

# Disparities in 36 cancers across 185 countries: secondary analysis of global cancer statistics

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**Abstract** Cancer is a major public health problem and represents substantial disparities worldwide. This study reported estimates for 36 cancers across 185 countries by incidence, mortality, 5-year prevalence, mortality-to-prevalence ratio (MPR), and mortality-to-incidence ratio (MIR) to examine its association with human development index (HDI) and gross national income (GNI). Data were collected from the GLOBOCAN 2020. MPR and MIR were calculated by sex, age group, country, and cancer type and then summarized into totals. Segi's population and global cancer spectrum were used to calculate age- and type-standardized ratios. Correlation analyses were conducted to assess associations. Results showed that breast cancer was the most diagnosed cancer globally. Low- and middle-income countries had high MPR and MIR. Cancers of esophagus, pancreas, and liver had the highest ratios. Males and the older population had the highest ratios. HDI and GNI were positively correlated with incidence and mortality but negatively correlated with MPR/MIR. Substantial disparities in cancer burden were observed among 36 cancer types across 185 countries. Socioeconomic development may contribute to narrowing these disparities, and tailored strategies are crucial for regional- and country-specific cancer control.

**Keywords** cancer; burden; mortality-to-prevalence ratio; mortality-to-incidence ratio; disparities; global

## Introduction

Cancer is an intractable public health problem worldwide. The GLOBOCAN 2020 estimated 19.3 million cancer cases and 10 million cancer deaths globally [1]. This global burden is expected to increase uniformly with the growing and aging population and the adoption of behaviors and lifestyle factors known to contribute to cancer development [2]. According to current trends, cancer may overtake cardiovascular disease as the major cause of premature mortality in most countries by the end of the century [3].

Huge disparities in cancer burden exist in transitioned (very high and high human development index (HDI) countries) and transitioning countries (low and medium HDI). In transitioning countries, the projected future burden of cancer in 2040 exhibits a striking increase [1].

In transitioned countries, the barriers must be reassessed because the incidence (twofold to threefold for both sexes) and mortality (< twofold for men and minimal for women) are disproportionately higher than those in transitioning countries [1]. Determining disparities across regions worldwide is crucial to obtain information related to cancer prevention.

The corresponding burden must be assessed using quantified indicators to guide the application of targeted prevention measures. Incidence, mortality, and prevalence are applied for the description of disparities between subgroups within populations [1]. Disability-adjusted life-years (DALY), which combines years of life lost due to premature mortality (YLLs) and years of healthy life lost due to disability (YLDs), are commonly used as indicators to assess disease burden [4]. Meanwhile, mortality-to-prevalence ratio (MPR) and mortality-to-incidence ratio (MIR) can serve different but complementary purposes in addressing burden in prognosis outcome and healthcare priorities. MPR could reflect the severity of the disease and has been used as a

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sensitive epidemiological parameter to estimate differences in overall survival outcomes among populations [5] and describe the heterogeneity of cancer burden within various countries [6]. MIR has been used to estimate survival rates, especially where survival studies are less feasible and limited [7], demonstrate disparities in cancer burden among different countries [8], and examine relationships of cancer burden with healthcare quality [9].

MPR and MIR provide a powerful way to pinpoint areas where studies are most likely to identify the reasons for large, persistent, and cancer-related disparities. However, they are not as commonly used for a comprehensive description. To further understand the patterns of cancer burden distribution and regional differences, we abstracted data from the GLOBOCAN database and calculated MPRs and MIRs for 36 different cancer types across 185 countries worldwide to evaluate disparity outcomes at the sex, age, country, and cancer type levels. In particular, we attempted to link cancer burden to indicators such as HDI and gross national income (GNI) to explore potential associations. In this secondary analysis, we aimed to capture the key characteristics of cancer-specific variations within different regions and provide a renewed global profile of cancer burden in 2020.

## Methods

### Data sources

Data for cancer burden were extracted from the GLOBOCAN project, which was founded by the Cancer Surveillance of the International Agency for Research on Cancer. The GLOBOCAN 2020 database contains high-quality registry data and offers comprehensive statistics from 185 countries or territories for 36 cancer types by sex and age group (including all cancers combined and all cancers excluding nonmelanoma skin cancer) [1]. The data collected from the GLOBOCAN statistics included overall, age-(divided by every 5 years), sex-specific incidence, mortality, and 5-year prevalence in 2020 of every country and cancer subdivision.

