The Cancer Atlas

The Cancer Atlas FOURTH EDITION

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Ahmedin Jemal
Hyuna Sung
Kieran Kelly
Isabelle Soerjomataram
Freddie Bray

American Cancer Society®

International Agency for Research on Cancer
World Health Organization

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PART THREE

TAKING ACTION

APPENDIX

What's New!

This fully updated fourth edition of *The Cancer Atlas* features the latest global cancer patterns, drawing on data from the GLOBOCAN 2022 estimates and the Cancer Incidence in Five Continents (CI5) series. It also includes new evidence on cancer prevention and control, with added chapters addressing timely and emerging topics such as alcohol, climate change, social inequalities, and health system resilience, as well as new site-specific chapters on colorectal, cervical, and liver cancer.

For expanded interactivity and access to downloadable data, please visit the companion digital experience at canceratlas.cancer.org

"We are optimistic that by working together and using the fourth edition of ***The Cancer Atlas*** as a tool, we can continue to accelerate the progress we have made over the past several decades and ensure that this benefits everyone."

— William L. Dahut

William L. Dahut, MD

Chief Scientific Officer,
American Cancer Society

At the American Cancer Society, we often celebrate the extraordinary progress we have made to reduce the death and suffering from cancer, driven by dramatic changes in the use of combustible tobacco, strategies to detect cancer earlier, the explosion of new therapeutics, and a greater focus on survivorship. In fact, in the United States, the cancer mortality rate has declined 34% since 1991 averting approximately 4.5 million cancer deaths. Yet we cannot be satisfied with the status quo. Although we have made great advances in the nation, we still anticipate there will be greater than 2 million cancer diagnoses and over 600,000 cancer deaths in 2025. This number of cancer deaths is equivalent to the loss of the population of St. Louis, Missouri and Pittsburgh, Pennsylvania every year due to cancer.

If we have learned anything over the past decades, it is the importance of worldwide strategic cooperation in order to make real advances against significant health challenges. As you will see in the pages of *The Cancer Atlas, Fourth Edition*, the risk factors that are driving cancer diagnosis and mortality are becoming less geographically distinct. Although great strides have been made in tobacco use in some countries, tobacco smoking continues to be the leading cause of preventable cancer in many higher income countries with concerning trends in economically transitioning areas. Also, consumption of ultra processed food, heavy alcohol use, and sedentary lifestyle are increasingly adopted in economically transitioning countries. Overall, close to half of cancer deaths globally are preventable by modifiable risk factors. This calls for concerted and coordinated efforts between local governments, health departments, community leaders, civic societies, and donors to implement proven interventions broadly in every community.

The American Cancer Society and the American Cancer Society Cancer Action Network, our nonprofit non-partisan advocacy affiliate, work at the state and federal level of government to ensure that all patients can obtain quality, affordable healthcare in prevention through treatment. We and others remain concerned that many of the extraordinary improvements in therapies as well as the evolving use of artificial intelligence and digital technology may exacerbate gaps already in healthcare access and outcomes highlighted in the fourth edition of *The Cancer Atlas*. We are deeply committed to working with our worldwide partners to develop actions to ensure that we enhance equitable cancer care throughout the world. In the United States, we have areas, particularly rural America, where the cancer outcomes lag significantly behind. Early detection and cancer prevention are proven strategies that can make meaningful important differences in the burden and suffering from cancer worldwide. We are optimistic that by working together and using the fourth edition of *The Cancer Atlas* as a tool, we can continue to accelerate the progress we have made over the past several decades and ensure that this benefits everyone.

“Urgently addressing the cancer burden is essential for mitigating social and economic inequities, driving economic growth, and advancing sustainable development. I hope and believe that this book will inspire many, reinforcing the critical importance of prioritizing cancer prevention as the cornerstone strategy in combating the global cancer epidemic.”

— Elisabete Weiderpass

Elisabete Weiderpass, MD, MSc, PhD

Director, International Agency for Research on Cancer

Cancer represents a critical societal and economic challenge to global health. The magnitude of the cancer burden is unprecedented, as a result of both population aging and growth and changes in exposures to risk factors linked to globalization. As of 2022, there were an estimated 19 million new cases of cancer worldwide and close to 10 million cancer deaths (excluding non-melanoma skin cancer). In view of ongoing demographic and epidemiologic transitions, the cancer burden is projected to rise by 74% in 2050, and become the leading cause of premature death in every country of the world in this century.

Although these statistics are of utmost concern, much can be done to reduce the future cancer burden. Cancer prevention strategies — including the reduction of risk factors and the implementation of effective interventions — have the potential to reduce new cancer diagnoses by 40%. Early detection, combined with timely, affordable, and effective treatment can markedly reduce the burden and suffering from the disease.

The International Agency for Research on Cancer (IARC), the specialized cancer agency of the World Health Organization (WHO), plays a central role in advancing cancer prevention research globally. IARC’s mission is to lead interdisciplinary research efforts aimed at reducing cancer incidence via international collaboration, enhancing the scientific capacity of the global community in cancer prevention. By fostering a robust network of partnerships, IARC contributes to WHO’s cancer prevention programs, particularly in countries where the needs are greatest, thereby supporting global efforts to alleviate the cancer burden worldwide.

Building on the success of the third edition of *The Cancer Atlas*, published in 2019, this fourth edition serves as a comprehensive resource for shaping cancer control strategies across the cancer continuum. *The Cancer Atlas* provides a global overview of the most current data on cancer burden and trends, leveraging insights from IARC’s cancer statistics and the underlying risk factors associated with cancer to highlight proven measures for cancer prevention and cancer control. This publication is aimed at cancer researchers, public health professionals, policymakers, and broader society.

Urgently addressing the cancer burden is essential for mitigating social and economic inequities, driving economic growth, and advancing sustainable development. I hope and believe that this book will inspire many, reinforcing the critical importance of prioritizing cancer prevention as the cornerstone strategy in combating the global cancer epidemic.

EDITORS

Ahmedin Jemal, DVM, PhD

Dr. Jemal is the Scientific Vice President of the Surveillance & Health Services Research Program at the American Cancer Society. He also holds an appointment as adjunct Associate Professor of Epidemiology at the Rollins School of Public Health, Emory University.

Dr. Jemal's principal research interests include cancer disparities and the social determinants of health and health services and outcomes research. His main goal at the American Cancer Society has been to build a strong team of cancer surveillance and health services researchers to promote the application of evidence-based cancer prevention and control in the United States and worldwide. Dr. Jemal's work has informed public health policies and cancer prevention and control.

Hyuna Sung, PhD

Dr. Sung is an epidemiologist and cancer surveillance researcher in the Department of Surveillance & Health Equity Science at the American Cancer Society. Her research centers on tracking progress against cancer and identifying health disparities across the cancer continuum to inform cancer prevention and control strategies in the United States and globally.

Using population-based cancer registry and other health data, she analyzes temporal, geographic, and socio-demographic variations in cancer incidence, mortality, and survival with standard descriptive tools supplemented by novel statistical methods. She conducts research to identify emerging cancer trends, explore how changes in cancer burden relate to evolving risk factors and clinical practices, and assess the complex medical and social needs of the expanding and aging population of cancer survivors.

Kieran Kelly, MPH

Mr. Kelly is an epidemiologist and associate scientist II in the Department of Surveillance & Health Equity Science at the American Cancer Society. His research focuses on emerging global cancer trends among young adults, with the goal of advancing cancer surveillance to inform prevention and control efforts worldwide. Using population-based cancer registry data, he examines temporal and geographic patterns in cancer incidence and mortality, with particular attention to the rising cancer burden in younger populations. He previously collaborated on research investigating neighborhood-level gentrification, greenspace change, and obesity prevalence in Atlanta, Georgia, and currently serves as managing editor for the fourth edition of *The Cancer Atlas*.

Isabelle Soerjomataram, MD, PhD

Dr. Soerjomataram is Deputy Head of the Cancer Surveillance Branch at the International Agency for Research on Cancer. She is a medical epidemiologist with a special interest in prevention of cancer and improving cancer outcomes. She took the position at IARC in 2011, where she is currently assessing international variation in the cancer burden and survival using mainly population-based datasets and how policy can mitigate the rising burden of cancer.

In addition to her research activities, she is (co) coordinating several large projects. Today she coordinates the IARC Initiative for Resilience in Cancer Control, a global project aiming to assess the impact of crises on cancer burden to provide robust evidence to mitigate the impact. She is also leading global estimation of attributable fractions for cancers related to various risk factors. In addition, she leads cancer survival projects in high-, and low-, and middle-income settings assessing the effectiveness of the local health system.

Freddie Bray, MSc, PhD

Dr. Bray is Head of the Cancer Surveillance Branch at the International Agency for Research on Cancer in Lyon, France. His areas of research revolve around the descriptive epidemiology of cancer, including the estimation of the global cancer burden and the analysis of time trends of cancer including predictions of the future scale and profile of cancer globally linked to human development transitions.

In support of the overwhelming need for high quality cancer surveillance systems given their current paucity and an ever-increasing cancer problem, Dr. Bray leads the Global Initiative for Cancer Registration (http://gicr.iarc.who.int), an international multi-partner program designed to ensure a sustainable expansion of the coverage and quality of population-based cancer registries in low- and middle-income countries through tailored, localized support and advocacy to individual countries.

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Introduction

The Cancer Atlas aims to open readers' eyes to the global scale and impact of cancer, covering the extent and magnitude of the disease, the major causes, and the different ways the disease can be prevented and treated. As with previous editions, this fourth edition of *The Cancer Atlas* is grouped into three parts, namely Risk Factors, The Burden, and Taking Action, with additional chapters to address timely and emerging important topics including Climate Change and Health System Resilience.

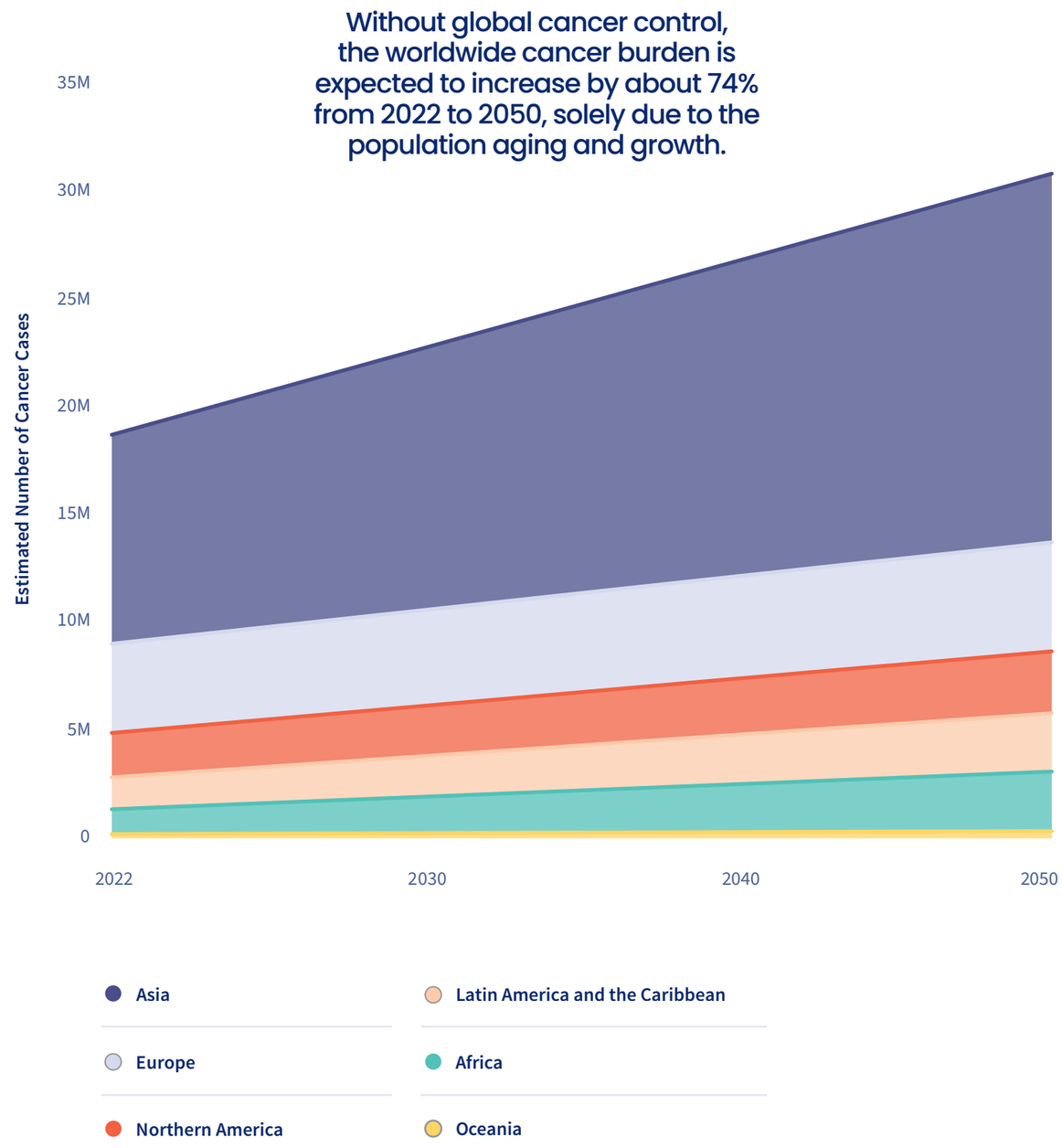
The first part, **Risk Factors**, highlights regional and international variations in major risk factors for cancer, including tobacco use, infection, excess body fatness, and ultraviolet radiation. Tobacco smoking continues to be the predominant cause of cancer in most high-income countries, while infection still plays a major role in many sub-Saharan African and Asian countries. The importance of excess body fatness as a major risk factor for cancer continues to escalate in most parts of the world, including many economically transitioning countries. New chapters in the section on risk factors include alcohol consumption, a major preventable cause of cancer, for which public awareness remains low, and climate change, which increases heatwaves and harmful sun exposure, exacerbating the burden of skin cancer, as well as the frequency and magnitude of related events, such as hurricanes and wildfires that disrupt the delivery of care. Finally, there is also a new chapter on the social inequalities that impact an individual's risk of developing cancer and their access to cancer care, contributing to broader health disparities across populations.

The second part, **The Burden**, describes the geographic diversity in cancer occurrence worldwide and, in separate chapters, for each of the major world regions overall and for select major cancers. This burden is also described in terms of the national Human Development Index, the primary measure of a country's societal and economic development used in *The Cancer Atlas*. New chapters have been added to describe the geographic diversity of colorectal cancer for which incidence is rising among young adults in many countries; liver cancer, a leading cause of cancer death in several parts of Asia and Africa; and cervical cancer, the leading cause of cancer death among women in many sub-Saharan African countries and the focus of a World Health Organization-led global strategy aimed at accelerating its elimination as a public health problem.

The final part, **Taking Action**, describes major interventions across the cancer continuum, from the prevention of risk factors to early detection, treatment, and survivorship and palliative care, highlighting disparities in the availability and implementation of these interventions across the world. It also portrays the multiple organizations working in cancer control, alongside policies and legislation that seek to reduce the burden of cancer and other non-communicable diseases at the population level. This section also includes a new chapter on health system resilience to improve cancer control during a pandemic and large-scale conflicts.

In summary, *The Cancer Atlas* is intended to deliver an evidence-base of the global essentials of cancer using a format that is easy to grasp. This resource, which is available in print and digital formats (https://canceratlas.cancer.org/), was carefully designed to ensure user-friendly, accessible, and downloadable descriptions and graphics that can be easily used by cancer control advocates, government and private and public health agencies, and policymakers, as well as patients, survivors and the general public. *The Cancer Atlas* is an illustrative guide to cancer's diversity and disparities, but also a positive vehicle for the promotion and delivery of cancer prevention and cancer control worldwide.

Figure 1.1
Estimated increase in the number of cancer cases (excluding non-melanoma skin cancer) worldwide from 2022 to 2050



Risk Factors

Learn about the prevalence of major known risk factors for cancer in populations around the world.

Overview

About half of all cancer deaths worldwide are attributable to potentially modifiable risk factors.

Among the numerous potentially modifiable risk factors for cancer, reductions in tobacco use, infectious agents, excess body fatness, unhealthy diet, physical inactivity, alcohol consumption, excess exposure to ultraviolet radiation, environmental pollutants, and occupational exposures can have an important impact in reducing the morbidity and mortality associated with cancer in every part of the world. Exposures to these risk factors vary substantially across and within countries and are often associated with socioeconomic status (see *Social Inequalities,* Chapter 13).

Smoking is the leading preventable cause of cancer incidence and mortality globally (see *Tobacco,* Chapter 4). Smoking and smokeless tobacco cause at least 17 and three cancer types, respectively, and together account for one in five cancer deaths worldwide (**Figure 2.1**).

Infectious agents can cause a wide range of cancer types (see *Infection,* Chapter 5). They account for about 12% of new cancer cases globally, ranging from one in 25 in some countries in North America and Oceania to one in four cancer cases in many sub-Saharan African countries. Human papillomavirus (HPV) infection alone accounts for more than one in five cancer cases in Botswana, Zambia, and Eswatini (**Map 2.1**), largely due to historically high infection rates and limited access to cervical cancer screening.

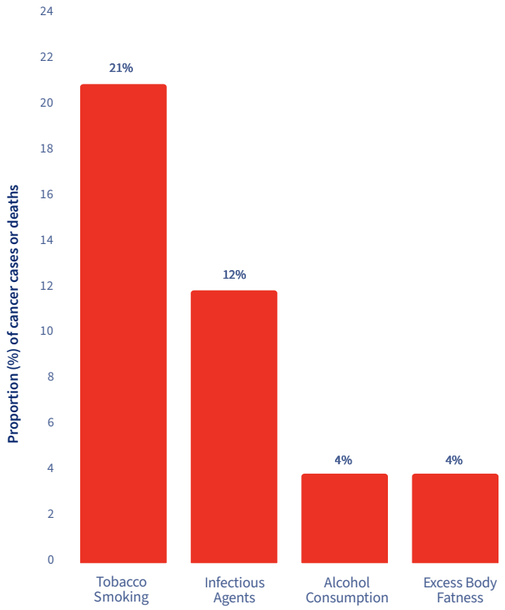
Excess body fatness, unhealthy diet, and physical inactivity cause multiple types of cancer (see *Body Fatness, Physical Activity, and Diet,* Chapter 6). With a rising prevalence of these risk factors, the burden of cancers associated with these risk factors has been increasing in most parts of the world. Among adults, obesity has increased up to 3-fold across World Health Organization (WHO) regions and levels of income over the past three decades (**Figure 2.2**). Around 4% of all new cancer deaths globally are attributed to excess body fatness (**Figure 2.1**). A similar proportion of new cancer cases are attributable to alcohol consumption (see *Alcohol,* Chapter 7). In addition, 70-90% of all cutaneous melanoma cases globally are attributable to excessive exposure to ultraviolet radiation from the sun and indoor tanning (see *Ultraviolet Radiation,* Chapter 8).

Other notable cancer risk factors include reproductive and hormonal factors (see *Reproductive and Hormonal Factors,* Chapter 9), occupational exposures to carcinogenic agents, and environmental pollutants such as air pollution (**Figure 2.3**), arsenic, and aflatoxin (see *Environmental Pollutants and Occupational Exposures*, Chapter 10). Climate change can also increase exposure to environmental pollutants (see *Climate Change*, Chapter 11).

> "The cancer miracle isn't a cure. It's prevention."
>
> — **Madeline Drexler**
> Editor, Harvard Public Health

Figure 2.1

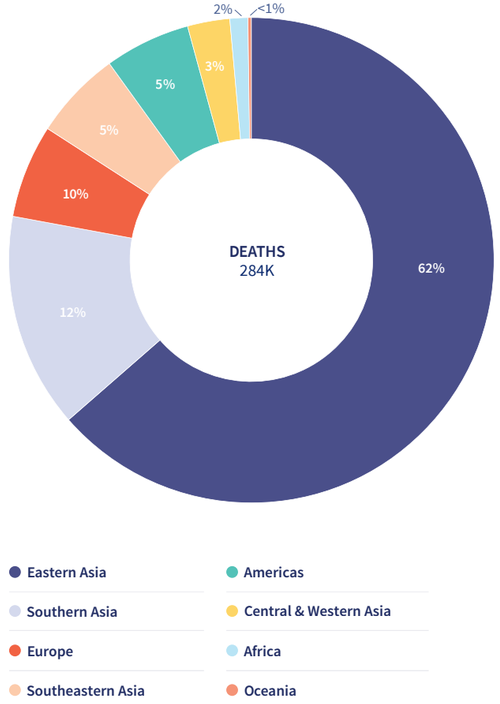
Proportion (%) of cancer burden attributable to major preventable risk factors globally, 2020/2021



Footnote
The cancer burden (excluding nonmelanoma skin cancers) attributable to smoking and excess body fatness is estimated based on 2021 cancer mortality data, while the burden linked to alcohol and infection is derived from 2020 cancer incidence data.

Figure 2.3

Number of lung cancer deaths attributable to outdoor air pollution by world region, 2021



Map 2.1

Proportion (%) of cancer cases attributable to human papillomavirus (HPV) infection among females, 2020

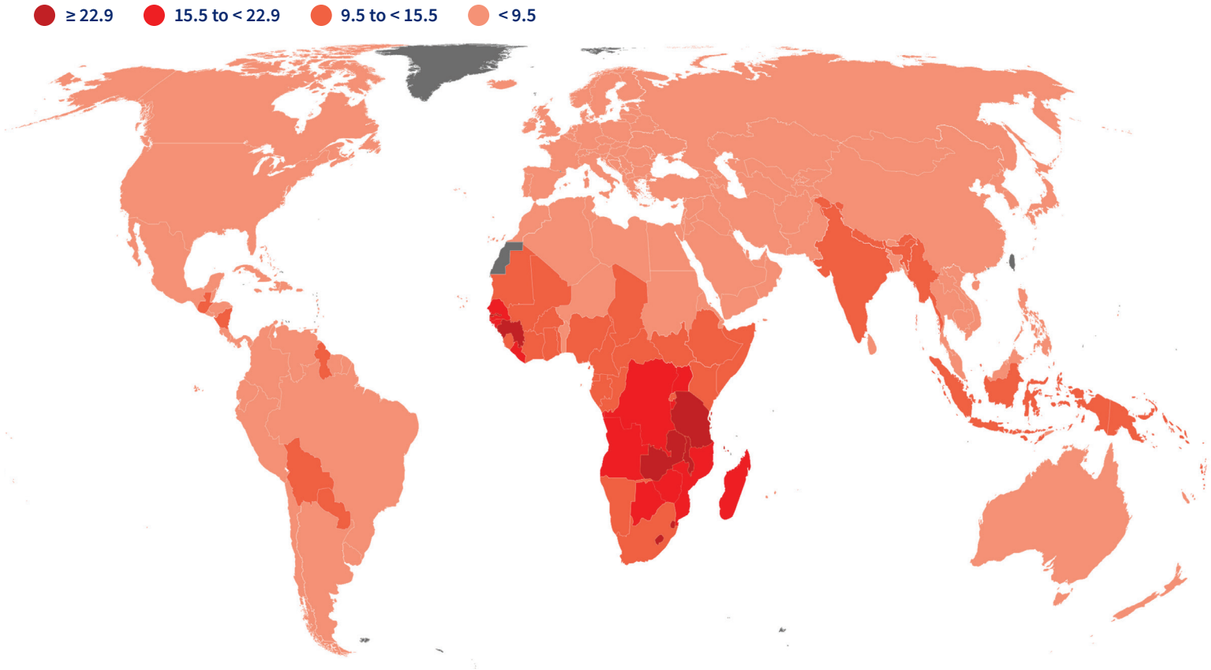
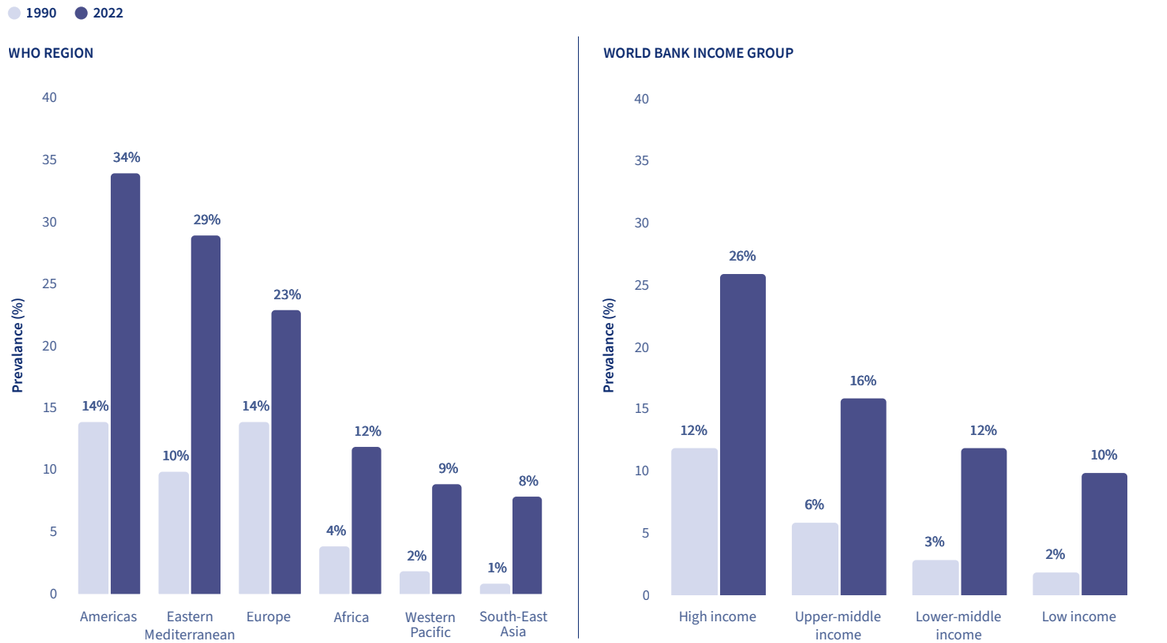


Figure 2.2

Age-standardized prevalence (%) of obesity (body mass index ≥30 kg/m²) among adults (18+ years) in 1990 and 2022



Human Carcinogens

Identified by the IARC Monographs program

Almost 130 agents have been classified as having sufficient evidence to cause cancer in humans.

The IARC Monographs identify the causes of human cancer. Sometimes called the World Health Organization's "Encyclopedia of Carcinogens," the *IARC Monographs* are systematic evaluations of the strength of evidence that an agent can cause cancer in humans. Since the program's inception in 1971, over 1,040 agents have been evaluated, including chemicals, complex mixtures, physical and biological agents, personal habits, and occupational exposures.

The agents are classified as *carcinogenic to humans* (Group 1), *probably carcinogenic to humans* (Group 2A), *possibly carcinogenic to humans* (Group 2B), or *not classifiable as to their carcinogenicity to humans* (Group 3). This classification, based on publicly available scientific literature, reflects evidence derived from studies of cancer in humans, cancer in experimental animals, and studies on carcinogen mechanisms in exposed humans, experimental animals, and in-vitro systems. Evidence from human and animal studies of cancer is considered as *sufficient*, *limited*, *inadequate*, or *suggesting lack of carcinogenicity*. Mechanistic evidence from *in-vitro* studies is considered as *strong*, *limited*, or *inadequate*, based on the key characteristics of carcinogens. To date, 129 agents have been classified in Group 1, mainly on the basis of *sufficient* evidence from epidemiological studies that the agent can cause one or more cancer types in humans, and with some agents classified based on *sufficient* evidence for cancer in experimental animals and strong evidence in exposed humans for the key characteristics of carcinogens.

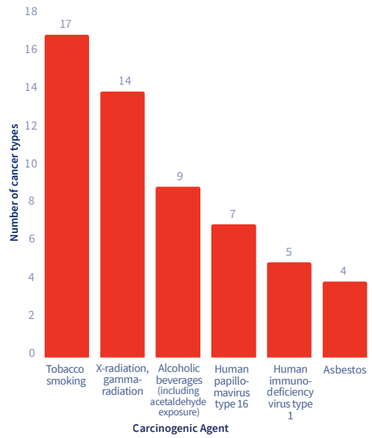
Some important risk factors for cancer in humans have not been evaluated by the *Monographs* program, notably genetic traits, reproductive status, and other diseases (e.g., diabetes), while certain protective factors, such as weight control, physical activity, or reduction of alcohol consumption (see *Body Fatness, Physical Activity, and Diet,* Chapter 6 and *Alcohol,* Chapter 7) have been evaluated by the *IARC Handbooks*. However, excess body fatness and sedentary behavior may be topics of future *Monographs* evaluations.

Figure 3.1 shows which agent(s) have sufficient evidence of causing cancer for each organ or group of organs in the human body.

The number of such agents for the most common cancer types (lung, breast, colorectum, prostate, stomach, and liver) is highly variable. For example, there are 32 known causes of lung cancer, but no known causes of prostate cancer identified by the *Monographs* program. Over 40 agents cause cancer in more than one target organ site, with tobacco causing cancer in 17 sites and X-radiation and gamma-radiation in 14 sites (**Figure 3.2**).

Figure 3.2

IARC Monograph Group 1 (carcinogenic to humans) agents associated with four or more cancer types, 2024

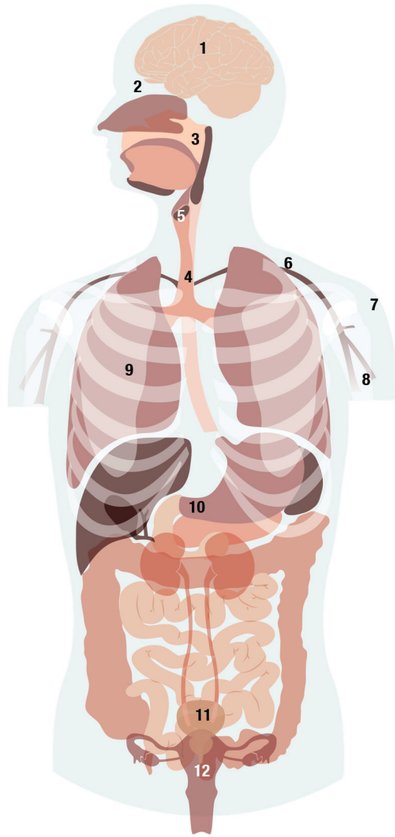


Footnote
Major cancer site groupings: some types are combined.

Figure 3.1

Group 1 (carcinogenic to humans) agents by target organ site

1 Brain and Central Nervous System	X-radiation, gamma-radiation		
2 Eye	Human immunodeficiency virus type 1 (HIV)	Ultraviolet-emitting tanning devices	Welding
3 Oral Cavity and Pharynx	**ORAL CAVITY** Alcoholic beverages Betel quid with tobacco Betel quid without tobacco Human papillomavirus type 16 Smokeless tobacco Tobacco smoking	**PHARYNX (ORO-, HYPO- AND/OR NOT OTHERWISE SPECIFIED)** Alcoholic beverages Betel quid with tobacco Human papillomavirus type 16 Tobacco smoking **SALIVARY GLAND** X-radiation, gamma-radiation	**NASOPHARYNX** Epstein-Barr virus Formaldehyde Salted fish, Chinese-style Wood dust **TONSIL** Human papillomavirus type 16
4 Respiratory System	**NASAL CAVITY AND PARANASAL SINUS** Isopropyl alcohol manufacture using strong acids Leather dust Nickel compounds Radium-226 and its decay products Radium-228 and its decay products Tobacco smoking Wood dust **LARYNX** Acid mists, strong inorganic Alcoholic beverages Asbestos (all forms) Opium consumption Tobacco smoking **LUNG** Acheson process (occupational exposures associated with) Acrylonitrile Aluminium production Arsenic and inorganic arsenic compounds	Asbestos (all forms) Beryllium and beryllium compounds Bis(chloromethyl)ether; chloro-methyl methyl ether (technical grade) Cadmium and cadmium compounds Chromium (VI) compounds Coal, indoor emissions from household combustion Coal gasification Coal-tar pitch Coke production Diesel engine exhausts Hematite mining (underground) Iron and steel founding MOPP (vincristine-prednisone-ni-trogen mustard-procarbazine mixture) Nickel compounds Opium consumption Outdoor air pollution Outdoor air pollution, particulate matter in Painter (occupational	exposure as) Plutonium Radon-222 and its decay products Rubber production industry Silica dust, crystalline Soot Sulfur mustard Tobacco smoke, secondhand Tobacco smoking X-radiation, gamma-radiation Welding fumes **MESOTHELIUM** Asbestos (all forms) Erionite Firefighter (occupational exposure as a) Fluoro-edenite Painter (occupational exposure as a)
5 Thyroid	Radioiodines, including iodine-131 (exposure during childhood and adolescence)		X-radiation, gamma-radiation



6 Hematopoietic System	Azathioprine Benzene Busulfan 1,3-Butadiene Chlorambucil Cyclophosphamide Cyclosporine Epstein-Barr virus Etoposide with cisplatin and bleomycin Fission products, including Strontium-90 Formaldehyde	Helicobacter pylori Hepatitis C virus HIV type 1 Human T-cell lymphotropic virus type 1 Kaposi sarcoma herpes virus Lindane Melphalan MOPP (vincristine-prednisone-ni-trogen mustard-procarbazine mixture) Pentachlorophenol Phosphorus-32, as phosphate	Rubber production industry Semustine [1-(2-Chloroeth-yl)-3-(4-methylcyclohexyl)-1-ni-trosourea, or methyl-CCNU] Thiotepa Thorium-232 and its decay products Tobacco smoking Treosulfan X-radiation, gamma-radiation
7 Skin	**MELANOMA** Solar radiation Polychlorinated biphenyls Ultraviolet-emitting tanning devices **OTHER MALIGNANT NEOPLASMS**	Arsenic and inorganic arsenic compounds Azathioprine Coal-tar distillation Coal-tar pitch Cyclosporine Methoxsalen plus ultraviolet A	Mineral oils, untreated or mildly treated Shale oils Solar radiation Soot X-radiation, gamma-radiation
8 Bone	Plutonium Radium-224 and its decay products	Radium-226 and its decay products	Radium-228 and its decay products X-radiation, gamma-radiation
9 Breast	Alcoholic beverages Diethylstilbestrol	Estrogen-progestogen contraceptives	Estrogen-progestogen menopausal therapy X-radiation, gamma-radiation
10 Digestive System	**ESOPHAGUS** Acetaldehyde associated with consumption of alcoholic beverages Alcoholic beverages Betel quid with tobacco Betel quid without tobacco Smokeless tobacco Tobacco smoking X-radiation, gamma-radiation **UPPER AERODIGESTIVE TRACT** Acetaldehyde associated with consumption of alcoholic beverages STOMACH Helicobacter pylori Rubber production industry Tobacco smoking X-radiation, gamma-radiation	**LIVER (ANGIOSARCOMA)** Vinyl chloride **LIVER (HEPATOCELLULAR CARCINOMA)** Aflatoxins Alcoholic beverages Estrogen-progestogen contra-ceptives Hepatitis B virus Hepatitis C virus Plutonium Thorium-232 and its decay products Tobacco smoking (in smokers and in smokers' children) **GALLBLADDER** Thorium-232 and its decay products	**BILIARY TRACT** Chlonorchis sinensis 1,2-Dichloropropane Opisthorchis viverrini **PANCREAS** Smokeless tobacco Tobacco smoking **COLON AND RECTUM** Alcoholic beverages Processed meat (consump-tion of) Tobacco smoking X-radiation, gamma-radiation **ANUS** HIV type 1 Human papillomavirus type 16
11 Urinary System	**KIDNEY** Tobacco smoking Trichloroethylene X-radiation, gamma-radiation **RENAL PELVIS** Aristolochic acid, plants containing Phenacetin Phenacetin, analgesic mixtures containing Tobacco smoking **URINARY BLADDER** Aluminum production	4-Aminobiphenyl Arsenic and inorganic arsenic compounds Auramine production Benzidine Chlornaphazine Cyclophosphamide Firefighter (occupational exposure as a) Magenta production 2-Naphthylamine Opium consumption Painter (occupational exposure as a)	Rubber production industry Schistosoma haematobium Tobacco smoking ortho-Toluidine X-radiation, gamma-radiation **URETER** Aristolochic acid, plants containing Phenacetin Phenacetin, analgesic mixtures containing Tobacco smoking
12 Genital System	**CERVIX UTERI** Diethylstilbestrol (exposure in utero) Estrogen-progestogen contra-ceptives HIV type 1 Human papillomavirus type 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59 Tobacco smoking	**ENDOMETRIUM** Estrogen menopausal therapy Estrogen-progestogen meno-pausal therapy Tamoxifen **OVARY** Asbestos (all forms) Estrogen menopausal therapy Tobacco smoking	**VAGINA** Diethylstilbestrol (exposure in utero) Human papillomavirus type 16 **VULVA** Human papillomavirus type 16 **PENIS** Human papillomavirus type 16
Multiple Sites (Partly Unspecified	Cyclosporine Fission products, including Strontium-90 X-radiation, gamma-radiation (exposure in utero)		
All Cancers Combined	2,3,7,8-Tetrachlorodibenzo-para-dioxin		
Endothelium (Kaposi Sarcoma)	HIV type 1 Kaposi sarcoma herpes virus		
Less Than Sufficient Evidence in Humans*	Areca nut Aristolochic Acid Benzidine, dyes metabolized to Benzo[a]pyrene Ethanol in alcoholic beverages Ethylene oxide Etoposide Ionizing radiation (all types) 4,4'-Methylenebis (1-chloroani-line) (MOCA) Neutron radiation N'-Nitrosonornicotine, (NNN) and 4-(N-nitro-methyl-amino-1-(3-pyridyl)-1-but none (NNK)	2,3,4,5,8-Pentachlorodiben-zofuran 3,4,5,3',4'-Pentachlorobiphenyl (PCB-126) Perfluorooctanoic acid (PFOA) Polychlorinated biphenyls dioxin like, with a Toxic Equivalent Factor according to WHO (PCBs 77, 81, 105, 114, 118, 123, 126, 156, 167, 169, 189) Radionuclides, alpha-particle emitting, internally deposited Radionuclides, beta-particle emitting, internally deposited Ultraviolet radiation * Mechanistic upgrade or strong mechanistic evidence in exposed humans leading to Group 1	

Tobacco

Tobacco causes over 8 million deaths annually, including an estimated 1.3 million deaths in non-smokers who are exposed to second-hand smoke.

Tobacco products cause at least 17 forms of cancer, and are collectively responsible for over 2 million cancer deaths per year (**Figure 4.1**). Approximately 1.25 billion people use tobacco products worldwide, most of whom smoke cigarettes (**Map 4.1**). Other commonly used tobacco products known to cause cancer include smokeless tobacco, bidis, kreteks, pipes, and cigars (**Figure 4.2**). Globally, one in three oral cancer cases are linked to the use of smokeless tobacco or areca nut. Additionally, hookah (waterpipes) is considered a potential cause of cancer. While concerning, the health effects of emerging tobacco products including e-cigarettes, heated tobacco, and nicotine pouches are not well understood. Use of these products, particularly e-cigarettes, is increasing worldwide (**Figure 4.3**), especially among youth (see **Figure 34.4**). Concurrent use of two or more products is also increasingly common.

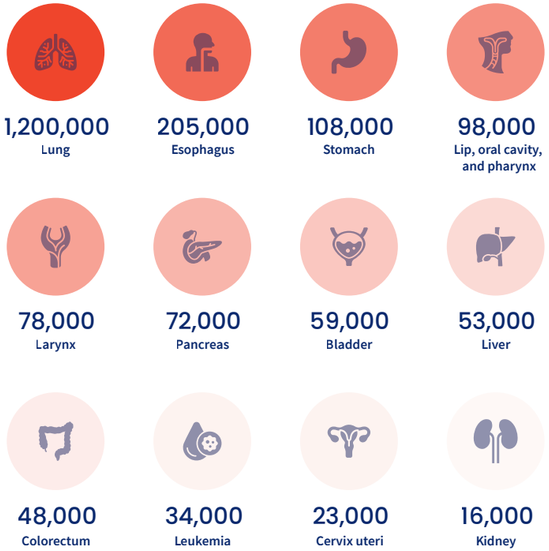
Considerable disparities in the cancer burden caused by smoking exist between and within countries and by sex. Exposures to secondhand smoke also cause cancers among nonsmokers, who are disproportionately women living in low- and middle-income countries (LMICs). Progress in tobacco control in many high-income countries has substantially reduced mortality rates of lung (see *Lung Cancer*, Chapter 14) and other smoking-related cancers. Yet in such settings, lung cancer remains the leading cause of cancer death, reflecting a higher smoking prevalence decades ago.

An estimated 80% of tobacco users live in LMICs. As a substantial percentage of teenagers in LMICs are current tobacco users (**Figure 4.4**), the number of cancer deaths caused by tobacco products is projected to increase substantially over the course of this century. Thus, comprehensive tobacco control is urgently needed in LMICs, including full implementation of the World Heath Organization MPOWER measures (see *Tobacco Control,* Chapter 34) and consideration of "Endgame Strategies". In addition to preventing initiation, support for tobacco cessation is an essential component of these efforts as cessation dramatically reduces cancer risks.

> "No single measure is known that would have as great an impact on the number of deaths attributable to cancer as a reduction in the use of tobacco."
>
> — Sirs Richard Doll and Richard Peto

Figure 4.1

Number of yearly cancer deaths attributable to tobacco smoking, 2021



Footnote
Smoking also causes cancers of the nasal cavity, paranasal sinuses and ovary (mucinous).

Figure 4.2

Different types of tobacco products

Map 4.1

Prevalence (%) of cigarette smoking by sex, 2022

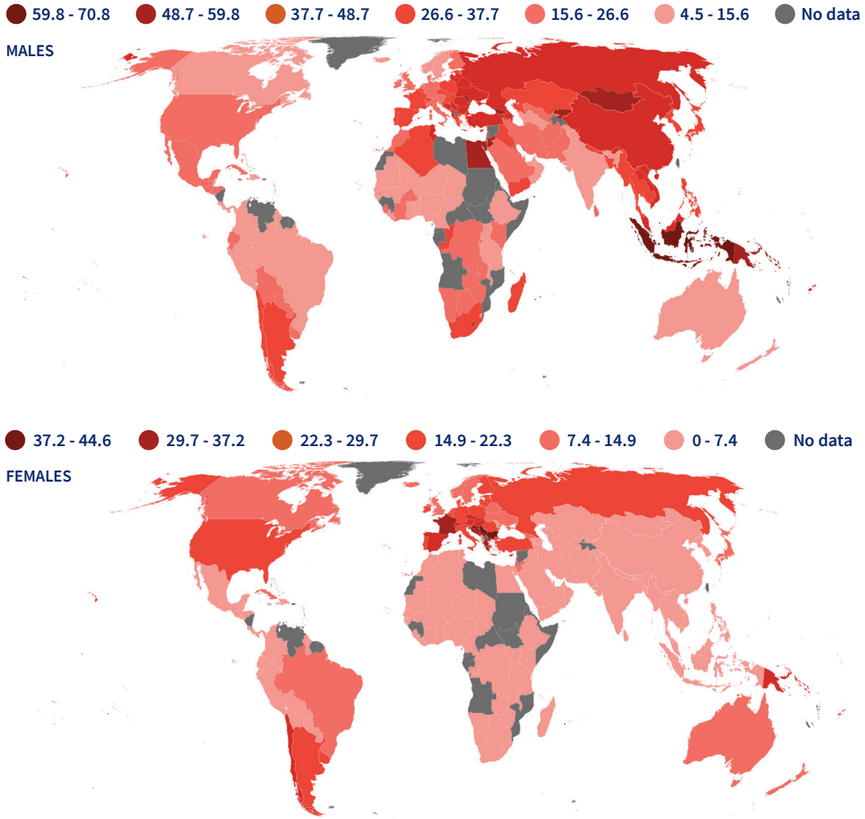
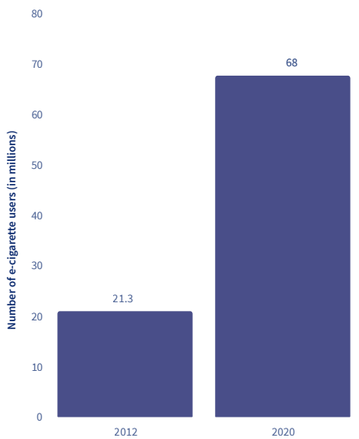


Figure 4.3

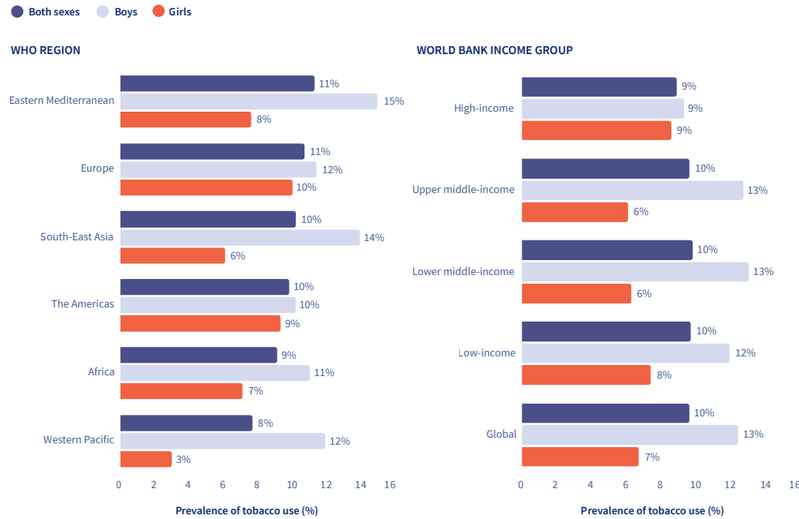
Projected changes in global number of e-cigarette users, 2012 and 2020



Footnote
The projection was based on the Global Number of Vapers Estimation from June 2020 and STATISTA data on global revenues in the e-cigarette market from May 2020 assuming at 93% linear relationship between the value of the e-cigarette market and the number of users.

Figure 4.4

Tobacco use (%) among boys and girls aged 13–15 by WHO region and World Bank income group, 2022



Infection

Infectious agents are an important cause of cancer worldwide, especially in low- and middle-income countries.

While infections (bacteria, viruses, parasites) are responsible for an estimated 12% of new cancer cases annually worldwide, they cause more than one-quarter of all cancers in many low-income countries in Africa and Asia (**Map 5.1**). The five most important cancer-causing infectious agents are *Helicobacter pylori* (850,000 cases globally), human papillomavirus (HPV) (730,000), hepatitis B virus (HBV) (380,000), hepatitis C virus (HCV) (170,000), and Epstein-Barr virus (EBV) (200,000) (**Figure 5.1**). Human papillomavirus, *Helicobacter pylori*, and Hepatitis B and C viruses cause more than 90% of all infection-related cancers worldwide. The contribution of each infectious agent to cancer burden varies substantially across different regions (**Figure 5.2**).

Helicobacter pylori causes 90% of stomach cancer, the majority of which occur in Eastern Asia. HPV infection is a necessary cause of cervical cancer, the leading cause of cancer death among women in many low-income countries, and is also responsible for a substantial proportion of anal, vulvar, vaginal, penile, and head and neck cancers (**Figure 5.3**).

Worldwide, HBV and HCV infections account for 55% and 21% of liver cancer deaths, respectively, with HBV tending to be the predominant cause of liver cancer in less developed countries and HCV in more developed settings. EBV causes lymphomas, nasopharyngeal carcinoma, and 7% of stomach cancer. Other cancer-causing infections include Kaposi sarcoma-associated herpesvirus (HHV-8; 42,000 cases, mainly in sub-Saharan Africa), human T-cell lymphotropic virus, Merkel cell virus, liver flukes, and *Schistosoma haematobium*. Human immunodeficiency virus (HIV) also indirectly causes infection-related cancers through immunosuppression and is estimated, for example, to be responsible for 20% of cervical cancer and 80% of Kaposi sarcoma in sub-Saharan Africa.

Effective prevention strategies exist for infection-related cancers, including HPV and HBV vaccines, screening for cervical and anal HPV-related precancer, and drugs to treat HBV, HCV, *Helicobacter pylori*, and HIV infections. EBV vaccines and EBV-targeted immunotherapies are in development.

The World Health Organization (WHO) has launched global mobilization efforts for the elimination of liver cancer (HBV and HCV), and cervical cancer (HPV), as public health concerns.

