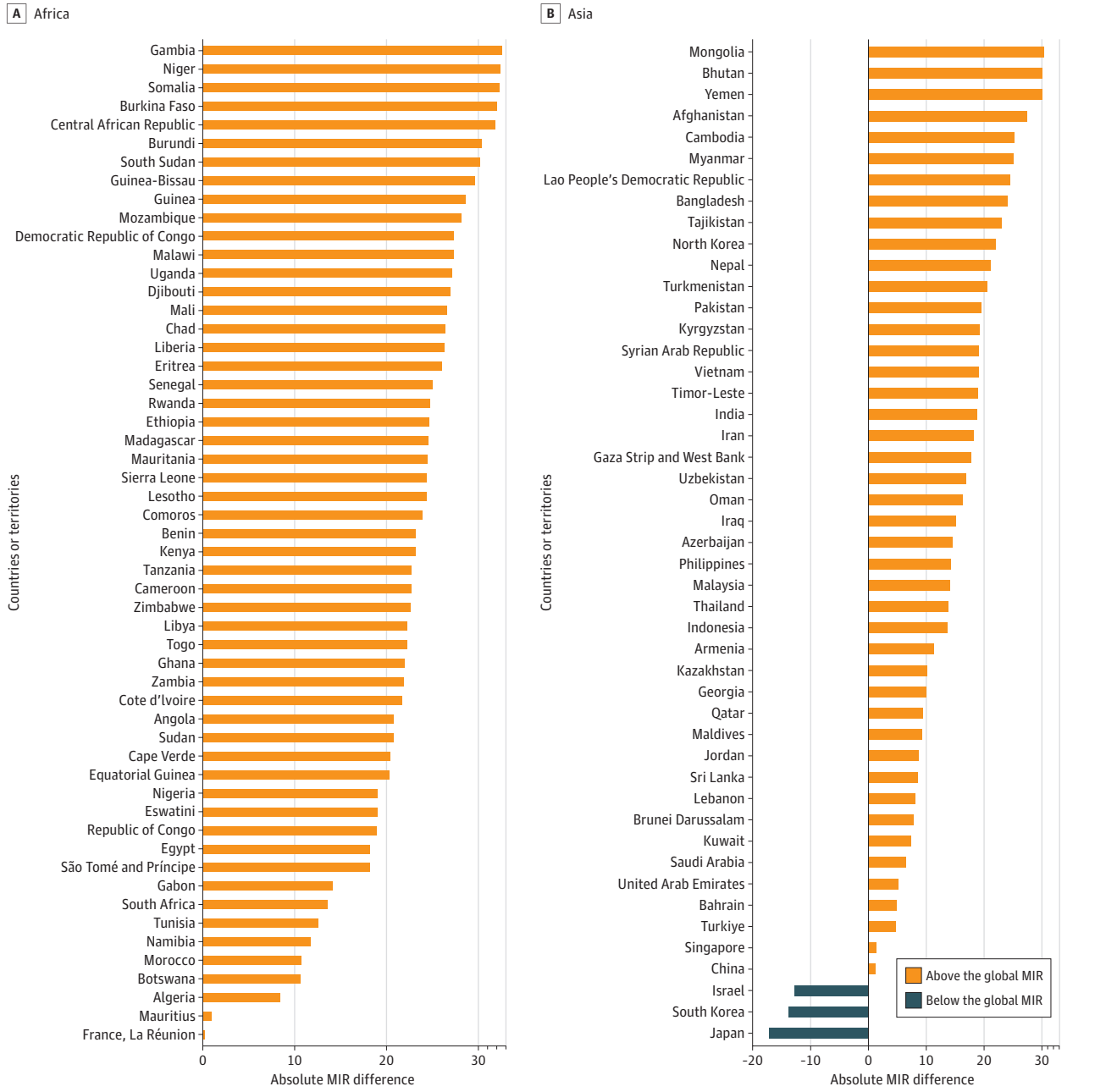
[b] The number of cases diagnosed in 2022 and survived in the same year, as well as the 5-year period prevalence, is presented in eTable 2 in Supplement 1.



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A 4-fold difference in MIR was also seen across countries and territories, ranging from 18.3% in Australia to 79.2% in the Republic of the Gambia. Of the 185 countries, 123 (66.5%) reported an MIR greater than 50.0%, 48 countries (25.9%) had an MIR ranging between 30.0% and 50.0%, and 14 countries (7.6%) had an MIR below 30.0% (eTable 7 in Supplement 1). The countries with the highest MIRs included the Republic of the Gambia, Niger, Somalia, Burkina Faso, and the Central African Republic. Rwanda has an MIR of 71.4%, which was lower than 25 low-HDI countries (eTable 7 in Supplement 1). Nearly three-fourths of countries and territories (136 [73.5%]) had an MIR higher than the global MIR (**Figure 2** and eFigure 2 and eTable 7 in Supplement 1). A quarter of countries and

**Figure 2. Differences in Mortality to Incidence Ratios (MIRs) in Each Country or Territory of 2 Regions Compared With the Global MIR, 2022**




Data are presented for countries in Africa and Asia. Absolute MIR differences between each country or territory and the global values were calculated by subtracting the global MIR from each country or territory value. The negative values are indicated below (lower than) the global values (46.6%).