Data for HDI and GNI were obtained from United Nations Development Program (UNDP) based on the 2020 HDI report. The HDI is a summary measure of human development that encompasses three dimensions, namely, long and healthy life, access to knowledge, and decent standard of living [10]. In the GLOBOCAN framework, countries and territories were categorized into very high, high, medium, and low regions. The HDI was rescaled by UNDP on 0 to 1, where 0 represents the lowest value and 1 represents the highest [10]. In general, countries with a high HDI exhibit improved overall quality of life and development progress. The GNI serves

as a measure to approximate the national socioeconomic status, reflecting the overall economic condition and living standards of populations in a country [11]. It is often adjusted for purchasing power parity to account for cost-of-living differences. Accordingly, countries with a high GNI are associated with a high income status. MPR and MIR are decimal values that generally range from 0 to 1 when assessing cancer but can exceed 1 under specific circumstances. High MPR and MIR indicate poor prognosis, potentially leading to unfavorable outcomes or treatment inefficacy.

### Statistical analysis

MPR and MIR were defined as the ratios between mortality and 5-year prevalence and between mortality and incidence, respectively. First, crude MPR and MIR were computed for 36 cancers across 185 selected countries by utilizing the GLOBOCAN 2020 data. The results were then analyzed by sex, age group, continent, and different HDI regions. Age-standardized ratio (ASR) and age, and type-standardized ratio (ATSR) were employed to compare discrepancies among countries worldwide. For ASR, Segi's world standard population was chosen as a reference. The age-specific rates for the country or region of interest were then computed. The standardized rate was calculated by multiplying the age-specific rates by the proportion of the reference population in each age group. Similarly, the standardization of cancer types was achieved by utilizing the global cancer spectrum provided by the GLOBOCAN 2020. Correlation analyses using Pearson correlation coefficients ( $R$ ), which range from  $-1$  to  $1$ , were performed to assess the association of cancer burden with the HDI and GNI of different countries. A  $P$  value of less than  $0.05$  was considered statistically significant. All statistical analyses and corresponding plots were carried out using R software (version 4.1.3)

## Results

### Global cancer burden in 2020

In 2020, approximately 19 292 789 cancer cases were reported worldwide (Table 1). Males had higher incidence than females. The regions with very high HDI had the highest number of new cancer cases. The majority of the newly diagnosed cases were in Asia, especially in China. The most frequently newly diagnosed cancer type was breast cancer, followed by lung, colorectum, prostate, and stomach cancer (Table 2).

Approximately 9 958 133 deaths related to cancer were reported worldwide (Table 1). Similarly, males had higher mortality than females. The regions with high HDI had the highest number of deaths. The majority of