> "I stand by the HPV vaccine as a critical advancement in preventive healthcare. Its widespread adoption is essential to protect future generations from the devastating effects of HPV-related cancers."
>
> — **Dr. Anthony Fauci**
> Former Director of the National Institutes of Health (NIH)

Map 5.1

Proportion (%) of cancer cases attributable to infectious agents, 2020

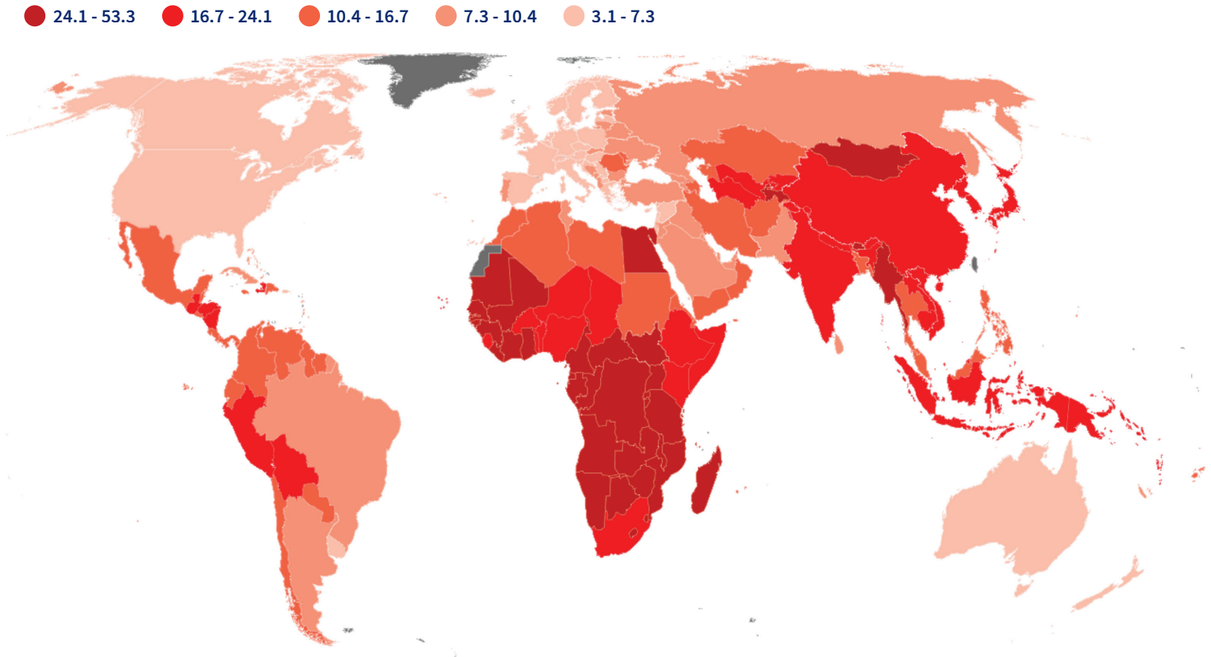


Figure 5.1

Leading cancer-causing infections worldwide (%), by sex, 2020

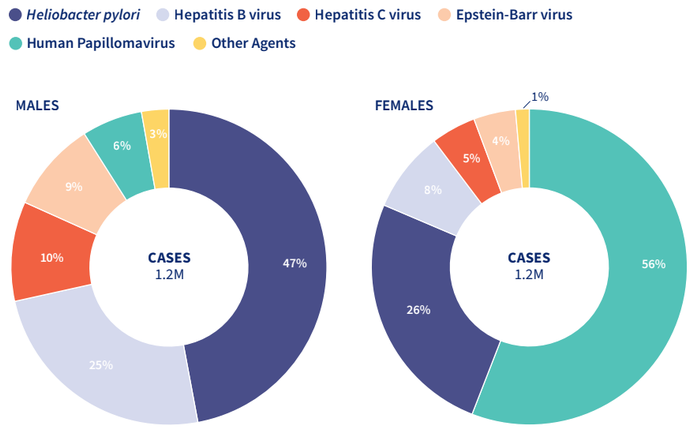


Figure 5.3

Most common infection-related cancers worldwide, 2020

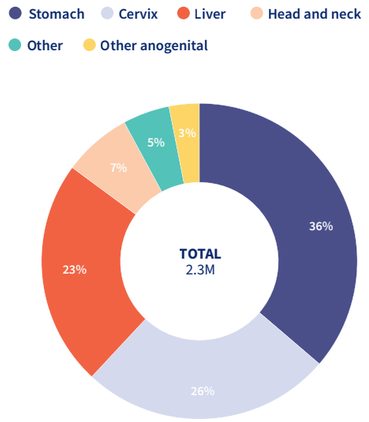
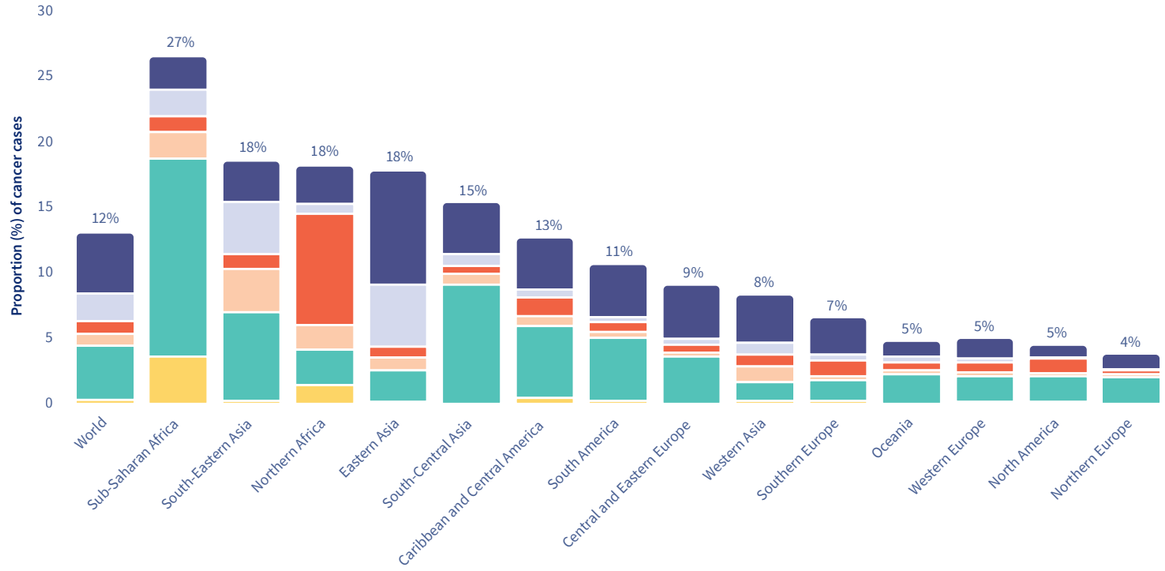


Figure 5.2

Proportion (%) of cancers attributable to infectious agents, by agent and United Nations region, 2020



Footnote
Sub-Saharan Africa includes sub-regions of Western, Middle, Eastern and South Africa.

Body Fatness, Physical Activity, and Diet

Over 80% of adolescents are not meeting physical activity guidelines for cancer prevention.

Excess body fatness – overweight and obesity – has been linked to at least 13 types of cancer. Overall, approximately 4.5% of all cancer deaths globally are attributable to excess body fatness, varying from <1% in low-income countries to 7-8% in some high-income countries. The proportion of deaths linked to excess body fatness differ by cancer type, with an estimated 40% of uterine cancer deaths, followed by 19% of kidney cancer deaths, and 18% from esophageal adenocarcinoma deaths (**Figure 6.1**). The prevalence of excess body weight substantially varies across the world, with the highest prevalence found in parts of North America and the Middle East and the lowest prevalence in parts of Africa (**Map 6.1**).

While unhealthy diet and physical inactivity contribute to excess body fatness, they also influence cancer risk independently of body weight. Emerging evidence highlights the link between greater consumption of ultra-processed foods and increased risk of a wide range of noncommunicable diseases, including cancer. Consumption of ultra-processed foods has risen globally (**Figure 6.2**), fueled by factors such as convenience, affordability, aggressive marketing, urbanization, and their addictive palatability.

A healthy dietary pattern, rich in a variety of plant foods, and low in red and processed meat, reduces the risk of certain cancers (**Figure 6.3**).

Being physically active reduces the risk of cancers of the bladder, breast, colon, endometrium, kidney, stomach, and esophageal adenocarcinoma. Nevertheless, over a quarter of adults do not meet the World Health Organization physical activity guidelines worldwide, and over 80% of adolescents are insufficiently active (**Figure 6.4**).

Promoting healthy eating and active living to reverse the obesity epidemic holds considerable potential for reducing cancer incidence and mortality. Ensuring advances in these areas will require a comprehensive approach to improve equitable access to healthy food, address commercial influences on food supply, and improve the built environment through partnerships among public, private, and community organizations. While strong, locally tailored health promotion and policies have shown promise, reversing the unfavorable trends in body fatness, diet quality, and physical inactivity will require additional resources, sustained political commitment, and global coordination (see *Health Promotion*, Chapter 33).

Figure 6.1

Proportion (%) of cancer deaths attributable to excess body fatness by cancer type, 2021

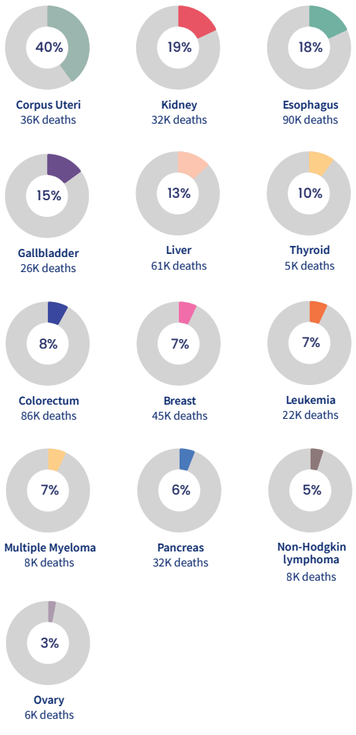


Figure 6.2

Ultra-processed food sales (kg) per capita by WHO region, 2024

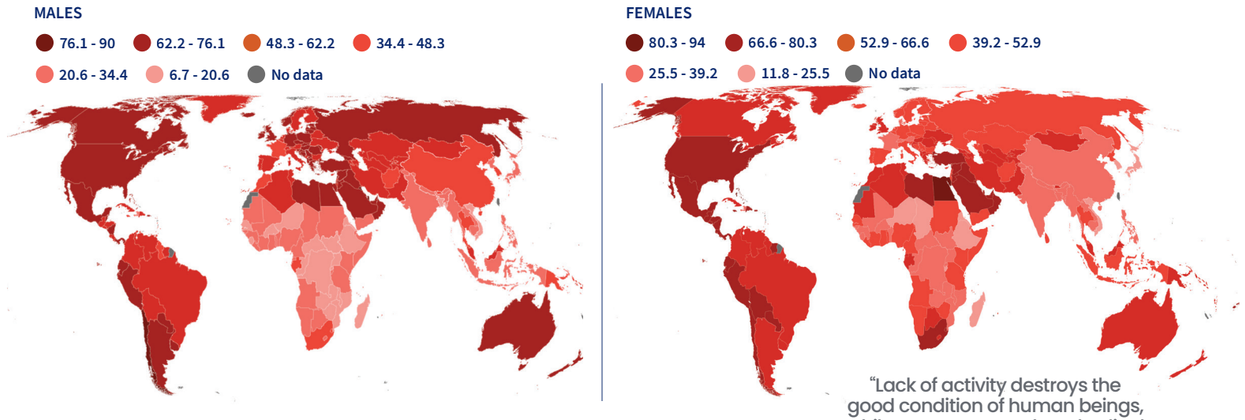
Figure 6.4

Age-standardized prevalence (%) of insufficient physical activity among adults (18+ years) in 2022 and adolescents (11-17 years) in 2016

Footnote
Insufficient physical activity is defined as less than 60 minutes of moderate- to vigorous-intensity physical activity daily.

Map 6.1

Prevalence (%) of excess body fatness (body mass index >25 kg/m²) among adults (18+ years), 2022



"Lack of activity destroys the good condition of human beings, while movement and methodical physical exercise save it and preserve it."

— Plato

Figure 6.3

Summary of evidence on body fatness, physical activity, diet, and cancer risk

Footnote
Conclusions on body fatness are based on Lauby-Secretan B et al., International Agency for Research on Cancer Handbook Working G: Body Fatness and Cancer--Viewpoint of the IARC Working Group, N Engl J Med 2016, 375:794-798, and are supplemented from the Continuous Update Project Expert Report 2018, World Cancer Research Fund/American Institute for Cancer Research: Diet, nutrition, physical activity and cancer: a global perspective. Continuous update project expert report 2018 (WCRF 2018). Conclusions on physical activity are drawn from 2018 Physical Activity Guidelines for Americans. 2nd ed. U.S. Department of Health and Human Services; Washington, DC: 2018. U.S. Department of Health and Human Services, and are supplemented with ECRF 2018. Conclusions on dietary factors are based on WCRF 2018.

Alcohol

We have known for decades that alcohol causes cancer, yet most people are not aware of the connection.

Ethanol – the primary form of alcohol in alcoholic beverages – is the most widely used psychoactive substance globally. In 2019, the average annual amount of pure alcohol consumed per adult aged ≥15 years ranged from <2.5 liters in some countries in Africa, the Middle East, and Southeast Asia to >12.5 liters in some countries in Eastern Europe (**Map 7.1**).

Alcoholic beverage consumption causes cancers of the oral cavity, pharynx, larynx, esophagus, upper aerodigestive tract, liver, colon, rectum, and female breast. All types of alcoholic beverages can cause cancer. Any amount of consumption increases the risk of oral cavity, pharynx, larynx, esophagus, and female breast cancer. A reduction or cessation of alcohol consumption can reduce the risk of both oral and esophageal cancer.

In 2020, an estimated 741,300 new cancer cases were attributable to alcohol consumption (4% of all new cancer cases) globally, with three-quarters of the cases occurring in men. Esophageal cancer among men (29%) and breast cancer (57%) among women were the biggest contributors to the alcohol-attributable cancer cases (**Figure 7.1**).

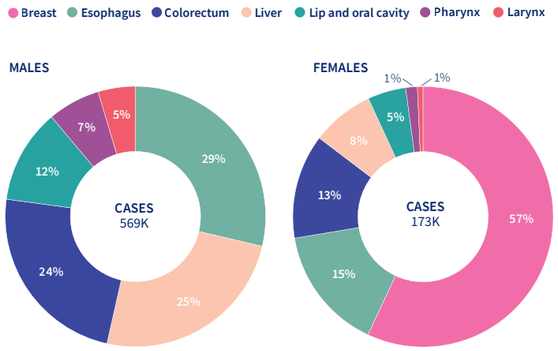
The cancer types with the largest attributable fraction due to alcohol vary by level of Human Development Index (HDI): colorectum and breast were the main contributors in very high HDI countries, oral cavity and esophagus in medium HDI countries, and esophagus and liver in low HDI countries (**Figure 7.2**). This variability may be due, at least in part, to variations in per capita alcohol consumption and the prevalence of other risk factors that have synergistic effects with alcohol consumption on cancer risk (e.g., tobacco use and hepatitis virus infection).

While most (92%) of the alcohol-related cancer cases in 2020 globally were attributable to risky (defined as 20-60 grams of ethanol/day) or heavy drinking (>60 grams of ethanol/day) among men, nearly a third (32%) were attributable to moderate drinking (<20 g of ethanol/day) among women (**Figure 7.3**).

Overall, the burden of cancer due to alcoholic beverage consumption is substantial, yet public awareness of the link between alcohol consumption and cancer remains low. Promoting alcohol reduction or cessation could have a considerable impact on reducing cancer morbidity and mortality. Toward that end, the World Health Organization (WHO) has identified five cost-effective interventions to reduce alcohol-related harms as part of the SAFER intervention program (**Figure 7.4**).

Figure 7.1

Estimated number and proportion of cancer cases attributable to alcohol consumption worldwide by sex, 2020

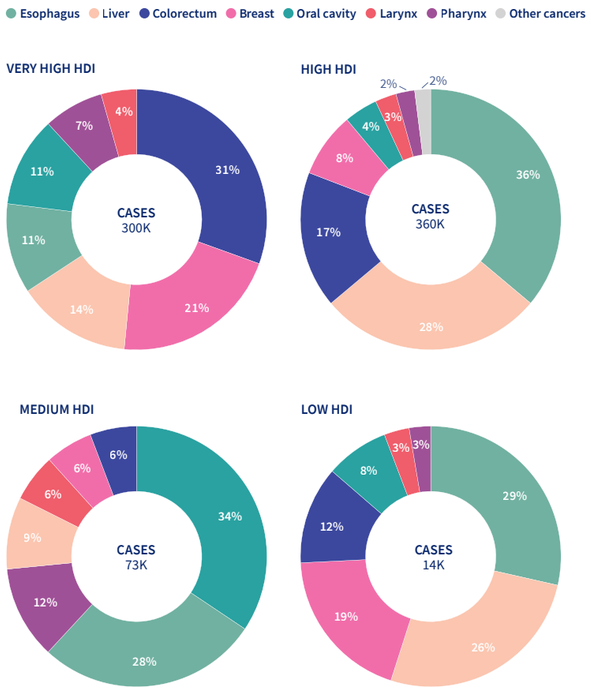


"Wine hath drowned more men than the sea."

— Thomas Fuller
Calculating Prodigy

Figure 7.2

Estimated number and proportion of cancer cases attributable to alcohol consumption by four-tier Human Development Index (HDI), 2020



Map 7.1

Alcohol consumption (liters) per capita, 2019

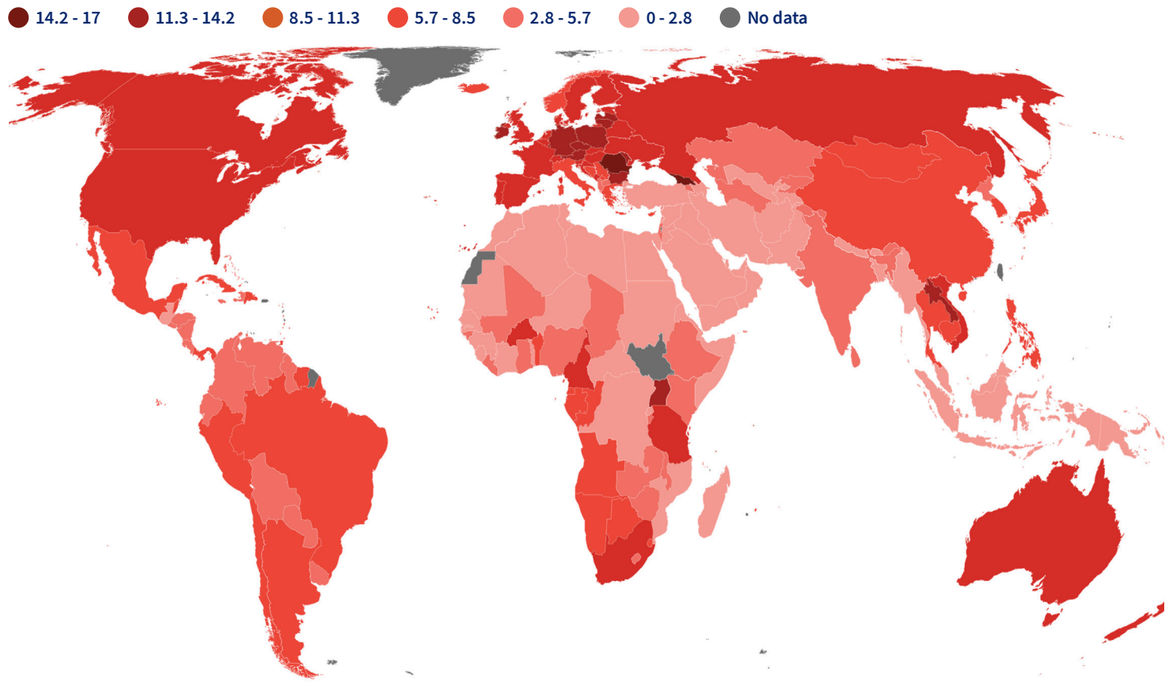
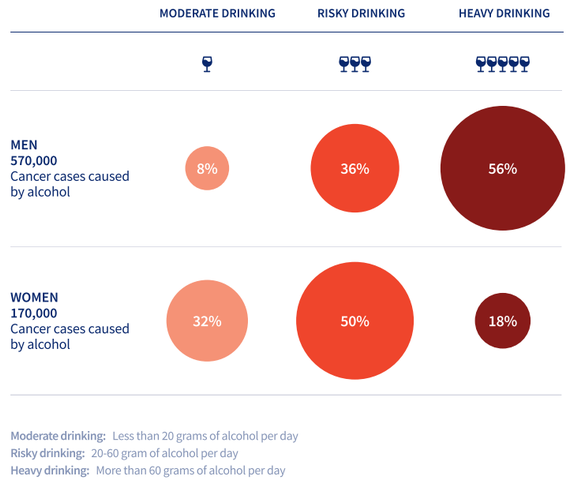


Figure 7.3

Proportion (%) of new cancer cases attributable to alcohol consumption by sex and consumption levels, 2020



Moderate drinking: Less than 20 grams of alcohol per day
Risky drinking: 20-60 gram of alcohol per day
Heavy drinking: More than 60 grams of alcohol per day

Figure 7.4

WHO SAFER Initiative – Interventions to prevent and reduce alcohol-related harm

- **S**trengthen restrictions on alcohol availability
- **A**dvance and enforce drink driving counter measures
- **F**acilitate access to screening, brief interventions and treatment
- **E**nforce bans or comprehensive restrictions on alcohol advertising, sponsorship, and promotion
- **R**aise prices on alcohol through excise taxes and pricing policies

Ultraviolet Radiation

Up to 90% of melanomas are attributable to harmful sun exposure.

Ultraviolet radiation (UVR) is the principal cause of common skin cancers: keratinocyte cancers (basal cell and squamous cell carcinomas, referred to as non-melanoma skin cancer in the remaining chapters) and cutaneous melanomas. Each year, more than 332,000 new cases of melanoma occur globally, resulting in more than 59,000 deaths. It is estimated that 70-90% of cutaneous melanomas and virtually all keratinocyte cancers are attributable to UVR exposure.

The UV Index describes the intensity of solar UVR. The UV Index varies according to the time of day (it is highest at noon), season of the year (highest in summer), and latitude (highest at the equator) (**Figure 8.1**). The highest UV Index readings are recorded in the tropics, particularly at high altitudes where the atmosphere is thin.

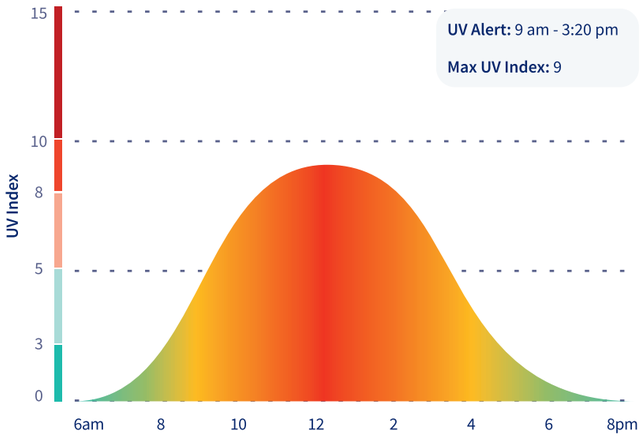
Most people are exposed to UVR from the sun, although some people receive high doses from artificial sources including solaria (tanning beds) and welding equipment. The high-energy photons of UVR penetrate the skin's outermost layers and cause genetic mutations in the deeper cells that serve to replenish the skin. This damage can ultimately progress to cancer. Melanin pigments in the skin provide some natural protection to skin cells from the harmful effects of UVR.

The highest incidence of skin cancer is observed among light skinned populations residing in regions that experience high UV Index throughout the year (**Map 8.1**). Patterns of melanoma incidence appear to be changing in some regions as a consequence of migration and population admixture.

People who start indoor tanning before the age of 35 have a 60% higher risk of melanoma.

Primary prevention of skin cancer aims to reduce population exposure to all sources of UVR. Long-running campaigns in Australia (which has the world's highest rates of skin cancer) recommend the public to protect themselves from sun exposure when the UV Index is forecast to be 3 or more by wearing protective clothing, sunglasses and hats, seeking shade, and applying sunscreen to all exposed skin (**Figure 8.2**). In addition, many jurisdictions have banned solaria (at least for young people), and sun-safe policies are being promoted in schools, workplaces, and recreational settings.

Figure 8.1
Ultraviolet (UV) index and sun protection recommendations



11+	EXTREME	**Extra Protection** Avoid being outside during midday hours. Seek shade. Shirt, suncreen and hat are a must.
8-10	VERY HIGH	**Extra Protection** Avoid being outside during midday hours. Seek shade. Shirt, suncreen and hat are a must.
6-7	HIGH	**Protection required** Seek shade during midday hours. Slip on a shirt, slop on suncreen and slap on a hat.
3-5	MODERATE	**Protection required** Seek shade during midday hours. Slip on a shirt, slop on suncreen and slap on a hat.
1-2	LOW	**No protection required** Most people can safely stay outside.

"I will never choose between UV protection and beauty again."

— **Hillary Fogelson**
Three-time melanoma survivor

Map 8.1
Incidence of melanoma of the skin, age-standardized rate (world) per 100,000, 2022

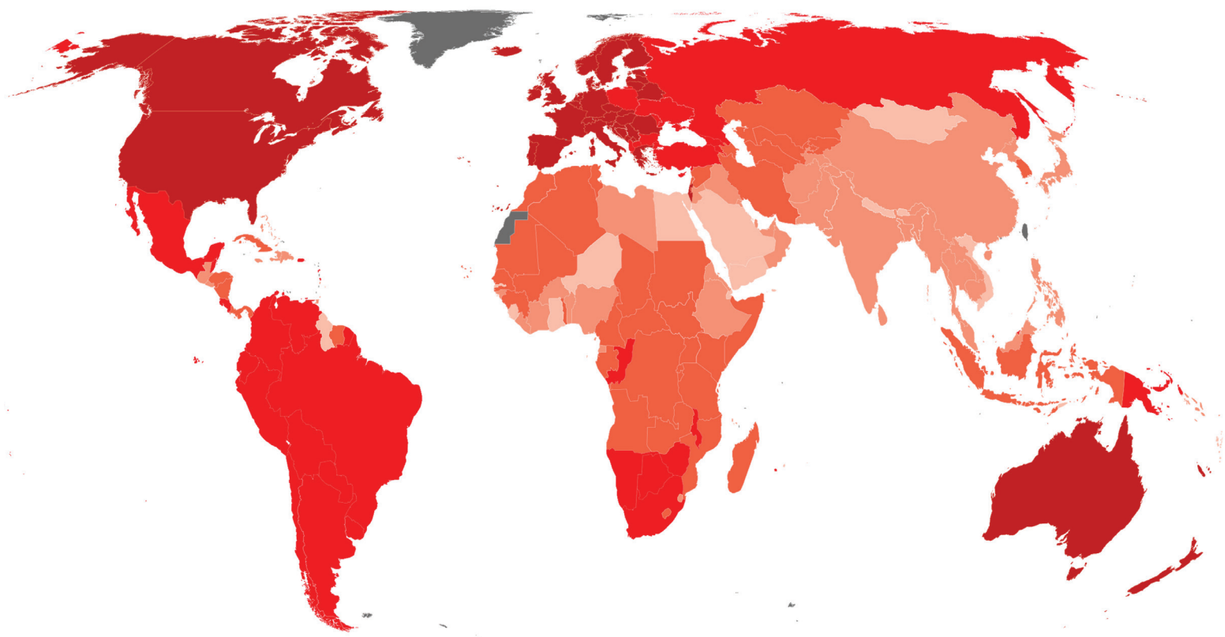


Figure 8.2
Sun Slip! Slop! Slap! Seek! Slide!
A Sun safety campaign by Cancer Council in Australia

"If you could see radiation, you'd protect your skin more."

— **Louisa Collins**
Viertel Cancer Research Centre,
Cancer Council Queensland

Reproductive and Hormonal Factors

Hormonally related cancers are among the most common cancers worldwide.

Reproductive and hormonal factors, both endogenous (naturally synthesized in the body) and exogenous (man-made), play important roles in the development of common cancers, including breast, endometrial, ovarian, and cervical cancer, with the strength and direction of these associations varying by cancer types (**Figure 9.1**). Increased access to higher education, evolving social norms, and better availability of and access to contraception have markedly changed women's reproductive patterns globally and, subsequently, the incidence rates of related cancer types.

Women are having fewer children (**Figure 9.2**) and delaying motherhood to older ages (**Figure 9.3**). The average age of menarche (first menstrual period) has been decreasing, while the average age of menopause (end of menstrual periods) has been increasing. Early menarche, late natural menopause, not having children, and first pregnancy after age 30 increase lifetime exposure to endogenous hormones, thereby increasing the incidence of breast and other hormone-related cancers (see *Breast Cancer*, Chapter 15). Although the protective effect of breastfeeding against breast cancer is well-documented, the current prevalence of breastfeeding in many high-income regions such as North America is lower than the World Health Organization target of 50% in 2023 (**Figure 9.4**).

Sustained use of exogenous hormones for contraception, reproductive assistance, or menopausal symptoms is associated with a transient increase in breast cancer risk, but a long-term reduction in ovarian and endometrial cancer risk (**Figure 9.1**). For example, estrogen and progestin combination therapy increases the risk of breast cancer, while it decreases the risk of endometrial cancer.

A new area of research is understanding how exogenous hormone use among individuals undergoing gender-affirming hormonal therapy affects their subsequent cancer risk. There is some evidence emerging that there is an increased risk of breast cancer (but a lower risk of prostate cancer) among transgender women compared to cisgender men, and a lower risk of breast cancer among transgender men compared to cisgender women.

Figure 9.1

Reproductive and hormonal factors and cancer risk

Figure 9.2

Trends in total fertility rate (number of children per woman) in selected countries, 1950-2023

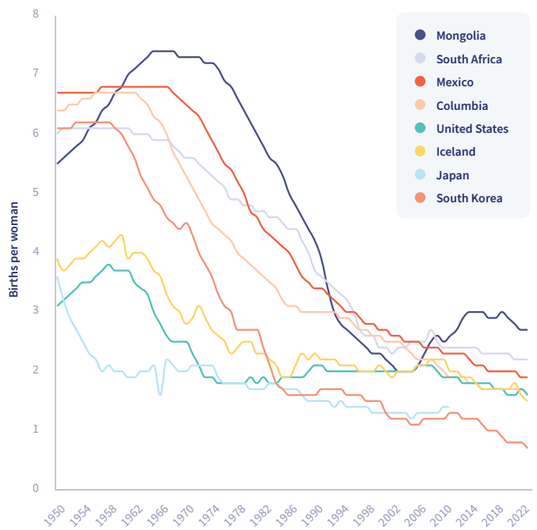


Figure 9.3

Trends in the mean age of women at birth of first child in selected countries, 1960–2020

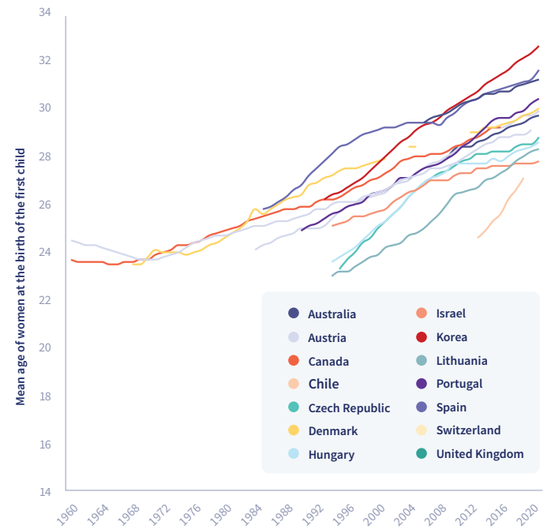
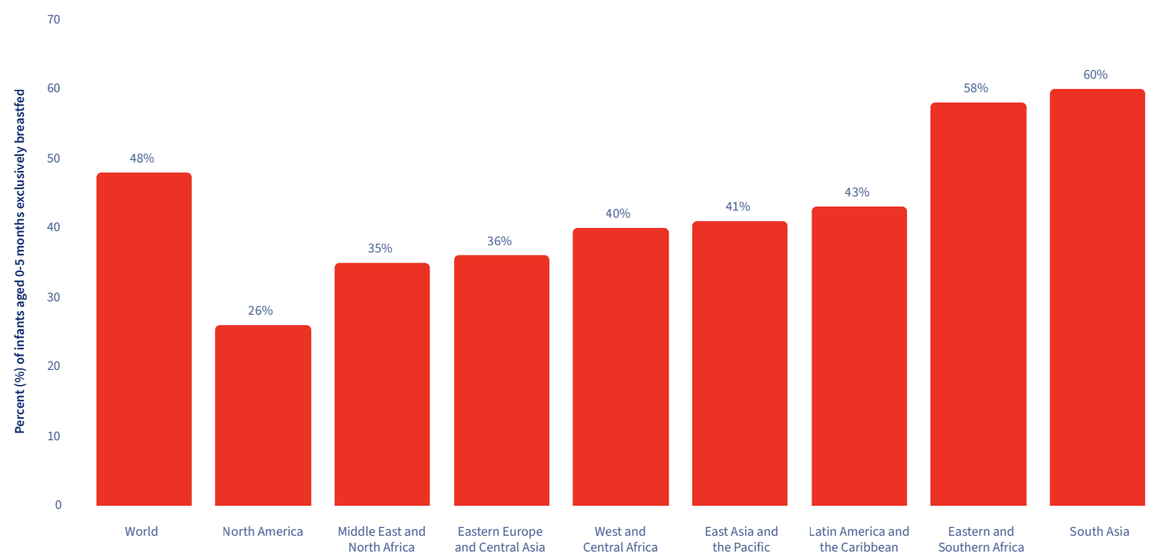


Figure 9.4

Percent (%) of infants (aged 0-5 months) exclusively breastfed by UNICEF region, 2022



Footnote
Exclusive breastfeeding means the infant receives only breast milk. No other liquids or solids are given – not even water – with the exception of oral rehydration solution, or drops/syrups of vitamins, minerals or medicines.

Environmental Pollutants and Occupational Exposures

Outdoor air pollution kills about 300,000 people every year from lung cancer alone.

Cancer-causing environmental pollutants can occur naturally (e.g., radon or arsenic) or are man-made (e.g., air pollution from burning fuels), and they can be found in the air, soil, or water. Radon, a radioactive gas that can accumulate in buildings, is the second leading cause of lung cancer in many countries, after tobacco use. Elevated levels of arsenic in drinking water or soil have been found in parts of Asia and throughout the Americas and are linked to an increased risk of skin, lung, and bladder cancer.

Outdoor air pollution level is particularly high in rapidly growing cities in low- and middle-income countries (LMICs) (**Map 10.1**). Also, the use of cooking fuel (e.g., wood, other biomass, and coal) remains a major source of indoor air pollution in some of these countries, although it is declining. Overall, outdoor air pollution alone accounts for about 15% (300,000) of lung cancer deaths worldwide, with the proportion varying from 34% in Qatar and Egypt to 2% in Tuvalu and Finland (**Map 10.2**).

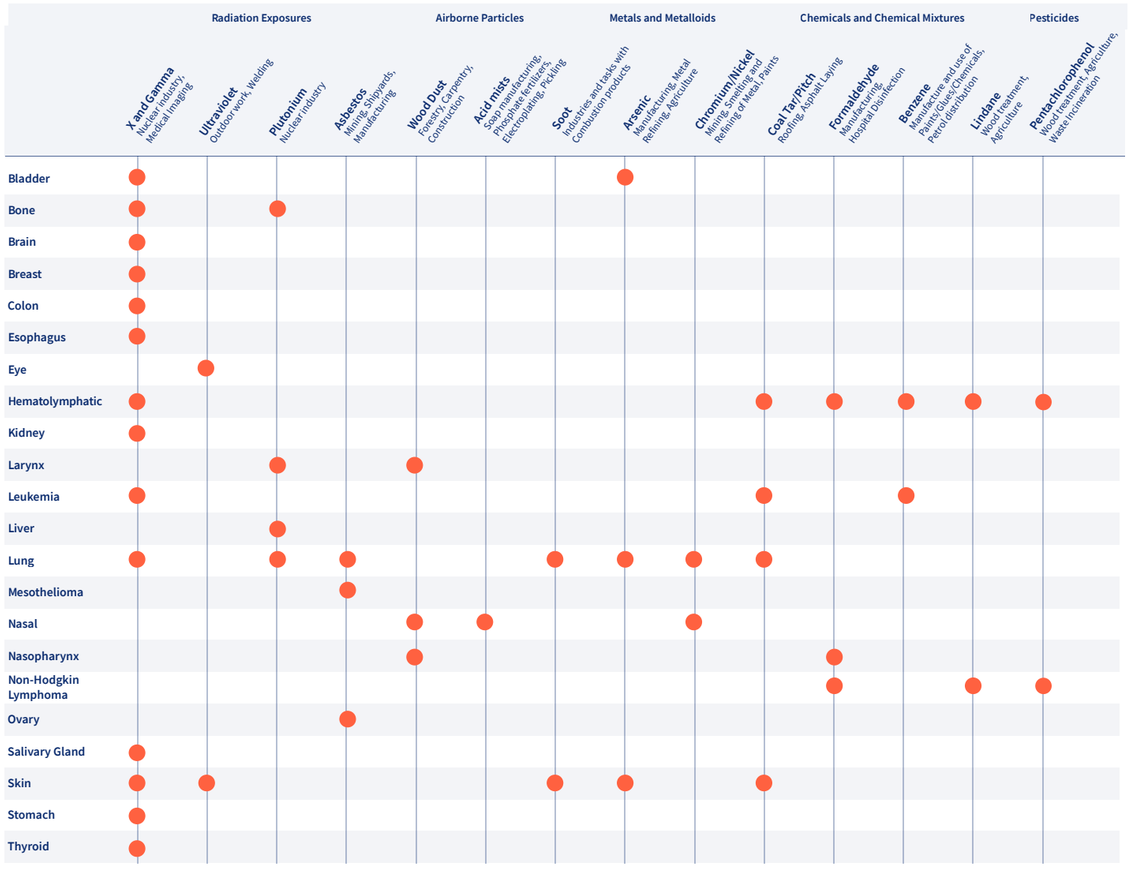
Emerging man-made environmental pollutants, such as per- and poly-fluoroalkyl substances (PFAS), are another growing concern due to their persistence in the environment and ubiquity across settings.

Numerous chemical substances and physical agents are known to cause cancer in occupational settings (**Figure 10.1**). Occupational exposure to carcinogens is particularly concerning in LMICs, where exposure levels may be higher and regulations and enforcement less strict.

Certain occupations, such as rubber manufacturing, are associated with prolonged exposure to these agents, increasing the risk of stomach, lung, and bladder cancer among workers (**Figure 10.2**). Enforcing laws and regulations is critical to ensure removal or substitution of carcinogenic materials, implementation of engineering solutions, and adequate provision of personal protective equipment to minimize, reduce, or eliminate exposures.

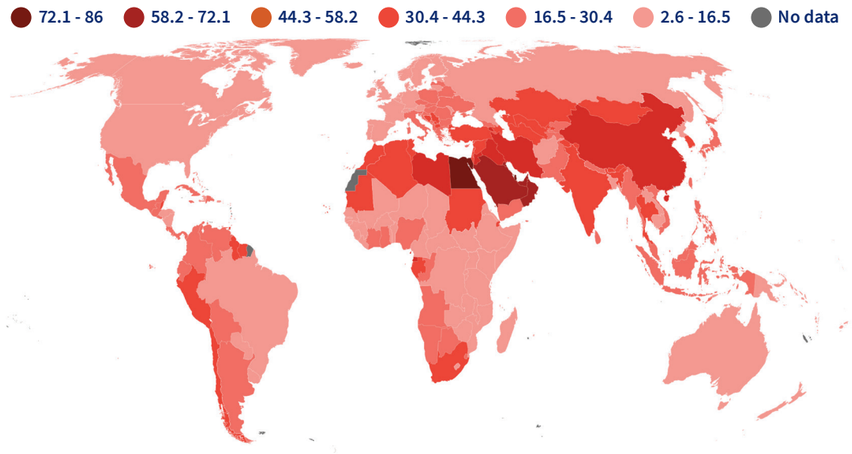
Figure 10.1

Examples of occupational carcinogens and associated cancer types



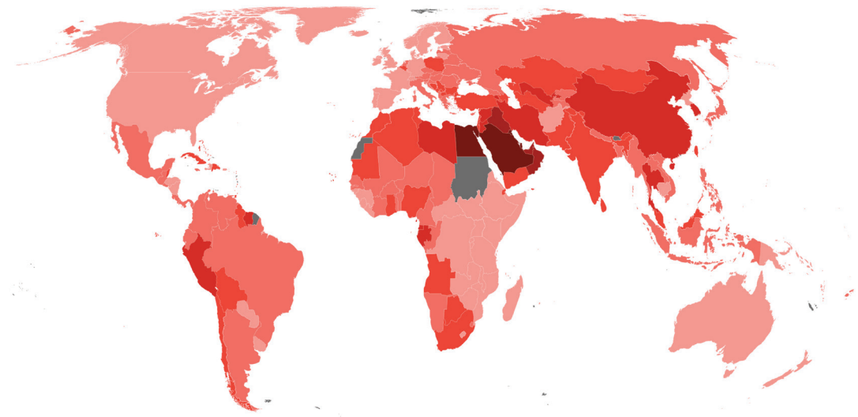
Map 10.1

Outdoor air pollution based on annual population-weighted PM2.5 concentration (µg/m³), 2021



Map 10.2

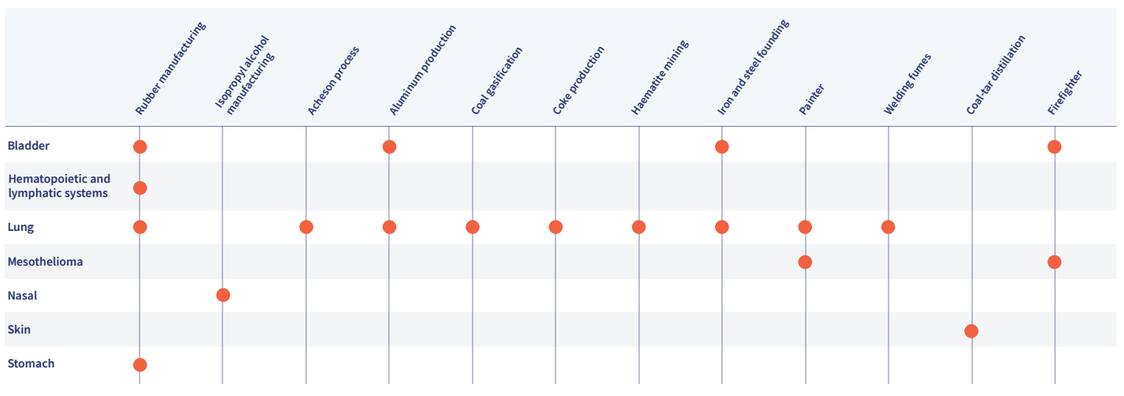
Proportion (%) of lung cancer deaths attributable to outdoor air pollution, 2021



> "The places where we live, work, and play should nurture us, not harm us."
>
> — **Dr. Tedros Adhanom Ghebreyesus**
> Director-General, World Health Organization

Figure 10.2

Examples of occupations and associated cancer types



Climate Change and Cancer

The cancer community is uniquely positioned to promote climate solutions with co-benefits for cancer control, given the activities driving climate change also exacerbate cancer outcomes.

Climate change impacts cancer control in multiple ways (**Figure 11.1**). First, human activities cause climate change and increase exposures to cancer-causing agents. For example, extraction, processing, and use of fossil fuels not only exacerbates the greenhouse effect but also increases the risk of certain cancers.

Second, climate change creates a feedback loop where climate-driven extreme weather events further increase exposure to carcinogens. Climate-driven floods can extend far beyond expected risk zones, reaching industrial areas (e.g., refineries, chemical plants), causing chemical spills, and exposing nearby communities to carcinogens released during fossil fuel extraction and processing (e.g., benzene, formaldehyde, vinyl chloride). Similarly, climate-driven wildfires can increase exposure to air pollution. Therefore, reducing pollution from human activities can have dual benefits for both climate change mitigation and cancer control.

Third, climate change leads to downstream consequences by altering the frequency and behavior of extreme weather events, creating increasingly unpredictable circumstances that complicate disaster preparedness efforts (**Figure 11.2**).

For example, climate change alters the behavior of storms because warmer air holds more water vapor, increasing the water capacity of tropical storms and consequentially heightening the risk of unanticipated and hazardous rainfall and floods. Such climate-driven extreme weather events can damage medical infrastructure, halt transportation, disrupt supply chains, and interrupt access to vaccinations, screenings, diagnosis, treatments, and survivorship care.

Finally, individuals diagnosed with cancer are vulnerable to the hazards of climate change due to the physical, psychological, and socioeconomic consequences of cancer diagnosis and treatment. Some chemotherapy agents can impair the body's ability to regulate temperature or weaken the immune system, increasing susceptibility to infections during floods and to temperature-related illnesses during heatwaves.

Considering the serious threat climate change presents to cancer control, global cancer communities should champion climate mitigation and adaptation efforts. These include enhancing disaster preparedness strategies and establishing policies relevant to both global climate change and cancer control.

> "We do not inherit the earth from our ancestors, we borrow it from our children."
>
> — Native American proverb

Figure 11.2

Selected consequences of climate change

Pollution and Heat

Flooding and Healthcare

Wildfire and Cancer

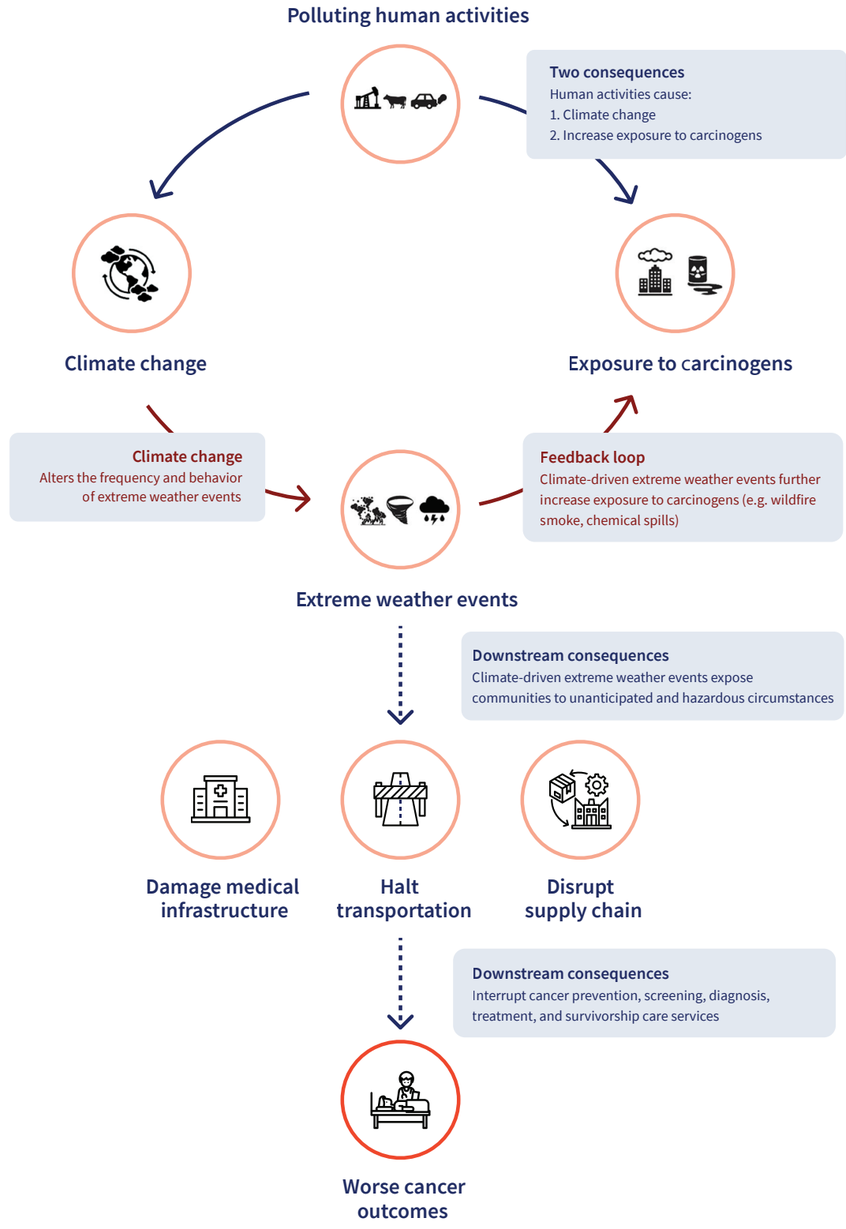
The same air pollution that causes lung cancer also traps heat in the atmosphere (i.e., the greenhouse effect). Heat influences weather patterns (i.e., climate change), resulting in more unpredictable extreme weather events, which have severe consequences for impacted communities, especially people who have been diagnosed with cancer.

Footnote
Photos: AP Images / John Raoux and AP Images / Noah Berger

> "Everyone committed to reducing the cancer burden needs to start action on climate change today. Later is too late."
>
> — Dr. Leticia Nogueira
> Scientific Director Health Services Research, American Cancer Society

Figure 11.1

Pathways through which climate change impacts cancer control



Footnote
Climate change impacts cancer control through several different pathways. **Polluting human activities** have **two consequences (1) climate change** and **(2) increased exposure to carcinogens.** Climate change alters the frequency and behavior of extreme weather events creating a **(3) feedback loop** where climate-driven extreme weather events further increase exposure to carcinogens. (**4**) **Downstream consequences** of climate-driven extreme weather events, which behave differently and expose communities to increasingly unpredictable circumstances, include interruptions in cancer control activities.

The Burden

Explore the global cancer burden in terms of incidence, mortality, prevalence, and survival for each major world region and the Human Development Index.

The Burden

At present, there are close to 19 million cancer cases and 10 million cancer deaths (excluding non-melanoma skin cancer) worldwide. In the absence of intervention, these numbers are projected to increase to 33 million cancer cases and 18 million cancer deaths by 2050.

For every 10 premature deaths (ages 30-69 years) from noncommunicable disease today, four are due to cardiovascular disease (CVD) and three are due to cancer. As countries undergo societal and economic transition, these two diseases become the leading causes of death (**Map 12.1**); in most countries, cancer eventually surpasses CVD as the leading cause in this age group, given the relatively greater impact of prevention and treatment in reducing CVD mortality.

Of the 20 million new cases and 9.7 million cancer deaths each year and across all ages, nearly one-half of all cases (52%) and a majority (56%) of cancer deaths are diagnosed in Asia, where close to 60% of the world's population reside (**Figure 12.1**). Africa accounts for 6% of the worldwide cases but for almost 8% of the deaths largely due to inadequate early detection and treatment services.

Lung cancer is currently the most frequently diagnosed cancer worldwide (13% of the total cases), followed by cancers of the female breast (12%), colorectum (10%), prostate (8%), and stomach (5%) (**Figure 12.2**). Lung cancer is also the leading cause of cancer death (19% of the total cancer deaths), followed by colorectal (9%), liver (8%), female breast (7%) and stomach (7%) cancers. In women, breast cancer is the most common cancer and the leading cause of cancer death, while lung cancer is the most frequent cancer and the leading cause of cancer death among men (**Figure 12.3**).

Cancer is the second leading cause of death worldwide and is likely to become the leading cause of premature death in every country of the world in this century.

Based on projected population ageing and growth, and assuming incidence and mortality rates remain unchanged, by 2050, the global burden is set to increase to 33 million new cancer cases and 18 million cancer deaths (**Figure 12.4**).