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territories (47 [25.4%]) had MIR values of 1.5 to 1.7 (ratios of MIR), as high as the global value (eTable 7 in Supplement 1). All 54 countries and territories in Africa had an MIR higher than the global estimate (Figure 2A), whereas 30 of the 40 European countries and territories (75.0%) exhibited an MIR lower than the global MIR (eFigure 2B in Supplement 1).

## Discussion

This study used population-based data from 185 countries and territories worldwide to describe the epidemiology of 36 cancers in 2022 and projections for 2050. We observed variations in cancer burden based on cancer type, sex, age, HDI, region, and specific countries and territories. A 3-fold increase in incident cancer cases (142.1% increase) and deaths (146.1% increase) is projected in low-HDI countries by 2050, compared with a 41.7% increase for cases and 56.8% for deaths in very high–HDI countries, highlighting the growing divide in the global cancer burden. Cancer incidence and mortality rates varied by region, with an increase expected in 181 of the 185 countries and territories in this study (97.8%) from 2022 to 2050. Approximately half of these countries are projected to see their cancer incidence and death rates double, with Kuwait experiencing the largest increase in both incidence and death rates. In this study, lung cancer was the leading cancer in terms of the number of incident cases and deaths, and it is expected to remain so by 2050, accounting for over 10% of all cases and deaths. Higher MIRs, indicating lower survival rates, were noted for less common and rare cancers such as mesothelioma, pancreatic, liver, and esophageal cancers. We found that low- and medium-HDI countries had MIRs nearly double those of very high–HDI countries, suggesting a gap in the availability of prevention, early detection, and optimal treatment services. The MIR was found to be 10.4% higher in males than in females, with projections by 2050 indicating a greater increase in cancer cases (15.8%) and deaths (8.0%) among males than females. Despite incidence and mortality rate increasing with age, the MIR was higher in the extreme age groups ($\leq$19 or $\geq$75 years).

Cancer prevention and health promotion strategies play a vital role in mitigating the global cancer burden by addressing modifiable risk factors such as tobacco use, alcohol use, overweight, and exposure to carcinogens and UV radiation, alongside promoting healthy and balanced dietary choices, physical activity, vaccination, and screening uptake.[24-27] Strengthening the development and implementation of tobacco and alcohol control measures (including taxation, advertising bans, and smoke-free policies) and promoting access to and consumption of healthy diets rich in fruits, vegetables, and whole grains while limiting processed foods and saturated fats have been shown to reduce cancer risk.[24-27] Expansion of community-based screening programs will be important for prevention, early detection, and reduction of cancer-related morbidity and mortality.[24-27] These programs can be expanded through various options, including educational campaigns using diverse platforms such as social media, print materials, and public workshops; scaling up trust and satisfaction by disseminating culturally acceptable and multilingual screening information; ensuring access by offering mobile screening options; and working closely with primary care providers for timely referral and service provision. Moreover, working closely with local organizations, government agencies, and advocacy groups to mobilize resources and shape policies that prioritize cancer prevention and promotion is essential.[24-27]

Expanding universal health insurance coverage and primary health care worldwide presents a promising strategy to reduce disparities and improve cancer outcomes through leveraging efforts for cancer prevention and providing basic cancer care options.[28,29] However, there is a notable gap regarding universal health insurance coverage and access to primary health care between low- and high-HDI countries or within high-HDI countries, signaling the importance of sharing experiences within countries to achieve better cancer outcomes.[28,29] For example, Rwanda, a low-HDI country, had a lower MIR compared with 25 low-HDI countries. This finding might be partially attributed to Rwanda's more accessible universal health insurance coverage,[28] and low-HDI countries could take the lessons from Rwanda to improve their efforts to expand universal health insurance coverage.[28]



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Among high-HDI countries, Australia had the lowest MIR in this study, which could be attributed to its high ranking in health care system performance (measured by ensuring universal health insurance coverage and access and equity in primary health care).[29] Hence, high-HDI countries could learn from Australia's example in reducing cancer disparities.[29]

Compared with high-HDI countries, low- and medium-HDI countries experienced higher MIRs in this study, and disproportionately higher increases in cancer cases and deaths are projected. Many factors could contribute to this, such as increased life expectancy and aging, which are disproportionately affected by global emergencies and crises. Targeted cancer interventions could also be affected due to experiencing a double burden of disease and the associated competing priorities in resource allocation and cancer-targeted intervention.[27,30,31] Low- and medium-HDI countries were among those with their cancer services highly disrupted by the COVID-19 pandemic and market crisis (including medical equipment) as a result of war, for example, in Ukraine, Yemen, Somalia, and Ethiopia.[1,30,32] Between 2020 and 2021, the decline in numerical values of HDI due to a drop in HDI indicators within countries was approximately 2-fold greater in low- and medium-HDI countries (60%) compared with high-HDI countries (30%), signaling the importance of strengthening global efforts for pandemic preparedness and maintaining consistent cancer services.[1] Promising and parallel reductions in common modifiable risk factors of cancer, such as smoking, also have not been observed in low-HDI countries compared with high-HDI countries, highlighting poor implementation of mass strategies.[31] For instance, between 1990 and 2020, the worldwide smoking rate declined by 40%.[31] However, this decline was uneven, with low- and medium-HDI countries experiencing a minimal decrease (<10%) or no reduction (eg, ≥50% continued smoking in Asia).[31] This finding underscores the importance of strengthening cancer prevention efforts in low- and medium-HDI countries.[27,31]