**Table 1** Global cancer burden by sex, human development index, and region and country, 2020

	Incidence (No.)	Mortality (No.)	Prevalence (No.)	Mortality-to-prevalence ratio			Mortality-to-incidence ratio		
				Crude	Age- standardized	Age- and type- standardized	Crude	Age- standardized	Age- and type- standardized
Worldwide	19 292 789	9 958 133	50 550 287	0.20	0.15	0.26	0.52	0.39	0.41
Sex									
Male	10 065 305	5 528 810	24 828 480	0.22	0.17	0.34	0.55	0.44	0.51
Female	9 227 484	4 429 323	25 721 807	0.17	0.13	0.24	0.48	0.35	0.43
Human development index (HDI) <sup>a</sup>									
Very high	8 390 110	3 183 923	27 181 209	0.12	0.05	0.12	0.38	0.18	0.26
High	7 026 620	4 317 256	15 411 087	0.28	0.15	0.28	0.61	0.39	0.43
Medium	2 959 754	1 864 270	6 249 879	0.30	0.21	0.31	0.63	0.50	0.46
Low	698 436	469 500	1 219 219	0.39	0.32	0.36	0.67	0.59	0.53
Region and country <sup>b</sup>									
Asia	9 391 695	5 750 836	20 301 710	0.28	0.18	0.28	0.61	0.43	0.43
China	4 568 754	3 002 899	9 294 006	0.32	0.16	0.25	0.66	0.40	0.42
India	1 324 413	851 678	2 720 251	0.31	0.23	0.32	0.64	0.53	0.49
Indonesia	396 914	234 511	946 088	0.25	0.17	0.22	0.59	0.43	0.37
Japan	1 028 658	420 124	2 710 728	0.15	0.05	0.07	0.41	0.16	0.21
The Republic of Korea	230 317	88 597	630 991	0.14	0.05	0.08	0.38	0.15	0.23
Mongolia	5714	4469	9012	0.50	0.27	0.18	0.78	0.58	0.34
Thailand	190 636	124 866	426 366	0.29	0.16	0.21	0.65	0.40	0.41
Turkey	233 834	126 335	581 636	0.22	0.11	0.21	0.54	0.31	0.43
Europe	4 399 659	1 955 889	13 510 129	0.14	0.06	0.15	0.44	0.21	0.29
France	467 965	185 621	1 501 881	0.12	0.05	0.11	0.40	0.17	0.29
Germany	628 519	252 065	2 188 176	0.12	0.04	0.11	0.40	0.15	0.26
Italy	415 269	174 759	1 230 693	0.14	0.05	0.12	0.42	0.16	0.29
Russian Federation	591 371	312 122	1 580 383	0.20	0.10	0.22	0.53	0.29	0.37
United Kingdom	457 960	179 648	1 514 320	0.12	0.04	0.10	0.39	0.15	0.25
Africa	1 105 336	709 404	2 158 533	0.33	0.27	0.34	0.64	0.55	0.52
Egypt	134 632	89 042	278 165	0.32	0.20	0.28	0.66	0.46	0.45
Ethiopia	77 352	51 865	130 858	0.40	0.34	0.31	0.67	0.58	0.46
Nigeria	124 815	78 899	233 911	0.34	0.27	0.30	0.63	0.54	0.46
Somalia	10 134	7439	13 212	0.56	0.48	0.39	0.73	0.64	0.53
South Africa	108 168	56 802	262 455	0.22	0.16	0.26	0.53	0.42	0.45
Latin America and the Caribbean	1 449 034	704 039	3 781 938	0.19	0.13	0.27	0.49	0.35	0.46
Argentina	130 878	70 074	358 627	0.20	0.11	0.26	0.54	0.33	0.43
Brazil	592 212	259 949	1 563 761	0.17	0.11	0.24	0.44	0.32	0.44
Colombia	113 221	54 987	293 524	0.19	0.13	0.30	0.49	0.36	0.44
Mexico	195 499	90 222	530 602	0.17	0.11	0.30	0.46	0.33	0.45
Peru	69 849	34 976	175 090	0.20	0.15	0.30	0.50	0.41	0.45
Northern America	2 569 519	704 931	9 497 874	0.07	0.04	0.12	0.27	0.15	0.25
Canada	274 364	86 684	1 023 261	0.08	0.04	0.13	0.32	0.15	0.32
The United States of America	2 281 658	612 390	8 432 938	0.07	0.04	0.12	0.27	0.15	0.25
Oceania	250 812	67 520	979 868	0.07	0.05	0.12	0.27	0.17	0.27
Australia	200 021	48 236	808 997	0.06	0.03	0.11	0.24	0.10	0.26

(Continued)

	Incidence (No.)	Mortality (No.)	Prevalence (No.)	Mortality-to-prevalence ratio			Mortality-to-incidence ratio		
				Crude	Age- standardized	Age- and type- standardized	Crude	Age- standardized	Age- and type- standardized
New Zealand	35 934	10 508	142 413	0.07	0.04	0.11	0.29	0.15	0.28

<sup>a</sup>Excluding Democratic People's Republic of Korea and Somalia because the United Nations Development Program (UNDP) did not report HDI 2020 in these countries. <sup>b</sup>Countries were selected in major endemic regions by incidence.