Figure 12.1

Estimated number of new cancer cases and deaths (excluding non-melanoma skin cancer) worldwide by region, 2022

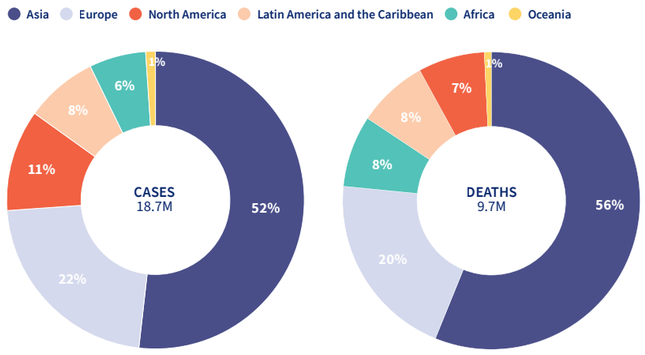


Figure 12.2

Estimated number of new cases and deaths (excluding non-melanoma skin cancer) worldwide by cancer type, 2022

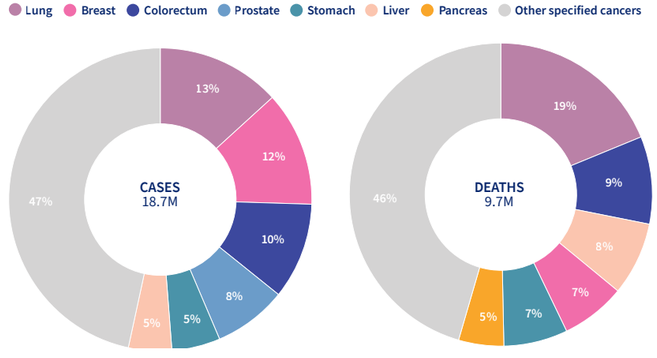
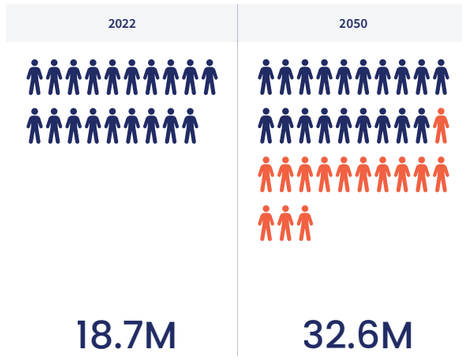


Figure 12.4

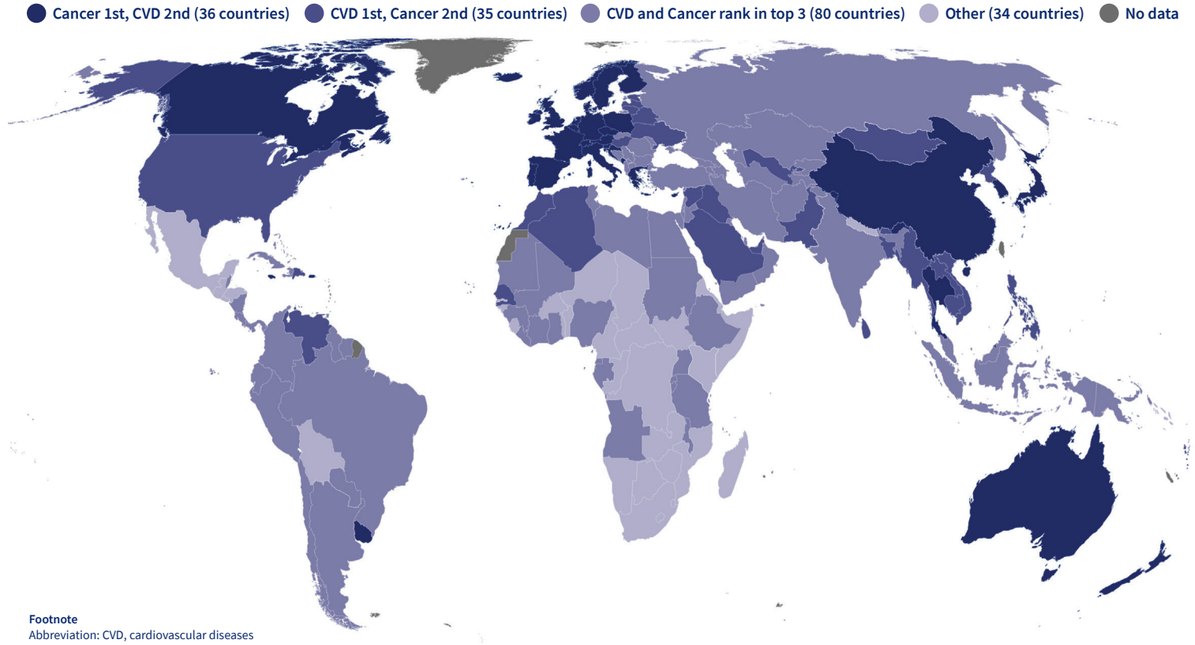
Estimated number of new cancer cases (excluding non-melanoma skin cancer) from 2022 to 2050



> "An African proverb states, 'The best time to plant a tree is 20 years ago. The second-best time is today.' In light of the major cancer burden predicted to affect many [transitioning] countries over the next 20 years, it is imperative that we act today."
>
> — Temidayo Fadelu, MD, MPH & Timothy R. Rebbeck, PhD

Map 12.1

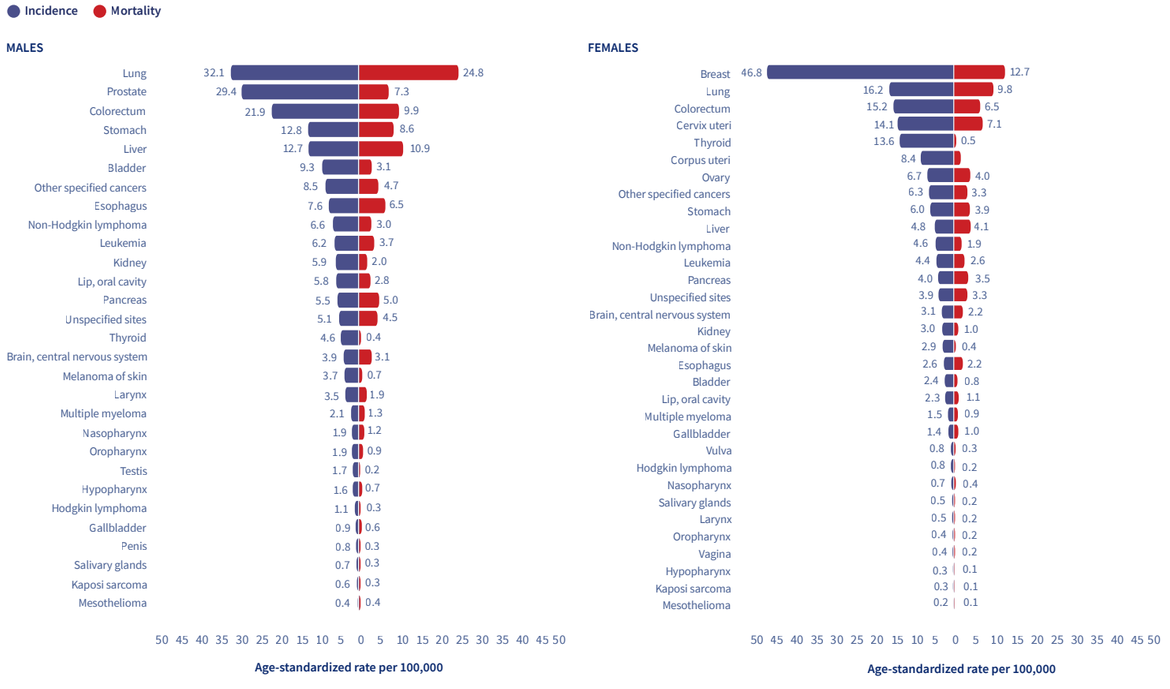
The ranking of cancer as a leading cause of premature death among adults (ages 30-69), 2019



Footnote
Abbreviation: CVD, cardiovascular diseases

Figure 12.3

Age-standardized incidence and mortality rates (world) per 100,000, by cancer type and sex, 2022



Social Inequalities

Breast cancer mortality is considerably higher in low-income compared with high-income countries despite their lower incidence due to inequalities in early detection and treatment.

With sufficient investment, cancer prevention can mitigate the marked cancer inequalities that exist between and within countries worldwide. Health inequalities refer to differences in people's health that are unjust and avoidable (**Figure 13.1**) and may relate to differences between groups based on, among others, socioeconomic position, race or ethnicity, sex, disability, gender, migration status, or place of residence. For cancer, inequalities in the cancer burden may exist throughout the entire continuum: from prevention, early diagnosis and detection, to the likelihood of receiving and accessing timely and effective cancer treatment, to accessing palliative care.

Cancer inequalities across countries are evidenced by differences in the magnitude of national cancer-specific incidence, mortality rates, and survival. For example, the hepatitis B virus (HBV) vaccine became available much earlier in high-income countries, which lowered the prevalence of HBV infections and liver cancer incidence and mortality today. In contrast, low-income countries, where vaccination would have the greatest impact, still face higher rates of HBV-associated liver cancer (**Map 18.1**).

Breast cancer incidence rates in very high-income countries are among the highest globally, with 1 in 10 women diagnosed with the disease in their lifetime, yet one in 100 women dying from the disease (**Figure 13.2**). This contrasts with low-income countries, where breast cancer mortality rates are among the highest globally, and where one in 20 women are diagnosed with the disease in their lifetime, yet closer to one in 30 women die from it. The high risk of breast cancer death in the low-income countries despite their low risk of developing the disease reflects a lack of or limited early detection and treatment services. Breast cancer mortality is considerably higher in low-income than high-income countries despite their lower incidence due to inequalities in early detection and treatment.

Socioeconomic inequalities in cancer rates between countries are paralleled by those within countries, as **Figure 13.3** illustrates for cervical cancer mortality in selected European countries. Countries in Central/Eastern Europe (with relatively lower average education) have higher cervical cancer mortality – despite having lower incidence rates – than those in Northern/Western Europe (with relatively higher average education). The variability in cervical cancer mortality among higher-education groups is relatively small, with much of the disparities between countries found within lower-education groups.

Preventative strategies offer an effective mechanism to mitigate social inequalities in cancer. At present, the disproportionately lower investment in policies of cancer prevention relative to treatment, for example, in precision oncology, may have the opposite effect, whereby existing inequalities are exacerbated.

> "Health inequalities and the social determinants of health are not a footnote to the determinants of health. They are the main issue."
>
> **— Sir Michael Marmot**
> Professor of Epidemiology and Public Health at University College London

Figure 13.1
Representation of the structural determinants of health

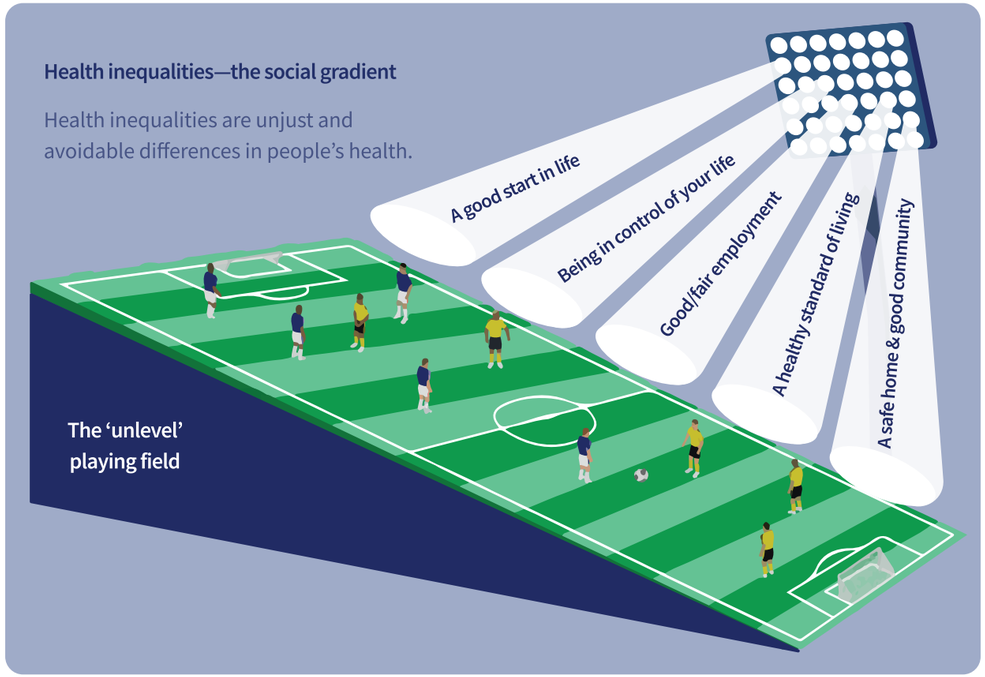


Figure 13.2
Estimated cumulative risk (%) of female breast cancer incidence and mortality before age 75 in ten countries, 2022

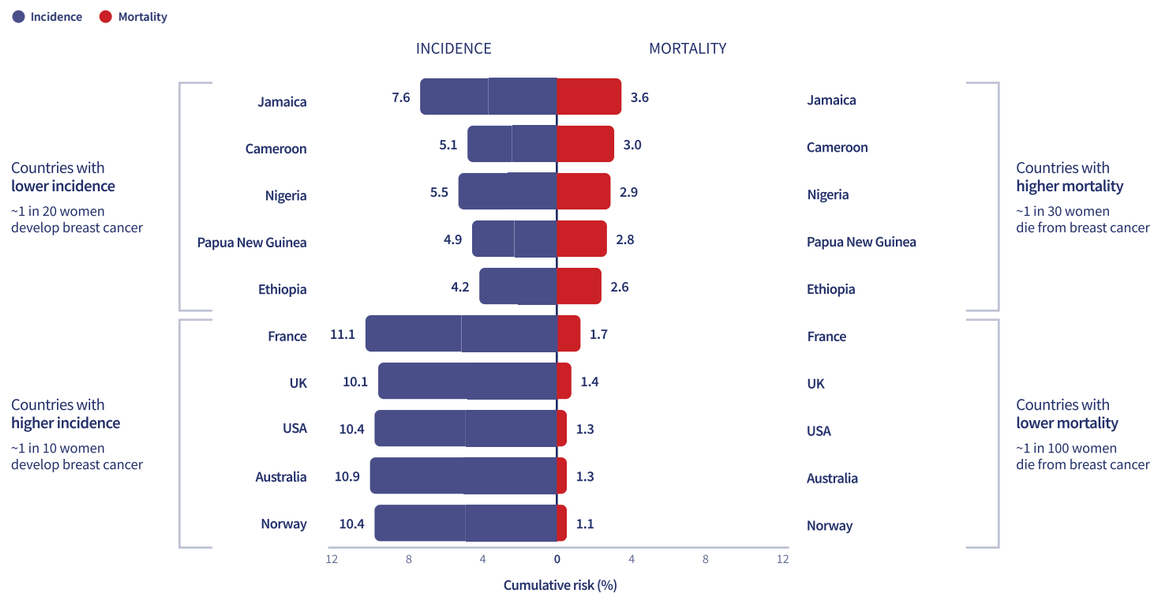
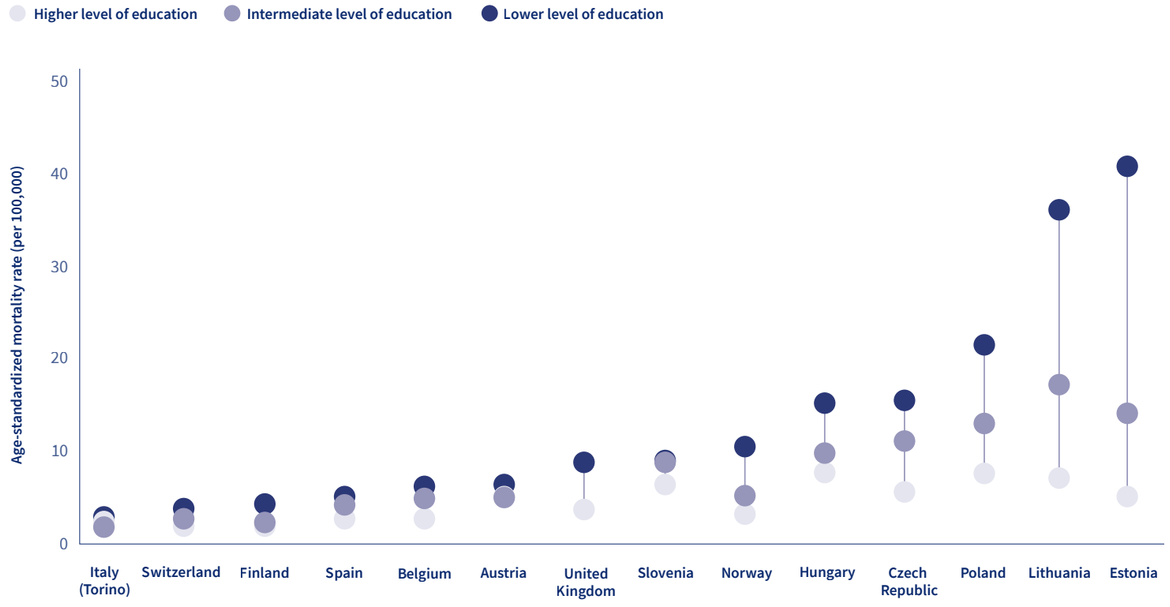


Figure 13.3
Educational inequalities between and within countries in cervical cancer mortality in Europe, by sex, 1998-2015



Footnote
The period of observation varies between 1998 and 2015, depending on the country.

Lung Cancer

Each year, 1.8 million people die from lung cancer, the cancer with the greatest number of preventable cancers.

Lung cancer is the most commonly diagnosed cancer and the leading cause of cancer death worldwide, with about 2.5 million new cases and 1.8 million deaths in 2022. Overall rates are twice as high in men than women. The highest incidence and mortality rates in both sexes are found in most parts of Europe, North America, and Australia/New Zealand and the lowest in sub-Saharan Africa (**Map 14.1**).

The historical trends in lung cancer rates in each country follow trends in smoking prevalence, with a delay of at least 25 years. Trends over time show distinct sex-specific patterns, reflecting the past and current differences in tobacco use. Among men, lung cancer incidence rates have been decreasing in most countries, starting in the early 1970s (e.g., the United Kingdom), but not until the late-1990s in women, 20 years later than men. In some countries, lung cancer mortality rates in women have continued to increase, and have surpassed those in men, as seen in Sweden and Denmark. Such trends are not observed in transitioning countries in Asia and Africa, where rates tend to be either decreasing or are stable in men and remain low in women (**Figure 14.1**).

Today, 45% of lung cancers globally are estimated to be adenocarcinomas (39% in men and 57% in women, respectively) (**Figure 14.2**). The distribution of lung cancer subtypes is shifting from squamous cell carcinoma to adenocarcinoma due to changing smoking habits, cigarette composition, other environmental causes of lung cancer (such as air pollution), and opposing incidence trends with rates of adenocarcinoma rising and squamous cell carcinoma falling. Adenocarcinoma accounts for a disproportionately higher burden of lung cancer in women compared to men.

Tobacco control remains the cornerstone for reducing lung cancer and other tobacco-related cancers in every country (see *Tobacco Control,* Chapter 34). In countries with the highest level of human development, there is a growing movement towards implementing lung cancer screening for high-risk populations.

Figure 14.2

Distribution of lung cancer by histologic subtypes worldwide by sex, 2020

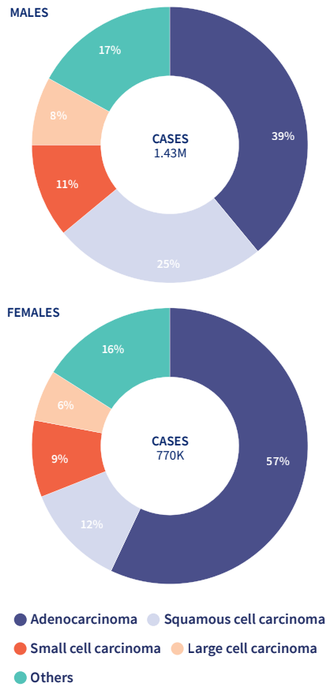
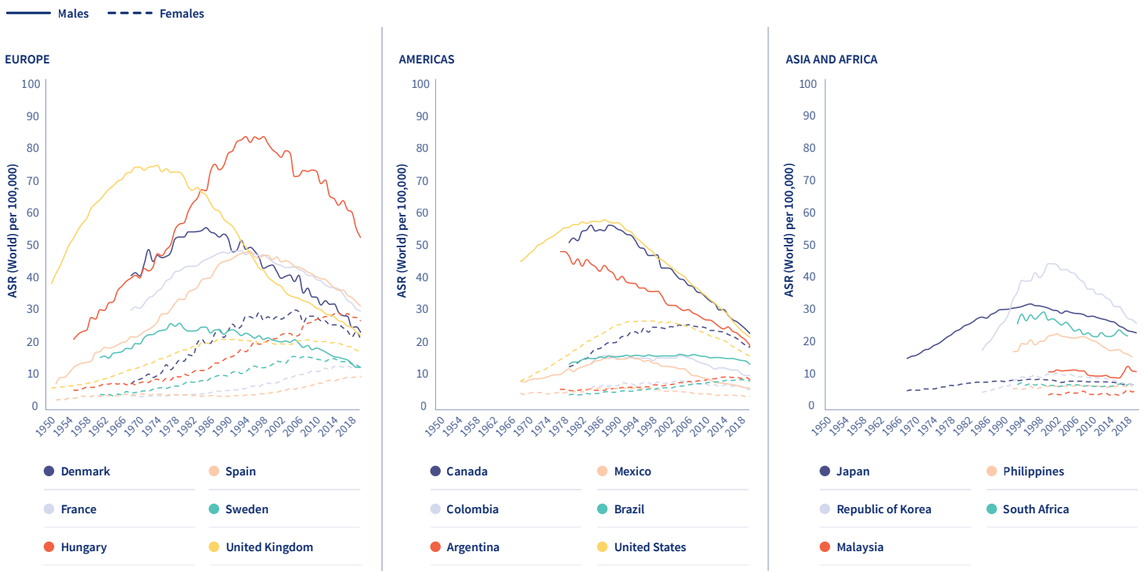


Figure 14.1

Trends in lung cancer mortality in selected countries, age-standardized rate (world) per 100,000, in males and females, 1950-2020

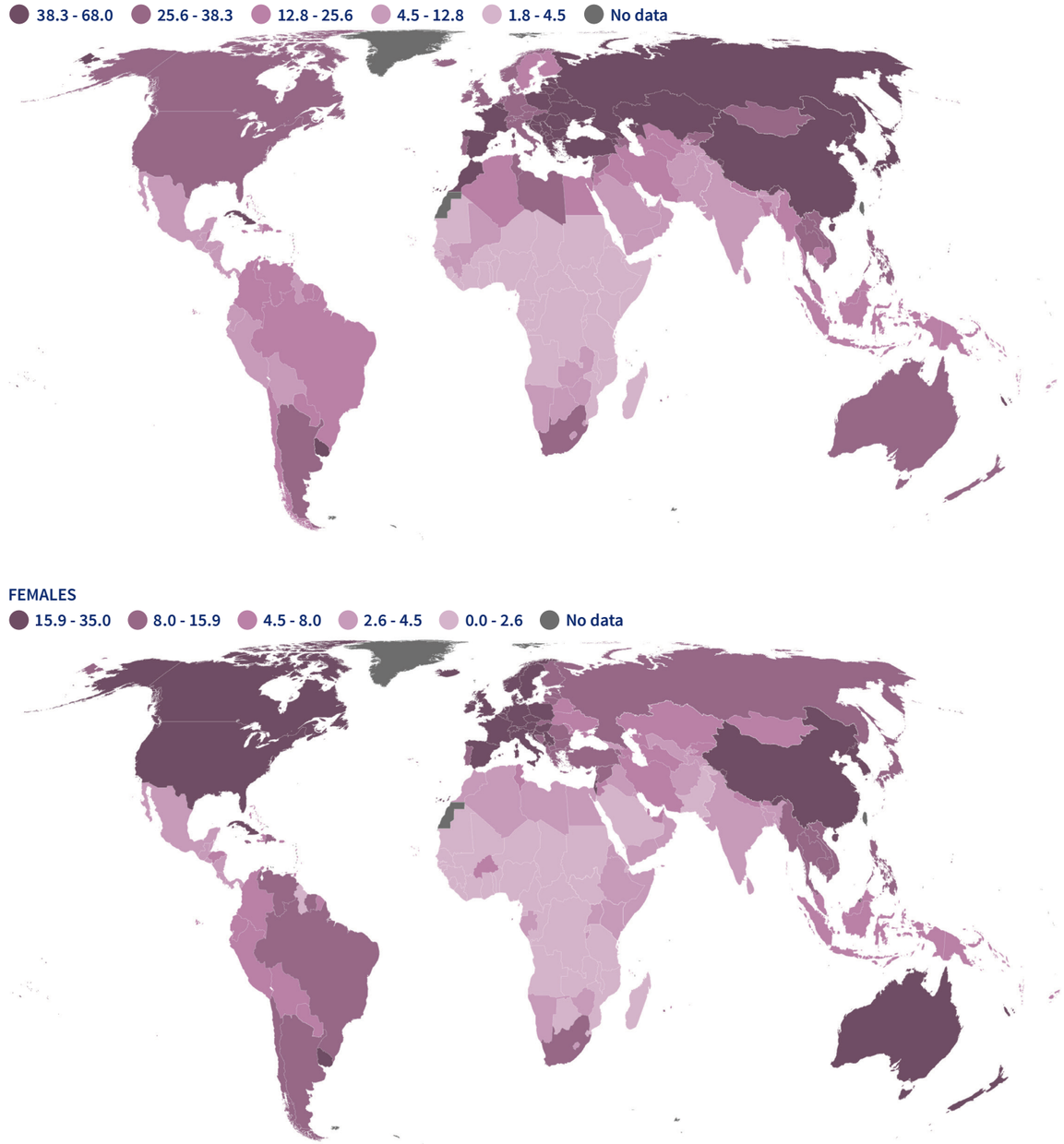


"Both of my grandparents died of lung cancer. So I got quite a lesson in the payback later in life of smoking, and if you keep it up, how bad it can be."

— George Clooney
Actor

Map 14.1

Lung cancer incidence by sex, age-standardized rate (world) per 100,000, 2022



Breast Cancer

Breast cancer is the most frequent type of cancer in women in almost 90% of the world's countries.

Today, breast cancer is the most commonly diagnosed cancer (27% of all cancer cases) and the leading cause of cancer death (16% of all cancer deaths) in women globally, ranking the cancer first in 158 countries for incidence and 111 countries for mortality (see *Geographic Diversity,* Chapter 22). While incidence rates are highest in higher-income countries in North America, Europe, and Australia/New Zealand, the inverse occurs for mortality rates, where rates are highest in lower-income countries in Western Africa, Melanesia, Polynesia, and the Caribbean (**Map 15.1**).

Breast cancer incidence rapidly increased during the 1980s and 1990s in many high-income countries, driven by shifts in risk factor prevalence and widespread adoption of mammographic screening. While overall increases have slowed or stabilized in many of these countries, many countries with historically low rates are experiencing rapid increases of 3%-5% annually (**Figure 15.1**).

The trend is linked to economic growth and changes in sociocultural dynamics, leading to changes in women's reproductive patterns (e.g., the postponement of childbearing and having fewer children) and behavioral factors (e.g., higher levels of excess body fatness and alcohol intake), along with increased detection resulting from improved awareness and diagnostic facilities. Since around the 1990s, breast cancer mortality has decreased in many high-income countries, owing to advancements in early detection and treatment. However, mortality is rising in many countries in Asia, Africa, and South America, reflecting growing incidence and an absence of the tertiary care advances seen in high-income settings (**Figure 15.2**). Diagnostic delays and insufficient treatment are common in many of these countries due to systemic, economic, and social barriers.

The projected breast cancer incidence and mortality burden in 2050 will impact countries in transition greatest (**Figure 15.3**). To strengthen systems for detecting, diagnosing, and treating breast cancer, the World Health Organization launched the Global Breast Cancer Initiative in 2021, aiming to reduce annual breast cancer mortality rates by 2.5% per year, saving 2.5 million lives over the next 20 years.

Figure 15.1

Trends in breast cancer incidence, age-standardized rate (world) per 100,000, 1975-2020

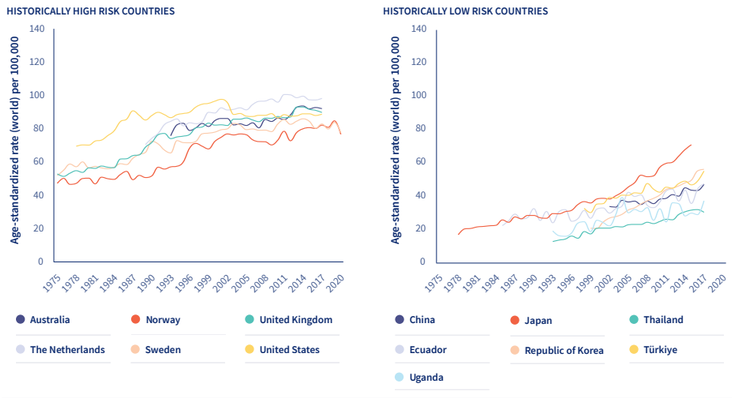


Figure 15.2

Trends in breast cancer mortality, age-standardized rate (world) per 100,000, 1975-2020

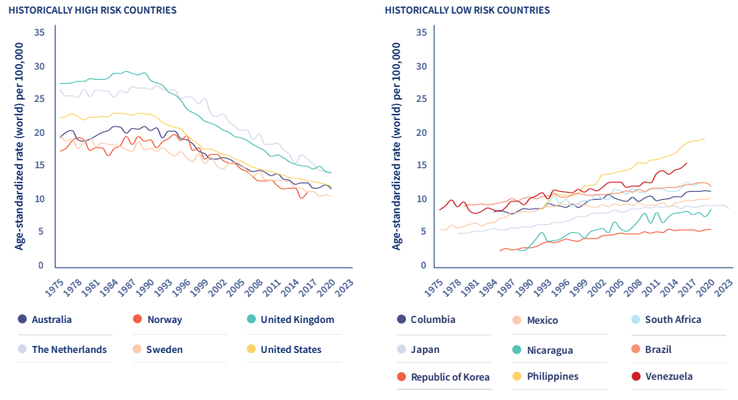
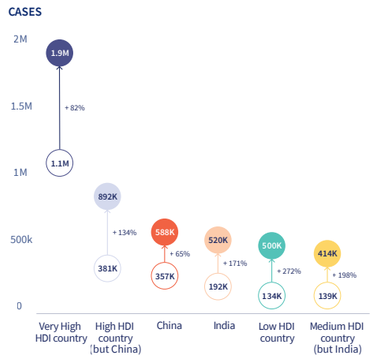


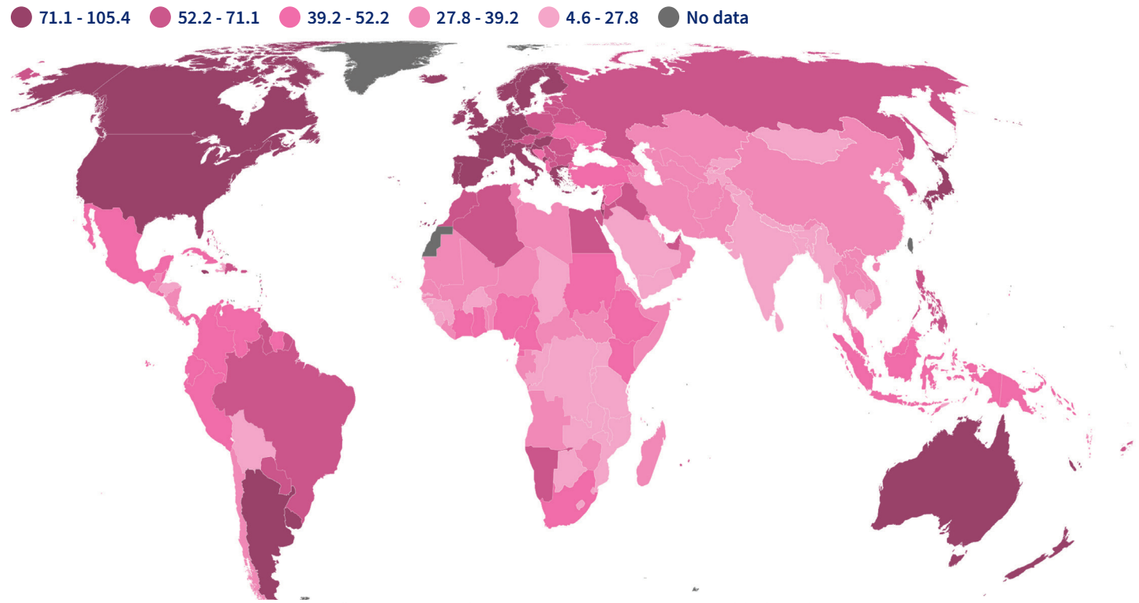
Figure 15.3

Estimated number of breast cancer cases and deaths from 2022 to 2050 by four-tier Human Development Index (HDI), China, and India



Map 15.1

Female breast cancer incidence and mortality, age-standardized rates (world) per 100,000, 2022



"The success of WHO's Global Breast Cancer Initiative will not only reduce hundreds of thousands of deaths from breast cancer each year, [but] it will also alleviate the impact of these deaths on families and on societies."

— **Dr. Valerie McCormack**
Deputy Branch Head, Environment and Lifestyle Epidemiology,
International Agency for Research on Cancer

Colorectal Cancer

More than half of all colorectal cancers can be prevented by adopting healthy behaviors.

Colorectal cancer is the second leading cause of cancer death worldwide, with an estimated 1.9 million new cases and 900,000 deaths. Incidence rates range from <5 per 100,000 in Cape Verde, Sierra Leone, and India to >45 per 100,000 in Denmark and Norway (**Map 16.1**) and are strongly correlated with human development levels (**Figure 16.1**).

Overall incidence rates are increasing in transitioning countries (**Figure 16.2**), coinciding with a rising prevalence of risk factors, such as consumption of red meat, processed meat, sedentary lifestyle, excess body fatness, smoking (in some countries), and alcohol intake. In contrast, rates have declined or stabilized in many high-income countries, such as the United States, the United Kingdom, and New Zealand, because of changing patterns in risk factors (**Figure 16.3**), such as less smoking, and uptake of screening in recent decades.

This progress, however, is confined to older adults in many countries, as colorectal cancer rates have been rising among adults aged <50 years in numerous high-income countries since around the mid-1990s (**Figure 16.2**). Studies of colorectal cancer incidence rates by birth cohort demonstrated that the risk of developing colorectal cancer is increasingly elevated among successive generations born since the 1950s. The reasons remain undetermined but may include increases in excess body weight and changes in diet.

Colorectal cancer screening is associated with reduced incidence and mortality (**Figure 16.4**). However, whether to implement organized screening programs is dependent on both the disease magnitude and whether there are sufficient resources to provide adequate diagnostic follow-up and treatment services. Screening reaches only a small fraction of the target population worldwide, and even in countries where it is available, socio-economic and regional disparities remain in screening uptake.

Primary prevention represents an opportunity to mitigate the escalating global burden of colorectal cancer, including interventions that support individuals to quit smoking, abstain or reduce alcohol consumption, engage in regular exercise, and maintain a healthy diet and body weight.

Map 16.1

Colorectal cancer incidence by sex, age-standardized rate (world) per 100,000, 2022

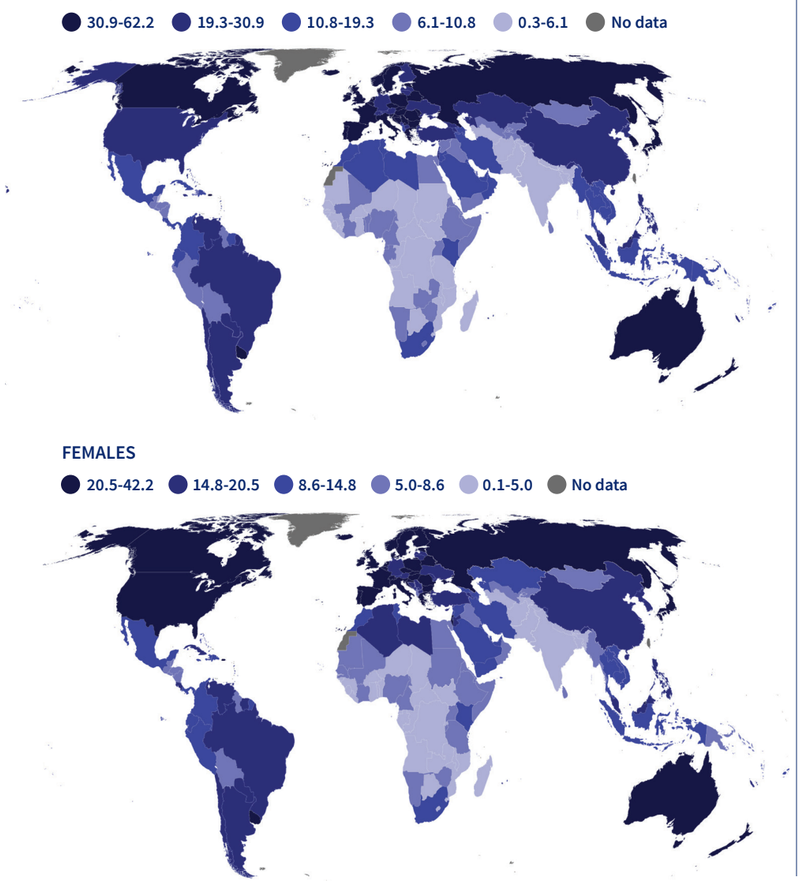


Figure 16.2

Trends in colorectal cancer incidence by age group, age-standardized rate (world) per 100,000, 1953-2017

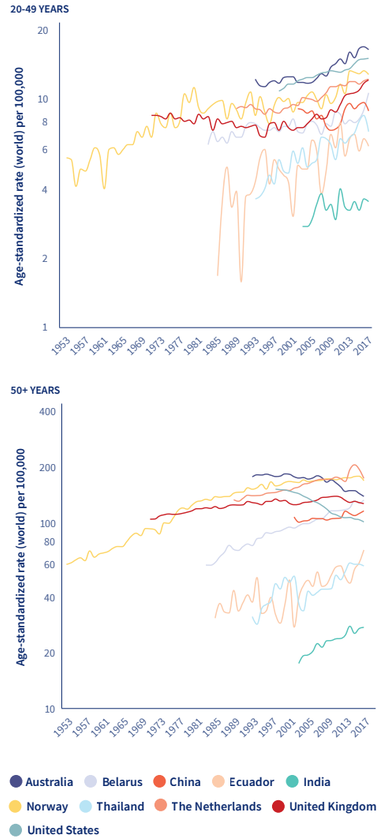


Figure 16.3

Colorectal cancer risk factors and relative risk

FACTORS THAT INCREASE RISK	RELATIVE RISK
Heredity and medical history	
At least 1 first-degree relative	2.2
At least 1 first-degree relative with diagnosis before age 50	3.6
At least 1 second-degree relative	1.7
Inflammatory bowel disease	1.7
Type 2 diabetes	
Male	1.4
Female	1.2
Behavioral factors	
Heavy alcohol consumption (daily average >3 drinks)	1.3
Obesity (body mass index ≥ kg/m^2)	1.3
Colon	
Male	1.5
Female	1.1
Rectum	
Male	1.3
Female	1.0
Red meat consumption (100 g/day)	1.1
Processed meat consumption (50 g/day)	1.2
Smoking	
Proximal colon	1.2
Distal colon	1.1
Rectum	1.3
FACTORS THAT DECREASE RISK	**RELATIVE RISK**
Behavioral factors	
Physical Activity	0.7
Dairy consumption	0.9

Footnote
The risk of disease in people with a particular "exposure" compared to people without the exposure. For dietary factors the highest versus lowest consumption is compared. A value greater than 1 indicates higher risk with exposure, whereas less than 1 is a protective effect.

Figure 16.1

Colorectal cancer incidence, age-standardized rate (world) per 100,000, by Human Development Index (HDI) and continent, 2022

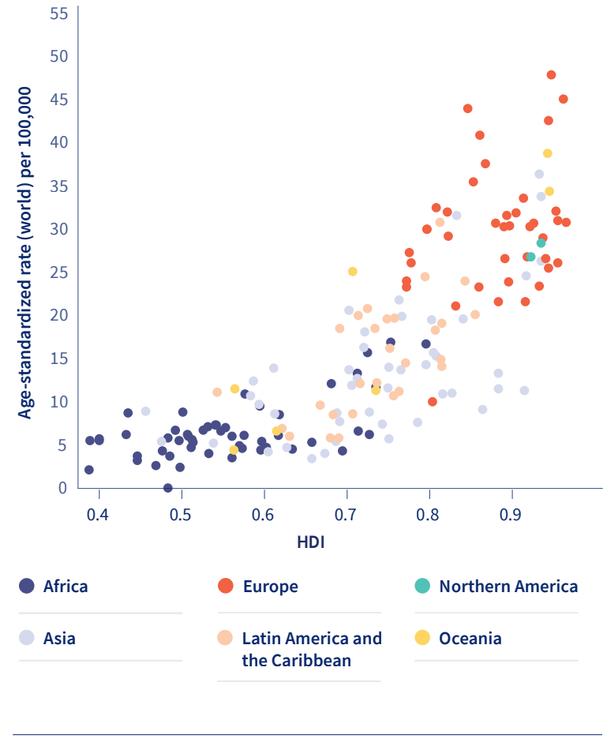


Figure 16.4

Colorectal cancer screening techniques for which there is sufficient evidence of a mortality reduction and a favorable benefit-to-harm ratio

SCREENING TEST	FREQUENCY AND MODALITY
Stool-based tests	• Screening every 2 year with guaiac test without rehydration • Screening every 1 or 2 years with higher-sensitivity guaiac test (with rehydration) • Screening every 2 year with fecal immunochemical test (FIT) for stool-based testing
Endoscopic techniques	• Single screening with sigmoidoscopy • Single screening with colonoscopy

Cervical Cancer

Cervical cancer is the leading cause of cancer death among women in 29 countries in sub-Saharan Africa.

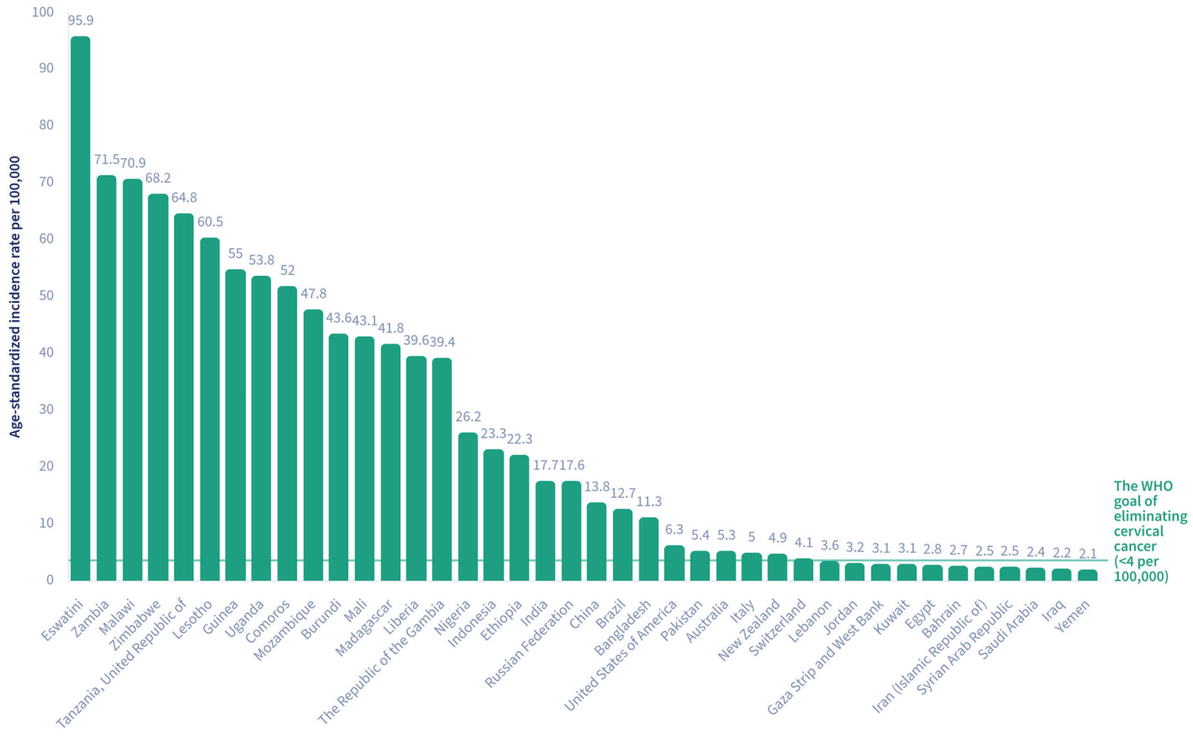
Cervical cancer is preventable, owing to effective primary prevention via human papillomavirus (HPV) vaccination and secondary prevention via screening. However, it remains the fourth most common cancer and the third leading cause of cancer death in women worldwide, with 662,000 new cases and 350,000 deaths estimated in 2022. There is a 45-fold difference in cervical cancer incidence rates across countries (**Figure 17.1**) due to uneven progress made against the disease (**Figure 17.2**). Efforts to reduce the cervical cancer burden is particularly critical in sub-Saharan Africa, where incidence rates are the highest in the world (**Figure 17.1**) and the disease remains the leading cause of cancer death in women in 29 countries (**Map 17.1**).

To achieve the goal of incidence rates of less than four per 100,000 women set by the World Health Organization (WHO) Cervical Cancer Elimination Initiative (CCEI), each country should meet the 90-70-90 targets aiming at 90% of age-eligible girls being HPV-vaccinated, 70% of age-eligible women having ≥1 lifetime cervical screening, and 90% of women with precancerous and cancerous cervical lesions being treated effectively, by the year 2030 (**Figure 17.3**). Nevertheless, by 2019, nearly two decades after the HPV vaccines were recommended by the WHO, only 1% of girls in Northern Africa and Western Asia were vaccinated (first dose), compared with 86% in Australia and New Zealand (see *Vaccination*, Chapter 35, **Map 35.2**). In 2019, only one in three women aged 30-49 years had ever been screened for cervical cancer, and 63 of 202 countries did not have official screening recommendations as of 2021 (see *Early Detection*, Chapter 36, **Map 36.2**).

Single-dose HPV vaccination reduces cost and simplifies implementation of HPV vaccine programs, while HPV-based cervical screening, paired with self-collected cervical samples, improves risk-stratification and increases screening access in remote and underserved areas. Cervical cancer is an extreme example of a global health disparity. Dramatic progress is needed. Targeted efforts to implement cervical cancer prevention measures are key to reducing disparities in cervical cancer incidence and mortality worldwide.

Figure 17.1

Cervical cancer incidence, age-standardized rate (world) per 100,000, in selected countries, 2022



Map 17.1

Cervical cancer as the leading cause of cancer death, 2022

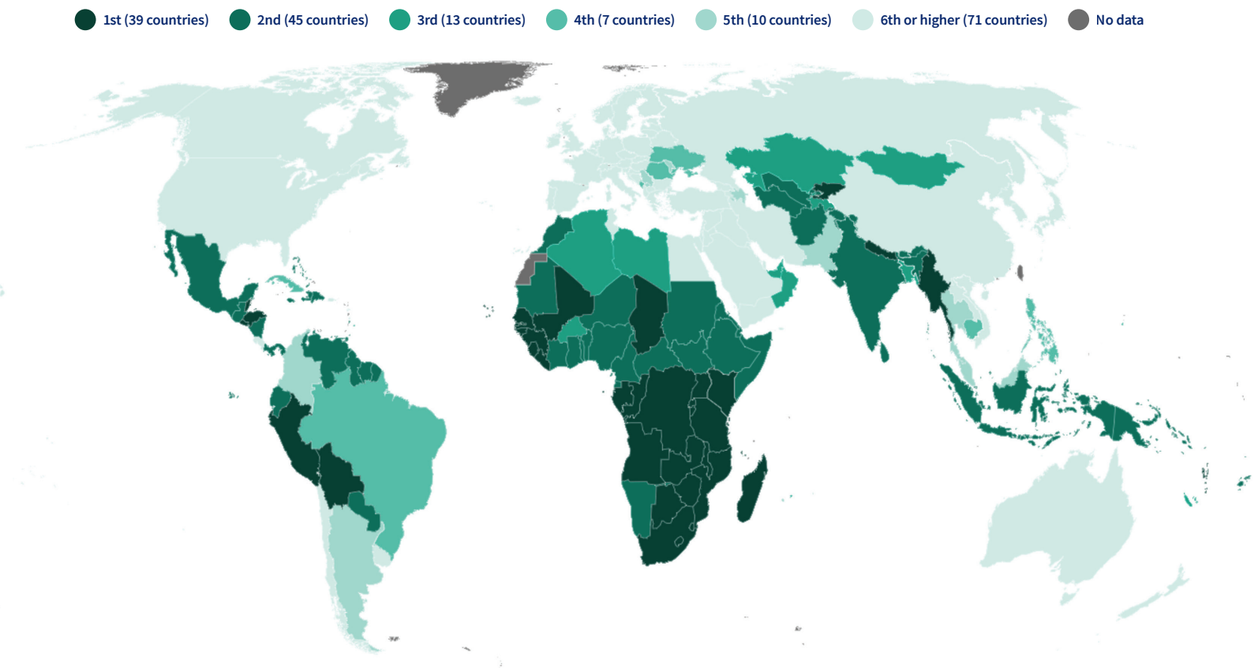


Figure 17.2

Trends in cervical cancer incidence, age-standardized rate (world) per 100,000, 1960-2020

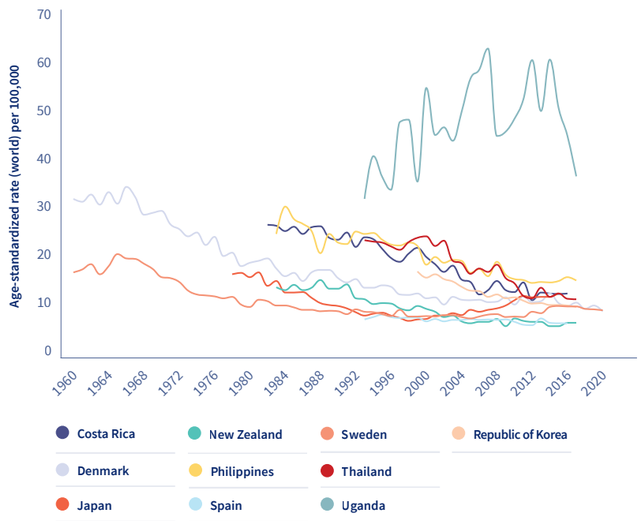


Figure 17.3

The 2030 targets of the Cervical Cancer Elimination Initiative (CCEI)

"For the first time, the elimination of a cancer is within our reach."

— Dr. Tedros Adhanom Ghebreyesus
Director-General, World Health Organization

Liver Cancer

Hepatitis B virus infection accounts for over half of all liver cancer cases occurring each year worldwide.

Liver cancer is the sixth most frequently occurring cancer in the world, but due to the poor prognosis associated with the disease, it is the third largest contributor to cancer mortality, with an estimated 870,000 cases and 760,000 deaths in 2022 (**Map 18.1**). The highest incidence rates per 100,000 persons occur in Micronesia (26.4), Eastern Asia (22.4), and Southeast Asia (21.2) in men and Northern Africa (10.1) and Eastern Asia (7.2) in women (**Figure 18.1**). The lowest rates are in South Central Asia in both men and women. In almost all regions, rates among men are two to four times higher than those among women. In Central America and the Caribbean, however, the male-to-female ratio is less than 1.5.

Major risk factors for liver cancer include hepatitis B virus (HBV), hepatitis C virus (HCV), aflatoxin B1 (AFB1), alcohol consumption, cigarette smoking, and the related conditions of excess body fatness, type-2 diabetes, and metabolic dysfunction-associated steatotic liver disease (MASLD) (**Figure 18.2**). HBV infection, the dominant risk factor globally, accounts for approximately 55% of liver cancers in the world, while HCV accounts for 21% of the cases (see *Infection,* Chapter 5). In general, HBV and AFB1 are more common risk factors in much of Eastern Asia and sub-Saharan Africa, while HCV and alcohol are more common factors in North America and Europe.