Disparities by sex were observed in this study, with males having higher MIRs or cancer cases and deaths than females in 2022, and the variations in cases and deaths are projected to further widen by up to 15.8% in 2050. These disparities could be attributed to a complex interplay of factors. For example, compared with females, males are less likely to engage in cancer prevention activities, more likely to under use available screening and treatment options, and face a higher burden of modifiable risk factors such as smoking and alcohol consumption. Biological differences may also contribute.[31,33] Although female-specific cancer screening programs, such as for breast and cervical cancer, have benefited females, there is a crucial lack of comparable programs for male-specific cancers such as prostate and testicular cancer.[33] Furthermore, males participate less frequently in shared screening programs such as those for colorectal cancer.[33] Males also have higher occupational exposure to carcinogens as well as a higher smoking rate than females (32.6% vs 6.5% in 2020).[31,34]

Higher incidence rates of cancer in high-HDI countries could be attributed to several interrelated factors, such as aging, sedentary behavior, consumption of highly processed foods, and high diagnostic rates.[35,36] Although rates of smoking and alcohol consumption declined between 1990 and 2020, their previous exposure could lead to higher cancer cases.[31,35,36] In this study, the observed higher MIR (indicative of better survival) among high-HDI countries, despite their high incidence rates, could be attributed to their advanced health care infrastructure.[24-27]

## Limitations

This study had some limitations, such as the quality of the GLOBOCAN data, including the potential cancer surveillance disruptions during COVID-19, that may influence the study's estimates. This is particularly important for low- and middle-income countries with less robust cancer registries and civil registration systems.[14,15] However, GLOBOCAN used various estimation strategies, including leveraging national data or modeling based on neighboring countries, to enhance the accuracy of estimates where possible.[12] It is important to note that the current study's findings align with prior population-based global research.[37,38] Notably, the quality and coverage of cancer registry data sources have been improving over time, and continued efforts toward their expansion and maintenance are crucial for generating precise cancer outcome estimates worldwide.[14,39]



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## Conclusions

In this cross-sectional study based on GLOBOCAN data from 2022, disparities were observed by HDI, region, cancer type, age, and sex, with inequities estimated to further widen by 2050. A higher MIR was observed for rare and less common cancer types, among males, by age group (≤19 or ≥75 years), and for low- and medium-HDI countries or territories. On the basis of these findings, cancer cases and deaths are projected to nearly triple in low-income countries by 2050 compared to a moderate increase in high-income countries (142.1% vs 41.7% for cancer cases and 146.1% vs 56.8% for cancer deaths). Greater increases in cancer cases (15.8%) and deaths (8.0%) are projected among males compared with females. Strengthening health care access and quality, including universal health insurance coverage, and health care systems in the prevention, early diagnosis, management, and treatment of cancer will be paramount for improving clinical outcomes and slowing projected trends.

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## SUPPLEMENT 1.

**eMethods.**
**eTable 1.** *International Classification of Diseases, Tenth Revision* (*ICD-10*), Codes for Cancers
**eTable 2.** Cancer Prevalence in 2022 and Over the Past 5 Years From 2018 to 2022, by Cancer Type, Age, Region, and Human Development Index
**eTable 3.** Top-10 Ranked Cancers by Country or Territory and Various Epidemiological Measures (Cases, Deaths, ASIR, ASMR, Prevalence, and MIR) for 2022 and 2050
**eFigure 1.** Rates of Cancer in Each Country or Territory, 2022
**eTable 4.** Distribution of Cancer Cases and Incidence Rate in 2022 and the Projected Cases and Percentage of Change by 2050 in Each Country or Territory Sorted by Alphabetical Order
**eTable 5.** Distribution of Cancer Deaths and Mortality Rate in 2022 and the Projected Deaths and Percentage of Change by 2050 in Each Country or Territory Sorted by Alphabetical Order
**eTable 6.** Cancer Prevalence in 2022 and Over the Past 5 Years (2018-2022) by Country or Territory
**eTable 7.** Distribution of Cancer Mortality to Incidence Ratio (MIR), Absolute Differences, and Ratios Compared to the Global MIR in 2022 in Each Country or Territory Sorted by Alphabetical Order
**eFigure 2.** Differences in Mortality to Incidence Ratios (MIRs) in Each Country or Territory of 3 Regions Compared With the Global MIR, 2022
**eReferences**

## SUPPLEMENT 2.

**Data Sharing Statement**



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