**Table 2** Global cancer burden by cancer type, 2020

Cancer type	Incidence (No.)	Mortality (No.)	Prevalence (No.)	Mortality-to-prevalence ratio		Mortality-to-incidence ratio	
				Crude	Age-standardized	Crude	Age-standardized
All cancers	19 292 789	9 958 133	50 550 287	0.20	0.15	0.52	0.39
All cancers excl. nonmelanoma skin cancer	18 094 716	9 894 402	44 091 402	0.22	0.15	0.55	0.39
Oesophagus	604 100	544 076	666 388	0.82	0.72	0.90	0.70
Pancreas	495 773	466 003	379 958	1.23	0.56	0.94	0.62
Gallbladder	115 949	84 695	137 466	0.62	0.55	0.73	0.61
Mesothelioma	30 870	26 278	37 047	0.71	0.50	0.85	0.46
Stomach	1 089 103	768 793	1 805 968	0.43	0.47	0.71	0.60
Liver	905 677	830 180	994 539	0.83	0.44	0.92	0.73
Lung	2 206 771	1 796 144	2 604 791	0.69	0.36	0.81	0.62
Hypopharynx	84 254	38 599	132 717	0.29	0.33	0.46	0.44
Brain, central nervous system	308 102	251 329	837 152	0.30	0.23	0.82	0.64
Multiple myeloma	176 404	117 077	450 579	0.26	0.23	0.66	0.52
Kaposi sarcoma	34 270	15 086	82 033	0.18	0.21	0.44	0.48
Prostate	1 414 259	375 304	4 956 901	0.08	0.21	0.27	0.30
Larynx	184 615	99 840	518 380	0.19	0.20	0.54	0.45
Leukemia	474 519	311 594	1 340 506	0.23	0.20	0.66	0.56
Bladder	573 278	212 536	1 720 625	0.12	0.19	0.37	0.27
Lip, oral cavity	377 713	177 757	959 248	0.19	0.19	0.47	0.45
Nasopharynx	133 354	80 008	382 507	0.21	0.19	0.60	0.44
Cervix uteri	604 127	341 831	1 495 211	0.23	0.19	0.57	0.40
Colorectum	1 931 590	935 173	5 253 335	0.18	0.17	0.48	0.37
Oropharynx	98 412	48 143	258 543	0.19	0.17	0.49	0.32
Vagina	17 908	7995	44 613	0.18	0.17	0.45	0.35
Non-Hodgkin lymphoma	544 352	259 793	1 544 488	0.17	0.16	0.48	0.40
Ovary	313 959	207 252	823 315	0.25	0.15	0.66	0.37
Breast	2 261 419	684 996	7 790 717	0.09	0.14	0.30	0.30
Hodgkin lymphoma	83 087	23 376	281 112	0.08	0.13	0.28	0.25
Salivary glands	53 583	22 778	160 292	0.14	0.13	0.43	0.28
Kidney	431 288	179 368	1 207 547	0.15	0.12	0.42	0.34
Vulva	45 240	17 427	135 892	0.13	0.12	0.39	0.30
Nonmelanoma skin cancer	1 198 073	63 731	6 458 885	0.01	0.09	0.05	0.18
Penis	36 068	13 211	102 157	0.13	0.08	0.37	0.22
Corpus uteri	417 367	97 370	1 415 213	0.07	0.06	0.23	0.16
Testis	74 458	9334	296 686	0.03	0.05	0.13	0.16
Melanoma of skin	324 635	57 043	1 092 818	0.05	0.04	0.18	0.13
Thyroid	586 202	43 646	1 984 927	0.02	0.03	0.07	0.08

Note: Specific cancer type is ranked based on the age-standardized mortality-to-prevalence ratio. Excl., excluding.

cancer-related deaths occurred in Asia, especially in China. Lung cancer was the leading cause of cancer-related deaths, followed by colorectum, liver, stomach, and breast (Table 2).

Approximately 50 550 287 prevalent cases with cancer were recorded worldwide (Table 1). The number of male patients was higher than females, and the highest number of patients with cancer was recorded in the regions with very high HDI. The majority of patients with cancer were in Asia, particularly in China. For cancer types, the highest number was recorded for breast, followed by colorectum, prostate, lung, and thyroid (Table 2).

**Global MPR in 2020**

In 2020, the global crude MPR for all cancers was 0.20. Males had higher MPR than females (0.22 vs. 0.17) (Table 1). After standardization, the ratio increased to 0.26 (0.34 for males and 0.24 for females). The MPR showed a decreasing trend with high HDI levels, ranging from 0.12 (ASR = 0.05, ATSR = 0.12) in countries with very high HDI to 0.39 (ASR = 0.32, ATSR = 0.36) in countries with low HDI (Table 1).