The prevalence of these risk factors has been changing, affecting liver cancer incidence in recent decades. Rates in some traditionally high-risk countries such as China, Japan, and the Republic of Korea, began to decline in the late 20th century (**Figure 18.3**). The decline is likely related to a reduction in AFB1 exposure, the initiation of neonatal HBV vaccination, and the advent of antiviral therapy for HCV infection. In contrast, rates in many lower-risk countries, such as the United States, the United Kingdom, and Australia, began increasing in the later decades of the 20th century (**Figure 18.4**). The increase is likely related to the spread of HCV in the mid-20th century, as well as the increasing prevalence of MASLD. The recent stabilization of incidence rates in some of these countries (e.g., the United States) may reflect the removal of HCV from national blood supplies. MASLD is now becoming the most common cause of liver cancer in many countries.

Liver cancer reduction strategies for HBV infection include neonatal vaccination and antiviral therapy among persons chronically infected; for HCV, they include antiviral therapy to eliminate the virus among persons chronically infected; for AFB1, they include pre- and post-harvest strategies to reduce/eliminate exposure; for alcohol and tobacco, they include reduction/cessation of exposure; and for metabolic conditions, they include maintenance of bodyweight below obesity and adherence to anti-diabetes therapy.

Figure 18.2

Major risk factors of liver cancer

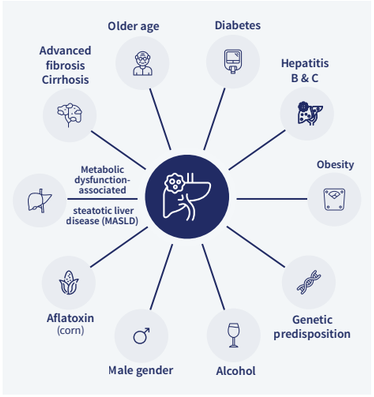
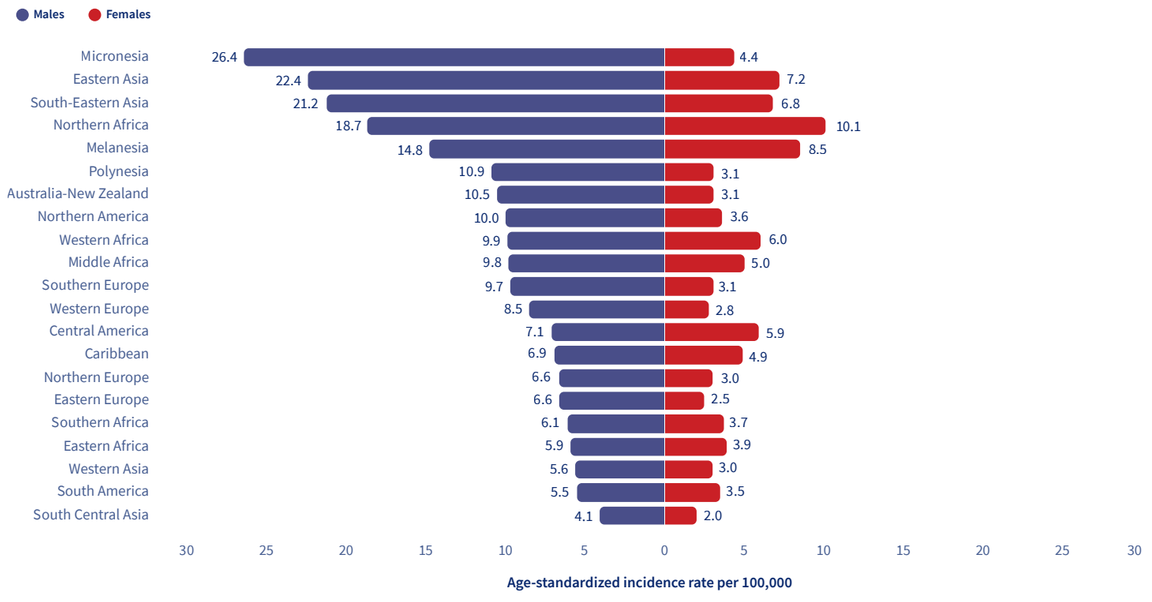


Figure 18.1

Liver cancer incidence, age-standardized rate (world) per 100,000, by UN region in males and females, 2022



Map 18.1

Liver cancer incidence, age-standardized rate (world) per 100,000, 2022

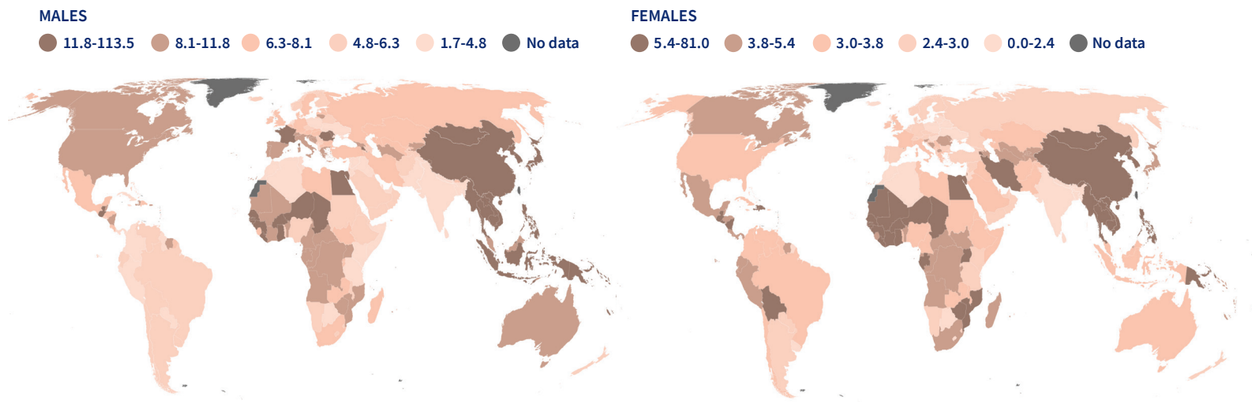


Figure 18.3

Trends in liver cancer incidence, age-standardized rate (world) per 100,000, in selected countries, Eastern Asia, 1975-2017

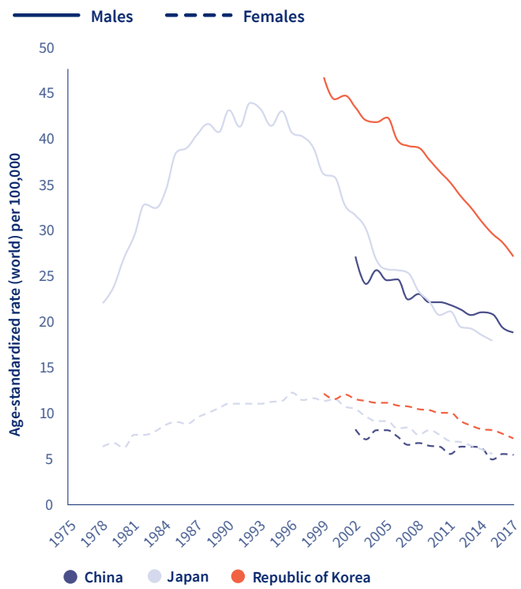
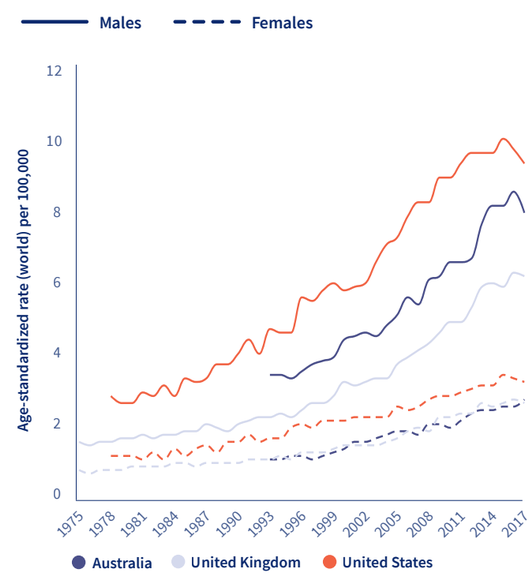


Figure 18.4

Trends in liver cancer incidence, age-standardized rate (world) per 100,000, in selected high-income Western countries, 1975-2017



"By addressing the root causes and implementing effective strategies, we can prevent unnecessary suffering, premature deaths, and the economic burden caused by hepatitis and liver cancer."

— Dr. Nino Berdzuli

Director of the Division of Country Health Programs, World Health Organization, Europe

Childhood Cancer

Fewer than 1 in 10 children with cancer survive 5 years after diagnosis in some countries in some Eastern African countries.

Cancers occurring in childhood and adolescence differ markedly from adult cancers in terms of the magnitude of the burden and biologic characteristics. Worldwide, the average annual incidence among children aged less than 15 years is 150 cases per million people and among adolescents aged 15-19 years the average annual incidence is 200 per million people. Incidence rates vary by geographical location, with the highest rates found in North America, Oceania, and Europe (**Figure 19.1**).

While young children (ages 0-14) often develop leukemia and embryonal tumors, adolescents (ages 15-19) are more frequently diagnosed with lymphomas, carcinomas, or germ cell tumors (**Figure 19.2**). Overall, cancer is about 20% more frequent in boys than in girls, although some types occur more often in girls (**Figure 19.3**). The steady increase in incidence rates over time remains mostly unexplained, but has been partly related to improved diagnosis over time. Exposures to high doses of ionizing radiation, high birth weight, and certain genetic syndromes have been consistently associated with increased rates of childhood cancer. The role of other risk factors, such as air pollutants, tobacco or pesticide use, older parental age, or fewer children per family is being investigated.

Mortality is disproportionally higher in low-income countries despite lower incidence rates (**Figure 19.1**), largely due to poorer survival proportions. Only 30% of children diagnosed with leukemia in Kenya survive for three years, compared to approximately 90% in Puerto Rico and Costa Rica (**Figure 19.4**). Factors contributing to these inequalities include lack of awareness, delayed or incorrect diagnosis, and barriers to treatment such as unaffordability, abandonment, or unavailability.

Childhood cancer survivors experience an increased risk of second cancers, cardiovascular diseases, and other health impairments, and may benefit from survivorship care plans for long-term follow-up. The World Health Organization's (WHO) Global Initiative for Childhood Cancer, launched in 2018, challenges countries to improve childhood cancer survival to reach at least 60% globally. The International Agency for Research on Cancer (IARC) and St. Jude Children's Research Hospital support transitioning countries in the promotion of childhood cancer registration to inform targeted childhood cancer control via the ChildGICR programme.

Figure 19.2

Incidence rates of cancer in children and adolescence by age groups by cancer types, 2001-2010

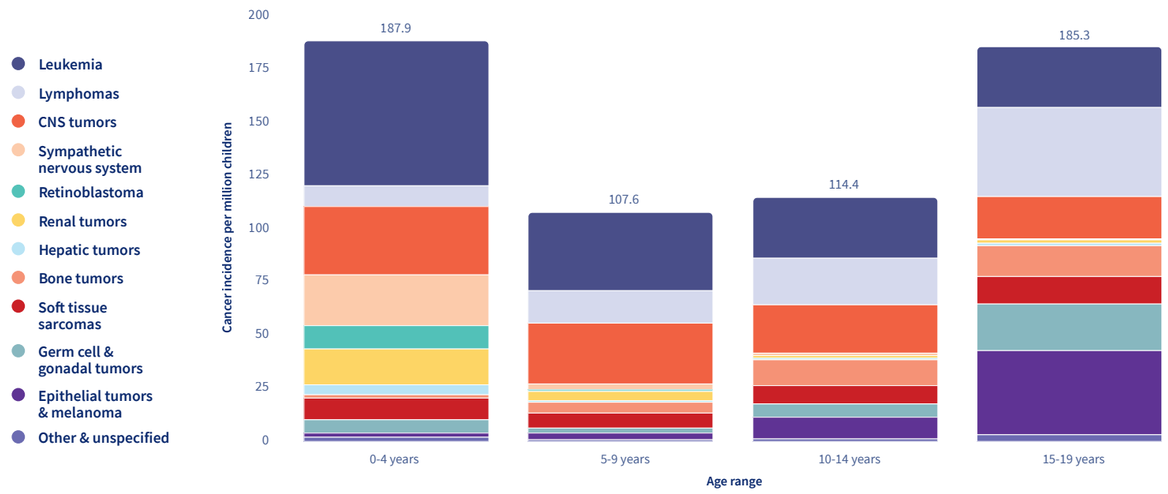


Figure 19.1

Incidence and mortality rates of cancer (excluding non-melanoma skin cancer) in children (ages 0-14) and adolescents (ages 15-19) by continent, 2022

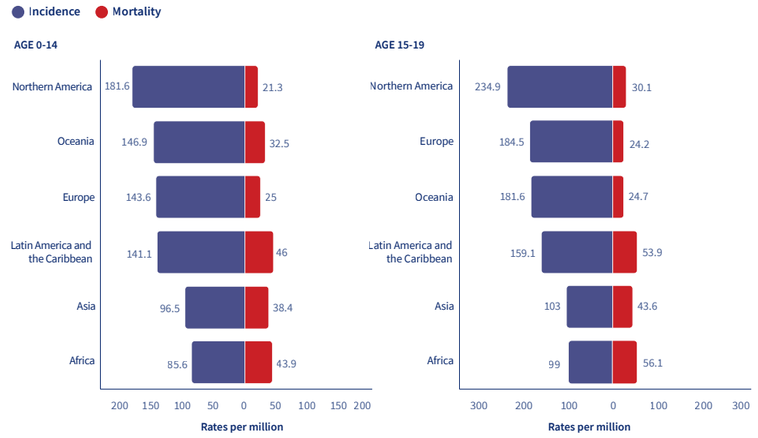
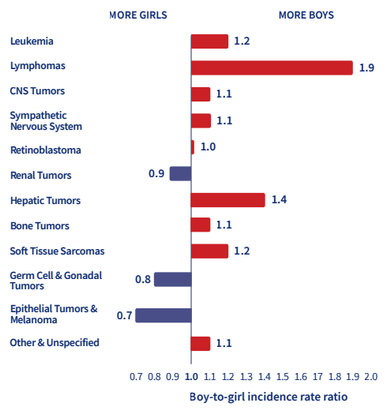


Figure 19.3

Sex ratio of childhood cancer incidence rates by cancer type, 2001-2010



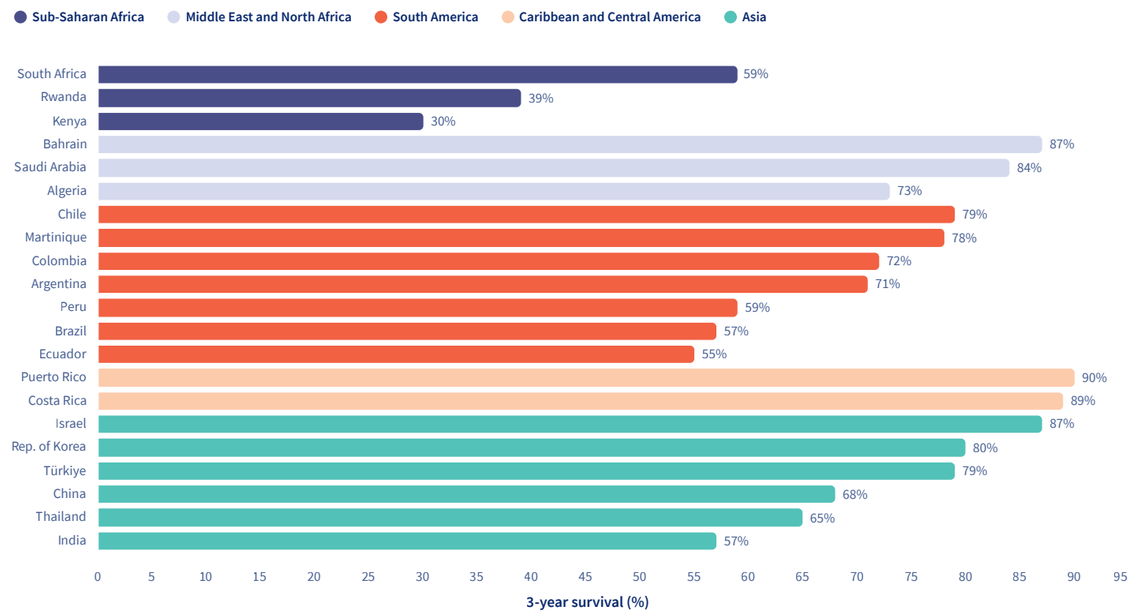
"Unless we address the shortage and poor quality of cancer medicines in many parts of the world, there are very few options to cure childhood cancers."

— Carlos Rodriguez-Galindo, MD

Executive Vice President and Chair, St. Jude Department of Global Pediatric Medicine, and Director, St. Jude Global

Figure 19.4

Three-year observed survival (%) among children (ages 0-14) diagnosed with leukemia from 2008-2017 in selected countries



Human Development Index

The scale and profile of cancer continue to evolve as countries undergo major transitions in human development.

The Human Development Index (HDI) is a summary measure of average achievement in countries based on national levels of educational attainment, life expectancy, and income. **Map 20.1** displays the four tiers of HDI for the year of 2021. By examining cancer through the lens of human development, we can assess cancer transitions and cancer inequalities that are of direct relevance to setting cancer-control priorities.

Figure 20.1 shows the most frequent forms of cancer incidence and mortality by the four-tier HDI and for the vast populations of China and India. Cancer is complex, with 13 different cancer types ranking among the top five across the four broad regions (excluding China and India), as well as in China and India individually. The profiles can be viewed as a snapshot of the impact of changes in lifestyle and the built environment linked to social and economic development, but also the extent to which early diagnosis and curative treatment programs are available and accessible in different settings.

Despite lung cancer being the most frequent cancer type globally and in China, female breast cancer is the most common form of incidence at each level of HDI and in India. Colorectal cancer is among the top five leading cancers for both incidence and mortality across HDI levels and in China. There is still a persistence of infection-associated cancers in populations, particularly in low and medium HDI countries. Liver cancer ranks among the leading form of cancer mortality irrespective of HDI rank, cervical cancer ranks in the top five cancers for both incidence and mortality in low and medium HDI regions, as well as India, and stomach cancer is an important cause of cancer death in high HDI countries and China.

The rising cancer burden will hit low and medium HDI countries the hardest. **Figure 20.2** demonstrates the upsurge in new cancer cases by 2050 will be proportionally greatest in lower HDI settings. There is a need for concerted and coordinated efforts by local governments, donors, and civic societies to implement tailored and cost-effective interventions in these countries.

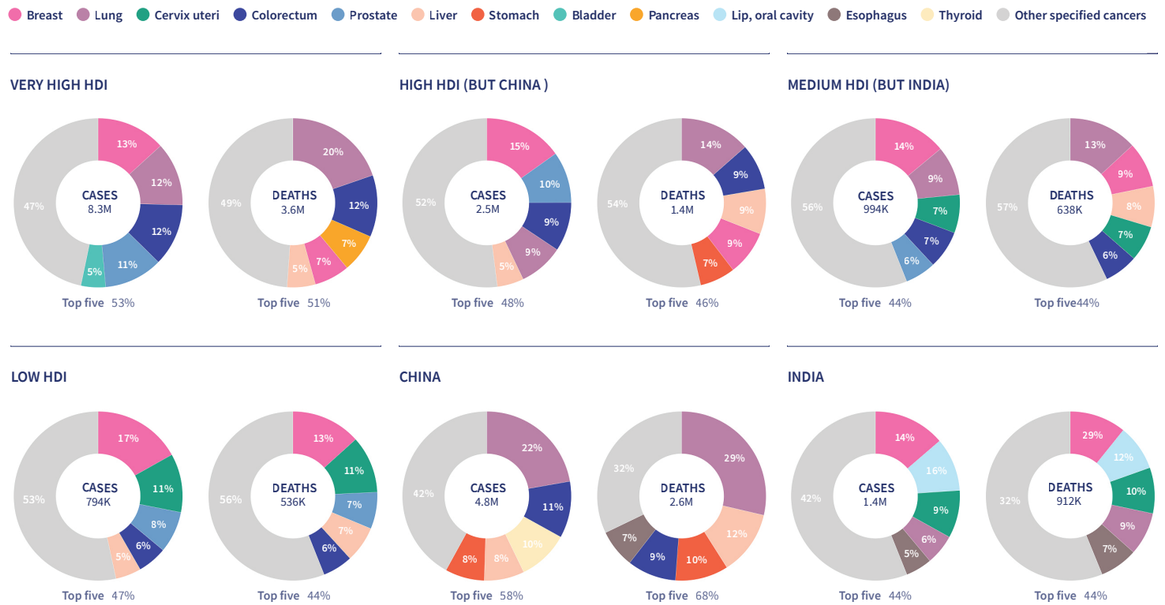
Figure 20.2

Estimated number of new cancer cases (excluding non-melanoma skin cancer) from 2022 to 2050 by four-tier Human Development Index (HDI), China, and India

> "You cannot achieve environmental security and human development without addressing the basic issues of health and nutrition."
>
> — Gro Harlem Brundtland
> Former Prime Minister, Norway

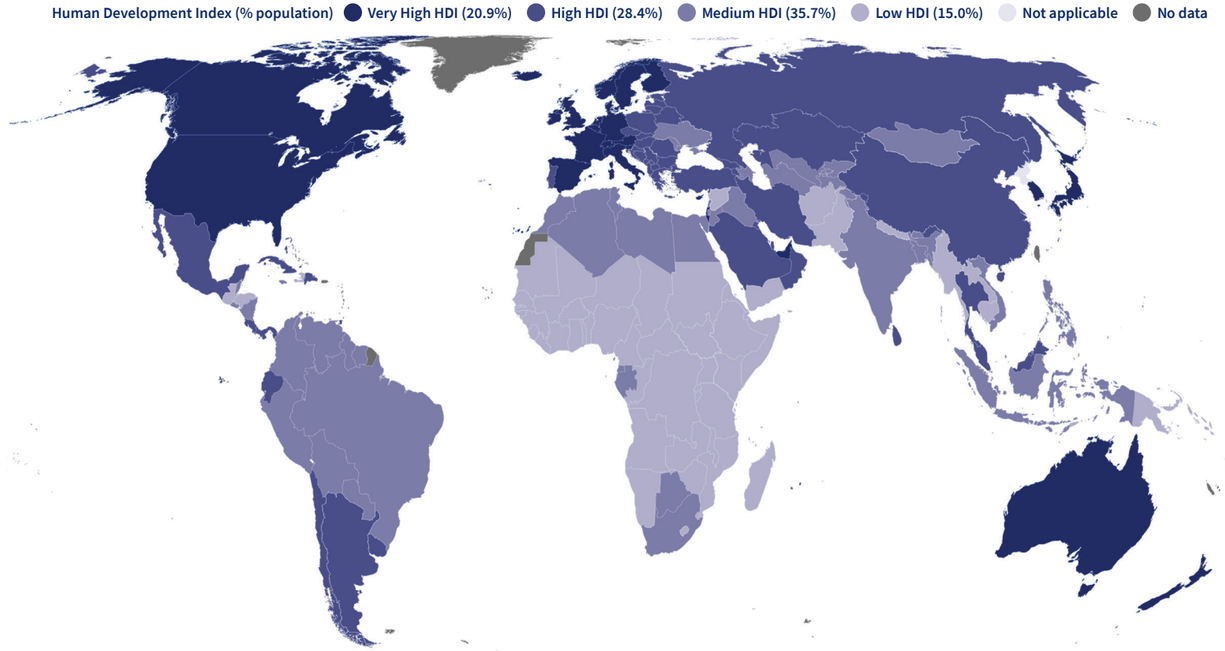
Figure 20.1

The top five cancers in terms of incidence and mortality (excluding non-melanoma skin cancer) by four-tier Human Development Index (HDI), China and India, 2022



Map 20.1

Four-tier Human Development Index, 2021



Cancer In Indigenous Populations

Cervical cancer screening rates among Aboriginal and Torres Strait Islander women in Australia are only half those of non-Indigenous women.

Cancer remains a stark example of the deep inequities in health care faced by Indigenous communities.

The United Nations reports that over 476 million Indigenous people reside in over 90 countries across the globe, representing 6.2% of the world's total population. Despite being a numerical minority worldwide, Indigenous people contribute significantly to global cultural diversity, with an estimated 5,000 distinct cultures and over 7,000 languages (**Figure 21.1**).

Comprehensive cancer-related data for Indigenous populations is limited in many regions. Most reported information comes from a few high-income countries (e.g., Australia, Canada, New Zealand, the United States, Norway, Sweden, and Finland) and some parts in Africa and South America.

Indigenous people often experience greater disadvantages and poorer health outcomes compared to non-Indigenous people due to historic and ongoing systematic discrimination. Globally, Indigenous people experience higher incidence and lower survival for cancers such as lung, liver, and cervix. The incidence of these highly preventable and common cancers is markedly greater in Indigenous people compared with non-Indigenous people in Australia and New Zealand, with rates up to three times higher in Indigenous populations (**Figure 21.2**).

A range of sociocultural and political factors, with varying relative importance across regions, contribute to the high cancer burden among Indigenous populations, including a high prevalence of smoking, consumption of alcohol, unhealthy diets, physical inactivity, and excess body weight (**Figure 21.3**). Indigenous peoples have not fully benefitted from cancer screening programs, with screening participation rates generally lower compared to non-Indigenous people (**Figure 21.4**). For instance, cervical cancer screening rates were 28% among Aboriginal and Torres Strait Islander women, compared to 53% among non-Indigenous women in Australia. Similarly, 62% of Māori women underwent cervical cancer screening, compared to 77% of non-Indigenous women in New Zealand.

Comprehensive and persistent initiatives driven by Indigenous leadership and engagement are crucial for enhancing cancer outcomes among Indigenous populations. Progress in cancer control planning tailored by and for Indigenous communities is underway in some regions.

> "As long as cancer continues to have such a devastating impact on our people and communities, we will advocate for the changes needed to achieve health equity in cancer care."
>
> — Queensland Aboriginal and Islander Health Council, 2024

Figure 21.2

Cancer incidence rate ratios comparing Indigenous and non-Indigenous populations for common cancers in selected countries

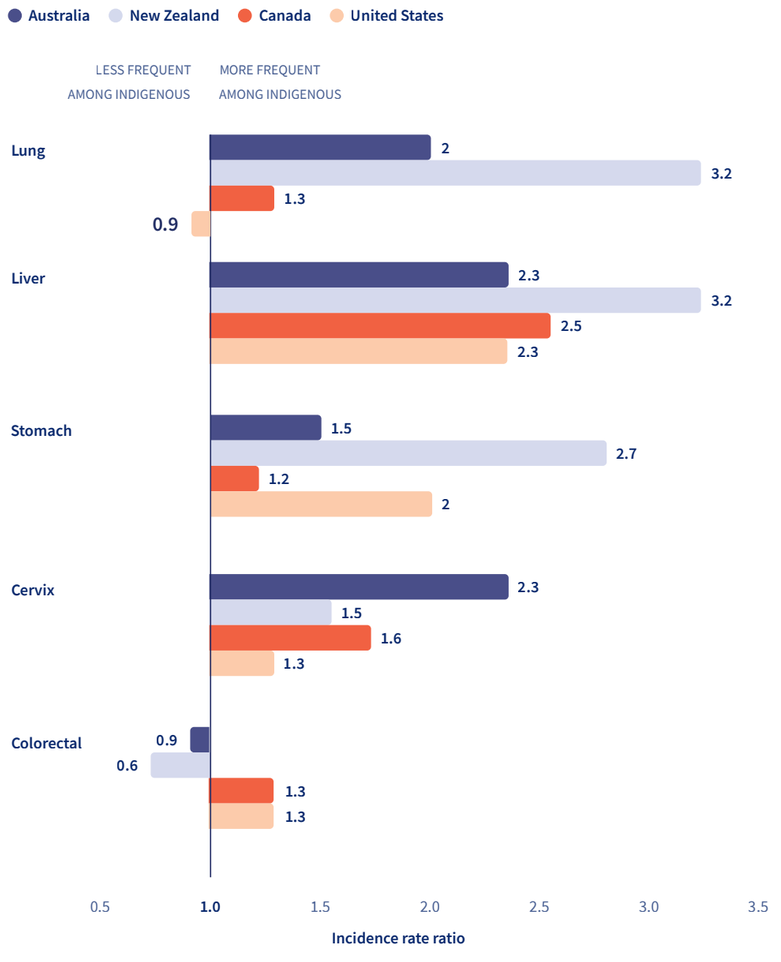


Figure 21.1

The World's Indigenous Peoples

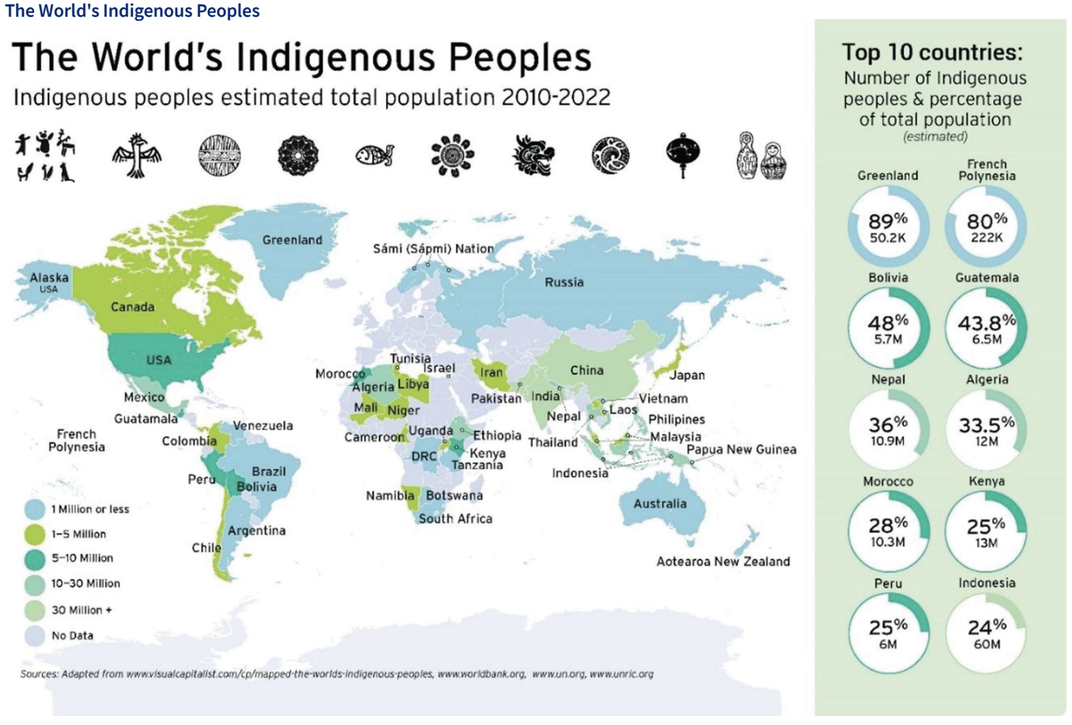
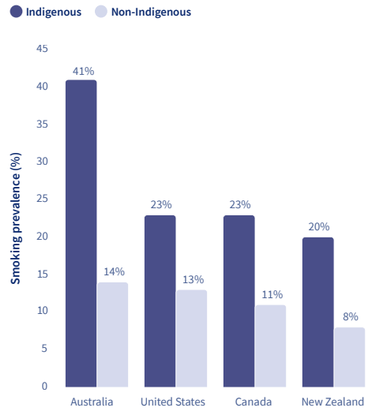


Figure 21.3

Smoking prevalence (%) among Indigenous adults in comparison to non-Indigenous adults in selected countries



Footnote
Indigenous populations for each country: Australia - Aboriginal and Torres Strait Islanders (2018-2019), USA – American Indian and Alaskan Native (2022), Canada - Aboriginal (First Nations, Inuit, Metis) (2022), New Zealand - Māori (2022-2023). Smokers are defined as persons who smoke daily, at least once a week, and less than weekly, except for Canadian smokers defined as smoking in the past 30 days.

Figure 21.4

Cancer screening prevalence (%) among Indigenous and non-Indigenous populations in selected countries

Footnote
Survey years vary by country: Australia (2016–2022), United States (2022), New Zealand (2022–2024), and Canada (2007–2011).

Geographic Diversity

There are an estimated 19 million new cancer cases and 9.7 million cancer deaths (excluding non-melanoma skin cancer) worldwide each year. Over half of the cases (9.7 million) and 56% of the deaths (5.4 million) occur in Asia (**Figure 22.1**), where 60% of the global population (4.6 billion) reside. Europe has the second highest cancer burden, with 4 million new cases (22% of the total burden) and 2 million cancer deaths (20%), followed by North America for incidence, with 2.1 million new cases (11% of the global burden) and Africa for mortality, with 0.8 million deaths (8% of the global burden). The disproportional contribution of Europe and North America to the global cancer burden contrasts with their relatively small population sizes, which make up only 9% and 5% of the global population, respectively.

Among men, prostate cancer dominates in most countries as the most commonly diagnosed cancer, followed by lung. For mortality, this is reversed, with lung cancer being the leading cause of death followed by prostate cancer (**Map 22.1**). Among women, breast cancer is the most diagnosed cancer in almost all countries globally (158 countries) and the leading cause of death in 111 countries, followed by cervical cancer in 24 countries for incidence and 38 countries for mortality, most of which are in sub-Saharan Africa (**Map 22.2**).

The patterns of cancer that we observe can be linked to the underlying risk factors, diagnostic practices, early detection programs, and access to and availability of treatment. Such factors are discussed in detail in each regional chapter (see *Chapters 23-29*). As well as population size, the age structure of the populations – and their evolution – differ by world region. This demographic transition will have a major impact on the future cancer burden, e.g., the incident cases are expected to increase by 139% in Africa by 2050, compared to 22% in Europe (**Figure 22.2**).

Figure 22.1

Estimated number of cases and deaths (excluding non-melanoma skin cancer) by continent, 2022

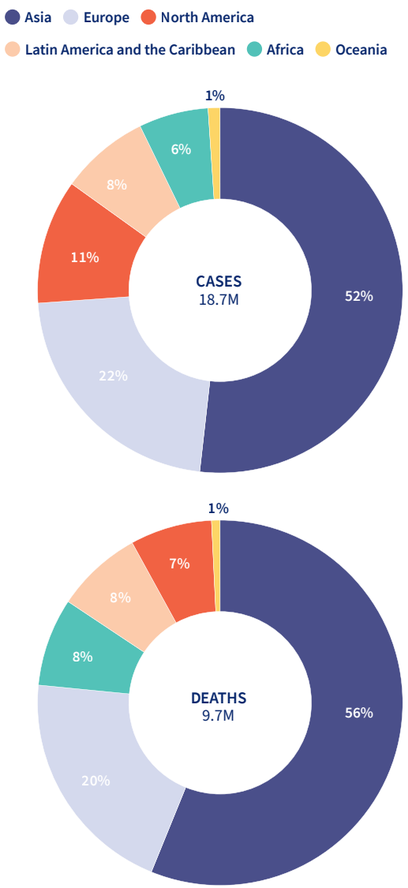
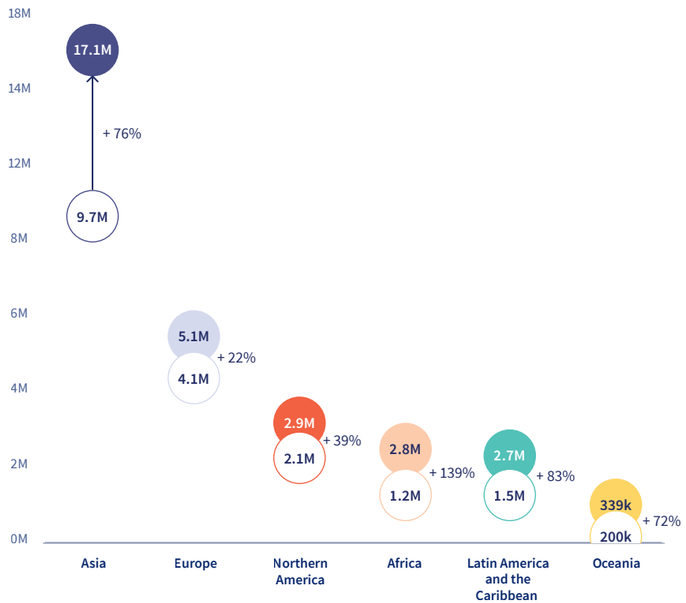


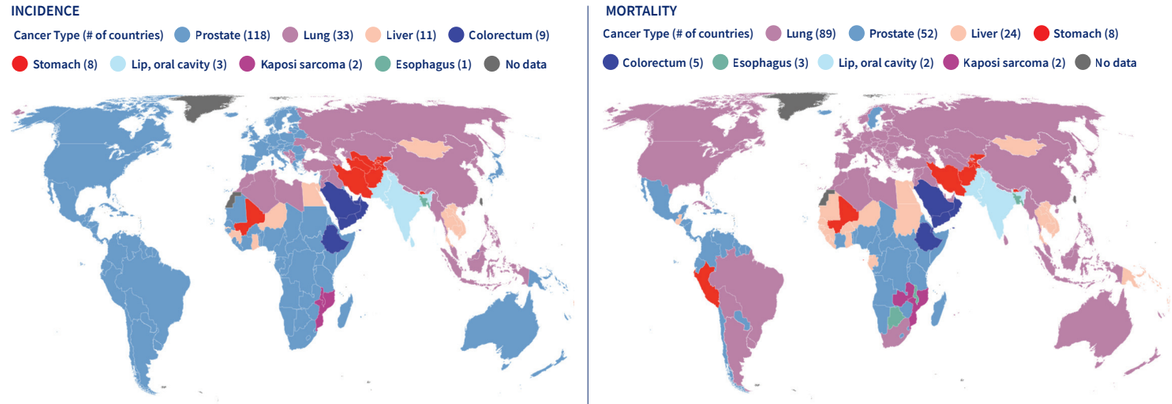
Figure 22.2

Estimated number of new cases for all cancers (excluding non-melanoma skin cancers) combined from 2022 to 2050 across continents



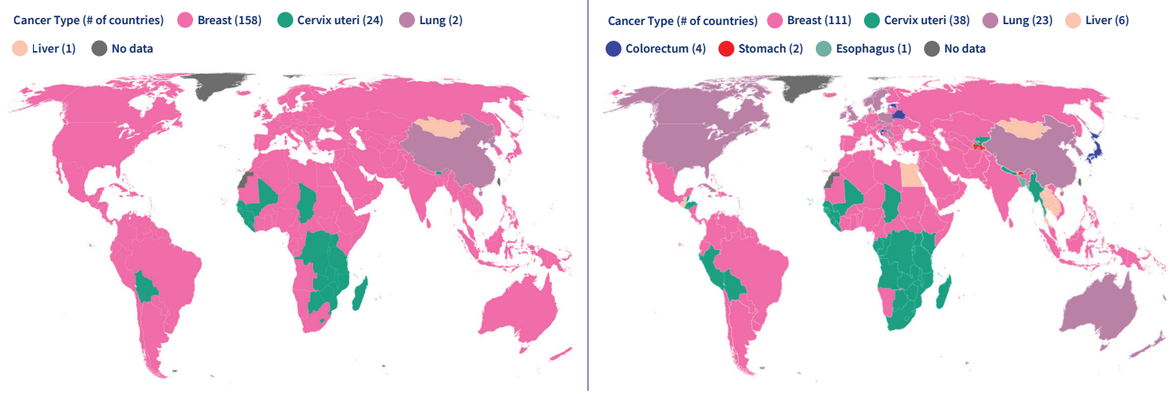
Map 22.1

Most common cancer types in terms of cases and deaths in males, 2022



Map 22.2

Most common cancer types in terms of cases and deaths in females, 2022



> "I have a neighbor who knows 200 types of wine. ... I only know two types of wine - red and white. But my neighbor only knows two types of countries - industrialized and developing. And I know 200."
>
> — Hans Rosling
> Physician, Academic

Cancer in Sub-Saharan Africa

Infections account for up to 30% of cancer cases in some East African countries.

Cancer is now a major public health problem in sub-Saharan Africa, with the disease among the three leading causes of premature death (ages 30-69) in almost all countries in the region.

About 820,000 new cancer cases and 550,000 deaths were estimated to have occurred in 2022 in sub-Saharan Africa. For both sexes combined, cancers of the female breast, cervix, and prostate dominate the cancer incidence pattern (**Figure 23.1**) and taken together comprise two-fifths of the cancer incidence burden in the region. Cervical cancer is the second most commonly diagnosed cancer and the leading cause of cancer death in sub-Saharan Africa.

These cancers also represent the top three causes of cancer mortality in the region, with cervical cancer leading with the cumulative mortality (before age 75) of 2.5% (**Figure 23.2**), signifying that one in 40 women will die from this cancer during their lifetime.

The importance of these cancers is also reflected in terms of the leading types of cancer at the country level, with prostate cancer ranking first as the most frequently diagnosed cancer in men in 40 of the 48 countries, while in women, breast and cervical cancer rank first in 26 and 22 countries, respectively (**Map 23.1**).

There are however marked geographic variations in the risk of other important cancers (e.g., Kaposi sarcoma and liver cancer in men), in part reflecting variations in the prevalence of the underlying risk factors. According to data from population-based cancer registries (PBCR), many of the region's cancer types are on the rise, including cervix, female breast, and prostate. The cancer burden is expected to double in the constituent countries within three decades solely due to the aging and growth of the population (**Figure 23.3**). To inform national implementation of cancer-control strategies and to monitor progress and impact – including scaling up the World Health Organization's (WHO) signature initiatives – sustainable investments in PBCR as the unique source of cancer incidence and survival remains critical.

Figure 23.1

Estimated number of new cancer cases and deaths (excluding non-melanoma skin cancer) by type in sub-Saharan Africa, 2022

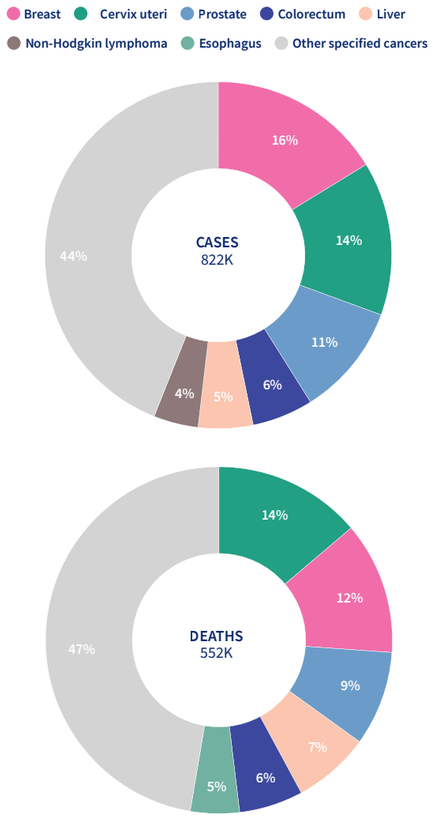
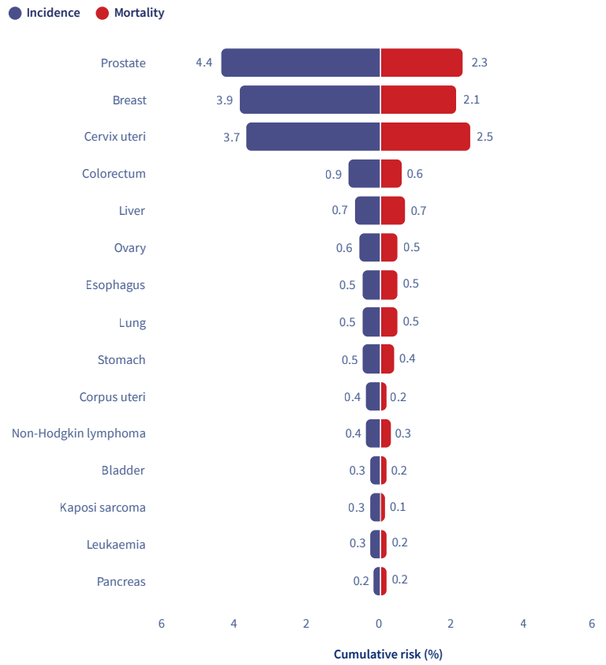


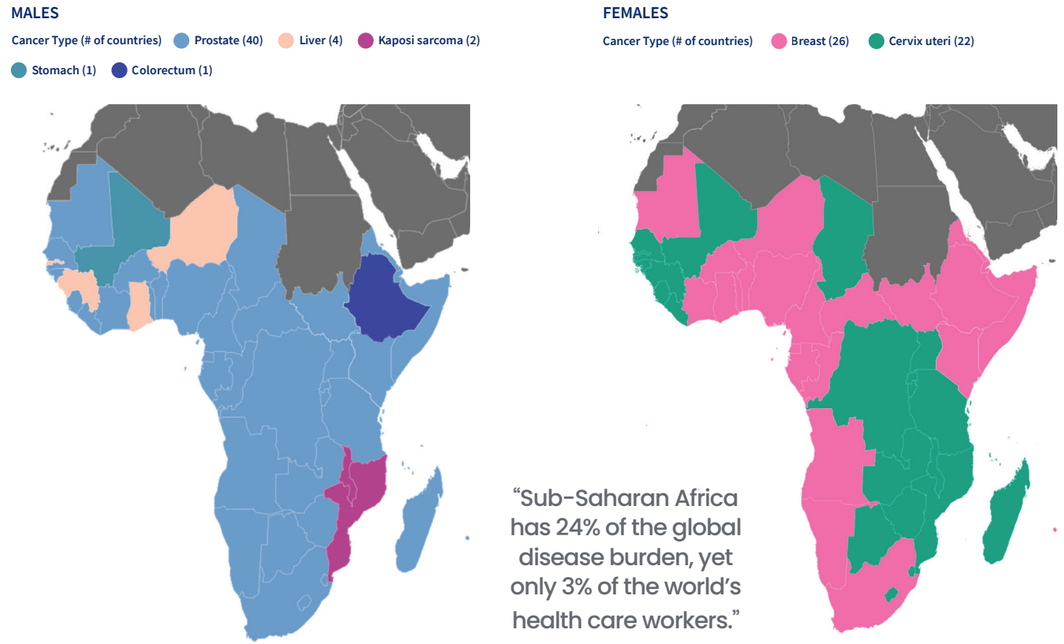
Figure 23.2

Estimated cumulative risk (%, ages 0-74) of cancer incidence and mortality in sub-Saharan Africa for the top 15 leading cancer types, 2022



Map 23.1

Most commonly diagnosed cancer types by sex in sub-Saharan Africa, 2022

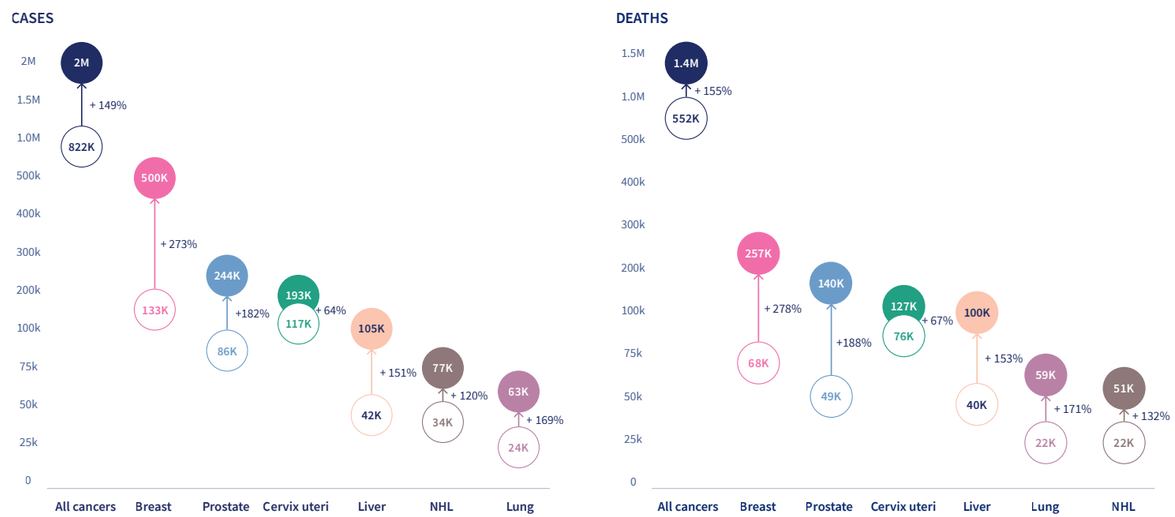


"Sub-Saharan Africa has 24% of the global disease burden, yet only 3% of the world's health care workers."

— Dr. Mitch Besser
Founder, mothers2mothers

Figure 23.3

Estimated number of new cancer cases and deaths (excluding non-melanoma skin cancer) from 2022 to 2050 in sub-Saharan Africa



Footnote:
NHL, non-Hodgkin lymphoma

Cancer in Latin America and the Caribbean

The rising cancer burden in the region reflects the rapid adoption of more westernized lifestyles at the population level.

The Latin America and the Caribbean (LAC) region has doubled in population size over the last half-century to 665 million inhabitants today. About 1.5 million new cancer cases and 741,000 cancer deaths, excluding non-melanoma skin cancers, are estimated to occur in the LAC region in 2022. The five most common cancers are prostate (226,000 new cases per year, 15%), female breast (220,000, 15%), colorectal (145,000, 10%), lung (105,000, 7%) and stomach (74,000, 5%) (**Figure 24.1**). Lung cancer is the leading cause of cancer death (91,000, 12%) followed by colorectal (74,000 10%), prostate (61,000, 8%), female breast (60,000, 8%) and stomach (58,000, 8%) cancers.