Among the regions, the highest crude ratio was found in Africa and the lowest in Northern America and

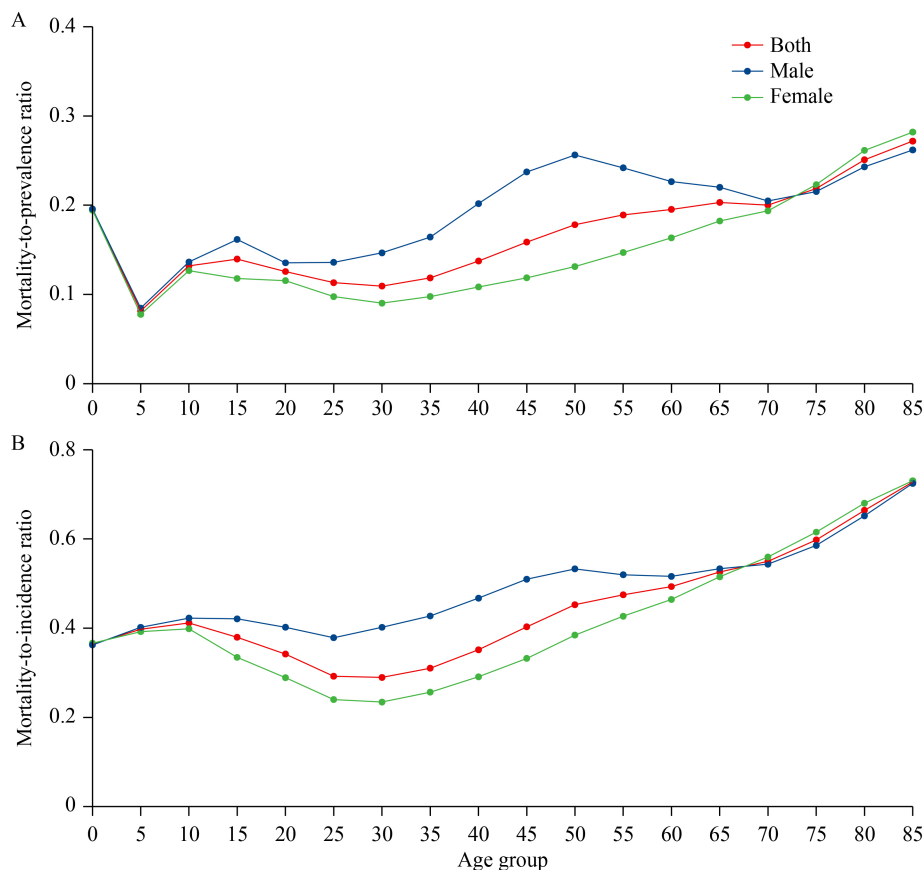
Oceania (Table 1). Among the countries, the highest standardized MPR was found in Somalia. India had the highest ratio among Asian countries. By contrast, countries such as Japan, the Republic of Korea, and UK had low MPRs (Table 1).

Among the cancer types, the highest crude MPR was found for pancreatic cancer and the lowest for nonmelanoma skin cancer (Table 2). After age adjustment, the highest ratio was found for esophagus and the lowest for thyroid. Among male reproductive system tumors, prostate cancer had the highest age-standardized MPR. In females, the highest ratio was found for cervix uteri (Table 2).

For both sexes combined, the MPR generally increased with age, with the highest value found in the 85-year age group (Fig. 1A). In males, the MPR showed an increasing trend in the age groups between 20 and 50 years and over 70 years. In females, the MPR increased from the 30-year age group and peaked in the 85-year age group. Overall, males had significantly higher levels than females, but a crossover occurred between 70 and 75 years (Fig. 1A).

**Global MIR in 2020**

Overall, the global crude MIR was 0.52. Similarly, males



**Fig. 1** Age-specific cancer mortality-to-prevalence ratio and mortality-to-incidence ratio, worldwide, 2020.

had slightly higher values than females (0.55 vs. 0.48) (Table 1). High values were obtained after standardization, that is, 0.41 overall, 0.51 for males, and 0.43 for females. Furthermore, the crude MIR and corresponding standardized ratios were almost two to three fold lower in countries with very high HDI compared with those in countries with low HDI (Table 1).

Among the regions, the highest crude ratio was also observed in Africa and the lowest in Northern America and Oceania (Table 1). After standardization, the lowest ratios were found in Northern America. Among the countries, the highest MIR occurred in Somalia, and low ratios were found in Japan, the Republic of Korea, and United States of America (Table 1).

Among the cancer types, the highest crude MIR was observed for pancreatic cancer and the lowest for nonmelanoma skin cancer (Table 2). After standardization, the highest ratio was found for liver and the lowest for thyroid. Among male reproductive system tumors, prostate cancer had the highest MIR. In females, the highest ratio was observed for cervical cancer (Table 2).