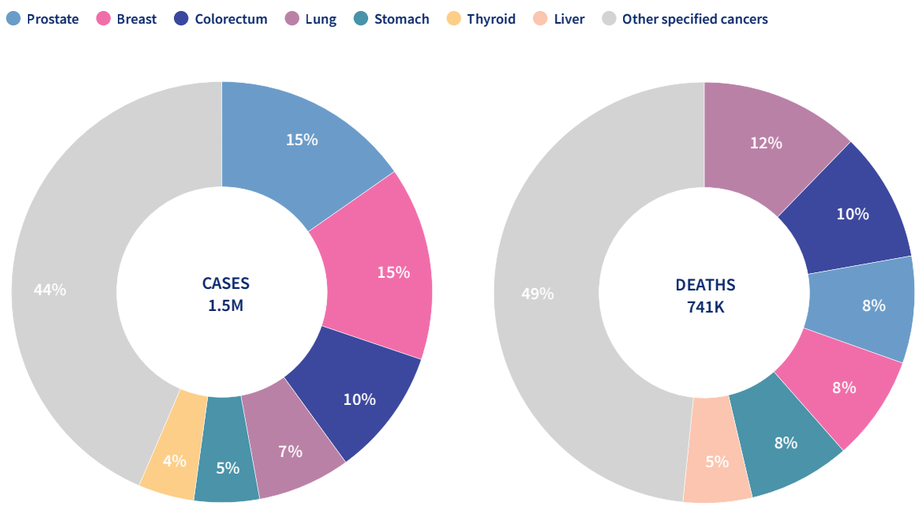
Cancer rates vary markedly in the region, with all-cancer incidence in both sexes ranging from 263 (per 100,000) in Uruguay to 106 (per 100,000) in Belize, and mortality from 128 to 60 in the same countries, respectively (**Map 24.1**). Breast cancer is the leading cause of cancer death among women in almost all LAC countries, though cervical cancer leads in Belize, Honduras, and El Salvador in Central America and in Bolivia and Peru in South America. In males, prostate cancer is the leading cause of cancer death in 25 countries in the region, notably in Central America and the Caribbean, while lung cancer is the most frequent cause of cancer death in Argentina, Bolivia, Brazil, Cuba, and Uruguay (**Map 24.2**).

Lung cancer rates considerably vary across countries partly due to differences in the implementation of tobacco-control measures. Tax hikes in Brazil and Uruguay beginning in 2005 and 2006, respectively, have led to a reduction in smoking prevalence in recent years. Uruguay became the first country in the region to implement plain tobacco packaging in 2018.

Nevertheless, the increasing cancer burden in the LAC countries reflects a multitude of sociodemographic changes across the region in the last decades.

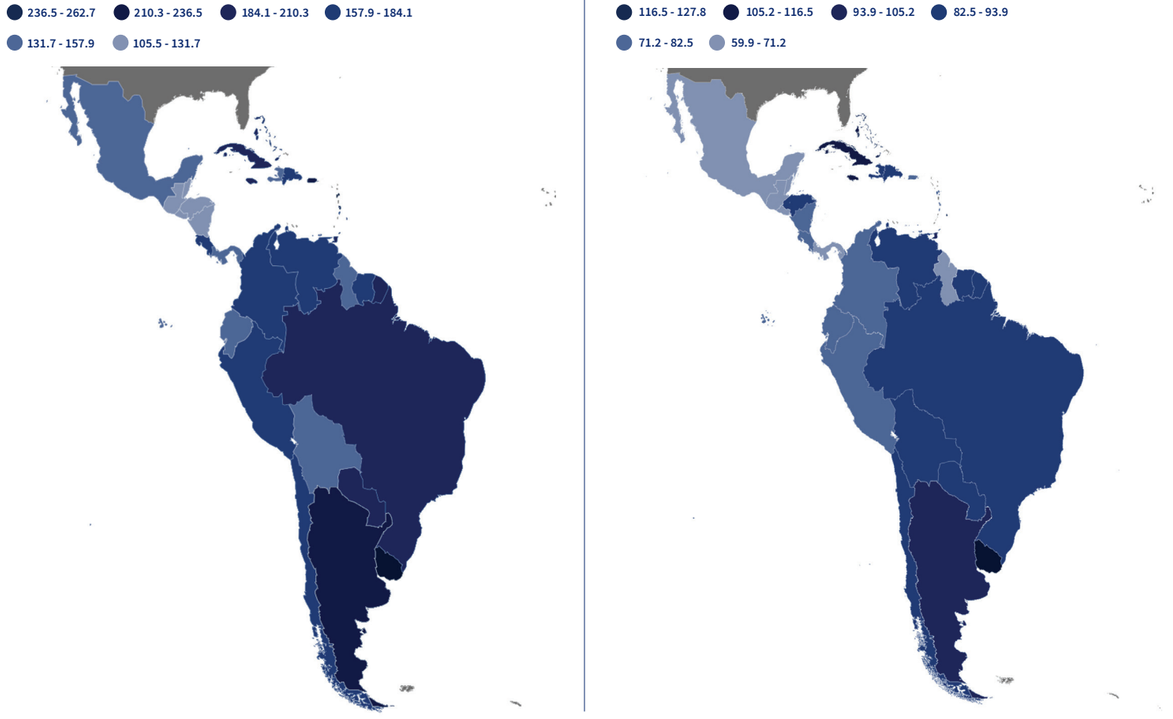
Figure 24.1

Estimated number of new cancer cases and deaths by type (excluding non-melanoma skin cancer) in Latin America and the Caribbean, 2022



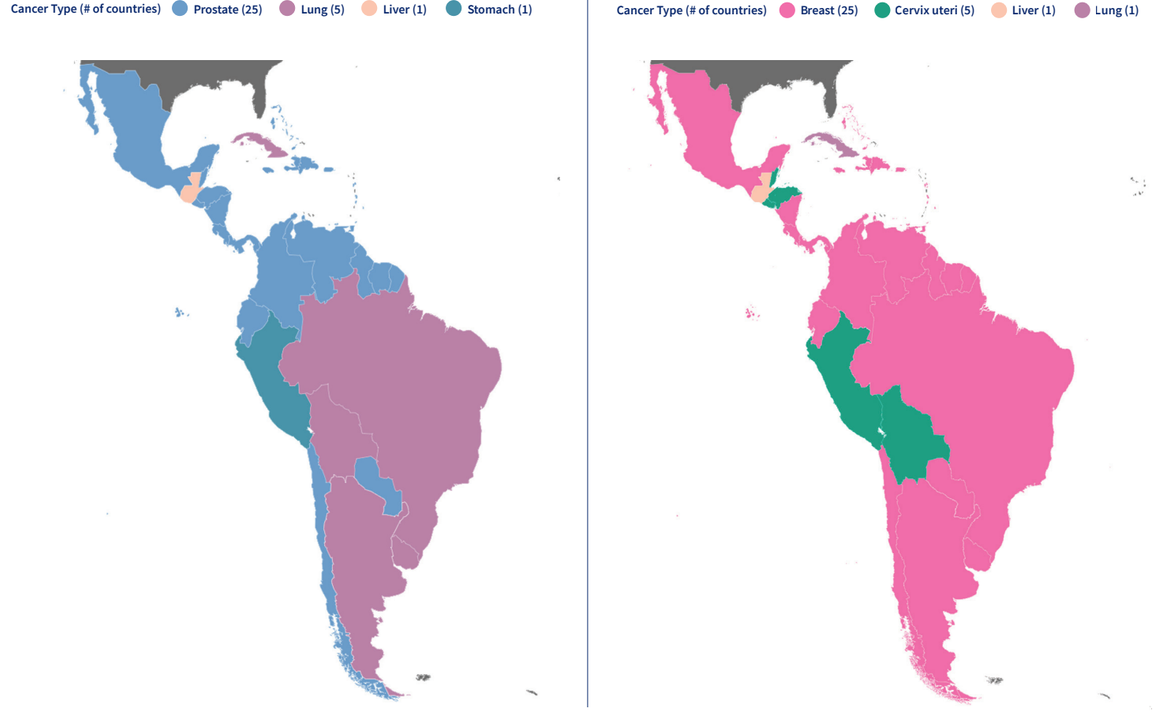
Map 24.1

All cancers combined (excluding non-melanoma skin cancer) incidence and mortality, age-standardized rates (world) per 100,000, in Latin America and the Caribbean, 2022



Map 24.2

Most common cancer deaths by cancer type and sex in Latin America and the Caribbean, 2022



Cancer in North America

Lung cancer remains the leading cause of cancer death in North America, despite four decades of declines in smoking prevalence.

Cancer is the leading cause of premature death in North America. An estimated 2.1 million new cancer cases and 701,000 cancer deaths occur in North America each year. The region contributes almost twice the proportion of cases compared to deaths globally (13% versus 7%) in large part because of high access to early detection and treatment.

Cancer patterns are similar in the United States and Canada, reflecting a shared prevalence of risk factors. Incidence is low for infection-related cancers, almost half of which are attributable to human papillomavirus, and high for cancers associated with unhealthy behavioral factors like smoking, excess body fatness, and sedentary lifestyle. The most common cancers are breast, lung, prostate, and colorectal (**Figure 25.1**). Young-onset colorectal cancer is on the rise, now the leading cause of cancer death among young men and the second leading cause among young women in the United States.

Despite decades of decline, lung cancer remains the leading cause of cancer death, accounting for more deaths in 2022 than colorectal (second) and pancreatic (third) cancers combined (**Figure 25.1**). Women in North America have the highest lung cancer incidence in 20 United Nations regions, in part because of slower cessation and smoking upticks in those born in the middle of last century, whereas men rank seventh. Consequently, lung cancer incidence in women is higher than in men among people ages 35-64 years in the United States. Rates also vary dramatically by state, province, and territory (**Map 25.1**).

Incidence for many other cancers is increasing during the most recent period, including prostate and breast, the two most common cancers (**Figure 25.2**). The rise in breast cancer incidence is partly attributed to increased body weight, which also may have contributed to increasing trends in early-onset colorectal cancer (see *Colorectal Cancer*, Chapter 16), pancreatic cancer, kidney cancer, and uterine corpus cancer in the region (**Figure 25.3**).

> "Treatment without prevention is simply unsustainable."
>
> **– Bill Gates**
> Co-founder, Microsoft and the Bill & Melinda Gates Foundation

Map 25.1

Lung cancer incidence, age-standardized rate (world) per 100,000, by state, province, and territory in North America, 2016–2020

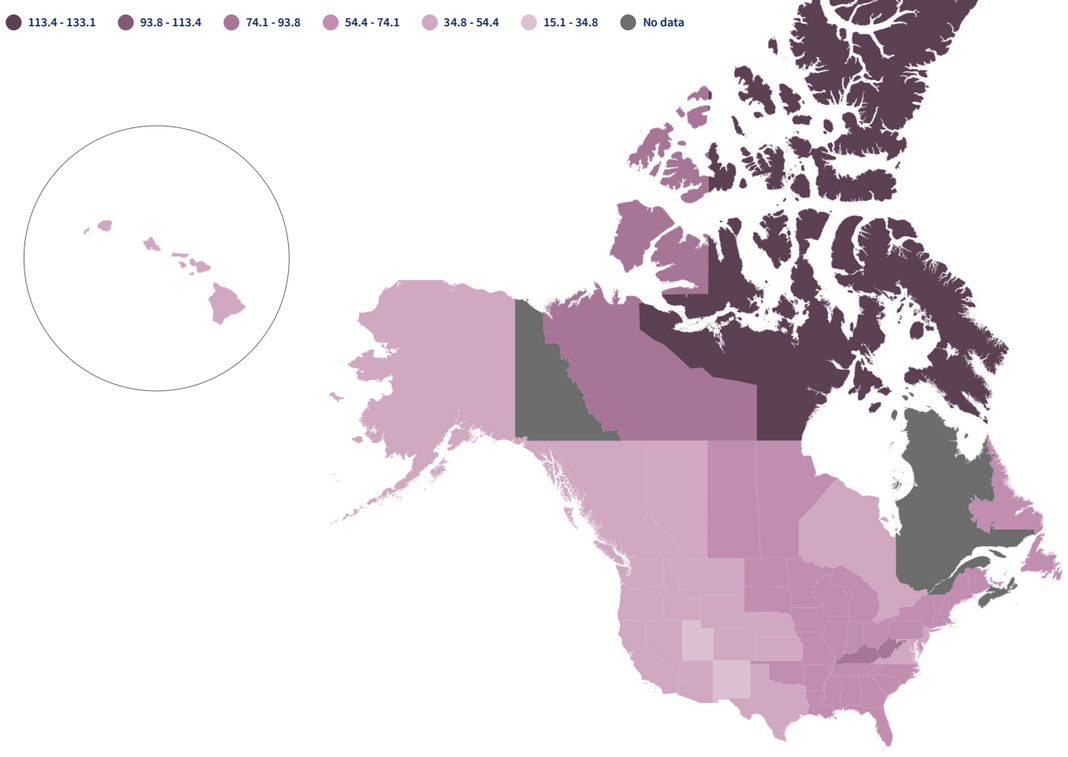


Figure 25.1

Estimated number of cancer cases and deaths (excluding non-melanoma skin cancer) by cancer type in North America, 2022

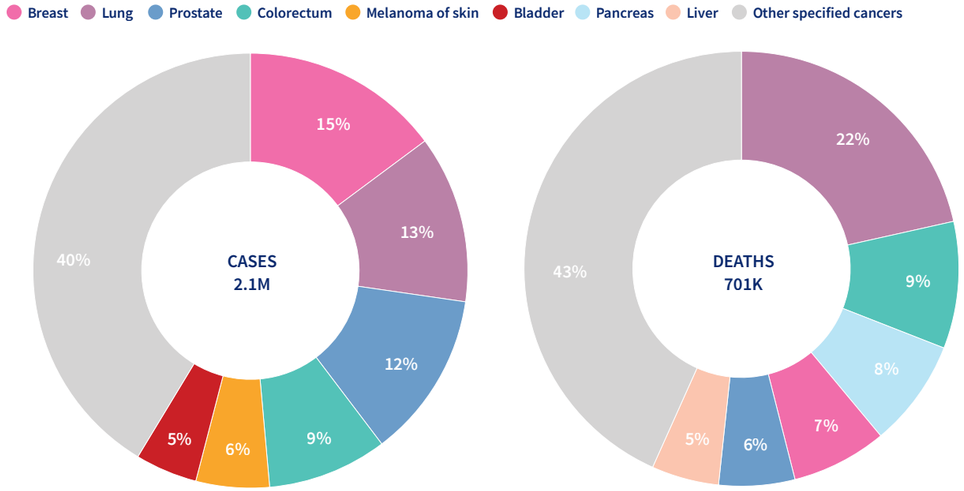


Figure 25.2

Trends in breast and prostate cancer incidence in North America, age-standardized rates (world) per 100,000, 2000-2021

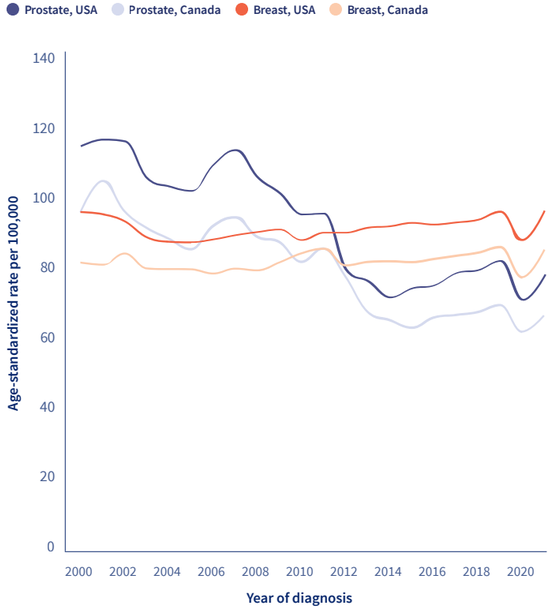
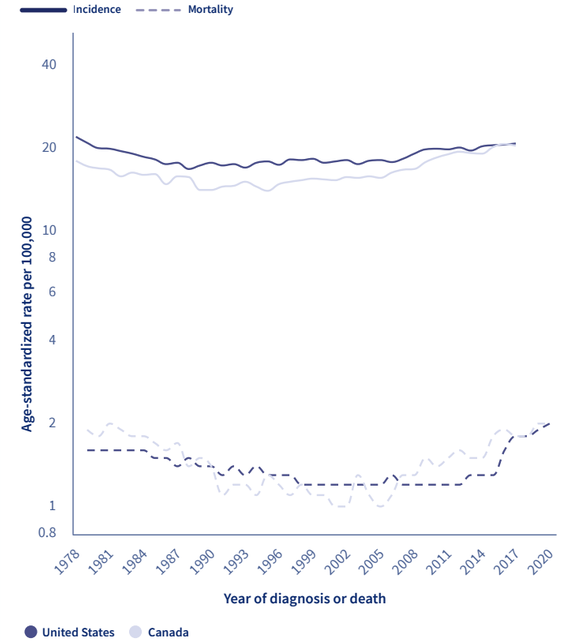


Figure 25.3

Trends in uterine corpus cancer incidence (1978-2017) and mortality (1979-2020) in North America, age-standardized rates (world) per 100,000



Cancer in Southern, Eastern, and Southeast Asia

The region contributes about 50% of all new cancer cases (9.2 million) and over half of cancer deaths (5.1 million) worldwide each year.

Southern, Eastern, and Southeast Asia are some of the most densely populated regions globally, with over 4.3 billion people (55% of the world population). The region contributes 49% of all new cancer cases (9.2 million) and 53% of cancer deaths (5.1 million) worldwide each year. China and India combined account for two-thirds of these cases and deaths. Lung (1,496,400 new cases), colorectal (915,800 cases), and female breast cancer (910,200 cases) are the most common cancers for both sexes combined, with lung cancer also being the leading cause of cancer deaths (1,079,100 deaths), followed by liver cancer (516,700) and stomach cancer (437,900) (**Figure 26.1**).

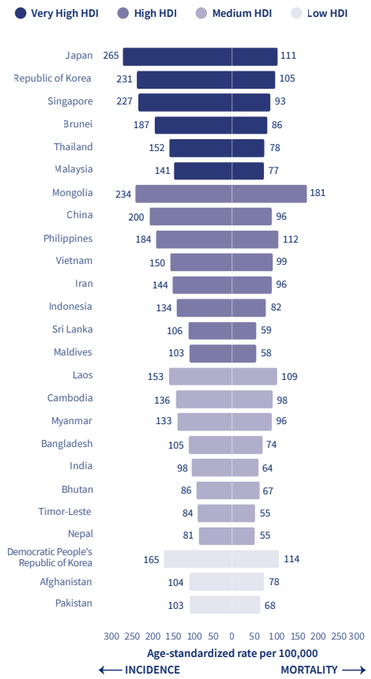
Breast cancer is the most commonly diagnosed cancer in 10 of 25 countries in the region, both sexes combined, and lung cancer leads in terms of cancer-specific mortality in 14 countries (**Map 26.1**). The risk of developing cancer increases with the Human Development Index (HDI) level, with incidence in very high HDI countries twice that of low HDI countries (227 versus 103 per 100,000), but mortality rates vary less (**Figure 26.2**). Five-year survival for cancers, such as breast, stomach, and lung, are higher in high-HDI countries like South Korea, compared to medium-HDI countries like India.

While lung cancer incidence has declined in some countries, it is still rising in nations with high smoking prevalence, such as China and India. Similarly, colorectal cancer incidence is also increasing, likely driven by sedentary lifestyles and higher intake of animal-source foods. Infection-related cancers (including stomach, liver, and cervix) have generally decreased, except for slight increases in cervical cancer in China and Japan.

Assuming constant incidence and mortality rates, over 16 million new cancer cases and 10 million deaths are predicted to occur in 2050 in the region as a result of population growth and aging. Lung, colorectal, breast, stomach, and liver cancers will have the highest burden (**Figure 26.3**).

Figure 26.2

Incidence and mortality of all cancers (excluding non-melanoma skin cancer), age-standardized rates (world) per 100,000, by country and Human Development Index (HDI), Southern, Eastern, and Southeast Asia, 2022



Map 26.1

Most common cancer types in terms of cases and deaths in Southern, Eastern, and Southeast Asia, 2022

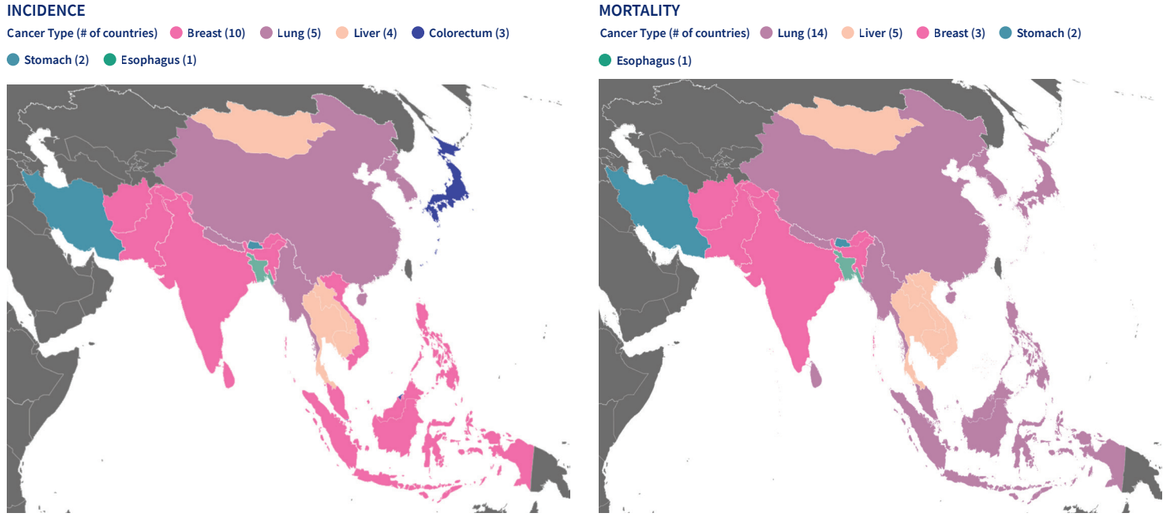
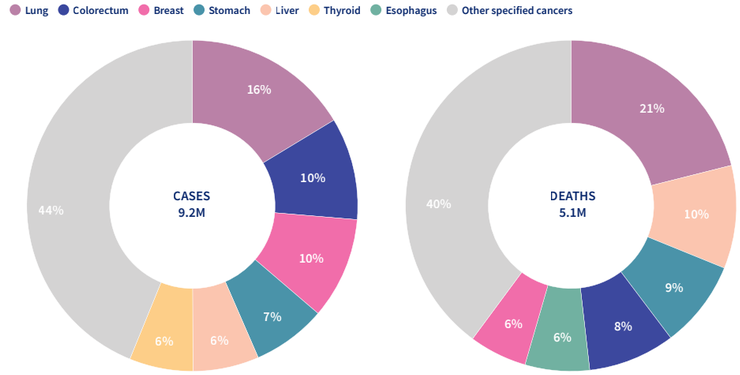


Figure 26.1

Estimated number of new cancer cases and deaths by type (excluding non-melanoma skin cancer) in Southern, Eastern, and Southeast Asia, 2022

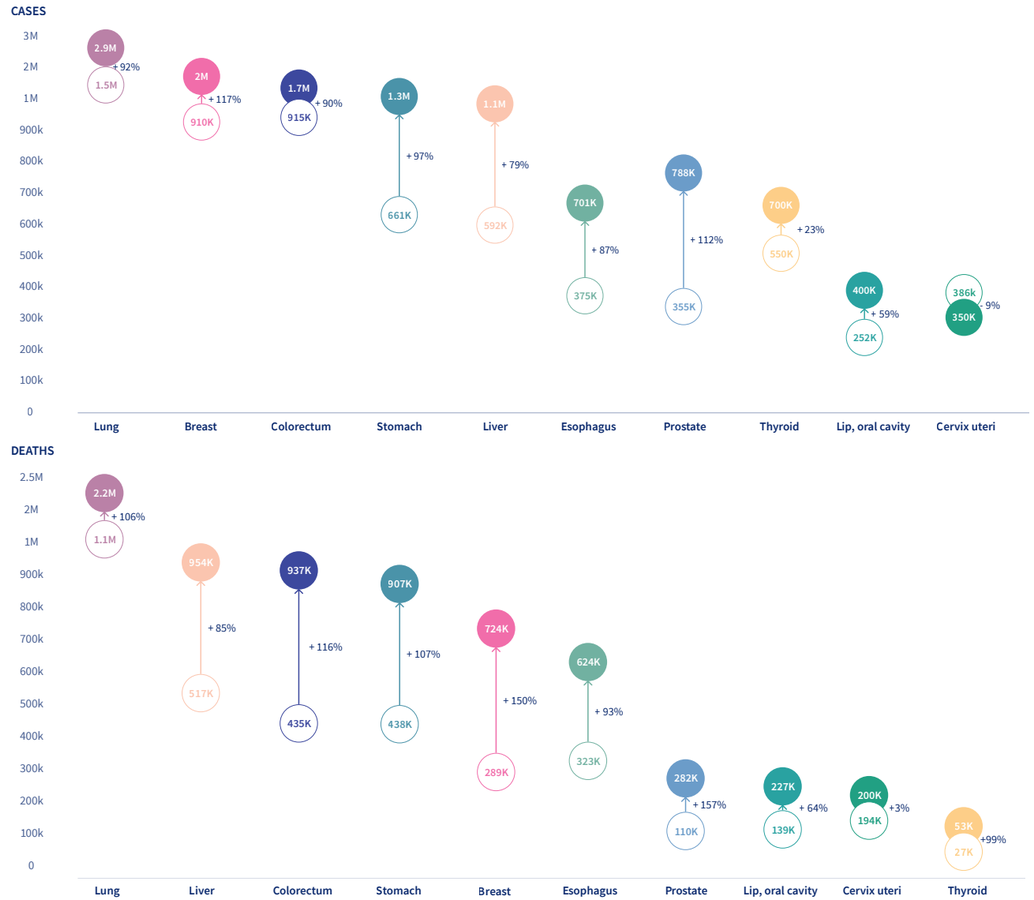


"The region faces a dual burden of infection-related and lifestyle-related cancers. As the cancer burden profile varies considerably between countries, locally tailored strategies for cancer prevention and control are essential."

– Dr. Wenqiang Wei
Director, Office of National Central Cancer Registry, National Cancer Center, China

Figure 26.3

Estimated number of new cancer cases and deaths (excluding non-melanoma skin cancer) from 2022 to 2050 in Southern, Eastern, and Southeast Asia



Cancer in Europe

Europe bears more than 20% of the global cancer burden despite representing less than 10% of the world's population.

In Europe, there are an estimated 4.1 million new cancer cases and almost 2 million cancer deaths each year. Cancers of the female breast, colorectum, lung, and prostate are the most common cancers, representing half of the overall cancer burden in the continent (**Figure 27.1**).

In men, prostate cancer is the most commonly diagnosed cancer in nearly all countries except seven Eastern European countries and the Russian Federation, where lung cancer is the leading cancer. For women, breast cancer is the most commonly diagnosed cancer in all European countries, including France, Cyprus, and Belgium. These cancers, together with colorectal and pancreatic cancers, are also the five leading causes of cancer death in Europe. Substantial variations in incidence and mortality rates are observed across the region (**Map 27.1**).

Lifetime risk of developing cancer in Europe ranges from 16% (one in six persons) in Albania to 33% (one in three persons) in Norway and Denmark. The risk of dying from cancer varies from 8% (one in 13 persons) in Switzerland to 16% (one in six persons) in Hungary (**Figure 27.2**).

After decades of rising trends, overall cancer incidence rates in men have stabilized or begun to decrease in the region, largely due to decreases in lung cancer incidence, even in Central and Eastern Europe, where rates remain high (**Figure 27.3**). In contrast, the incidence rate for women continued to rise, largely reflecting slower progress in reducing lung cancer rates (see *Lung Cancer,* Chapter 14). Since the 1990s, overall cancer mortality has consistently decreased, largely because of decreases in breast, prostate, colorectal, and lung (males only) cancers. The trend reflects advancements in prevention, early diagnosis, and curative treatment.

By 2050, the burden of cancer is projected to increase by 22% as compared to the numbers estimated in 2022 due to the aging and growth of the population, with the increase largely confined to those aged 70 or older.

Figure 27.1

Estimated number of cancer cases and deaths (excluding non-melanoma skin cancer), Europe, 2022

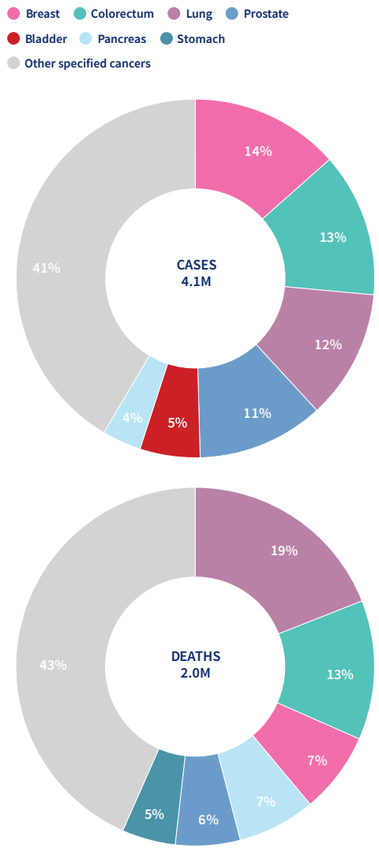
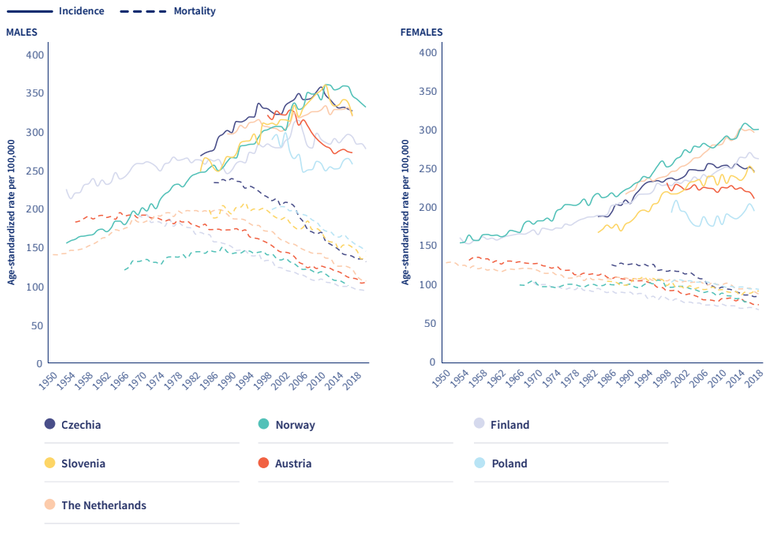


Figure 27.3

Trends in all cancers combined (excluding non-melanoma skin cancer) incidence (1953-2020) and mortality (1950-2020), age-standardized rates (world) per 100,000, Europe



Map 27.1

All cancers combined (excluding non-melanoma skin cancer) incidence and mortality, age-standardized rates (world) per 100,000, in Europe, 2022

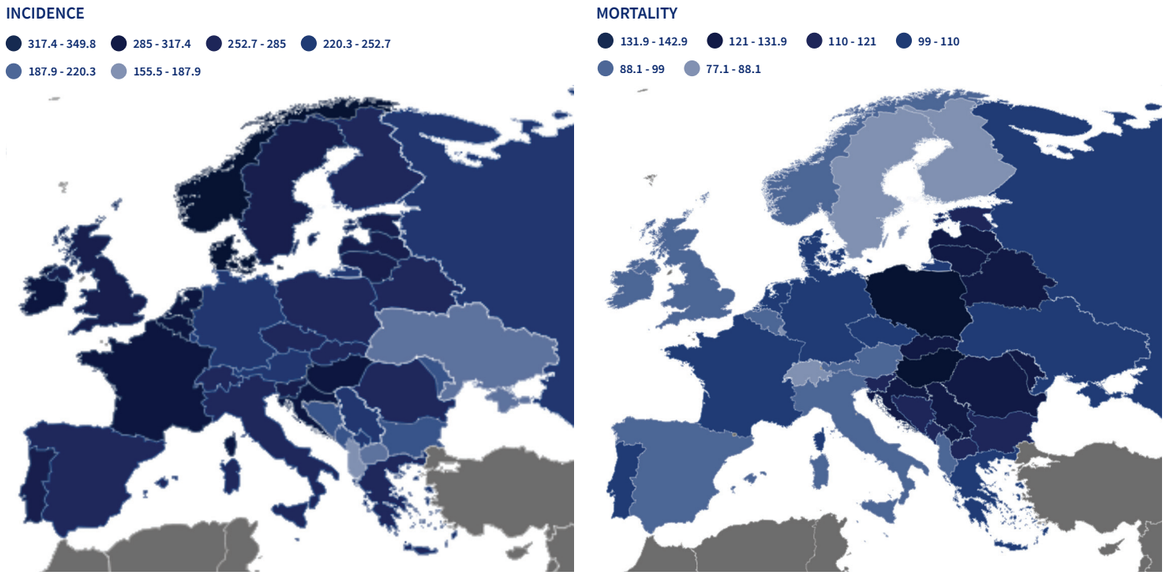
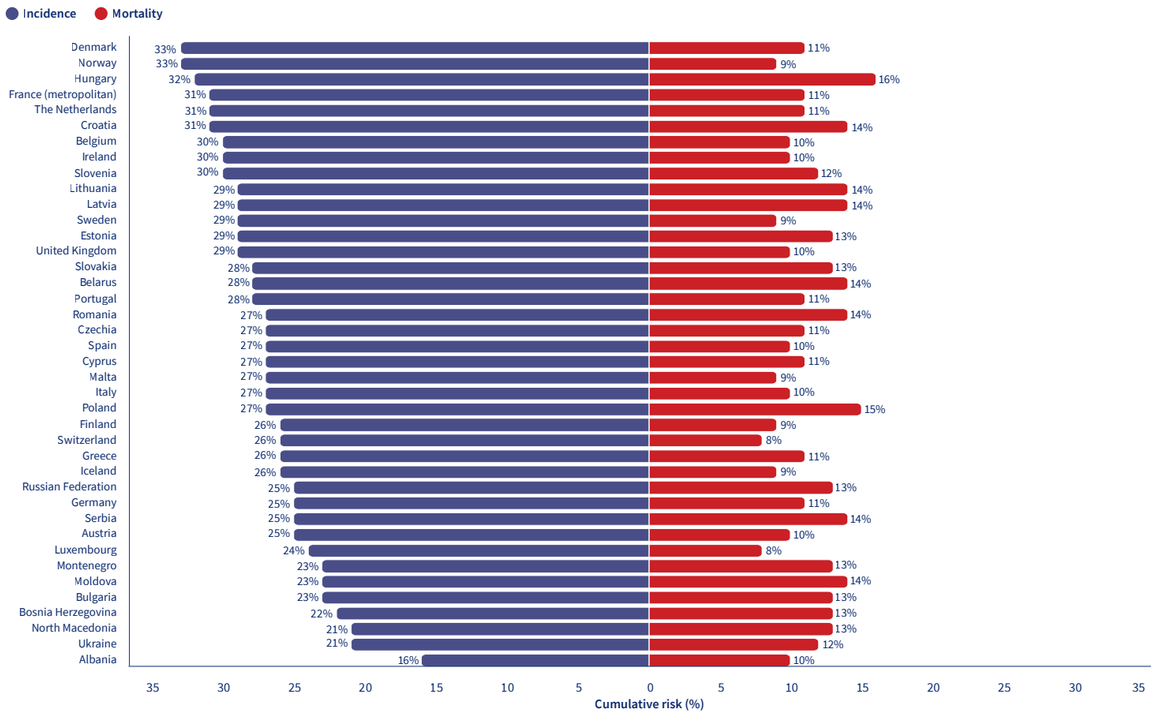


Figure 27.2

Estimated cumulative risk (%, ages 0-74) of incidence and mortality for all cancers combined (excluding non-melanoma skin cancer) by country in Europe, 2022



Cancer in Northern Africa, Central and West Asia

In 2023, Egypt became the first country to achieve WHO validation on the path to elimination of hepatitis C with the country's epidemic expected to end before 2030.

Northern Africa, Central, and West Asia is a diverse region characterized by relatively low but increasing cancer incidence rates. Breast cancer is the most common cancer in both sexes combined in all countries but Egypt (liver cancer), Kyrgyzstan and Tajikistan (stomach cancer), and Azerbaijan, Armenia, Tunisia, Türkiye (lung cancer) (**Map 28.1**).

The three subregions have quite distinct cancer profiles (**Figure 28.1**). In Northern Africa, liver cancer is the second most common cancer among both sexes after breast cancer, with incidence and mortality rates in Egypt estimated to be the second highest worldwide in both men and women, largely due to the high prevalence of hepatitis C virus infection in the country.

In Central Asia, the observed cancer profiles are consistent with low to medium human development index (HDI) countries, with a high incidence of infection-related cancers, in particular, stomach cancer (10% of all cancer cases), as well as cervical cancer (see *Human Development Index,* Chapter 20). Lung cancer mortality rates are second to breast cancer in the region (**Figure 28.1**).

West Asia is a large and diverse region, with specific cancer profiles corresponding to their high national levels of HDI, while also reflecting high levels of smoking in some countries, low alcohol consumption, as well as high prevalence of excess body fatness. Breast cancer is the most common cancer in both sexes combined, followed by lung cancer (**Figure 28.1**), the latter of which is also the most common cause of death from cancer in the region (**Figure 28.2**).

The overall number of cancer cases in Northern Africa, Central and West Asia, estimated at close to 900,000 in 2022, is predicted to more than double to 1.9 million cases by 2050. While population growth and population aging are the critical drivers of this increase, incidence rates of common cancers are expected to rise in many of the constituent countries due to changes in lifestyle and the built environment, including tobacco use, unhealthy diet, rising excess body fatness, and insufficient physical activity, making a compelling case for effective implementation of cancer prevention policies.

This diverse region is undergoing major epidemiologic transition, with changes in population demographics and an increasing prevalence of risk factors contributing to a possible doubling of the cancer burden by 2050.

Map 28.1

Most common cancer types in terms of cases and deaths in Northern Africa, Central and West Asia, 2022

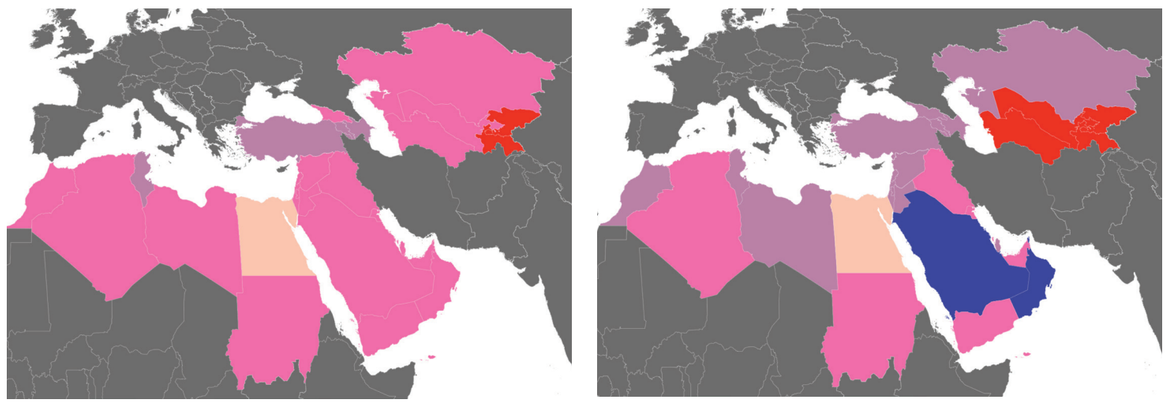


Figure 28.1

Estimated number of new cancer cases by type (excluding non-melanoma skin cancer) in Northern Africa, Central and West Asia, 2022

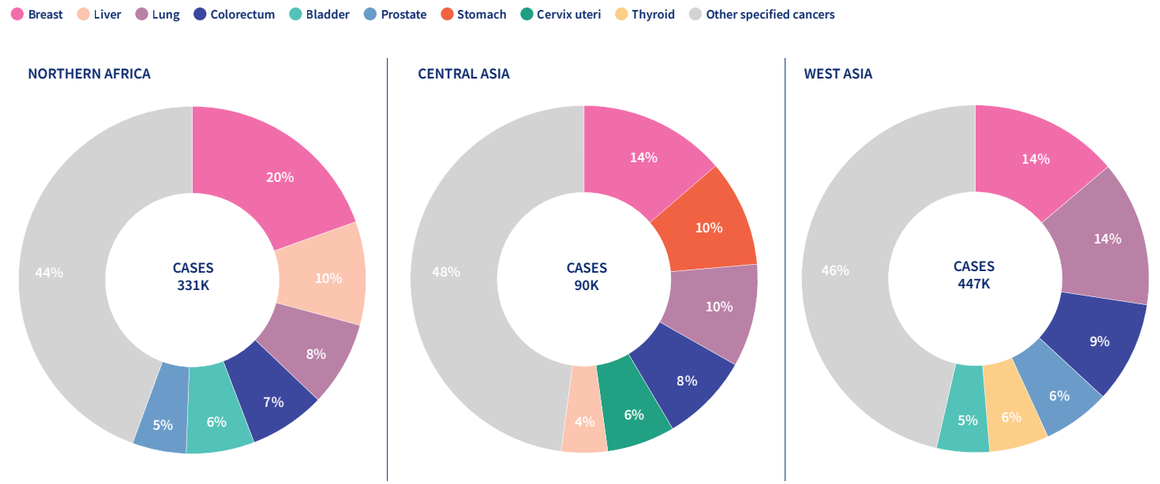
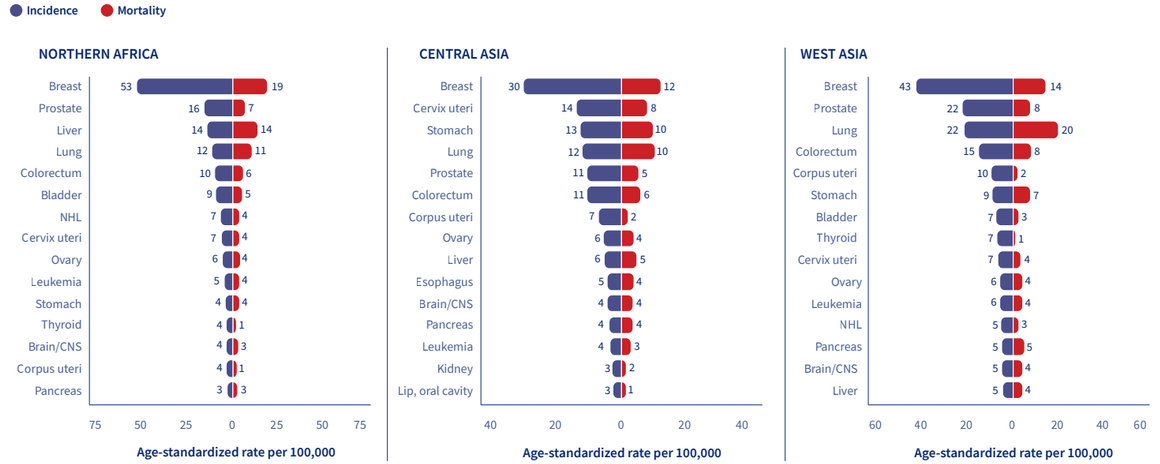


Figure 28.2

Incidence and mortality, age-standardized rates (world) per 100,000, for the most common cancer types in Northern Africa, Central and West Asia, 2022



Footnote
CNS: Central nervous system, NHL: Non-Hodgkin lymphoma

Cancer in Oceania

With excess body fatness exceeding 60–90%, small island nations in Oceania face a rising tide of cancer and other chronic diseases.

There are growing health challenges faced by many countries and territories in Oceania, with a rise in the burden of lifestyle-related diseases such as cancer exacerbated by the impact of climate change.

Annually, Oceania has an estimated 197,000 new cancer cases and 73,000 cancer deaths, excluding non-melanoma skin cancers. Cancer incidence rates vary more than threefold across countries, while mortality rates are less variable, with Samoa and French Polynesia ranking the highest, highlighting substantial disparities in early detection and treatment of cancers (**Figure 29.1**).

In men, the most commonly diagnosed cancers are prostate cancer (23%), melanoma (12%), colorectal cancer (11%) and lung cancer (10%), while lung cancer is the leading cause of cancer death (18%), followed by prostate (14%) and colorectal (11%) cancers (**Figure 29.2**). In women, breast cancer (31%), colorectal cancer (11%) and lung cancer (8%) are the most frequent forms of cancer diagnosis, while breast cancer is the leading cause of cancer death (17%), followed by lung (16%) and colorectal (11%) cancers (**Figure 29.2**).

The scale and profile of cancer in Oceania reflects the disproportionately large populations of Australia (60% of the total population), Papua New Guinea (22%), and New Zealand (11%), though marked differences in the cancer patterns are seen across the region. In men, lung cancer is the leading cause of cancer death in six out of 10 countries, and liver cancer in four countries (Fiji, Papua New Guinea, the Solomon Islands, and Vanuatu) (**Map 29.1**). In women, lung cancer is the leading cause of cancer death in Australia, New Zealand, Guam, and New Caledonia, while breast cancer dominates in the other islands, except Vanuatu, where cervical cancer ranks first (**Map 29.1**).

The region has demonstrated important cancer control successes, notably in Australia, with progress in tobacco control, cervical cancer screening and human papillomavirus vaccination, and ultraviolet radiation exposure prevention. Yet, these successes contrast with the growing challenges, worsened by the impacts of climate change, faced by many countries and territories on the continent. In particular, the Pacific Islands, geographically isolated, already suffer from health care systems that are overburdened by communicable diseases and are facing a rapid transition to lifestyle-related diseases, including cancer. Due to population aging and growth, cancer cases are expected to rise by 70% by 2050 in Oceania, with cancer deaths doubling, emphasizing the urgent need for effective, equitable cancer-control strategies.

Figure 29.1

All cancers combined incidence and mortality (excluding non-melanoma skin cancer), age-standardized rates (world) per 100,000, by country in Oceania, 2022

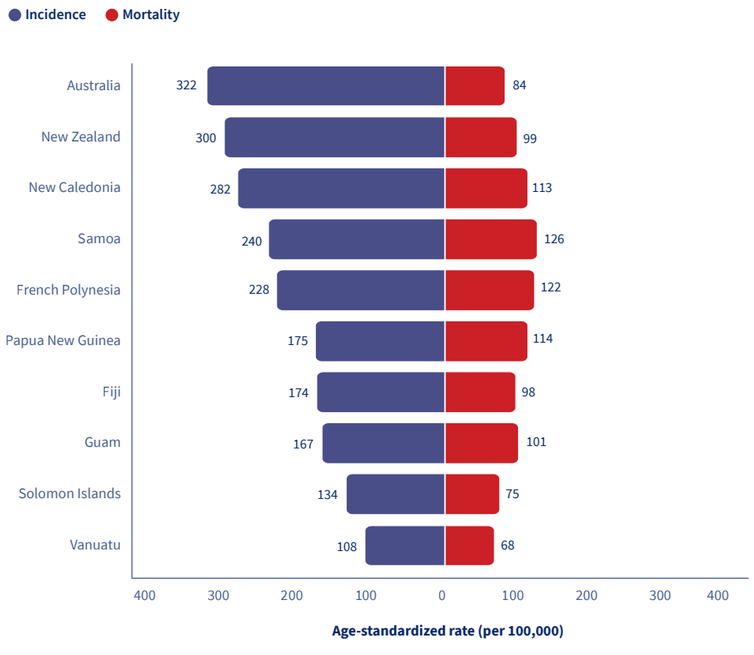
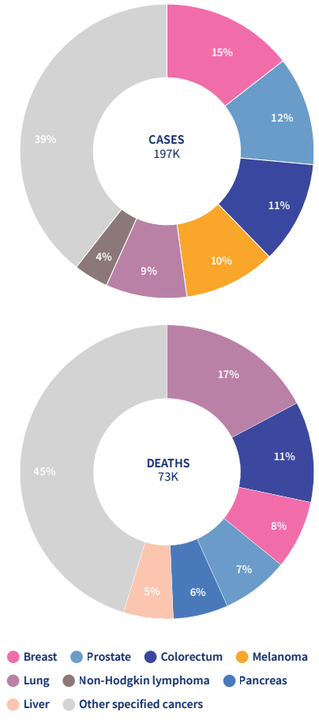


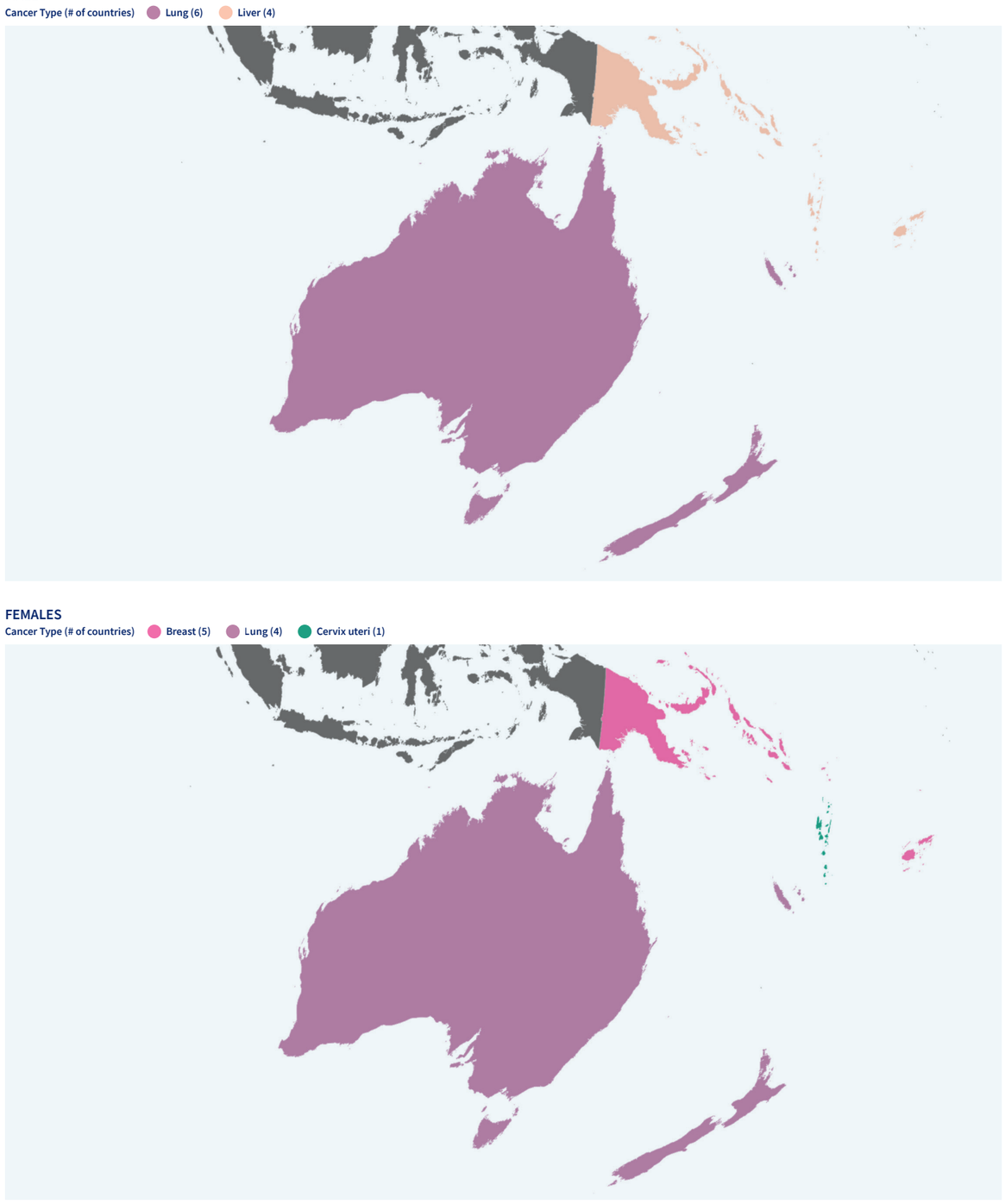
Figure 29.2

Estimated number of new cancer cases and deaths by type (excluding non-melanoma skin cancer) in Oceania, 2022



Map 29.1

Most common cancer deaths by cancer type and sex in Oceania, 2022



Cancer Survival

Despite advancements in diagnostics and treatment, substantial disparities persist in cancer survival both between and within countries worldwide.