The lowest MIR was found in the 30-year age group for

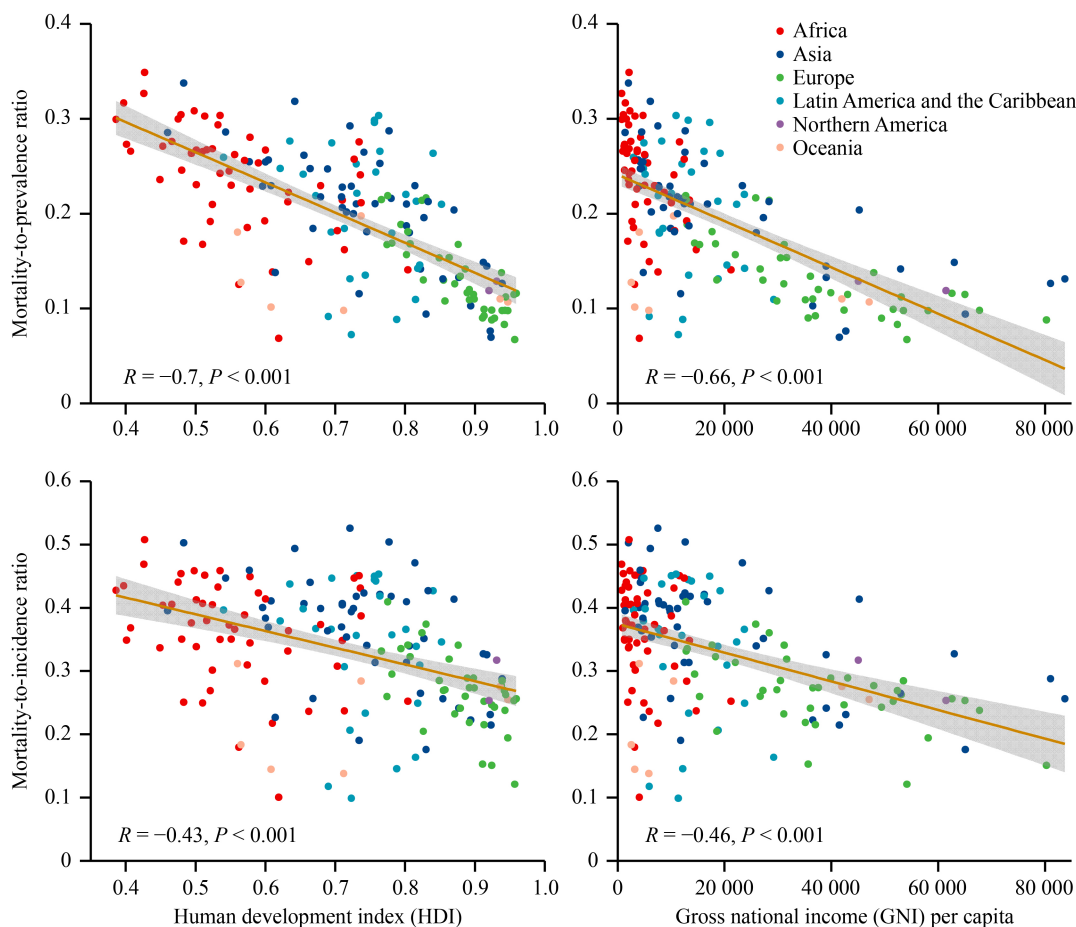
both sexes and then gradually increased with age (Fig. 1B). For males, the MIR remained relatively stable in people aged between 0 and 25 years and then slowly increased with age. Overall, males had higher ratios than females, but a crossover occurred between males and females between 65 and 70 years (Fig. 1B).

### Associations of cancer burden with HDI and GNI

Significant positive correlations with incidence were observed for HDI ( $R = 0.78$ ,  $P < 0.001$ ) and GNI ( $R = 0.68$ ,  $P < 0.001$ ) (Fig. S1). However, mortality showed weak correlations with HDI ( $R = 0.29$ ,  $P < 0.001$ ) and GNI ( $R = 0.12$ ,  $P = 0.11$ ). Significant negative correlations with MPRs were found for HDI ( $R = -0.70$ ,  $P < 0.001$ ) and GNI ( $R = -0.66$ ,  $P < 0.001$ ) (Fig. 2). A similar association was observed for MIRs, showing significant negative correlations with HDI ( $R = -0.43$ ,  $P < 0.001$ ) and GNI ( $R = -0.46$ ,  $P < 0.001$ ) (Fig. 2).