Cancer survival statistics highlight the degree of health care equity, reflecting the effectiveness of health systems in detecting, diagnosing, and treating cancers. Despite advancements in diagnostics and treatment, substantial disparities persist in international cancer survival both between and within countries due to inequality in the dissemination of advancements in diagnostic and treatment to all populations.

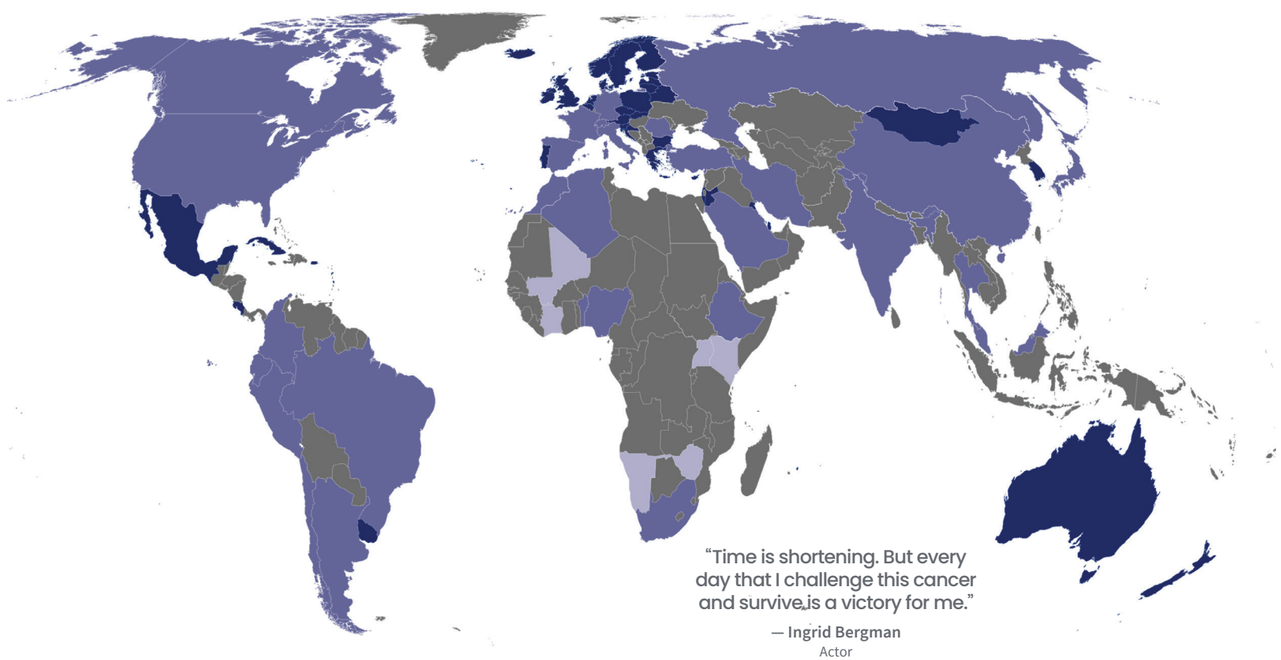
For cancers with limited advances in early detection and treatment (e.g., pancreas), survival remains poor globally (**Figure 30.1**). Conversely, cancers that benefit from early detection show significant disparities in survival across countries, reflecting inequalities in access to screening and timely diagnosis. The exceptionally high survival in high-income countries for certain cancers (e.g., breast, prostate) may be partially attributable to overdiagnosis, which is the detection of cancers that do not cause harm during a lifetime if left untreated.

Quality of care is another important determinant of survival. A study in sub-Saharan Africa showed that receipt of guideline concordant treatment ranged from 73% in Namibia to only 13% in Uganda, contributing to disparities in cancer survival. A report from seven high-income countries with universal health coverage also showed disparities in quality of care, with chemotherapy receipt for rectal cancer patients ranging from 22% to 62%, leading to disparate survival. Survival disparities are also observed within a country. For example, cancer survival in the United States is lower among Black persons than White persons for almost every cancer type, even after controlling for stage at diagnosis, contributing to the persistent Black-White mortality gap (**Figure 30.2**).

Improving access to early detection and quality treatment in lower- and middle-income countries (LMICs), alongside the promotion of healthy lifestyle, are necessary steps to improve cancer survival and reduce the mortality gap globally. To address cancer survival disparities, the World Health Organization (WHO) has launched major initiatives. For example, the Global Breast Cancer Initiative aims to offer guidance to governments on delivering resource-appropriate and quality services for early detection and treatment of breast cancer (**Figure 30.3**). Furthermore, provision of high-quality survival estimates is key for cancer control at both national and subnational levels. Yet survival data remain limited, especially in LMICs (**Map 30.1**).

Map 30.1

Availability of high-quality data for survival statistics, 2008-2014



Footnote
Data quality varies according to cancer site and the quality determination in the map was based on breast cancer data. For additional information, refer to Allemani C et al., for the CONCORD Working Group. Global surveillance of trends in cancer survival 2000–14 (CONCORD-3): analysis of individual records for 37 513 025 patients diagnosed with one of 18 cancers from 322 population-based registries in 71 countries. *Lancet*. 2018 Mar 17;391(10125):1023–1075.

Figure 30.1

Five-year net survival (%) of select cancers by country and continent, for cases diagnosed from 2000-2014 with follow-up through 2014

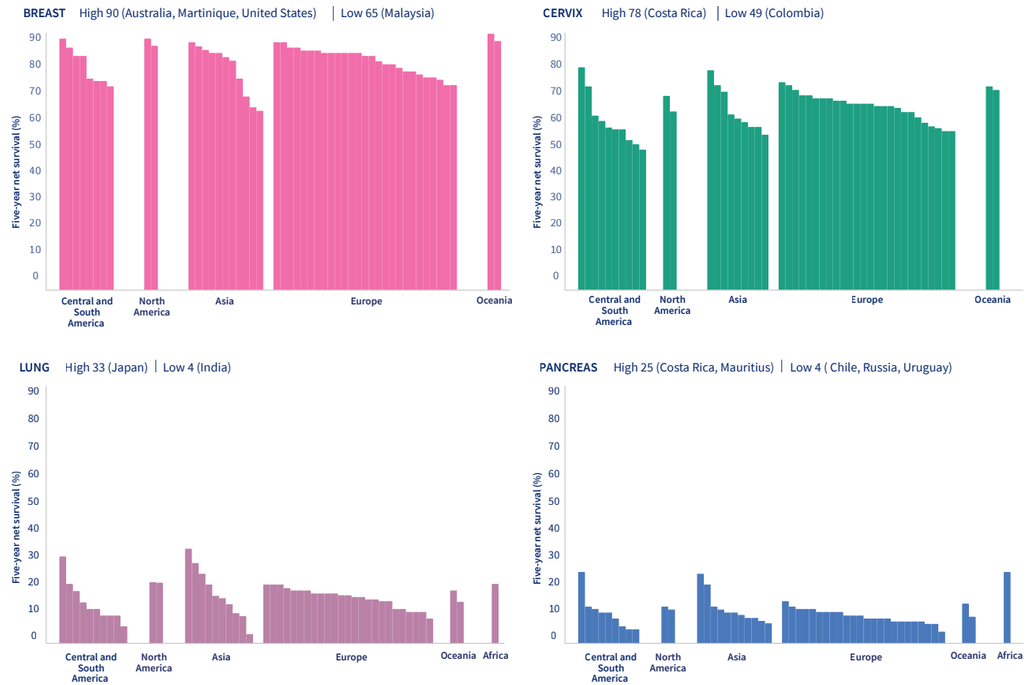


Figure 30.2

Five-year relative survival by cancer stage and race in the United States, for cases diagnosed 2014–2020 with follow-up through 2021

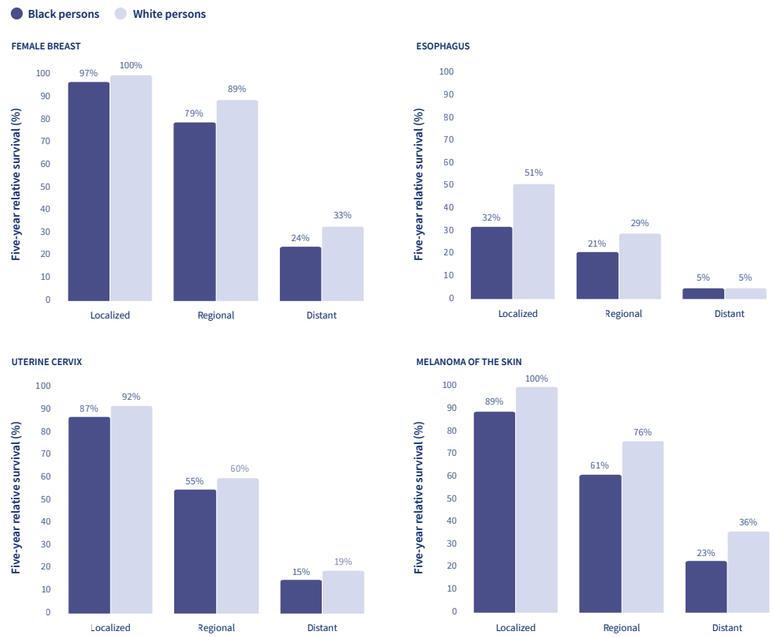
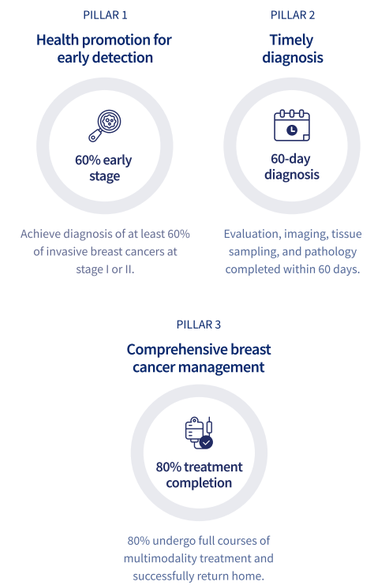


Figure 30.3

The WHO's Global Breast Cancer Initiative, 2021: Three Pillars of Action to Improve Survival and Reduce Mortality from Breast Cancer



Cancer Survivorship

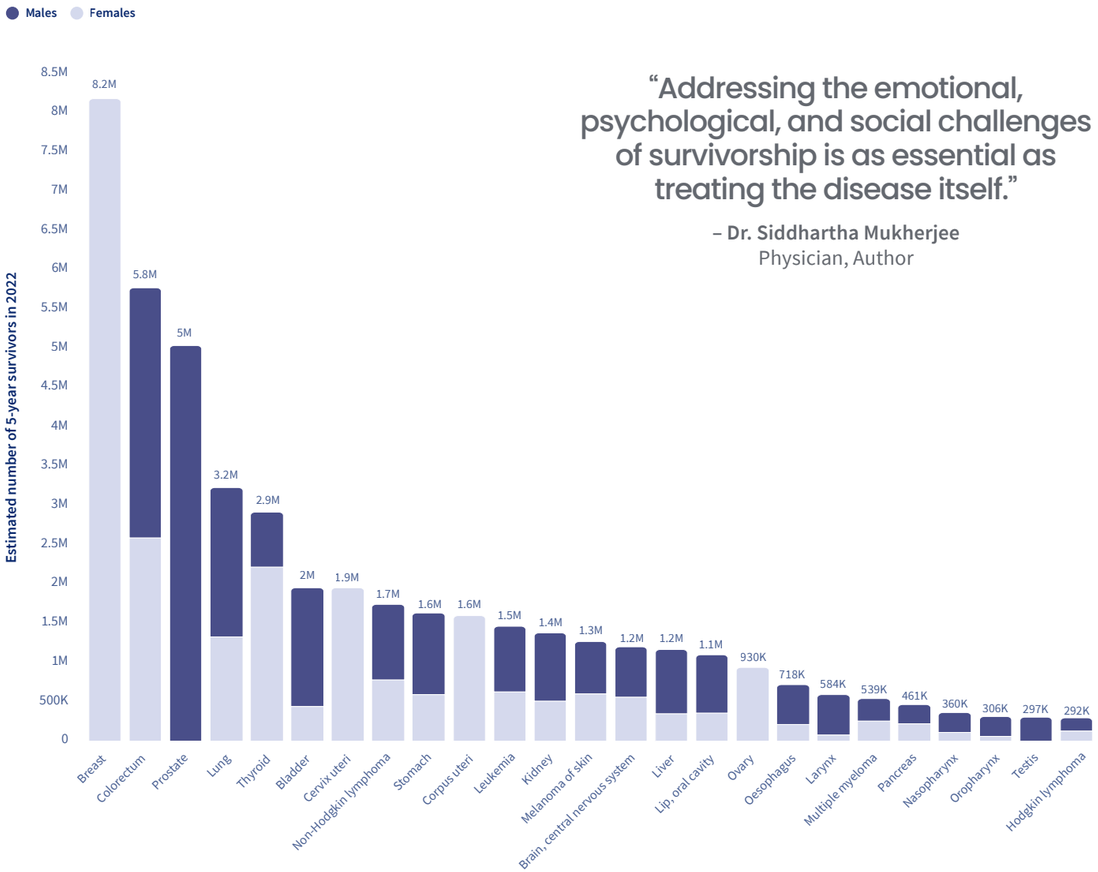
People are living longer after a cancer diagnosis due to advances in early detection and treatment. There are close to 54 million people worldwide who are currently diagnosed with a cancer diagnosis within five years (**Figure 31.1**). Although most cancer survivors are currently concentrated in high-income countries (**Map 31.1**), the number is expected to grow faster in transitioning countries due to increasing cancer incidence, improving cancer survival, and population growth and aging.

Individuals are considered "cancer survivors" from diagnosis and throughout their lifetime. Although this term may or may not resonate with all individuals, it is meant to encompass individuals with a history of cancer. "Cancer survivorship care" refers to efforts to enhance health and well-being during and beyond treatment, aiming to prevent and mitigate acute, long-term, and late-occurring effects of cancer, which also benefits families and informal caregivers (**Figure 31.2**). In addition to health-related difficulties, cancer survivors often face medical financial hardship (see Economic Burden, Chapter 41). In the United States, approximately 60% of working-age cancer survivors report at least one type of financial hardship, such as foregoing or delaying medical care because of cost. A study from seven Southeast Asian countries found that over 75% of patients faced death or catastrophic health expenditure within a year of diagnosis.

Many countries are seeking to transform health care delivery to address cancer survivors' needs. For example, the United Kingdom has implemented personalized follow-up care, triaging survivors based on individual needs, improving their quality of life and in doing, saving 110 million US dollars over five years. In countries with constrained resources, however, survivorship care is often overlooked; only 9% of low-income countries address survivorship care in their non-communicable disease plan or national cancer-control plans, compared with 66% of high-income countries (see *Cancer Continuum,* Chapter 32). To advance equitable survivorship care globally, the implementation of resource-conscious guidelines in national cancer-control plans is needed, supported by more research in transitioning countries and increased collaboration and regional partnerships (**Figure 31.3**).

Figure 31.1

Estimated number of prevalent cases (5-year) by cancer type, 2022



"Addressing the emotional, psychological, and social challenges of survivorship is as essential as treating the disease itself."

– Dr. Siddhartha Mukherjee
Physician, Author

Map 31.1

Estimated number of prevalent cases (5-year), as a proportion (world) per 100,000, 2022

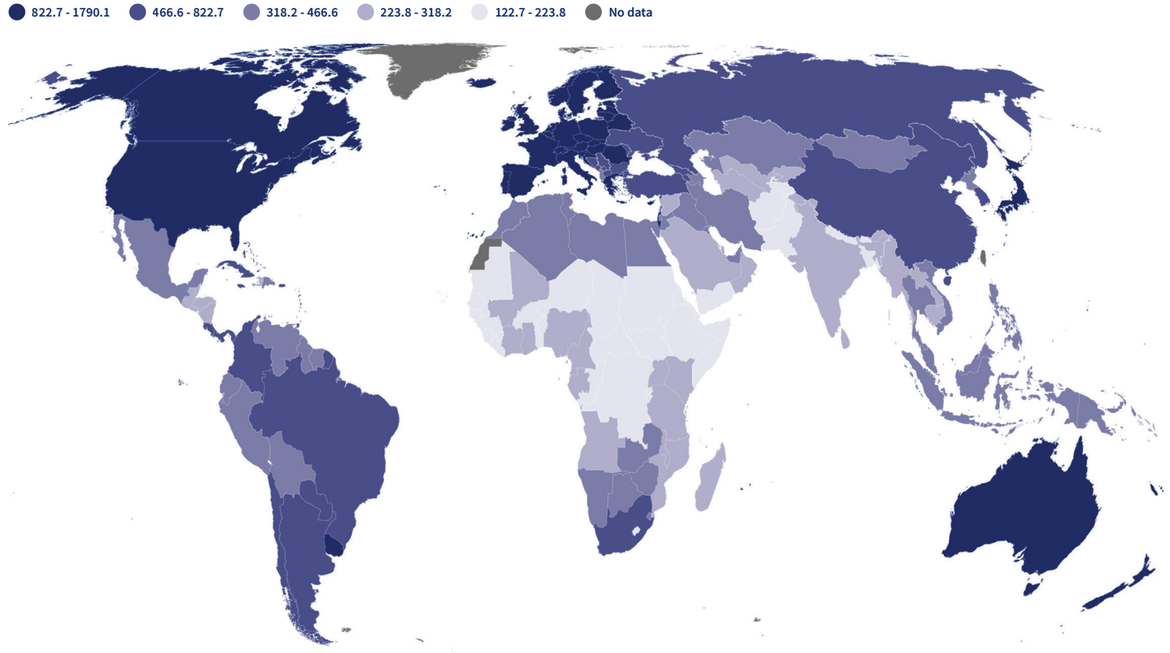


Figure 31.2

Long-term and late-effects of cancer diagnosis and treatment

Figure 31.3

Recommendations for advancing equitable cancer survivorship care across the globe

- **Research examining the current state of survivorship care in low- and middle-income countries and identifying opportunities to improve care**
- **Expand the number of nation and local cancer control plans that provide effective cancer survivorship**
- **Develop and disseminate resource-stratified guidelines for effective survivorship care**
- **Call for theformation of regional partnerships to improve survivorship care**

Footnote
Recommendations from Jacobsen PB, Mollica MA. Understanding and addressing global inequities in cancer survivorship care. Journal of Psychosocial Oncology Research and Practice. 2019;1(1)

Taking Action

Discover effective interventions across the cancer continuum, from prevention to early detection, treatment, and palliative care.

Cancer Continuum

Implementing effective interventions across the cancer continuum can reduce the burden and suffering from cancer and save millions of lives worldwide.

Each country has opportunities to prevent and control cancer through resource-stratified evidence-based interventions across the entire cancer care continuum, from risk factor prevention, early detection and timely diagnosis, to quality treatment, survivorship, palliative care, and end-of-life care (**Figure 32.1**).

A comprehensive tobacco-control program – including interventions that increase tobacco prices by raising excise taxes, ban tobacco advertising, and support tobacco cessation – can effectively reduce smoking prevalence, thereby reducing the risk of lung (**Figure 32.2**) and 16 additional cancers and other smoking-related diseases. In addition to saving lives from smoking-related diseases, higher tobacco taxes also generate revenue for health care programs. However, many countries have only partly implemented comprehensive tobacco-control policies (see *Tobacco Control,* Chapter 34).

Systematic and policy actions such as health education, nutrition policies, active transport initiatives, and community health programs can foster healthy lifestyle and improve cancer prevention (see *Health Promotion,* Chapter 33). Environmental policies can lower daily exposure to carcinogens, reducing cancer risk (see *Environmental Pollutants and Occupational Exposures,* Chapter 10). Sun protection measures help prevent skin cancer (see *UV Radiation,* Chapter 8). Vaccination against hepatitis B virus and human papillomavirus (HPV) can prevent several cancers, including liver, cervical, oral, and anogenital cancers (see *Vaccination,* Chapter 35).

Early diagnosis and screening enable early detection of cancers, ensuring timely and effective treatment and improved survival (see *Early Detection,* Chapter 36). Screening for cervical and colorectal cancers can also identify precancerous lesions, which can be removed before they become cancerous. Cervical cancer screening combined with a high uptake of HPV vaccination can accelerate the reduction in cervical cancers, helping to achieve the World Health Organization's (WHO) goal of eliminating cervical cancer (**Figure 32.3**).

Recent advances in cancer treatment, including immunotherapy and targeted drug therapies, have markedly improved cancer survival and lowered cancer mortality (**Figure 32.4**). While these drugs may not be available broadly in many lower- and middle-income countries (LMICs) because of their high cost, many of WHO's essential drugs are becoming increasingly accessible in LMICs, leading to improvements in outcomes (see *Management and Treatment,* Chapter 37). Effective pain management and palliative care services are essential for enhancing quality of life and providing comprehensive care for cancer patients (**Figure 32.5**) (see *Pain Control,* Chapter 38).

Implementing interventions across the cancer continuum in a resource-stratified manner can save thousands of lives in each country. However, many LMICs have not widely adopted these measures due to lack of political commitment to make cancer control a priority.

> "For too long, the focus in cancer control has been on clinical care and not on the broader needs of people affected by cancer."
>
> **— Dr. Tedros Adhanom Ghebreyesus**
> Director-General, World Health Organization

Figure 32.1

Proportion (%) of countries with national non-communicable disease (NCD) and national cancer control plans (NCCP) that address key elements across the cancer continuum, by World Bank income group, 2024

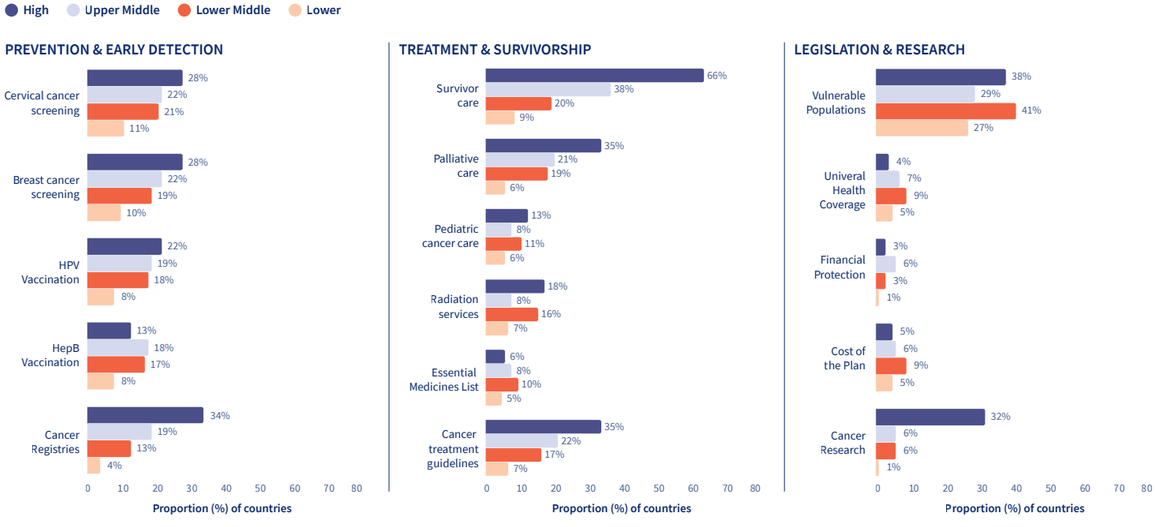


Figure 32.2

Estimated cumulative probability (%) of death from lung cancer by attained age and smoking status

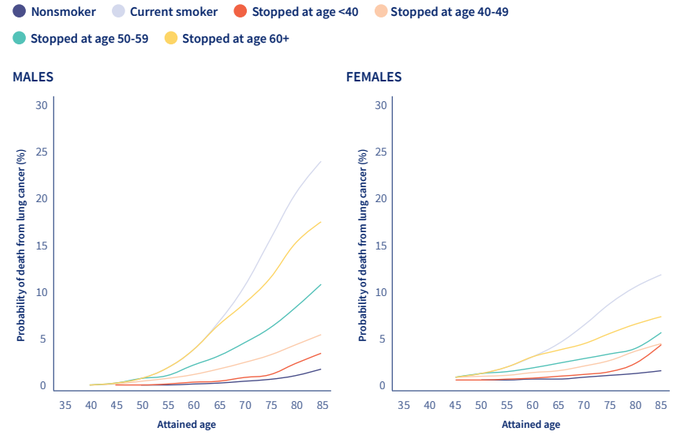


Figure 32.3

Global cervical cancer incidence rates under various scenarios of HPV vaccination and cervical screening, 2020-2120

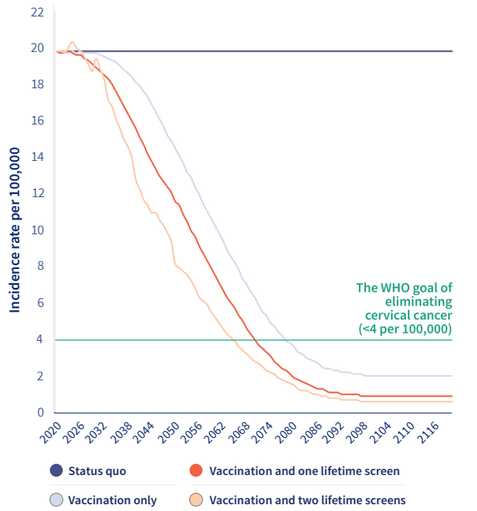


Figure 32.5

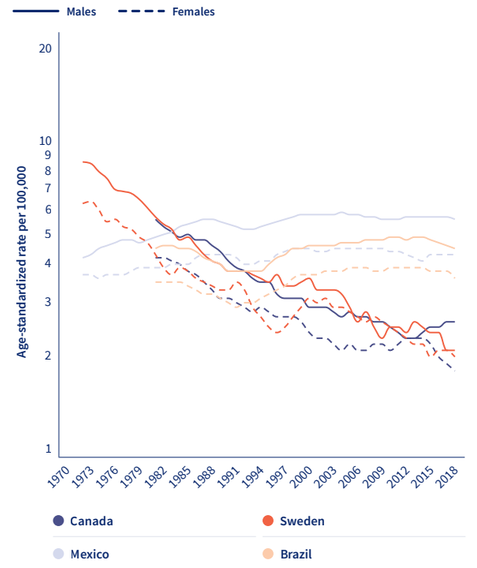
Palliative Care is Preventative Care

COMPONENTS OF PREVENTATIVE CARE	KEY ASPECTS	EXAMPLE 1 Symptom Prevention	EXAMPLE 2 Advance Care Plan
Insight into Illness	Natural history Prognostication	Stage IV pancreatic cancer = symptoms	Stage IV lung cancer = short prognosis
Foresight for individual	Anticipate concerns Risk factors	Mild pain can now get worse	Patient will deteriorate
Interventions available	Risk reduction Evidence-based	Opioids can be useful	Serious illness conversations
Introduce intervention	Timely initiation Longitudinal follow-up	Start scheduled opioids Educate and monitor	Prognostic discussions Advance care planning
Crisis prevention	Improved outcomes Preparations in place	StageIV pancreatic cancer = symptoms	Better quality of EOL Avoid ICU visit

Footnote
Adapted from Hui D, Hannon BL, Zimmermann C, Bruera E. Improving patient and caregiver outcomes in oncology: Team-based, timely, and targeted palliative care. *CA Cancer J Clin*. Sep 2018;68(5):356-376. doi:10.3322/caac.21490

Figure 32.4

Childhood and adolescent cancer mortality trends (ages 0-19), all cancer combined (excluding non-melanoma skin cancer), by sex, 1970-2018



Health Promotion

Policy change is a powerful way to make environments – where people live, work, play, learn, and shop – become more supportive of adopting healthy behaviors for everyone.

Modifiable risk factors cause a large proportion of cancer cases and deaths. A recent study shows that an estimated 40% of all cancer cases and 44% of cancer deaths in the United States are attributable to a combination of modifiable risk factors, including tobacco use, excess body fatness, and alcohol consumption.

Reducing the prevalence of these risk factors can help mitigate the cancer burden, but individual-focused initiatives are unlikely to succeed without addressing the external factors that influence behaviors. To be effective, health promotion efforts must tackle the environmental, economic, and social factors that influence an individual's opportunities to engage in healthier behaviors. This is especially important in the context of health equity, as underserved communities are most exposed to environments that are not conducive to adopting healthy behaviors (see *Cancers in Indigenous Populations*, Chapter 21). Policy change is a means to ensure environments are increasingly supportive of the adoption of healthy behaviors by everyone (see *Policies and Legislation,* Chapter 45).

To encourage policy change and promote healthy diets and physical activity, the World Cancer Research Fund (WCRF) has created the NOURISHING and MOVING policy frameworks (**Figure 33.1**). The NOURISHING framework consists of 10 key policy areas within three domains: food environment, food system, and behavior change communication. The MOVING framework consists of six policy areas across four domains: active societies, active environments, active people, and active systems.

Although the comprehensive set of nutrition and physical policies outlined in these frameworks have yet to be fully achieved, there are notable examples of progress. These include offering healthy foods in public institutions in the European Union (**Figure 33.2**) and city and regional efforts to implement a more sustainable, local food system (**Figure 33.3**). The Food Is Medicine Initiative is a tailored food-based nutritional intervention linked to the health care system intended to control chronic diseases, and often addresses food and nutrition insecurity and has recently gained traction in the United States. As of January 1, 2024, 11 states have applied for special legal permissions to provide nutrition interventions for Medicaid enrollees (**Map 33.1**). Moreover, there is increased recognition that policies aimed at reducing alcohol consumption and raising awareness about its health hazards are essential for lowering cancer risk (see *Alcohol,* Chapter 7) (**Figure 33.4**).

"The choices we make are shaped by the choices we have. Let's create better choices for everyone."

– Dr. Tom Frieden
Former Director,
Centers for Disease Control and Prevention

Figure 33.1

World Cancer Research Fund International (WCRF) NOURISHING and MOVING Frameworks

N O U R I S H	I N G
FOOD ENVIRONMENT	FOOD SYSTEM / BEHAVIOUR CHANGE COMMUNICATION

	POLICY AREA
N	Nutrition label standards and regulations on the use of claims and implied claims on food
O	Offer healthy food and set standards in public institutions and other specific settings
U	Use economic tools to address food affordability and purchase incentives
R	Restrict food advertising and other forms of commercial promotion
I	Improve nutritional quality of the whole food supply
S	Set incentives and rules to create a healthy retail and food service environment
H	Harness food supply chain and actions across sectors to ensure coherence with health
I	Inform people about food and nutrition through public awareness
N	Nutrition advice and counselling in health care settings
G	Give nutrition education and skills

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M O	V I	N G
ACTIVE SOCIETIES	ACTIVE ENVIRONMENTS	ACTIVE PEOPLE

	POLICY AREA	ACTIVE SYSTEMS
M	Make opportunities and initiatives that promote physical activity in schools, the community and sport and recreation	Governance systems
O	Offer physical activity opportunities in the workplace and training in physical activity promotion across multiple professions	Leadership
V	Visualise and enact structures and surroundings which promote physical activity	Physical activity surveillance
I	Implement transport infrastructure and opportunities that support active societies	Interdisciplinary research funding
N	Normalise and increase physical activity through public communication that motivates and builds behaviour change skills	Financing mechanisms
G	Give physical activity training, assessment and counselling in healthcare settings	Monitoring and evaluation of policy actions
		Life course / Health in all policies approach

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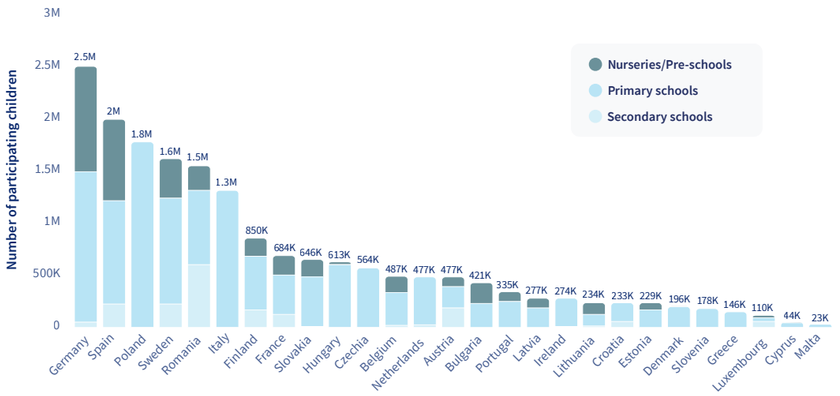
Figure 33.2

Children participating in School Scheme providing fresh fruit, vegetables, and milk, by country in Europe, 2022-2023



"When people can't make the healthy choice because their environment is stacked against them, we're failing as a society."

— Michael Bloomberg
Former Mayor of New York City and
Public Health Advocate

Figure 33.3

Local Food Policy for a more sustainable, local food system - example from Ghent, Belgium

STRATEGIC OBJECTIVE 1
A short, sustainable food chain

STRATEGIC OBJECTIVE 2
Sustainable food for everyone

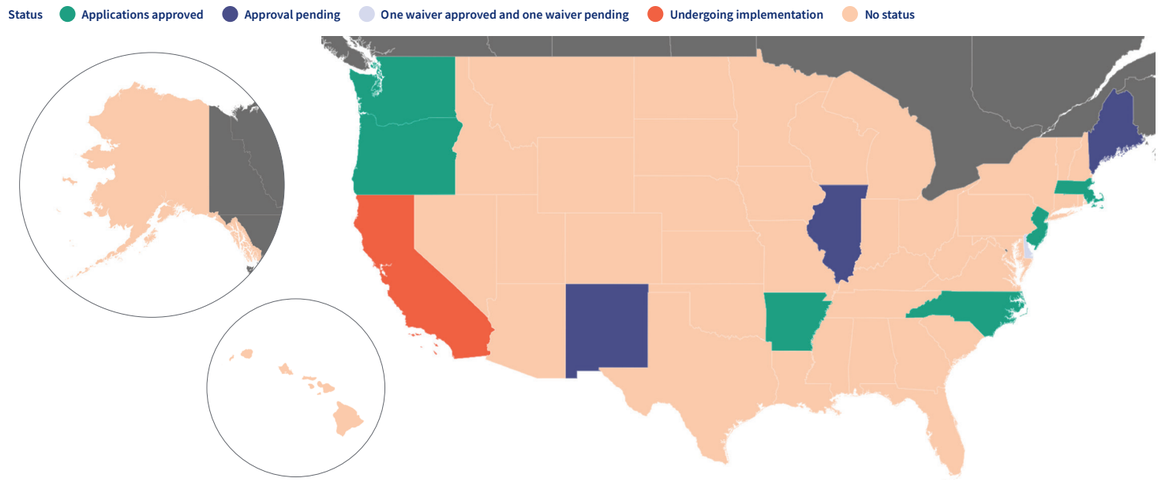
STRATEGIC OBJECTIVE 3
No food waste

Figure 33.4

Alcohol warning labels in Ireland

Map 33.1

States that applied for special legal permission from the federal government to provide nutrition interventions for Medicaid enrollees in the United States, January 1, 2024



Tobacco Control

More than a billion people still use tobacco products worldwide due to failure to fully implement proven tobacco control measures.

Curbing the tobacco epidemic is a global health priority to reduce the burden of cancer and other chronic diseases. The World Health Organization Framework Convention on Tobacco Control, the first global public health treaty, entered into force in 2005 and developed a set of six key tobacco-control measures (MPOWER, **Map 34.1**). By 2024, it has 183 parties, covering more than 90% of the world population, and has significantly reduced tobacco use among adults from one in five in 2000 to one in three in 2022 (**Figure 34.1**). Yet more than two billion people worldwide remain without protection from complete MPOWER policies.

Evidence-based best practices in tobacco-control policies include monitoring tobacco use, treatment for tobacco use, effective warnings about the harms of tobacco use, enacting and enforcing tobacco advertising and sponsorship bans, protecting people from exposure to secondhand smoke and aerosol, and raising tobacco taxes. Raising the tobacco tax has proven to be the most effective and fastest-acting measure of all (**Figure 34.2**). The payoff to investment in tobacco control is high and reflected in improvements in health, productivity, and standards of living. The rise and fall of lung cancer mortality rates closely follow trends in tobacco use, albeit at least a 25-year lag, reflecting the delayed impact of smoking on public health (**Figure 34.3**).

To accelerate progress further, many countries are proposing and/or adopting "Endgame Strategies," which include plain tobacco product packaging, phasing out tobacco sales to younger generations (sales are not allowed to people born after a certain date), reducing nicotine in cigarettes and other combusted tobacco products to non-addictive levels, and reducing the volume and density of tobacco retailers.

Yet, uneven progress in tobacco control policies and implementation has left many low- and middle-income countries behind, where 80% of the world's 1.3 billion tobacco users live (**Map 34.1**). Moreover, smokeless tobacco (e.g., chewed tobacco, snuff, snus) has been neglected in tobacco control and continues to cause life-threatening diseases like head and neck cancers. The rise of non-combusted tobacco products (e.g., electronic cigarettes or e-cigarettes, heated tobacco products) and the epidemic of youth e-cigarette use in many countries present further challenges (**Figure 34.4**). Despite substantial progress, a long road lies ahead to end the tobacco epidemic through the effective and innovative implementation of tobacco-control policies.

> "Everyone deserves to live a healthy life free from commercial tobacco-related disease and premature death."
>
> — Xavier Becerra
> Former Secretary, U.S. Department of Health and Human Services

Map 34.1

Degree of implementation of key tobacco control policies through MPOWER, 2022

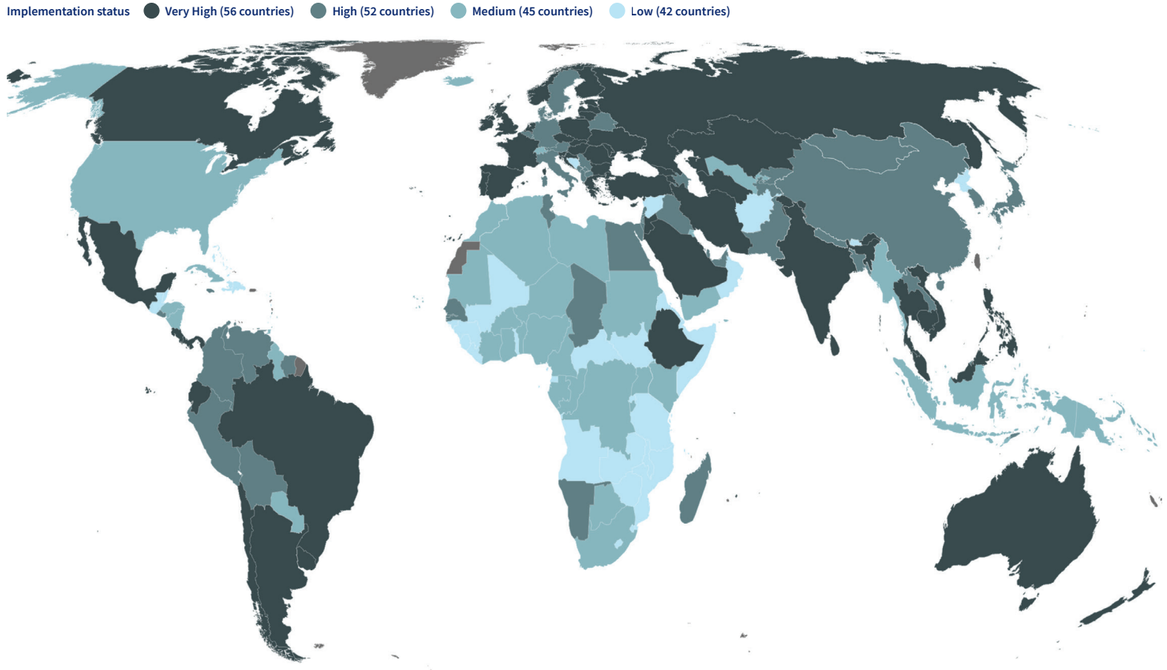
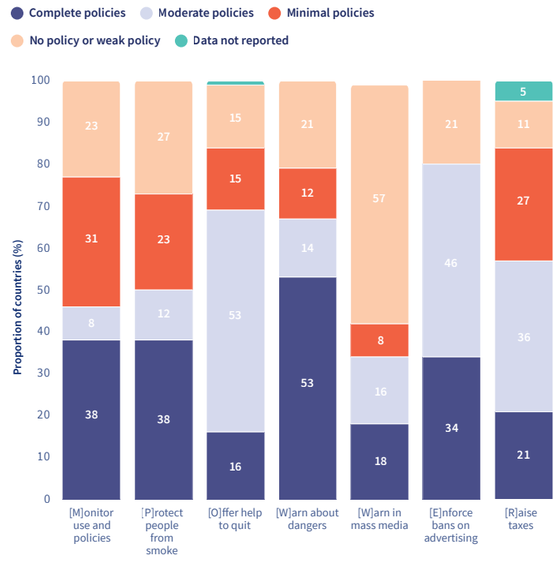


Figure 34.1

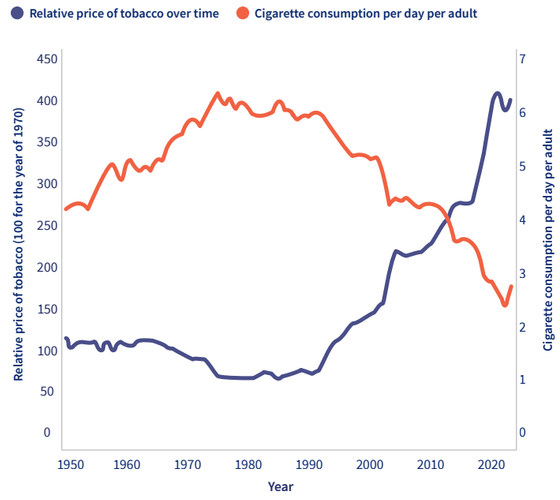
The status of selected tobacco control policies in 195 countries, 2022



Footnote
For [M]onitoring, "complete policies" refers to "recent, representative, and periodic data for both adults and adolescents"; blue refers to "recent and representative data for both adults and adolescents; and light blue refers to "recent and periodic data for either adults or adolescents".

Figure 34.2

Tobacco product price and cigarette consumption, France, 1950-2015



Raising tax on tobacco is not only the most effective tobacco control policy, but also raises revenue for other health programs.

Figure 34.3

Trends in tobacco consumption and lung cancer mortality rates by sex in the United States, 1900-2020

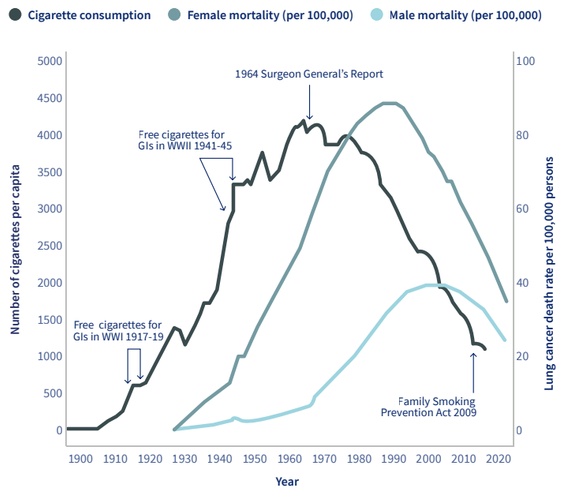
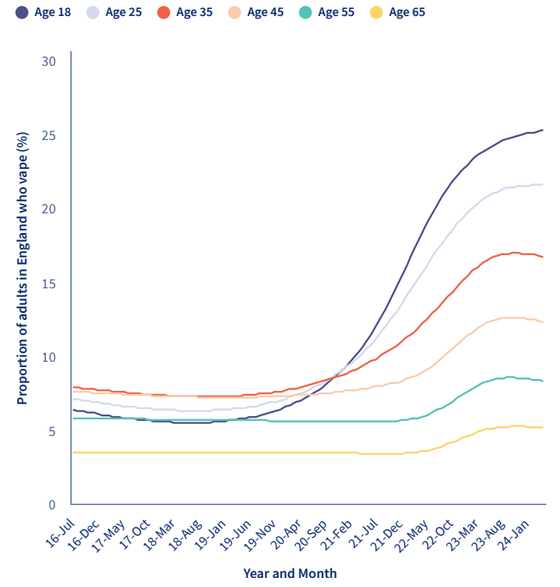


Figure 34.4

Trends in vaping by age among adults (18+ years) in England, July 2016–April 2024



Vaccination

As of August 2020, in Scotland, no cases of invasive cervical cancer in women immunized at 12 or 13 years of age have been reported since the vaccination program began in 2008, irrespective of the number of doses.

Highly effective prophylactic vaccines are available for two of the most important cancer-causing infections, hepatitis B virus (HBV) and human papillomavirus (HPV) (see *Infection*, Chapter 5).

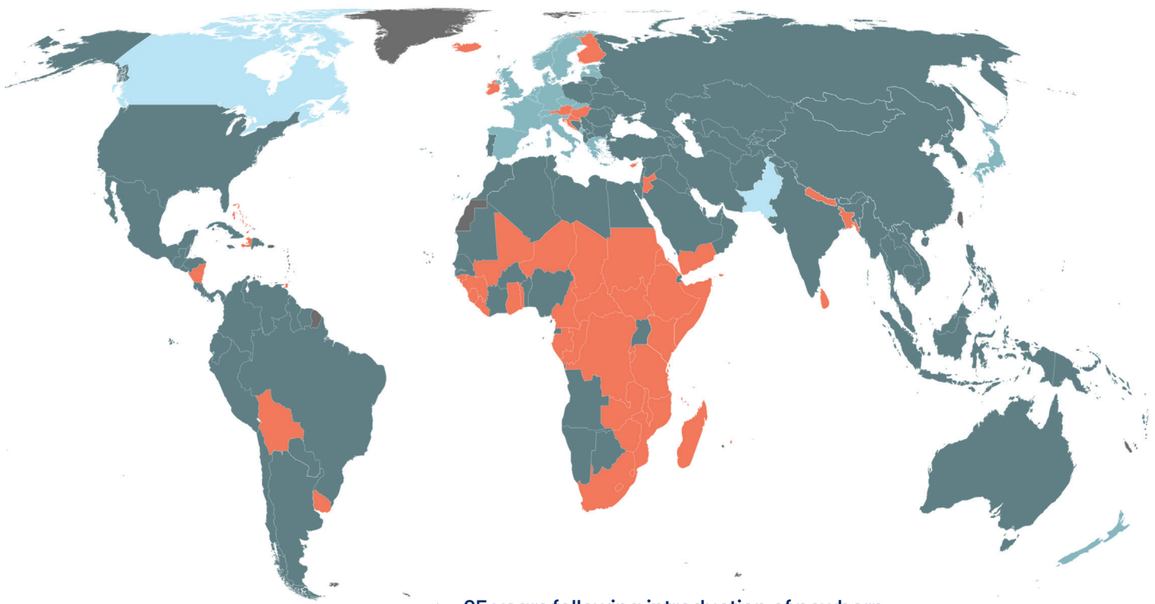
In 2022, there were an estimated 254 million people globally with chronic HBV infection; HBV infection causes nearly one million deaths annually, mostly from cirrhosis and hepatocellular carcinoma. Vaccines to protect against HBV have been available since 1982. The World Health Organization recommends that all newborns receive a hepatitis B vaccine birth dose (HepB-BD) within 24 hours of birth, followed by 2-3 additional doses, to confer full protection against HBV. By 2023, 190 (98%) countries had introduced universal infant hepatitis B vaccine in the immunization schedule with 83% of children globally receiving 3-doses. However, the coverage of birth dose vaccination is still low, at 45%, with only 115 (59%) countries introducing universal HepB-BD. An additional 24 countries provide selective or restrictive HepB-BD to infants born to mothers who have chronic HBV infection (**Map 35.1**). Lack of country prioritization for HepB-BD introduction, and implementation challenges resulting from high rates of home births, have limited the introduction and uptake of HepB-BD in several countries.

HPV is the cause of 730,000 cancers annually, including cervical, anogenital, and oropharyngeal cancers (**Figure 35.1**). HPV vaccines have been available since 2006 and were first approved as a 3-dose or a 2-dose series; more recent data show that one dose is highly effective. All available vaccines protect against HPV 16 and 18, types that cause over 70% of cervical cancers and the majority of other cancers caused by HPV. The nonavalent HPV vaccine (Gardasil 9) protects against 5 additional cancer-causing HPV types and prevents over 90% of cervical cancer. In most countries, the primary target group for HPV vaccination is girls aged 9-14 years. Increasingly, countries also recommend vaccination for boys. By 2024, over 145 of 194 countries had introduced HPV vaccination programs; however, coverage has varied by region (**Figure 35.2**). Globally, as of 2019, only 1 in 5 eligible girls had received HPV vaccination, far below the WHO target of 90% coverage.

Vaccine hesitancy, supply-demand imbalances, and other implementation challenges have limited HBV and HPV vaccine introductions and uptake in many countries. The Global Alliance for Vaccines and Immunization (Gavi) has provided critical financial support for HPV and HBV immunization programs in low- and middle-income countries.

Map 35.1

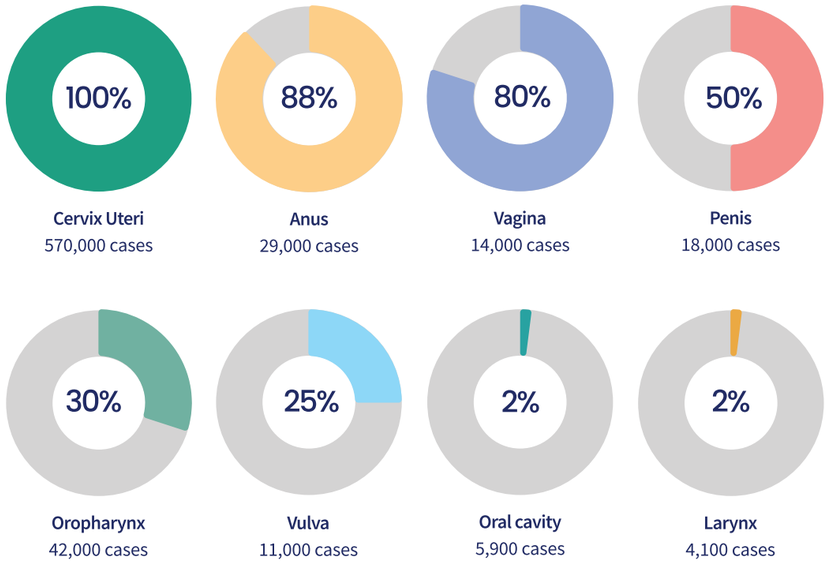
Countries that have introduced hepatitis B birth dose (HepB-BD) vaccine by 2023



25 years following introduction of newborn and infant hepatitis B vaccinations, incidence of primary liver cancer decreased by up to 75% in China, Taiwan and Thailand and by 100% in Alaska.