### Discussion

This study provides a comprehensive analysis of global



**Fig. 2** Associations of HDI and GNI with cancer mortality-to-prevalence ratio and mortality-to-incidence ratio.

cancer burden at the sex, age group, country, and cancer type levels using the GLOBOCAN database. Overall, breast cancer was the most common, and lung cancer was the leading cause of cancer deaths worldwide. Although the regions with very high HDI had the highest number of cancer cases, the lowest MPR and MIR were recorded in high-income countries located in Northern America and Oceania and the highest were observed in low- and middle-income countries (LMICs) with low HDI in Africa. We also observed high ratios in individual cancers: esophagus, pancreas, and liver. MPR and MIR were high in males and older populations. HDI and GNI were positively correlated with incidence and mortality but negatively correlated with MPRs/MIRs.

Breast cancer surpassed lung cancer and became the most substantially diagnosed cancer worldwide. It also ranked first in terms of incidence across 159 countries [1]. Possible explanations are related to reproductive patterns, western lifestyles including diet, and physical activity [12]. Furthermore, disparities in breast cancer incidence also existed. Countries undergoing rapid changes in human development are likely to experience a change in breast cancer profile [12]; this phenomenon is a reflection of the prevalence and distribution of risk factors across different regions [13]. Lung cancer was the second leading cause of cancer and remained the leading cause of cancer mortality in 2020. Smoking contributes to about two-thirds of lung cancer death worldwide; thus, effective tobacco-control programs at the country level should be taken [1]. The MIR has been found to decrease over time in specific cancers such as breast [14], oral [15], and skin cancer [16]. The MPR of breast cancer was negatively associated with socioeconomic status and decreased remarkably in countries with high-middle sustainable development index [6].

We found that cancer burden varied across world regions. The highest MPRs/MIRs were observed in Africa, which aligns with a previous study that highlighted the challenges in managing substantial cancer burden [17]. In terms of cancer treatment and care capacity, Africa is notably far behind, with many nations lacking essential services [18]. Factors such as poverty, limited access to healthcare facilities, and insufficient resources for cancer prevention and control contribute to the high mortality in these regions, posing significant challenges in establishing robust health systems. By contrast, the lowest MPR/MIR in Northern America and Oceania are characterized by a favorable prognosis for patients. These regions have robust and advanced healthcare systems, which are often accompanied by high levels of socioeconomic development. Northern American and Oceanian countries tend to prioritize cancer prevention initiatives, including early diagnosis, screening, and treatment, resulting in improved survival

rates for certain cancers [19]. The intensive screening programs for the detection of precancerous cells and *in situ* tumors have significantly contributed to these results [19]. Therefore, countries with low and medium HDI should prioritize economic development and policy improvements to establish sustainable health systems [20].

With regard to specific cancer types, pancreatic cancer had the highest crude MPR and MIR. This type is known for its low survival rate primarily due to its high malignancy and late-stage diagnosis [21]. Large-scale screening is not feasible because symptoms do not usually appear in the early stage and suitable tumor markers or feasible imaging technologies are lacking [22]. This study showed that after standardization, most gastrointestinal and lung cancer had the highest ratios because they are often diagnosed at advanced stages with the poorest prognosis [19]. Apart from colorectal cancer, gastrointestinal cancers contribute 1.4–1.8 times more cancer cases to the number of global cancer deaths [23]. In China, gastrointestinal cancers account for 45% of all cancer deaths and thus deserve targeted interventions [13]. The lowest MPR and MIR were found for nonmelanoma skin cancer and thyroid cancer, respectively. These low-risk cancers exhibit shared characteristics, including relatively high incidence rates, low mortality, and favorable survival outcomes [1,19]. After standardization, the ratios of thyroid cancer increased possibly due to the high incidence in adults primarily because of overdiagnosis [24].

Males generally had higher cancer burden than females. The possible causes include tobacco use, differences in tumor biology, and sex steroid hormones [25]. For females, cervical cancer stood out with the highest MPR and MIR. However, the majority of cases occur in regions with limited resources and among individuals from socioeconomically disadvantaged backgrounds [26]. Compared with other measures, cost-effective vaccination and screening offer more feasible options for eliminating cervical cancer in LMICs [27]. By contrast, prostate cancer showed high ratios in males; it was common in high-resource regions as a result of increased testing facilities for prostate-specific antigens and the most common among males in several sub-Saharan African countries with poor prognosis [28]. This finding highlights the need for improved detection methods and access to quality healthcare services to enhance early diagnosis and treatment outcomes.