Figure 35.1

Estimated number and proportion (%) of cancer cases attributable to Human Papillomavirus (HPV) infection worldwide by cancer type, 2020



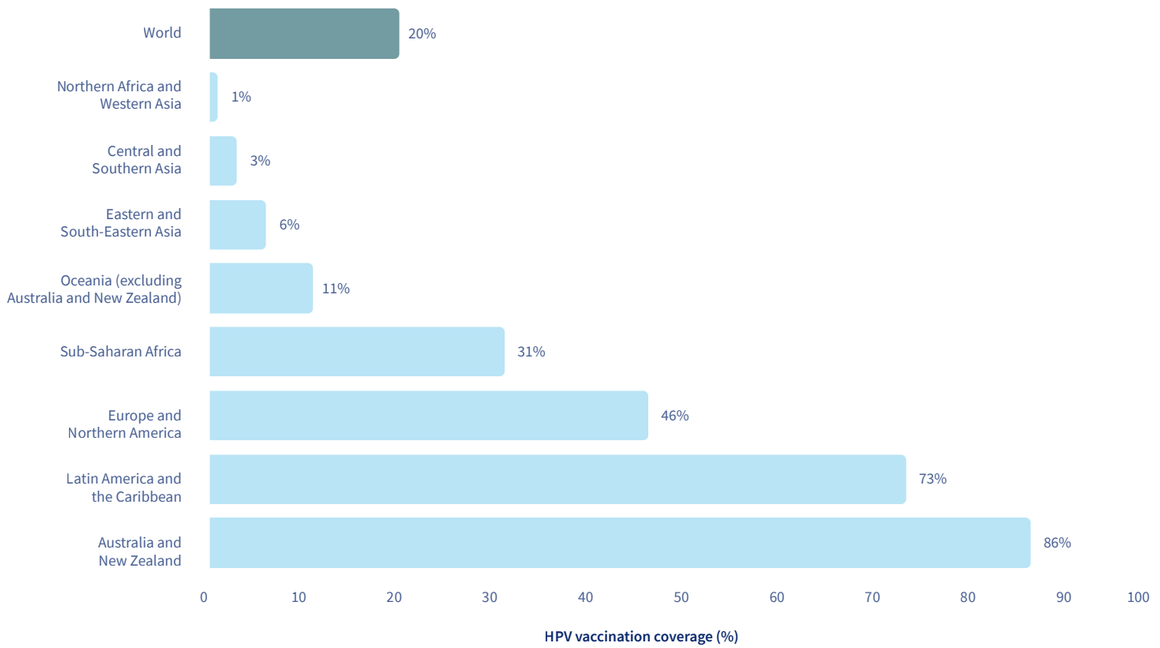
"I stand by the HPV vaccine as a critical advancement in preventive healthcare. Its widespread adoption is essential to protect future generations from the devastating effects of HPV-related cancers."

— **Dr. Anthony Fauci**
Former Director of the National Institute of Allergy and Infectious Diseases (NIAID), USA

Figure 35.2

Human Papillomavirus (HPV) vaccine coverage by geographic region, 2019

Girls at aged 9-14 years, first dose



Early Detection

Detection of certain cancers at an early stage, along with timely treatment, permits less aggressive interventions, resulting in improved quality of life and survival.

There are two approaches to early detection – screening and early diagnosis. Screening aims to detect cancers or pre-cancerous lesions in otherwise healthy and asymptomatic individuals, whereas early diagnosis identifies symptomatic cancers at the earliest possible stage (**Figure 36.1**).

Effective screening methods for early detection of cancer are available for cervical, colorectal, female breast, and lung cancers (**Table 36.1**). In addition, screening can prevent colorectal and cervical cancers through detection and removal of pre-cancerous lesions. However, implementing screening programs is complex and expensive. Decisions to introduce them involve balancing benefits against risks and limitations (**Figure 36.3**). A false positive test result can lead to significant physical, psychological, and financial harm.

Many countries struggle with fiscal and infrastructural resources required to implement high-quality screening programs. This creates an uneven playing field where some populations benefit more than others. For example, there is a strong recommendation from the World Health Organization to start cervical cancer screening using human papillomavirus (HPV) detection tests at age 30 years for average risk women and at age 25 years for women living with human immunodeficiency virus. Yet, only 19 countries have rolled out HPV detection-based screening, all of which are high-income countries (**Map 36.1**).

Early diagnosis, the second approach to the early detection of cancer, is much less resource intensive than screening as it targets individuals with symptoms to reduce delays in diagnosis and improve cancer outcomes. Although it is less effective than screening, early diagnosis can be used for many common cancers, including breast cancer, particularly in low-resource settings where screening may not be feasible.

To implement both screening and early diagnosis programs, population awareness, trained health care professionals, prompt referral systems, and appropriate diagnostic and therapeutic infrastructure are essential.

Globally, only about 30% of women aged 30-49 had ever been screened for cervical cancer, ranging from 4% in Ethiopia to nearly 100% in Sweden, far below the WHO's 70% target by 2030.

Map 36.1

Global status of HPV testing as part of cervical cancer screening, 2023

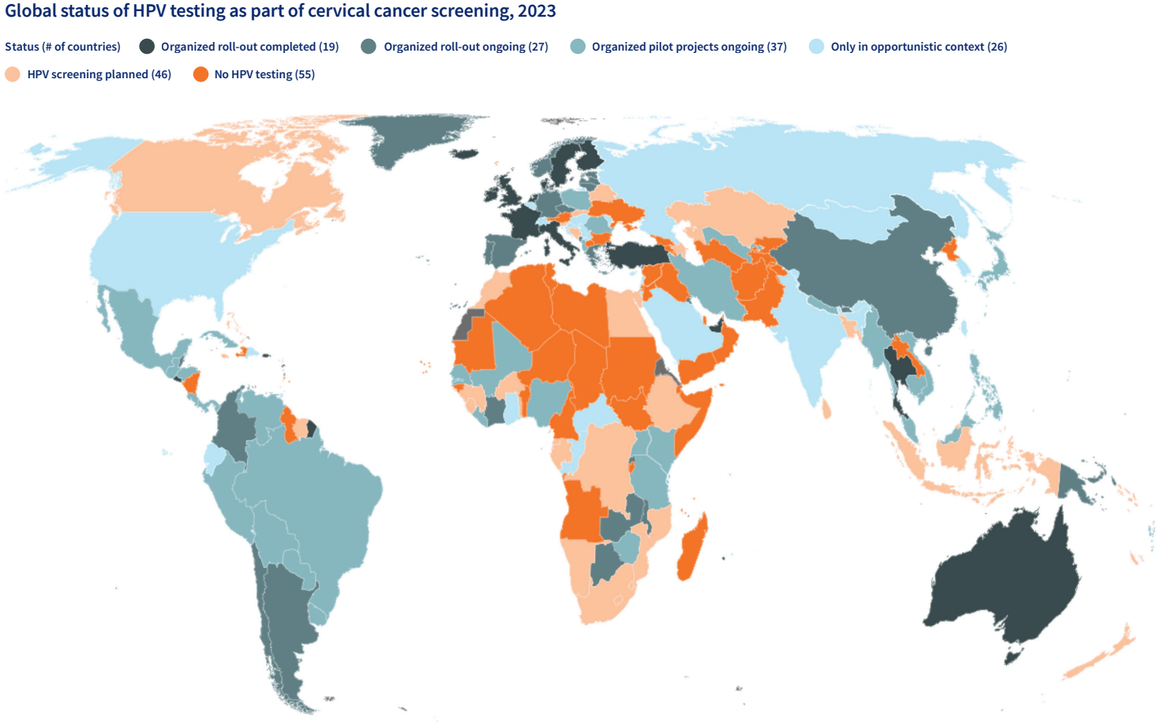


Figure 36.1

Screening versus early diagnosis according to symptom onset

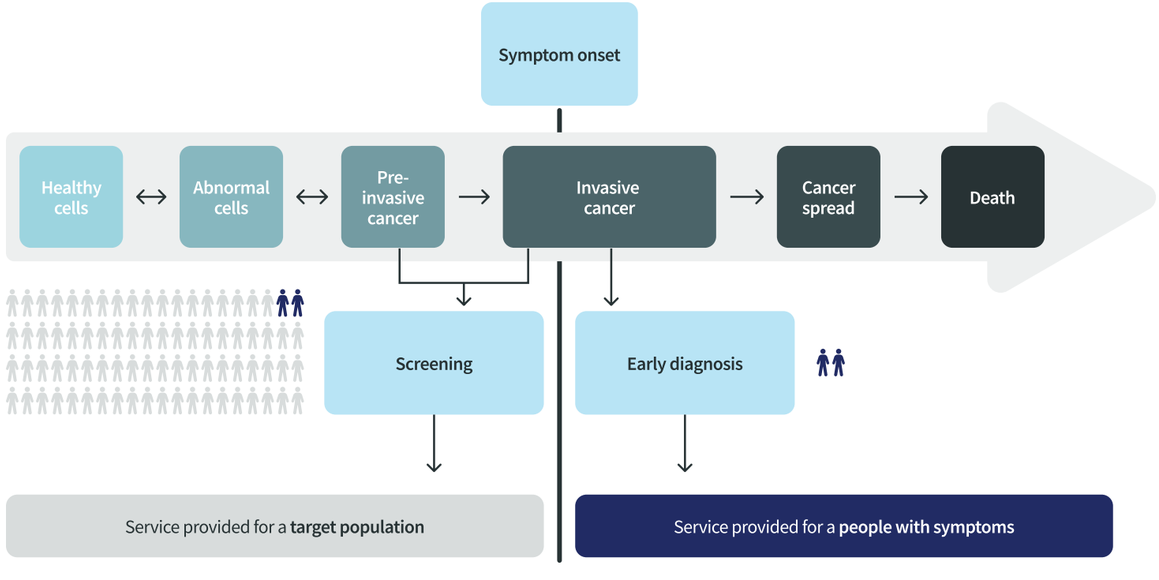


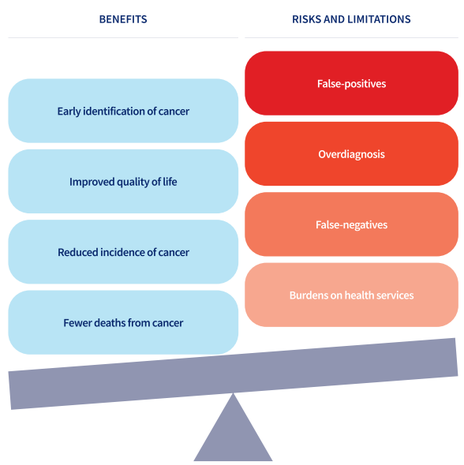
Figure 36.2

Common recommendations for screening of cancers of the cervix, breast, colorectum, and lung

SITE	SCREENING TEST	COMMUNITY RECOMMENDED TARGET AGE
Breast	• Annual or biennial mammogram (preferred) • Clinical breast exam (resource-limited setting for early diagnosis of symptomatic women)	• 50 to 69 years, every 2 years
Cervix	• Human papillomavirus (HPV) DNA-based test as primary test	• Beginning at age 30, every 5 to 10 years for women with average risk • Beginning at age 25, every 3 to 5 years for women with human immunodeficiency viruses (HIV)
Colorectum	• Stool-based tests (guaiac test or fecal immunochemical test (FIT) every 1 or 2 years • Lower endoscopy (colonoscopy every 10 years, flexible sigmoidoscopy every five years*)	• 50 to 74 years, every 1-2 years
Lung	• Low-dose computed tomography scan (low-dose CT scan or LDCT) for heavy smokers, current or those who have recently quit	• 50 to 80 years, annually

Figure 36.3

Benefits, risks, and limitations of cancer screening



"People just don't know that you can have colon cancer and be completely asymptomatic and healthy."

— **Julie Gerberding**
Former Director,
Centers for Disease Control and Prevention

Management and Treatment

In 2024, 23 low- and middle-income countries with populations over 1 million, mostly in sub-Saharan Africa, did not have access to radiotherapy.

The delivery of high-quality, patient-centered cancer care requires capacity across multiple domains (infrastructure, staffing, resources, research and data management systems) and multidisciplinary collaboration among health care centers, governments, nongovernmental organizations, and the international community. There remain unmet needs across the main modalities of cancer treatment in many areas of the world. For example, a study in sub-Saharan Africa showed that receipt of guideline-concordant breast cancer treatment ranges from 49% in Namibia to only 3% in Republic of Congo (**Figure 37.1**).

Surgical therapy

Overall, over 80% of all cancer patients require surgery, but over 90% of the population residing in lower- and middle-income countries (LMICs) lack access to safe, affordable, and timely surgical care, compared to 15% in high-income countries (HICs) (**Figure 37.2**).

Solutions to improve availability and access in LMICs include:

- Investing in long-term strategies to build a cancer surgical workforce
- Establishing regional centers for affordable, high-impact interventions
- Including surgical representation in cancer policy and guideline discussion
- Supporting universal health coverage (UHC) and microfinancing models

Systemic therapy

Systemic therapies, such as chemotherapy, immunotherapy, targeted therapy, and hormonal therapy, reduce cancer morbidity and mortality. Between 2018 and 2040, the annual number of patients requiring first-course chemotherapy will increase from 9.8 million to 15.0 million. While treatment guidelines exist across various settings, implementing equitable high-quality care and maintaining resource capacity across the globe remains challenging. For example, essential cancer medicines, as defined by the World Health Organization, are often unavailable in many LMICs due to supply chain issues and high costs (**Figure 37.3**). Partnerships with cancer centers from HICs, non-governmental organizations, and philanthropic groups can aid LMICs in workforce training, capacity-building, and securing access to lifesaving systemic therapies.

Radiation therapy

Access to radiotherapy, essential for curative or palliative care for many cancers, remains highly inequitable. In 23 LMICs with populations over 1 million, mostly in sub-Saharan Africa (78%), no active radiotherapy is available in 2024 (**Map 37.1**). Key challenges include infrastructure deficits, workforce shortages, lack of education and training for providers, and high patient cost. Solutions include decentralizing radiation services, fostering global-local partnerships for equipment maintenance, adopting hypofractionated schedules, using multidisciplinary clinics for care coordination, and utilizing e-learning platforms globally.

Figure 37.1

Receipt of adequate treatment for patients with breast cancer in sub-Saharan countries, 2009-2015

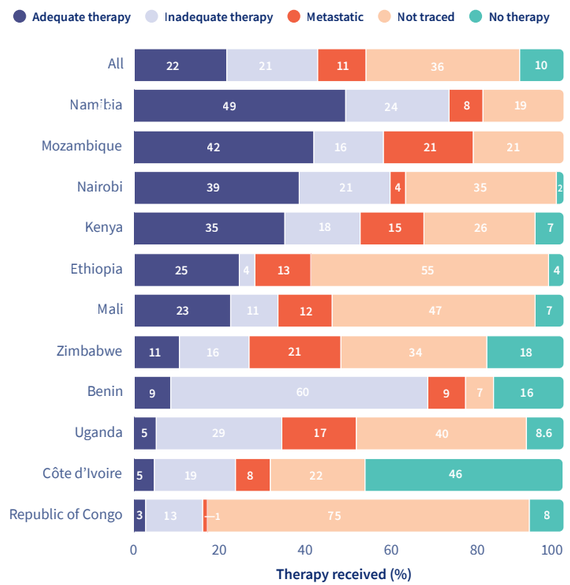
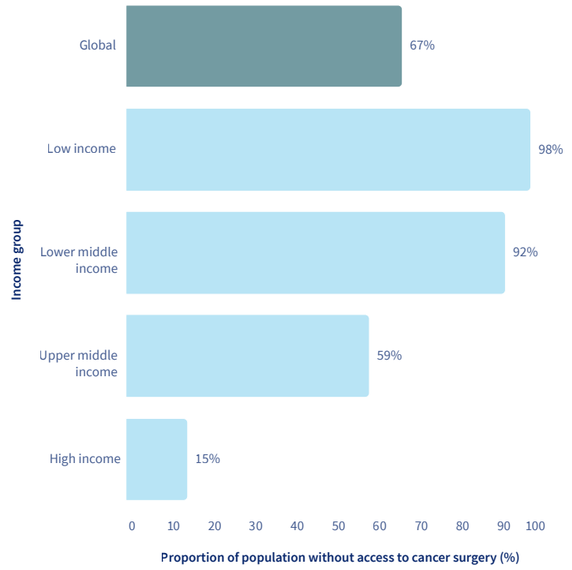


Figure 37.2

Proportion of population without access to cancer surgery, 2015



"Efforts to reduce cancer disparities still need the kind of visibility, status, investment, excellence, and rigor that the rest of cancer research enjoys."

— Satish Gopal
Director, National Cancer Institute Center for Global Health

Map 37.1

Number of radiotherapy machines per million people, 2023

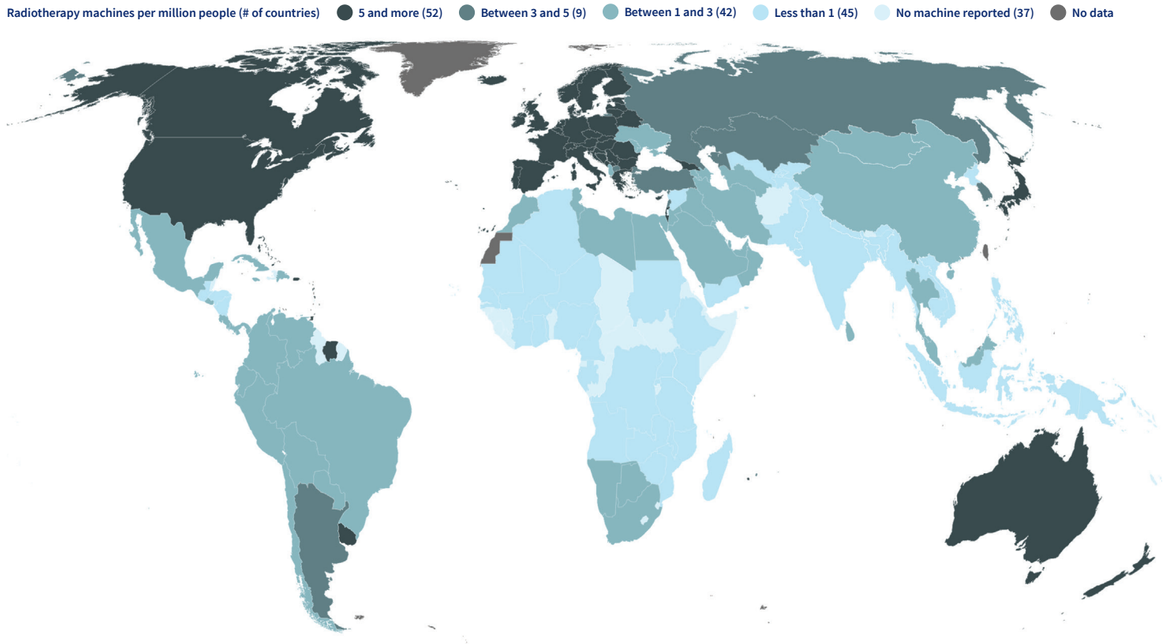
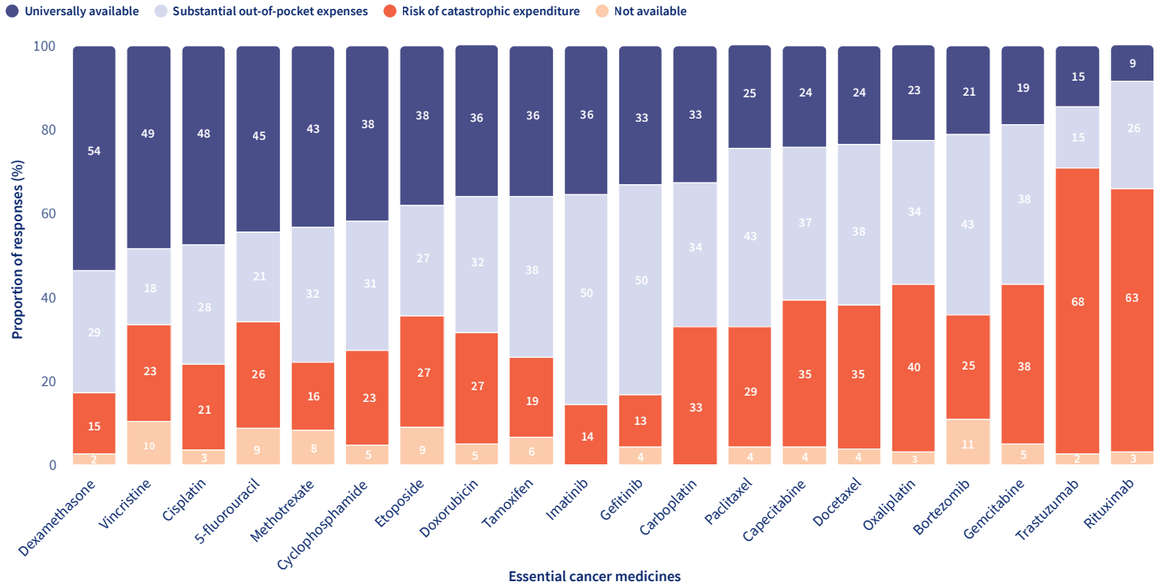


Figure 37.3

Proportions of physician's response to availability of 20 essential oncology medications in low- and low-middle-income countries, 2020



Pain Control

Only 0.2% of Nigerians in need of opioid morphine receive it, compared to a distribution in the United States that exceeds the need by 30 times.

About 30% of individuals facing serious health-related suffering are affected by cancer (**Figure 38.1**). Cancer pain remains a common and distressing symptom both during treatment and in survivorship, affecting approximately half of all cancer patients and two-thirds of those with advanced disease.

While affordable interventions exist in most high-income countries, palliative care and pain relief are often neglected in low- and middle-income countries (LMICs), especially for the populations in need such as patients with terminal cancers. Access to opioids, the primary treatment for cancer-related pain, remains critically insufficient in LMICs (**Figure 38.2**).

Much more needs to be done to develop and deliver palliative care in LMICs where nearly 80% of the need for palliative care exists. The World Health Organization (WHO) estimated that by 2037, nearly one-third of the global need for palliative care will be in Africa, driven by the increasing burden of cancer and human immunodeficiency virus in the region. With about 70% of operating palliative care services in high-income countries, a major effort to develop palliative care in LMICs is urgently needed (**Figure 38.3**). Key steps to improve cancer pain management in LMICs include: 1) appropriate training of health care professionals on pain management; 2) improved access to pain medicines; and 3) the provision of palliative care services (**Figure 38.4**). An affordable essential package of palliative care and pain relief interventions can substantially reduce suffering from cancer and other serious diseases. Public financing and integrating this package into national health systems as part of universal health coverage can offer a practical solution (see *Universal Health Care,* Chapter 46).

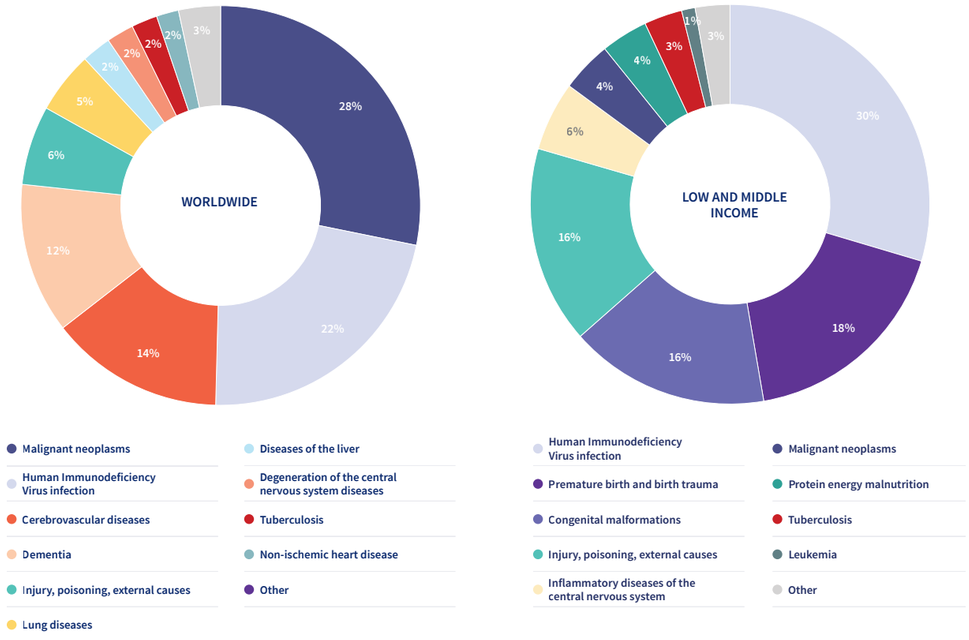
Advocacy and education at the governmental and societal levels are also vital. Finally, it is key to provide cancer pain education to health care providers and community health workers at the provincial and district hospital level to ensure that this is accessible to all.

TREAT THE PAIN
A program of the American Cancer Society

The American Cancer Society Treat The Pain initiative partners with governments in LMICs to educate health care providers and caregivers, addressing knowledge gaps and promoting better advocacy for improved access to pain medicines. Over 26,000 health care workers have received training across 75 health facilities in Eswatini, Ethiopia, Kenya, Nigeria, Rwanda, and Uganda, reducing pain scores for patients enduring moderate and severe pain. The implementation of the program across 48 hospitals in Rwanda led to an improvement in the average pain score, from 7/10 (severe pain) in 2018 to 3/10 (mild pain) by 2024.

Figure 38.1

Distribution of diseases contributing to serious illness for palliative care worldwide, and in low- and middle-income countries, 2015



> "Leaving people in pain when effective medicines are available for pain management, especially in the context of end-of-life care, should be a cause of serious concern for policymakers."
>
> — **Yukiko Nakatani**
> Assistant Director-General
> Medicines and Health
> Products, World Health
> Organization

Figure 38.2

Global distribution of opioid morphine equivalent and the estimated percentage of need met, 2018

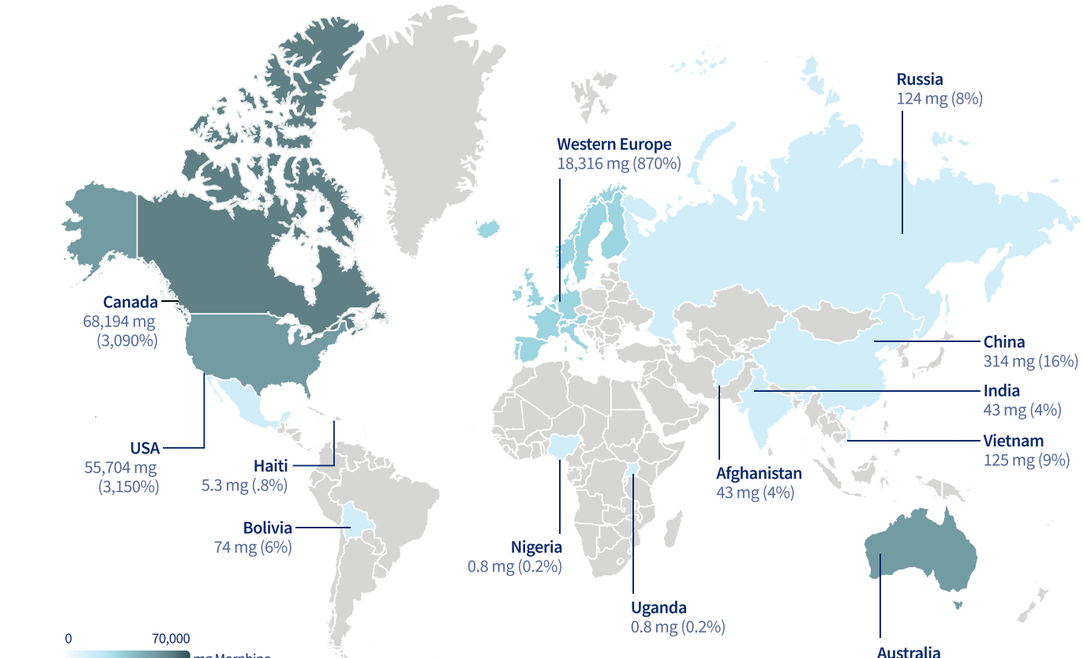


Figure 38.3

Availability of palliative care services for non-communicable disease patients, by World Bank income group, 2019

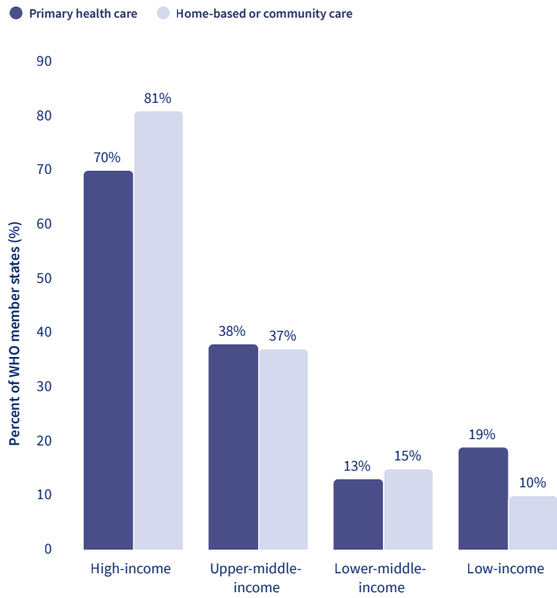
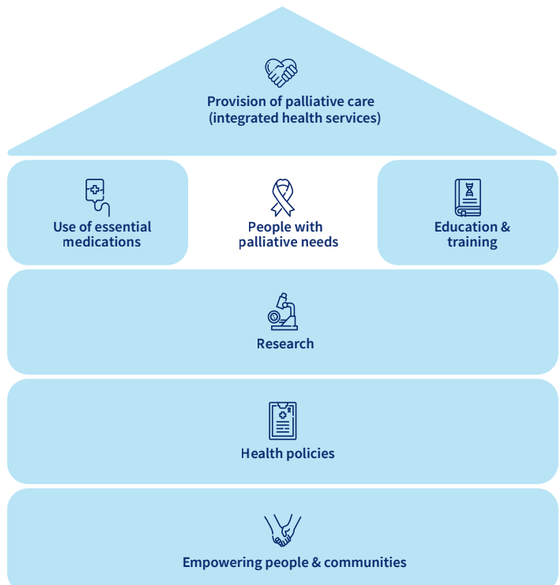


Figure 38.4

Priority action areas can strengthen the global delivery of and access to palliative care



Population-Based Cancer Registries

Globally, only one in three and four countries can report high-quality cancer incidence and cause-of-death mortality data, respectively.

Population-based cancer registries (PBCRs) are an essential foundation for the development and monitoring of national cancer-control plans, informing the planning of cancer services, and assessing the effectiveness of cancer-care delivery through benchmarking survival in different populations.

PBCRs represent a continual system of data collection, storage, validation, and analysis, with the recording and reporting of data undertaken according to international standards to ensure maximum comparability. They systematically collect cancer incidence and survival data for defined populations, including information on patient and tumor characteristics at diagnosis, including stage, type of treatment received, as well as follow-up of vital status.

While PBCRs may be national, more often, particularly in highly populated countries, the requirements for planning and monitoring national cancer-control programs (see *Cancer Continuum,* Chapter 32) can be achieved through one or more "sentinel" subnational PBCR. A controlled expansion of subnational PBCRs will increase national representativeness while curbing costs.

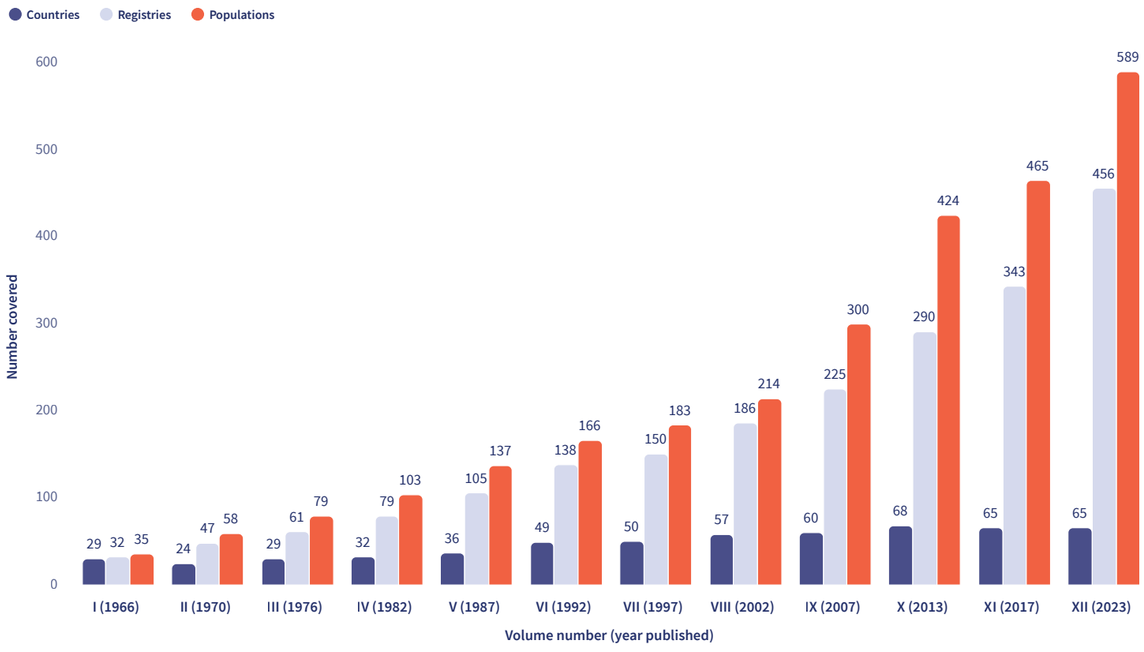
PBCRs are represented throughout the world by the International Association of Cancer Registries, an organization founded in 1966 that establishes standards and provides opportunities for cancer registry personnel to meet, exchange information, and receive training. Despite significant disparities in the status and quality of cancer registries worldwide, the number of high-quality PBCRs has increased (**Figure 39.1**) from 31 registries in 28 countries during the early 1960s (*Cancer Incidence in Five Continents*, Volume I) to 456 registries in 65 countries during 2013-2017 (Volume XII).

The data – both submitted and compiled – is the major source of information for the national GLOBOCAN estimates, showcased in the IARC's Global Cancer Observatory and the cancer statistics portrayed in The Cancer Atlas. In contrast to most countries in Europe and North America, many countries in Asia, Africa, Latin America, and Oceania have poor quality, or a complete absence of incidence data for cancer-control planning (**Map 39.1**). To address this data inequity, the Global Initiative for Cancer Registry Development (GICR) was established by IARC as a global partnership to improve the availability of high-quality cancer registry data in transitioning countries. Six IARC Regional Hubs and accompanying IARC centres of expertise work with local partners to provide direct support to registries, deliver training, conduct research, and develop networks (**Figure 39.2**).

> "Local data from cancer registries are pivotal in improving outcomes and saving lives. It is time to invest in the real world and not a mathematical representation of it."
>
> — **Freddie Bray and Max Parkin**
> International Agency for Research on Cancer (IARC)

Figure 39.1

Number of countries, registries, and populations covered by Cancer Incidence in Five Continents (CI5) volume I to XII



Map 39.1

Global coverage of population-based cancer registries (PBCR), 2023

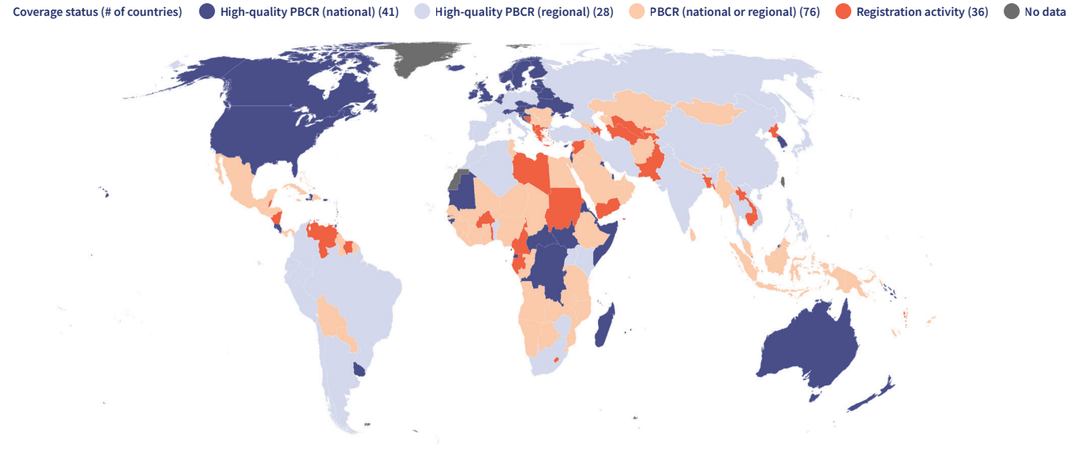
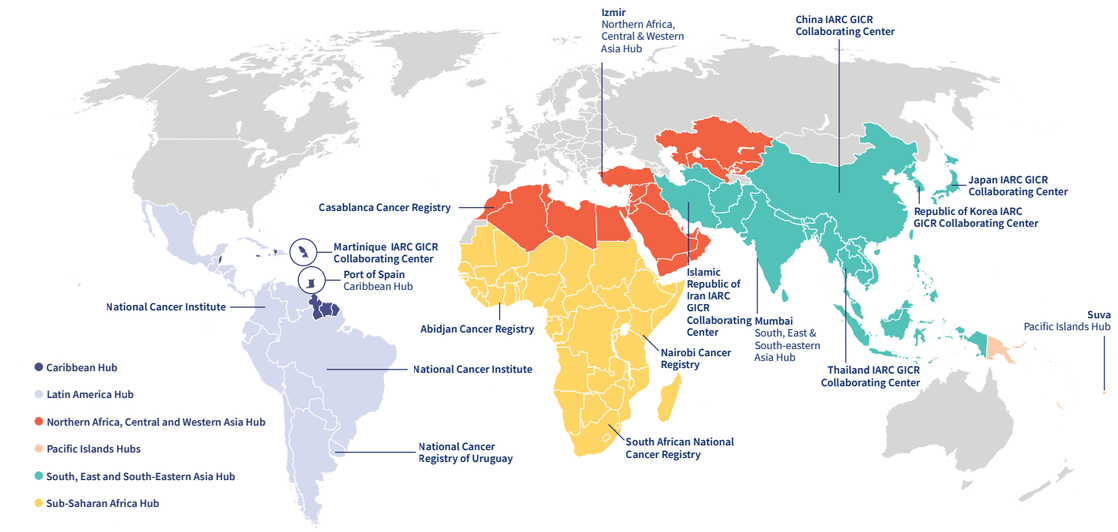


Figure 39.2

Global Initiative for Cancer Registry Development (GICR)'s Regional Hubs and Centers of Expertise worldwide, 2023



Research

Global collaborative partnerships accelerate efforts to bridge the research gap, particularly in the areas of prevention and implementation and translation, to improve cancer outcomes worldwide.

Global collaborative partnerships accelerate efforts to bridge the research gap, particularly in the areas of prevention and implementation and knowledge translation, to improve cancer outcomes worldwide. Countries and world regions need cancer research tailored to their unique disease burden and knowledge gaps to improve population health. Knowledge created in cancer prevention, early detection, treatment, and survivorship care in one country may not be translated to other countries due to differences in health systems, health care infrastructure, risk factor and disease characteristics, and sociocultural factors. In addition to saving lives from cancer, research also creates national wealth through innovation.

However, bibliometric analysis reveals a significant global disparity in cancer research output: in 2023, low- and middle-income countries (LMICs) account for about 10% of all publications (**Figure 40.1**), although they account for 70% of the total cancer deaths worldwide. Reasons for the disproportionately low research output in these countries include lack of funding, trained manpower, research infrastructure, data, and partnerships between the global north and global south. However, there are efforts by major funders to support collaborative research projects based on equitable partnership.

In addition, there has been progress in promoting and expanding cancer research in LMICs through south-south collaborations to address overlapping public health problems. Examples of these collaborations include the African Organization for Research and Training in Cancer (AORTIC), the African Research Group for Oncology (ARGO), National Cancer Grid of India, and the Research for Health in Conflict Middle East and North Africa (R4HC MENA) (**Figure 40.2**).

Over the next decade, LMICs should prioritize research on reducing the burden of cancers at advanced stages, improving access and affordability of cancer care, country-specific health economic assessments, scaling up quality improvement, and leveraging new technology to enhance cancer control efforts (**Figure 40.3**). Meeting the goals of cancer research requires dedicated commitment from governments, policymakers, funding agencies, health care leaders, researchers, and the public.

Only about 40% of cancer research focuses on low- and middle-income countries, although they represent more than 70% of the global cancer deaths.

Figure 40.1

Proportion of cancer related publications by world, by World Bank income group, 2024

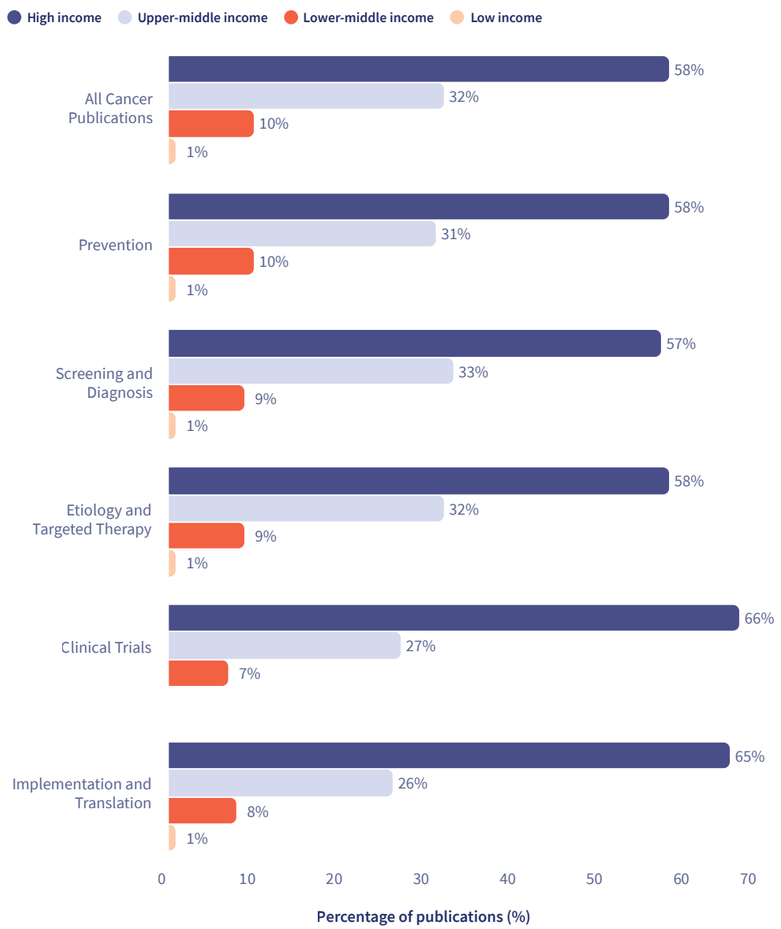


Figure 40.2

Examples of international and national research programs in low- and middle-income countries

The African Research Group for Oncology (ARGO) is a National Cancer Institute recognized consortium in Africa that strives to generate data for regional evidence-based management recommendations, explore prevention and early detection strategies, increase access to cancer care and improve cancer care training in rural and under-served communities in low-and middle-income countries.

The National Cancer Grid is a network of major cancer centers in India, research institutes, patient groups and charitable institutions across India with the goal of establishing uniform standards of patient care for prevention, diagnosis, and treatment of cancer, providing specialized training and education in oncology and facilitating collaborative basic, translational and clinical research in cancer.

The Research for Health in Conflict in the Middle East and North Africa (R4HC-MENA) program aims to build research and policy capacity in conflict affected areas focusing on health, political economy of health and complex non-communicable diseases (NCDs) such as mental health and cancer, by blending qualitative and quantitative methods and bridging social and clinical sciences.

African Organisation for Research and Training in Cancer (AORTIC) is an African based non-governmental organization that is dedicated to transforming cancer control in Africa through collaboration in education, research, and delivery of equitable and timely interventions to minimize the impact of cancer.

Figure 40.3

Five key research priorities for low- and middle-income countries over the next decade

Reduce the Burden

Reduce the burden of patients presenting with advanced-stage disease via contest-specific strategies at the individual, health system and population level.

Improve Access

Improve access, affordability and outcomes in cancer care via solution-oriented research.

Emphasize Economic Assessment

Emphasize country-level health economic assessment of cancer interventions and technologies, health financing mechanisms and value-based care.

Scale-up Quality

Scale-up quality improvement and implementation research in cancer control.

Leverage Technology

Leverage technology to improve cancer control supported by robust scientific evidence.

Footnote

Adapted from Pramesh CS, Badwe RA, Bhoo-Pathy N, et al. Priorities for cancer research in low- and middle-income countries: a global perspective. Nature Medicine. 2022/04/01 2022;28(4):649-657.

Economic Burden

The economic burden of lost productivity due to premature mortality from cancer is greater than the cost of cancer treatment and represents most of the total economic burden of cancer in countries.

Costs of new cancer treatments have grown exponentially and patients are treated longer with more agents, increasing the economic burden for patients and families, health care systems, and countries. The economic burden of cancer also includes indirect costs, measured as productivity losses from cancer morbidity and premature mortality, and productivity losses among informal caregivers. These costs represent lost opportunities and resources that households and countries could otherwise invest in competing priorities.

The global economic burden of cancer from 2020 to 2050 was projected as $25.2 trillion in 2017 international dollars. Approximately half was projected in high-income countries. Countries with the highest absolute economic burden were China, the United States, and India. Countries with the highest burden as a share of gross domestic product (GDP) were Bulgaria, Monaco, and Montenegro (**Map 41.1**). Variation in economic burden reflects country-level differences in population size, age distribution, health care delivery, treatment patterns, employment and real wages, and cancer occurrence. Variation in household-level burden reflects differences in health systems, labor markets, and treatment patterns.

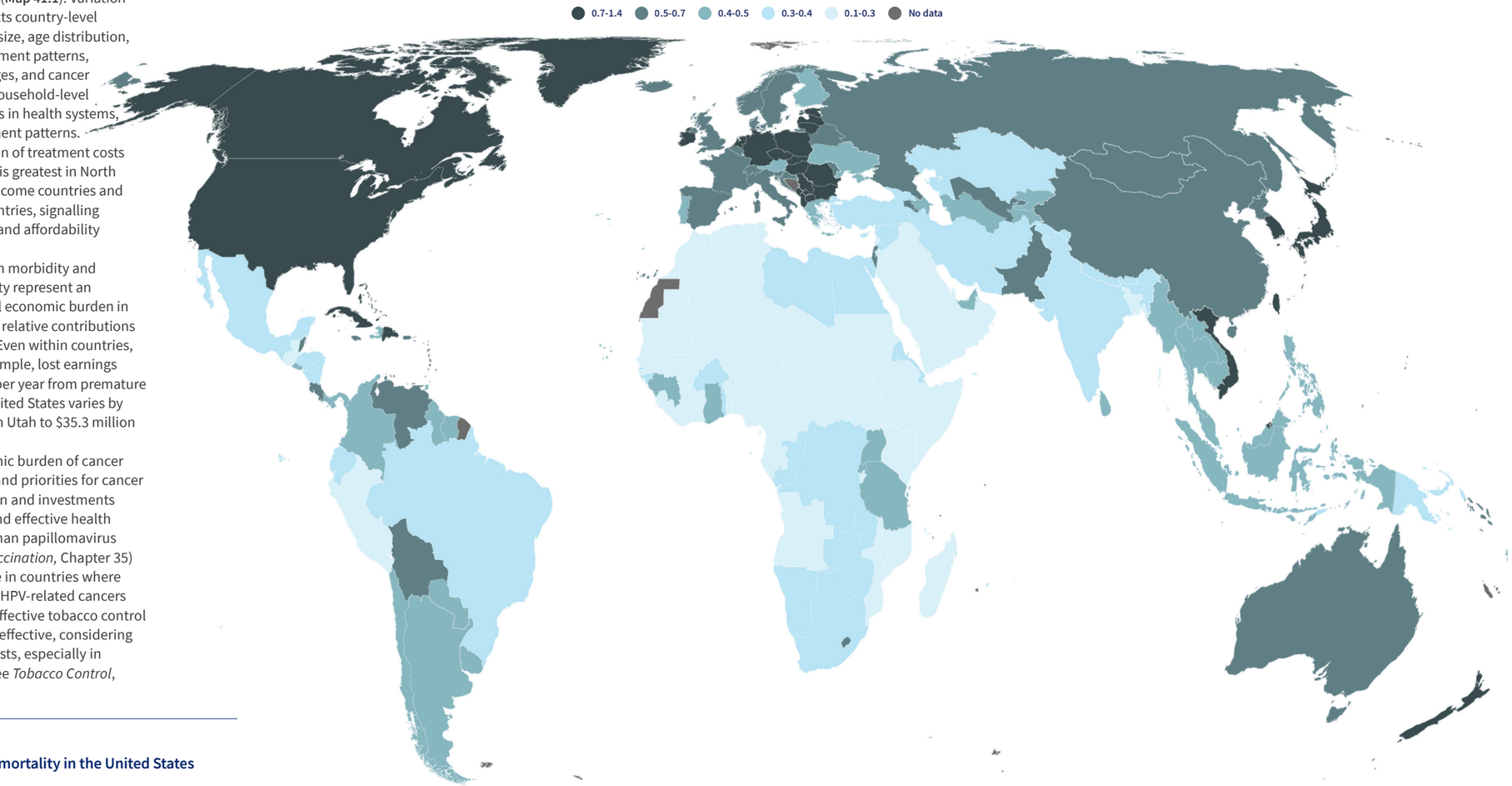
The relative contribution of treatment costs to total economic burden is greatest in North America and other high-income countries and lowest in low-income countries, signalling differences in availability and affordability of treatments.

Productivity losses from morbidity and premature cancer mortality represent an important part of the total economic burden in all countries, with highest relative contributions in low-income countries. Even within countries, the burden varies. For example, lost earnings rates per 100,000 people per year from premature cancer mortality in the United States varies by state, from $19.6 million in Utah to $35.3 million in Kentucky (**Map 41.2**).