Cancer-related MPRs and MIRs showed significant variations across age groups. High values were mainly observed in children and older age groups. The incidence of most epithelial cancers increases with age; hence, timely cure of childhood malignancies would lead to decades of productive life [29]. For instance, in children

under 15 years old, leukemia is the primary contributor to cancer-related mortality [30]. We also found that females had higher MPR and MIR than males after the age of approximate 70 years. Possible explanations include competitive risk from cardiovascular diseases, high prevalence of breast cancer in younger females, prostate cancer in older males, and long survival period among females [31].

The results reveal opposite correlations between cancer burden indicators and HDI and GNI. Significant positive relationships were established for overall cancer incidence and mortality [6,30]. In countries with high life expectancy, the probability of reaching high surviving ages is great, and so is the risk of cancer [32]. Moreover, lifestyle factors associated with westernization and improved medical services are possible contributors. Prior research confirmed the negative correlations of HDI with MIR and MPR in specific cancer types such as breast, lung, liver, and colorectal [6,14,33–35]. Effective implementation of cancer control programs taken by high HDI countries as early detection, diagnosis, and improved treatment results in favorable cancer outcomes [9]. Healthcare infrastructure and resources play a major role in shaping cancer outcomes and deserve emphasis for the success of cancer control programs.

The heterogeneity in cancer prognosis worldwide also highlights the challenge of accessing timely clinical treatments. Universal health coverage widely varies worldwide, especially for noncommunicable diseases [36]. Access to anticancer drugs, which are considered essential for the overall national health service capacity, is limited to only 32% and 57.7% in lower-middle-income and low-income countries, respectively, only if patients were willing to cover the full costs [37]. LMICs often struggle with the affordability of widely recognized cytotoxic drugs, and high-income countries face economic barriers related to the accessibility of the latest targeted therapies or immunotherapies [38]. Given these barriers, the World Health Organization (WHO) has implemented measures to ensure that only high-value medicines are recommended in the WHO Model List of Essential Medicines (EML), which serves as a valuable tool for policymakers to select essential medicines [38].

Given the varied influence of cancer, tailored recommendations based on preventive and treatment strategies are crucial for ensuring equitable benefits from cancer prevention programs. Inequalities between socioeconomic groups are expected to increase cancer burden in the future, highlighting the need for customized approaches to global health challenges [2]. For countries with middle or low HDI, prioritizing the availability and coverage of medications is essential. Regular screening programs for cancers with low MPR/MIR can improve early diagnosis and treatment outcomes. Allocating resources and providing medical support to underserved

regions, including EML utilization, is crucial to mitigate healthcare disparities. In addition, governments must take action to limit environmental carcinogen exposure. The WHO Framework Convention on Tobacco Control is a global example of such efforts [39]. Raising awareness through health educational programs is also crucial; individuals are empowered to take control of their health and adhere to recommended treatment plans.

Our study also has several limitations. First, the usage of GLOBOCAN data should be approached with caution. While this database provides general trends and overviews, specific analyses for individual cases or specific regions may require specific data. Second, cancer burden must be interpreted in conjunction with other relevant measures such as disease stage, pathological type, comorbidities, and access to healthcare. Finally, this study employs a cross-sectional descriptive design and is unable to offer information on longitude trends and changes, probably overlooking the dynamic changes of cancer over time. Therefore, additional longitudinal studies are necessary to investigate the changes and trends of factors underlying cancer patterns across geographical areas. Despite these limitations, our study contributes valuable insights for further examining prognosis differentials and highlights the need for targeted interventions to mitigate global disparities.

## Conclusions

Significant disparities in cancer burden were observed among 36 cancers across 185 countries. Socioeconomic development, which may contribute to mitigating these disparities, must be prioritized. Tailored strategies that consider regional- and country-specific factors influencing cancer control activities must be implemented to effectively address the global cancer burden.

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## Compliance with ethics guidelines

**Conflicts of interest** Qianru Li, Changfa Xia, He Li, Xinxin Yan, Fan Yang, Mengdi Cao, Shaoli Zhang, Yi Teng, Siyi He, Maomao Cao, and Wanqing Chen declared no conflicts of interest.

This manuscript does not involve a research protocol requiring approval by the relevant institutional review board or ethics committee.

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