Analyses of the economic burden of cancer can inform public policy and priorities for cancer control resource allocation and investments to ensure a sustainable and effective health system. For example, human papillomavirus (HPV) vaccination (see *Vaccination,* Chapter 35) is especially cost-effective in countries where cervical cancer and other HPV-related cancers are prevalent. Similarly, effective tobacco control becomes even more cost-effective, considering accelerating treatment costs, especially in high-income countries (see *Tobacco Control*, Chapter 34).

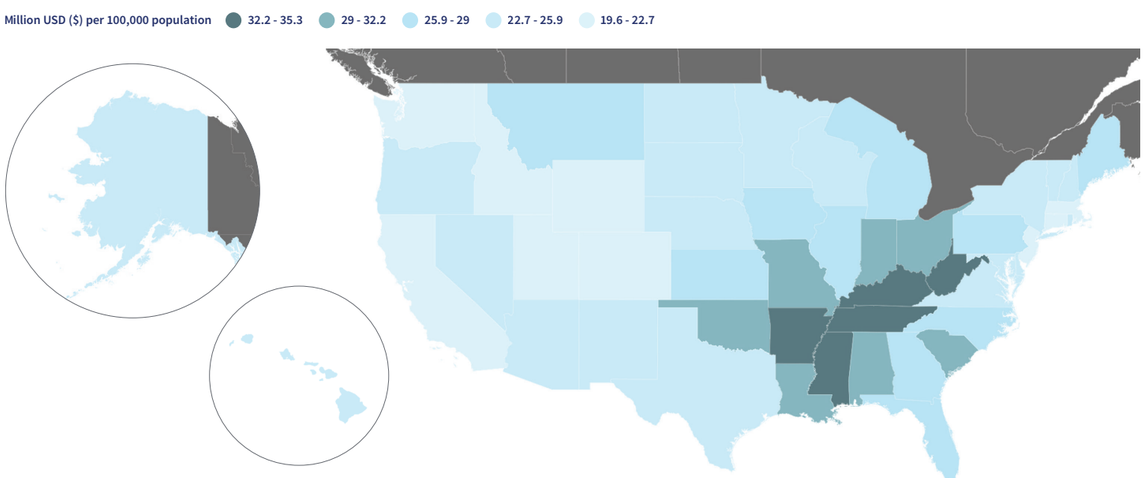
Map 41.1

Economic costs of cancer as a percentage (%) of total national gross domestic product (GDP), 2020-2050



Map 41.2

Age-standardized lost earning rates per 100,000 due to premature cancer mortality in the United States in 2015, US dollar



"Requests will always exceed resources. Doing good is imperative. Doing everything is impossible."

— J. Grant Howard
Author

Building Synergies

Global cancer control efforts anywhere should benefit cancer patients everywhere.

Global cancer control requires a coordinated response from national governments, researchers, funders, practitioners, advocates, patients, and international organizations. Multiple high-level resolutions have called for reduced cancer mortality, but work remains to meet targets and understand what approaches work best, especially in low- and middle-income countries (LMICs), where burden is increasing. Synergies created through equitable partnerships and networks are critical, coupled with strong research investment and implementation of emerging evidence. Connecting researchers with policymakers, practitioners, civil society, and people with lived experience ensures that policies and practices are evidence-based and that cancer research addresses real-world needs and experiences. This feedback loop allows all voices to be heard and cancer discoveries to reach populations who have been historically excluded (**Figure 42.1**).

Synergies across researchers and implementers are exemplified by the creation of integrated person-centered services to address non-communicable diseases in LMICs. In Zambia, human papillomavirus vaccination has been integrated in human immunodeficiency virus (HIV) clinics to reach national targets. Rwanda, for example, has integrated non-communicable diseases services in rural HIV clinics.

Additionally, a well-trained cancer workforce is essential. The US National Cancer Institute (NCI) and many other organizations, such as the African Organization for Research and Training in Cancer (AORTIC), Latin American and Caribbean Society of Medical Oncology (SLACOM), American Society of Clinical Oncology (ASCO), and others, support training and career development (**Map 42.1**). These programs, led by individuals or organizations around the world, leverage existing research collaborations and infrastructure, including those established for HIV, to build a rich global cancer workforce and ecosystem globally.

The International Cancer Control Partnership (ICCP), a group of more than 20 partner organizations and UN agency partners, convened by the US NCI and the Union for International Cancer Control, has focused on supporting and learning from countries as they navigate the process of national cancer-control plans implementation (**Map 42.2**). Cancer planners in countries build synergies across diverse partners and disciplines including academic, clinical, advocacy, and policy to achieve national objectives (**Figure 42.2**). ICCP works to expand analogous collaborations globally to enable cancer control at local, national, regional, and international levels.

Figure 42.2

Stakeholder groups involved in the development and implementation of National Cancer Control Plans in 2023

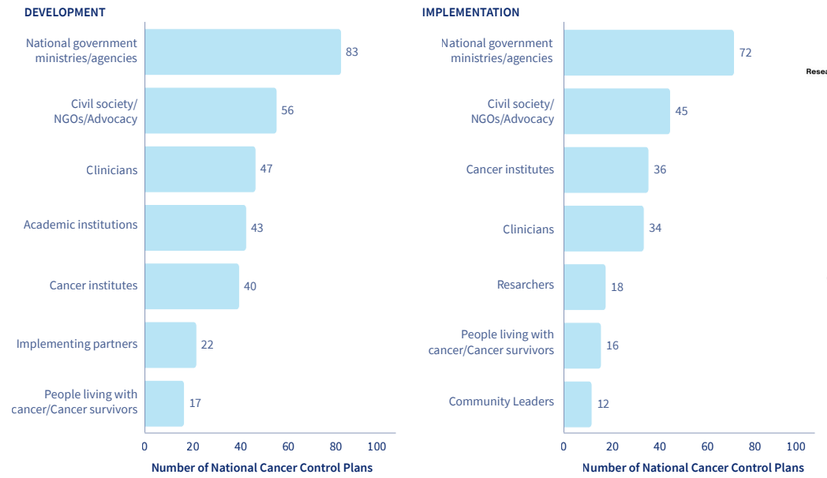
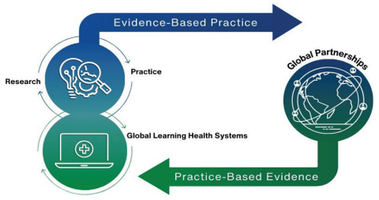


Figure 42.1

Research to practice & policy feedback loop

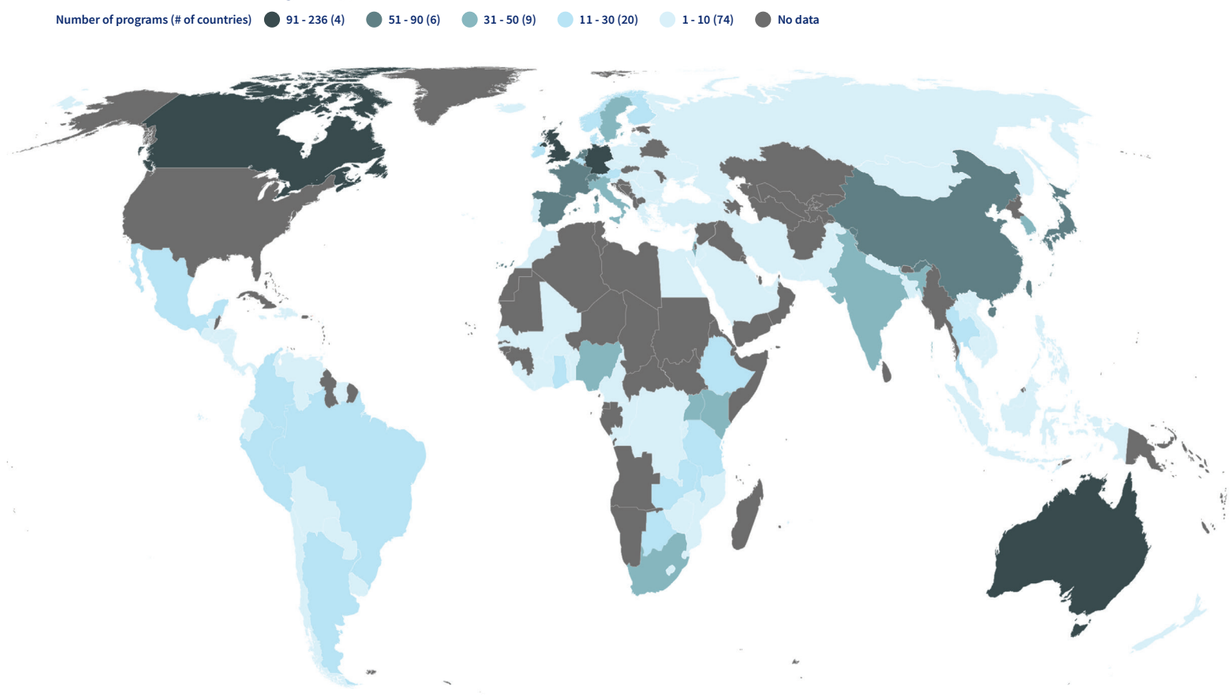


"We know that without continuous reflection, stakeholder engagement and recalibration, we cannot hope to be successful in meeting our shared goals and closing the [cancer] care gap around the world."

— **Dr. Mary Nyangasi**
World Health Organization

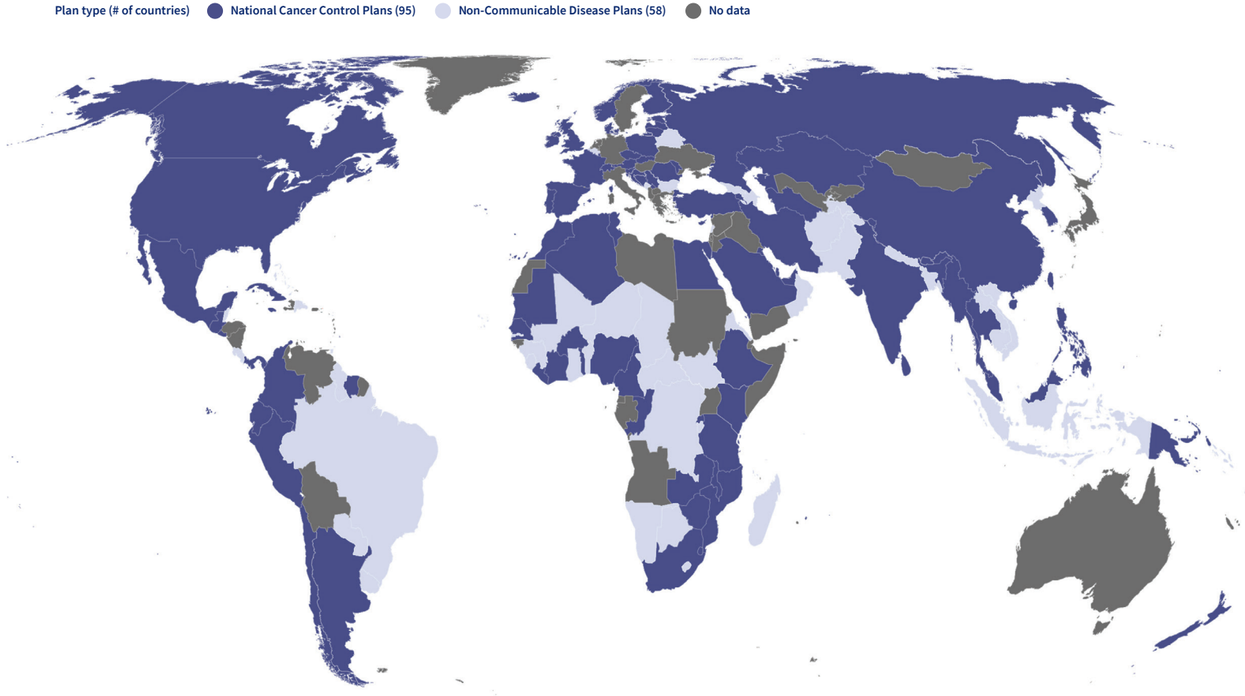
Map 42.1

Number of research and training programs supported by the Center for Global Health at the US National Cancer Institute, fostering international collaborations globally, 2024



Map 42.2

Global distribution of national cancer control and non-communicable disease plans, 2024



Uniting Organizations

Inequities in cancer control exist in every country. Global cancer communities are working toward closing the gap in their respective countries and regions.

The cancer community is united behind the common goal of advancing health equity in cancer control. Equity is at the forefront of the global cancer community's efforts to work toward a world where we can greatly reduce the risk of cancer and ensure that those who have cancer have access to quality treatment and care.

The global cancer community – including the United Nations, the World Health Organization, Ministries of Health, national cancer institutes, cancer societies, research and treatment centers, academia, patient support groups, appropriate private sector and survivors at the local, national and global levels – is taking steps to advance health equity in cancer control in their settings (**Figure 43.1; Figure 43.2**).

Examples of key actions to close the cancer care gap include (**Figure 43.3**): increasing funding for cancer research to understand the main disparities in cancer outcomes and the barriers that prevent certain populations from accessing care; developing and implementing an effective national cancer-control strategy (see *Cancer Continuum,* Chapter 32); incorporating comprehensive cancer services into national health benefit packages to achieve universal health coverage (see *Universal Health Care,* Chapter 46); implementing vaccination and screening programs for common cancers and ensuring that access to these is available and affordable (see *Vaccination,* Chapter 35 and *Early Detection,* Chapter 36); and addressing the commercial and social determinants of health that impede an individual's ability to access cancer care (see *Health Promotion,* Chapter 33).

Mayo Clinic, United States
Mayo Clinic Center for Health Equity and Community Engagement Research (CHCR) partners with communities and works in collaboration with internal and external stakeholders to develop and execute community outreach, engagement initiatives, and health equity research to address the needs of the communities.

"A single bracelet does not jingle."
— African Proverb

Asociación Guatemalteca Héroes de Esperanza, Guatemala
For over 20 years, the association has contributed to the education and empowerment of patients, caregivers, families, and the general public regarding cancer prevention, diagnosis, treatment of cancer, and enhancing quality of life.

NABD-BC2 (Best Care for Breast Cancer Association), Morocco
NABD-BC2 is a national, nonprofit organization dedicated to providing support and guidance to breast cancer patients in Morocco through promoting access to holistic, equitable, quality cancer care and improving the lives of breast cancer patients in the country.

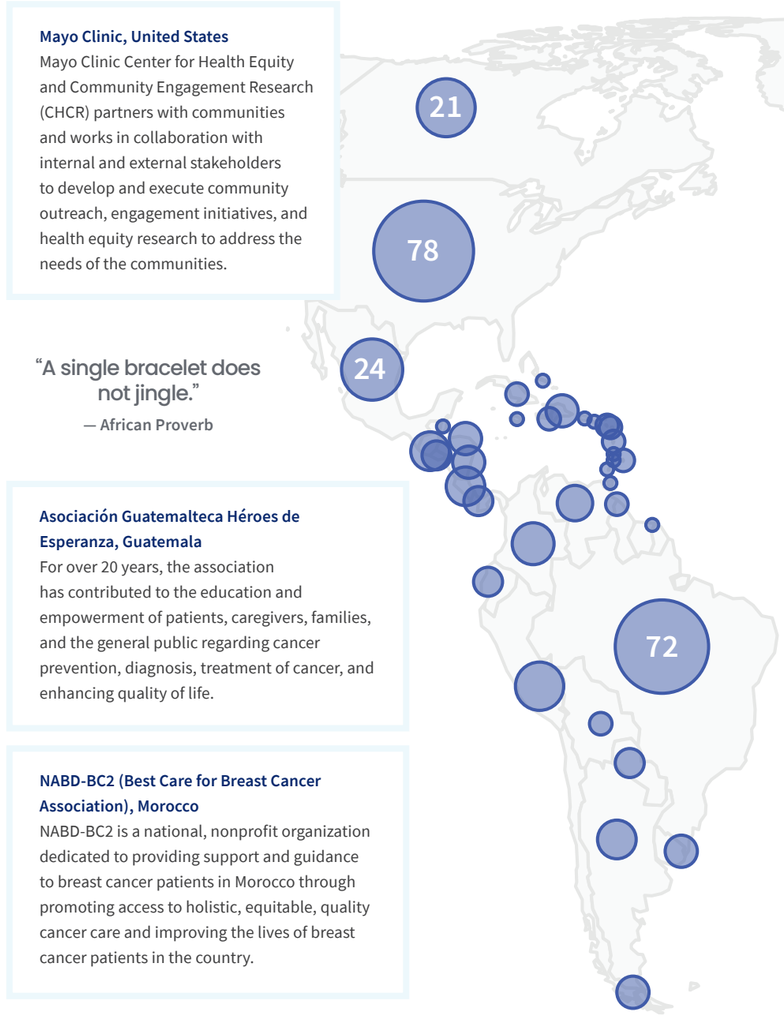
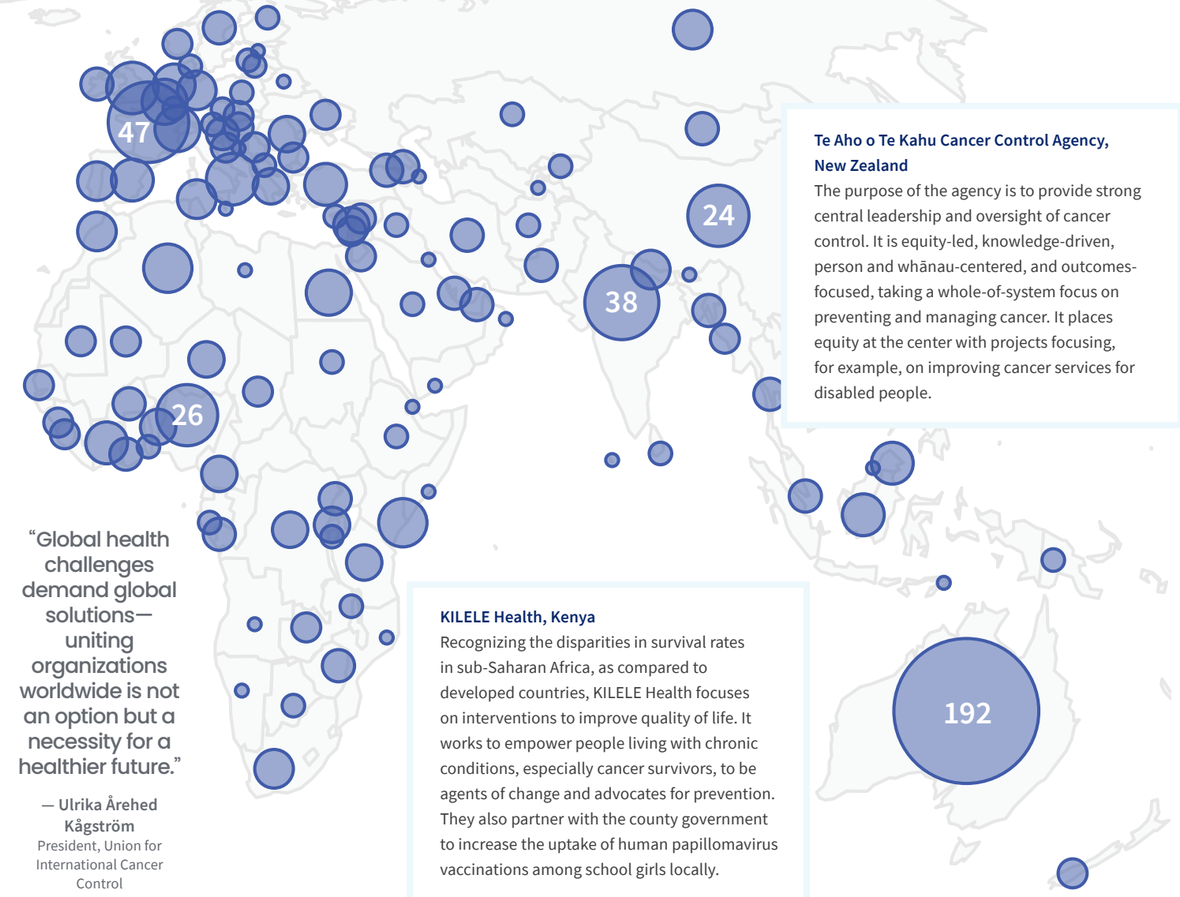


Figure 43.2
Events organized by UICC to convene stakeholders within and beyond the cancer community to advance health equity

World Cancer Leaders' Summit	This high-level policy meeting is an opportunity to reach key decision-makers, and identify new and innovative solutions with thought-leaders in the cancer field.
World Cancer Congress	The biennial World Cancer Congress provides a forum for cancer control experts, practitioners, and advocates to share best practice and the latest advances in cancer control.
World Cancer Day 4 February	World Cancer Day (February 4) unites the entire world in the global fight against cancer, raising general awareness around the disease.

Figure 43.1
A global network of cancer organizations, the Union for International Cancer Control (UICC) membership worldwide (over 1180 members in 174 countries) in 2025



Te Aho o Te Kahu Cancer Control Agency, New Zealand
The purpose of the agency is to provide strong central leadership and oversight of cancer control. It is equity-led, knowledge-driven, person and whānau-centered, and outcomes-focused, taking a whole-of-system focus on preventing and managing cancer. It places equity at the center with projects focusing, for example, on improving cancer services for disabled people.

"Global health challenges demand global solutions—uniting organizations worldwide is not an option but a necessity for a healthier future."
— **Ulrika Årehed Kågström**
President, Union for International Cancer Control

KILELE Health, Kenya
Recognizing the disparities in survival rates in sub-Saharan Africa, as compared to developed countries, KILELE Health focuses on interventions to improve quality of life. It works to empower people living with chronic conditions, especially cancer survivors, to be agents of change and advocates for prevention. They also partner with the county government to increase the uptake of human papillomavirus vaccinations among school girls locally.

Figure 43.3
Initiatives and organizations working toward advancing health equity in cancer control

ATOM Access to Oncology Medicines	**The Access to Oncology Medicines Coalition (ATOM Coalition)** A global initiative, led by UICC, in collaboration with over 40 partners across the private and civil society sectors. ATOM aims to address the barriers to availability, affordability and appropriate use of oncology medicines in low- and lower-middle income countries.
McCabe Centre FOR LAW & CANCER	**The McCabe Centre for Law and Cancer** Building capacity for the effective use of law in cancer control so that people affected by cancer have equitable access to treatment and care by training government lawyers and policymakers across the globe through their courses (including online).
NCD Alliance	**NCD Alliance** Uniting over 2,000 civil society organizations to raise the profile of non-communicable diseases (NCDs) as a development priority.

Global Relay For Life

Global Relay For Life celebrates survivors, remembers loved ones lost, and mobilizes communities to take a stand against cancer.

What started with one person in the US in 1985 to raise money and awareness has become a true global movement against cancer, uniting people in 35 countries (**Figure 44.1**) to do what no one country or organization can do alone: build a world free from cancer. Across the globe, the American Cancer Society Relay For Life® program fosters hope, healing, and inspiration in more than 3,000 communities (**Figure 44.2**). The Global Relay For Life® program engages global organizations to empower communities and accelerate the fight for a world without cancer. Across the world, cancer organizations are using the Relay For Life program as a platform to deliver on their mission.

The program is driven by volunteers who contribute to various facets of the program, including training, partner support, social media, survivorship programs, cancer advocacy, and data analysis. At the Danish Cancer Society, they use Relay For Life to extend their advocacy initiatives by engaging participants, survivors, and volunteers in anti-tobacco and caregiver advocacy events. The Cancer Association of South Africa's Relay For Life events engage diverse communities who come together to fight a common enemy. The Canadian Cancer Society has a large Relay For Life high school program that educates students about cancer prevention at an early age, above and beyond getting youth engaged in volunteering and fundraising for the organization.

The funds raised by Global Relay For Life are invested around the globe in cancer research, prevention, advocacy, and support of those impacted by cancer. This diverse network of passionate Relay For Life participants is bringing hope and support to millions of people impacted by cancer across the globe. To learn more about the Relay For Life movement, please visit relayforlife.org/global.

Figure 44.2
Global Relay For Life data

RELAYS	2,041
PARTICIPANTS	371,183
SURVIVORS	43,781
CAREGIVERS	67,658
LUMINARIA	555,263

SURVIVOR STORIES

Jakob Bouse, Canada

I was diagnosed with a brain tumor on March 21, 2015. As someone fighting a brain tumor everyday, it's infinitely meaningful to see the outpouring of support at every Relay event. My involvement with Relay has been unforgettable so far, and I can't wait to see what's next.

"It's a wonderful and humbling experience to support others who are uniting to create a world where everybody lives longer, better lives, free from the fear of cancer. Together we are beating cancer."

— Trudy Stammer
Head of Fundraising, Cancer Research UK

The Global Relay For Life *Heroes of Hope* program elevates selected cancer survivors who not only contribute to their local Relay but also fight cancer in a broader way.

Representing their cancer charities, heroes must be comfortable sharing their cancer story in public and connecting it to the impact of the organization. These ambassadors inspire others in their fight against cancer. As of 2024, we have welcomed a total of 362 Heroes from the beginning of the program and have active Heroes in 21 countries.

Figure 44.1
Global Relay For Life countries and representatives, 2024

SURVIVOR STORIES

Dorte Dalhoff, Denmark

In 2019 I took part in Relay For Life for the first time. I had been diagnosed with breast cancer in 2017, and received chemotherapy, surgery and radiation therapy. Taking part in Relay hit me deep in my heart. Until 2022, I participated in Relay for Life as a survivor and as a volunteer. However, in autumn 2022, I also experienced becoming a caregiver when my father was diagnosed with cancer. In 2023, I walked the first and last lap together with my father, and I will also do so again this year. Volunteering for Relay for Life has given me so much meaning – I know this is where I belong.

GLOBAL HEROES OF HOPE
Participants in Belgium

SURVIVOR STORIES

Satsuki Mimuro, Japan

Relay For Life changed my life and wiped away the anxiety after the diagnosis. My life after the diagnosis has always been with Relay For Life. It taught me how important it is to appreciate simple things and ordinary days. The passion and compassion of Relayers always gives me hope and energy. I am determined to keep Relaying to pass the baton of hope onto the future where cancer is no longer a life-threatening disease.

GLOBAL HEROES OF HOPE
Participants in Japan

GLOBAL HEROES OF HOPE
Participants in Kenya

SURVIVOR STORIES

Michael Williams, South Africa

In June 2021 I was diagnosed with lymphoma. I started chemotherapy treatment, and I was fortunate enough to be declared cancer free in January 2022! At this point I knew I wanted to give back to my community, focusing on cancer awareness for men. I enjoy being at our CANSA Relay For Life events, and this is my community where I feel welcomed. My involvement in CANSA Relay For Life helps me to motivate others and spread the message that as a survivor, you can overcome your disease.

GLOBAL HEROES OF HOPE
Participants in Australia

Policies and Legislation

Health is a fundamental human right, yet at least half of the global population lacks universal health coverage and does not receive necessary health services.

Law can be a powerful tool to address the burden of cancer – particularly for long-term, systemic change and addressing the underlying inequities and social determinants of health. Law encompasses a wide range of national, subnational, and international instruments and practices, including legislation, regulation, court cases, international agreements, administrative instruments, decrees, and customs. Laws create formal rights and duties on individuals, corporate entities, and governments and are related to but distinct from policies, which are norm-setting tools to guide decision-making (**Figure 45.1**).

Laws can reduce exposure to risk factors such as tobacco, alcohol, unhealthy diets, air pollution, or occupational risks. They can also regulate screening, diagnosis, treatment, and care to ensure they are accessible, affordable, safe, and effective for all (**Figure 45.2**). In addition, law can have a fundamental impact on many aspects of life for people diagnosed with cancer and their families, from employment protection to carers' rights, access to insurance, and welfare benefits.

Many different areas of law are relevant to cancer – and law can operate on many levels, from local to international laws, all impacting cancer prevention and control. Political leaders worldwide have made commitments to use law to reduce the burden of noncommunicable diseases including cancer under various international agreements, including those under the United Nations and World Health Organization.

Using law to protect and promote health requires collaboration across sectors. It also requires being able to manage conflicts of interest and defend against litigation, or threats of litigation, by corporate interests – such as the tobacco, alcohol, and food industries – which is becoming increasingly common.

Strengthening legal capacity to develop and defend laws and policies is an essential aspect of reducing the cancer burden.

Figure 45.1

Nine voluntary global targets endorsed by governments in the World Health Organization (WHO) Global Action Plan on Non-Communicable Diseases (NCD) for 2025-2030

Law is essential to implement a number of the globally agreed 'best buys' for NCDs—the evidence-based interventions considered the most cost-effective and feasible for implementation in low- and lower-middle-income countries.

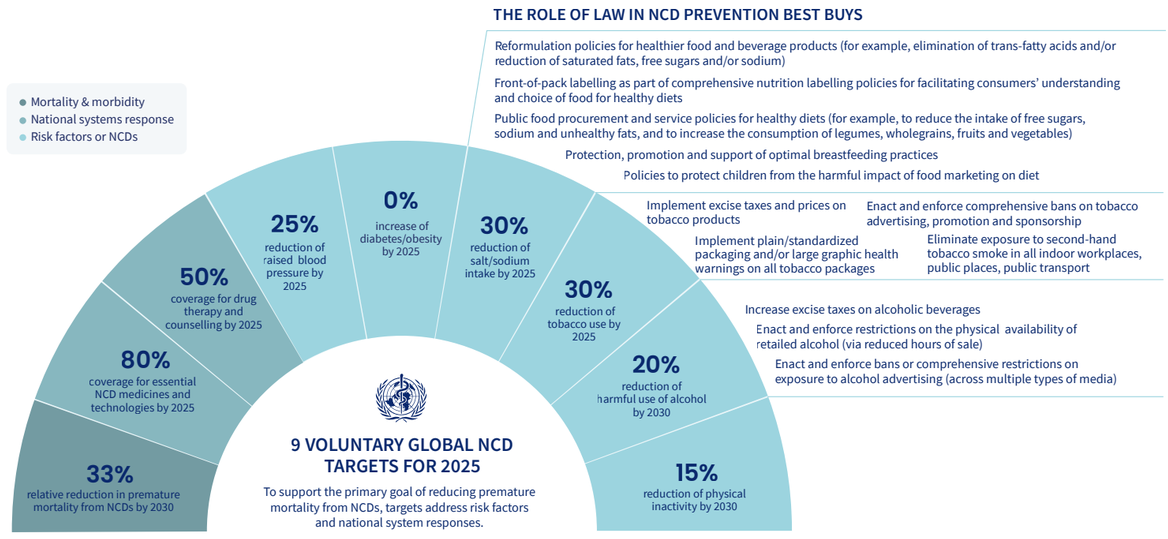
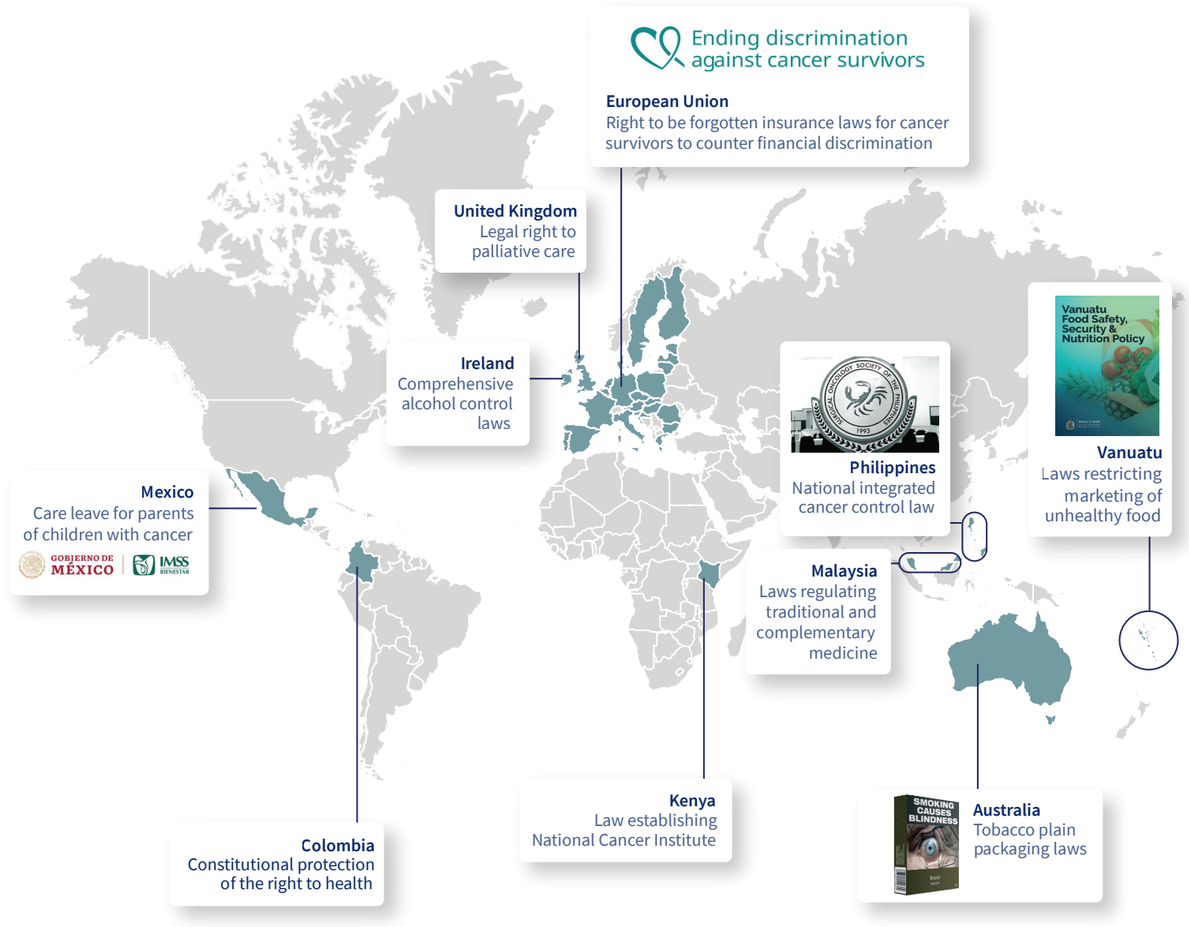


Figure 45.2

Examples of countries that have laws relating to cancer prevention and control



"Of all the forms of inequality, injustice in health is the most shocking and inhumane."

– Martin Luther King, Jr.

Universal Health Care

Implementing an essential set of cancer services as part of universal health coverage could save more than 7 million lives by 2030.

Universal health coverage (UHC) ensures all individuals have access to the high-quality health services they need without experiencing financial hardship. However, UHC access remains unequal worldwide, and in 2021, about 4.5 billion people lacked full coverage for essential health services (**Map 46.1**). Currently, only 28% of countries surveyed by the World Health Organization (WHO) include priority cancer services, inclusive of prevention, screening, treatment, and palliative care services in their national health benefits plans with varying degree across regions (**Figure 46.1**).

Several countries have implemented successful programs to expand UHC, resulting in improved survival and other positive cancer outcomes. In 2002, Thailand implemented a UHC program with nearly the entire population entitled to essential cancer services from preventative to curative and palliative care. The program has improved access to early detection and treatment, leading to increases in five-year net survival for female breast (from 61% to 75%), cervix uteri (55% to 60%), and colorectal cancer (40% to 48%) from 1997 to 2012 (**Figure 46.2**).

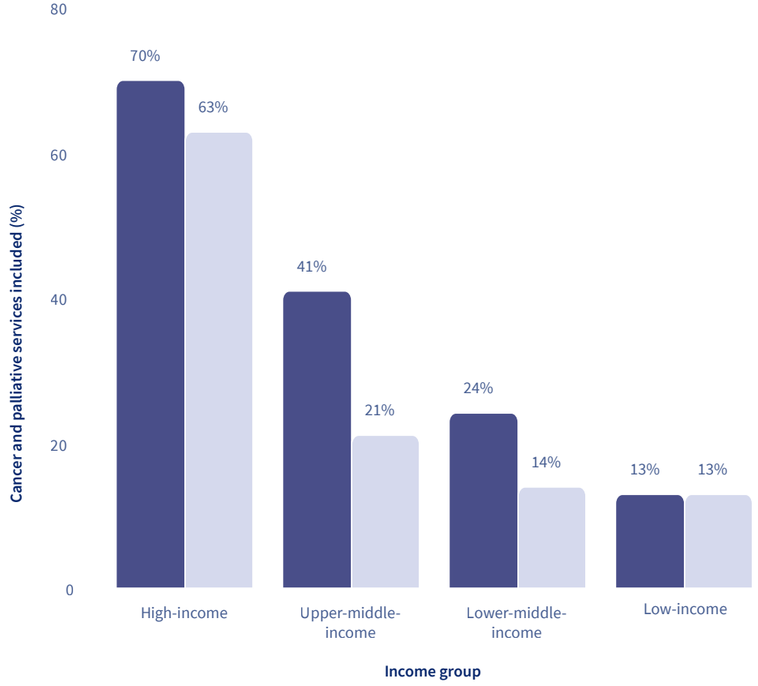
All countries, including high-income countries, must invest in all dimensions of UHC to adapt new services, ensure access for vulnerable populations, and curb out-of-pocket costs. In the United States, the Affordable Care Act was implemented in 2010 and expanded health care coverage for low-income people under 65, barred coverage denial due to preexisting conditions, and eliminated lifetime and annual limits on essential health benefits. Since then, the percentage of uninsured Americans has halved, and early cancer diagnoses and cancer survival have improved.

To increase global health care coverage, all governments have made commitments to UHC attainment through the 2030 Agenda for Sustainable Development. Treating cancer through a UHC system is not expensive and saves lives. The 2020 WHO Report on Cancer calculated that implementing a basic package of priority cancer services could as a part of UHC save more than 7 million lives by 2030. Progress toward UHC has been made, with low- and lower-middle income countries experiencing the largest gains in coverage for infectious diseases, leaving opportunity for improvement in noncommunicable diseases.

> "Health is a human right, not a privilege to be purchased."
>
> — **Shirley Chisholm**
> First Black woman to be elected to the United States Congress

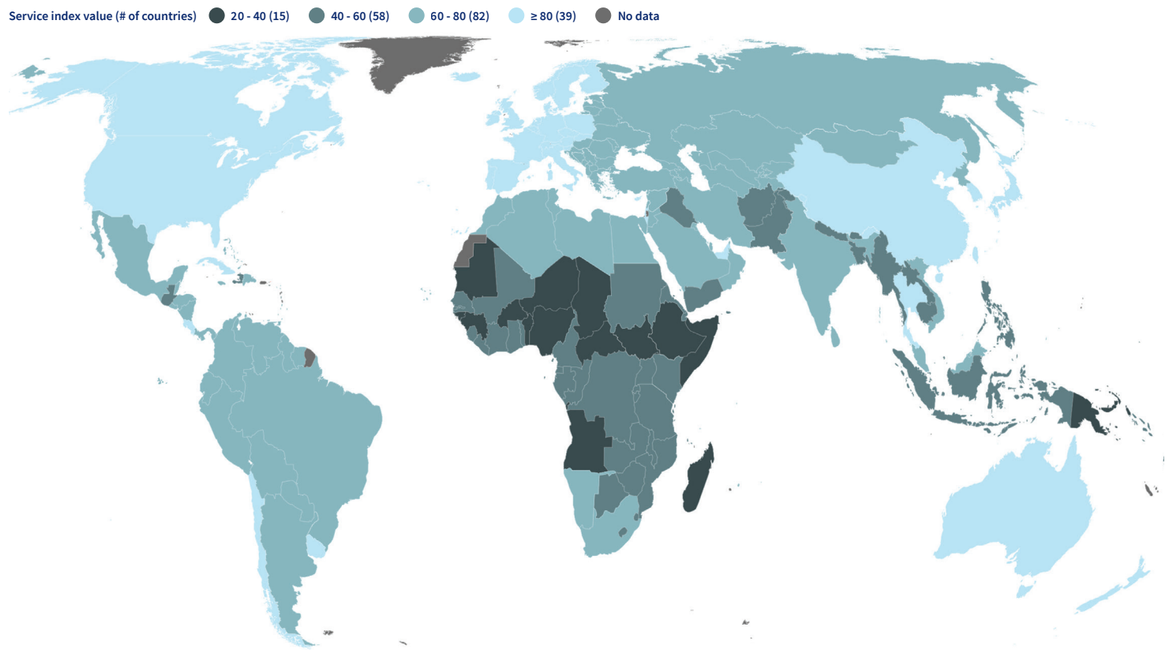
Figure 46.1

Proportion of cancer and palliative services in countries' public-sector health benefit plans, by World Bank income group, 2021



Map 46.1

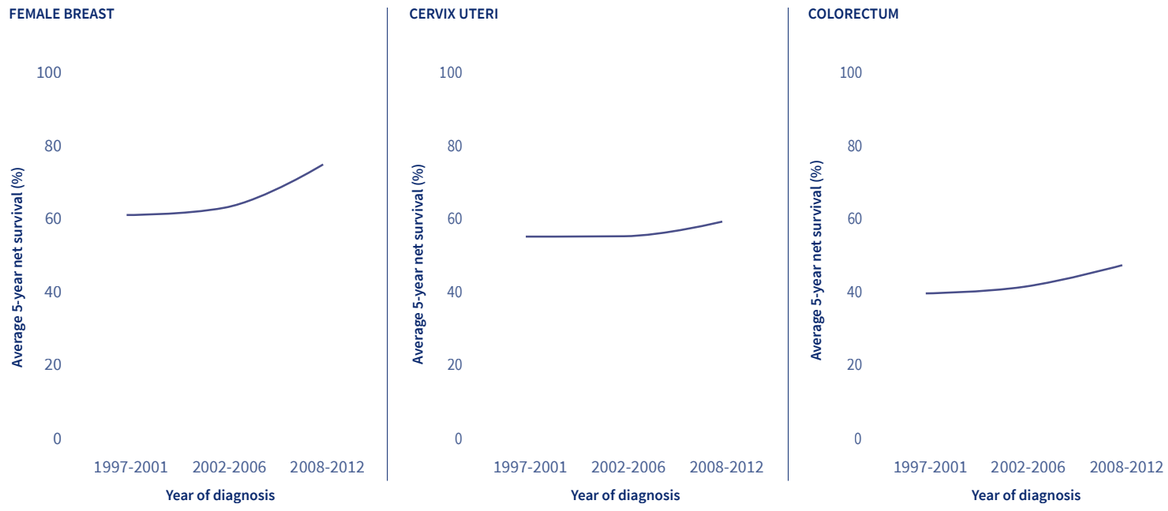
World Health Organization (WHO) Universal Health Coverage (UHC) Service Coverage Index (0–100 scale), 2021



Footnote
Coverage of essential health services (defined as the average coverage of essential services based on indicators that include reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases and service capacity and access, among the general and the most disadvantaged population).

Figure 46.2

Improvements in 5-year net survival of multiple cancers after universal health coverage implementation in 2002 in Thailand



Health System Resilience

Establishing cancer care central to an emergency response plan in all conflict settings requires rebuilding cancer care infrastructure and strengthening the workforce through international cooperation.

Nearly 7 million lives were lost due to COVID-19 during the 2020-2023 pandemic. Patients with cancer were affected both directly and indirectly by the disease (**Figure 47.1**). Patients recently diagnosed with cancer or undergoing active treatment, often being immunocompromised, faced a higher risk of COVID-19 mortality than the general population, with those with lung and hematological cancers carrying the greatest risk. One study estimated there were 39% fewer screenings for breast, cervical, and colorectal cancers in 16 countries where diagnostics and screening activities were suspended. Routine cancer treatments were disrupted with a reported 28% decrease in services (**Figure 47.2**). Countries made health system adjustments, such as rapid vaccination, specialized diagnostic pathways, and modified treatment locations and protocols to reduce hospital visits, yet it remains inconclusive if these efforts have reduced COVID-19 deaths among cancer patients.

Global cancer care communities also face numerous humanitarian crises amid rising international and regional conflicts, posing complex challenges. In affected areas, these situations often lead to (acute) collapse of health care systems and long-term impact, including cancer care. Sudden large-scale migrations strain local and national health care systems, which are often unprepared for the influx, leading to inadequate cancer diagnosis and care for migrants. Studies have shown that refugees experience later disease presentation, delayed diagnosis, and higher rates of treatment abandonment, leading to lower survival proportions (**Figure 47.3**). The need for reactive and adaptable health systems is evident to reduce the impact of crises on cancer risk and outcomes.

New international voices have emerged to empower the delivery of better cancer care for conflict-impacted populations (**Figure 47.4**) and to build a resilient health system capable of mitigating the effects of future crises (**Figure 47.5**). Pandemics and conflicts have worsened inequalities both across and within countries, disproportionally affecting underserved subpopulations in countries with already fragile health systems. Although data on cancer in crisis and conflict areas remains limited, monitoring these impacts, particularly in low- and middle-income countries, is vital to understanding long-term effects.

Figure 47.1

Impact of the COVID-19 pandemic on cancer continuum

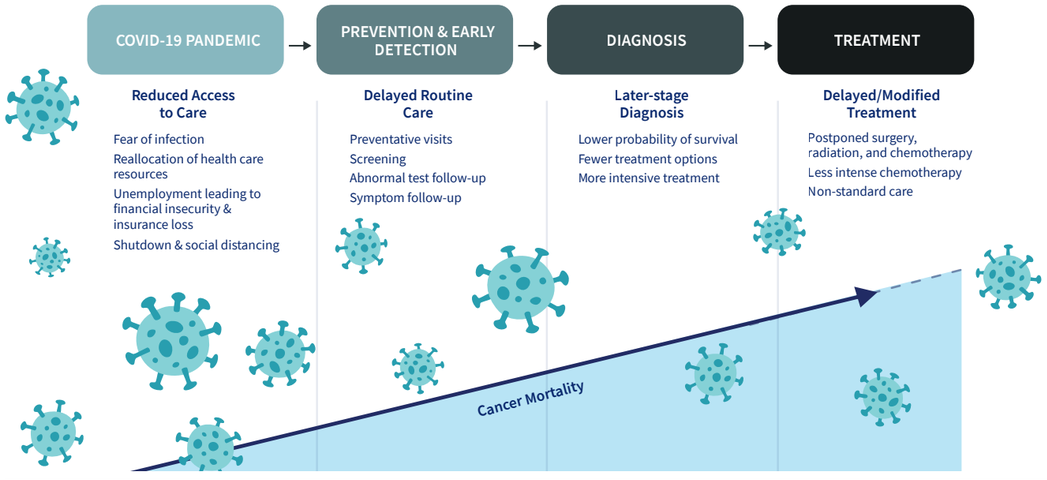
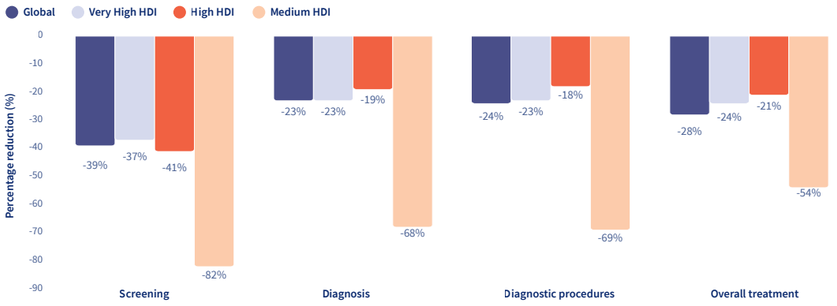


Figure 47.2

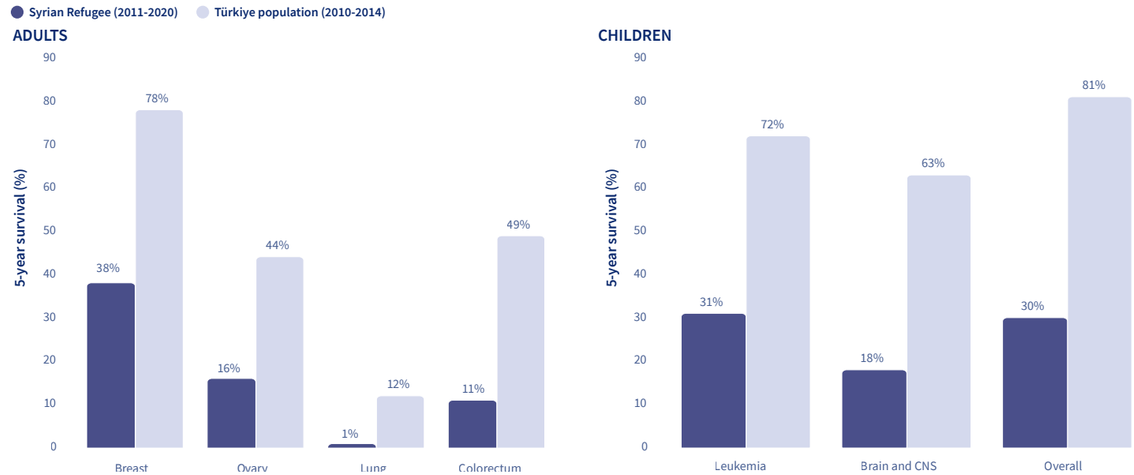
Impact of the COVID-19 pandemic on cancer diagnostics and services by four-tier Human Development Index (HDI)



> "The greater the force of your compassion, the greater your resilience in confronting hardships."
>
> — the Dalai Lama

Figure 47.3

5-Year observed survival among Syrian refugee adults and children with cancer compared with local residents in Türkiye



Footnote
Adult observed survival data acquired through GCO SURVCAN. Children net survival acquired through CONCORD-3. CNS: Central nervous system.

Figure 47.4

Seven key recommendations from the manifesto on improving cancer care in conflict-impaced populations

Ensure protection of medical staff, sick individuals, and health facilities
Demand full respect for the Geneva Convention to protect medical staff, prevent attacks on medical facilities and safeguard the rights of sick individuals, including cancer patients.

Advocate for cancer as a global health agenda
Push for the inclusion of cancer and non-communicable diseases (NCDs) in UN humanitarian discussions, especially during the upcoming high-level meeting on NCDs.

Form an inclusive advisory working group
Create a group within the WHO with key non-state actors to define and support ways to maintain cancer care in conflict-affected areas, including research efforts.

Develop inclusive care strategies
Promote care models for cancer patients in humanitarian setting, addressing the unique needs for palliative care and the specific challenges faced by different groups, like children with cancer.age

Create targeted strategies for cancer care
Develop specific plans to improve cancer care in conflict areas including online coordination platforms, blended financing, and technical support priorities.

Publish reports on cancer care
Collaborate with stakeholders to release biannual reports on cancer conflict refions, detailing progress, best practices, and recommndations, and include this in WHO reports.information

Integrate cancer care into emergency response plans
Establish caner care as a key element of emergency responses in conflict zones and seek investments to enhance access, rebuild infrastructure, and improve workforce training through international collaboration.

Footnote
Adapted from Ghebreyesus TA, Mired D, Sullivan R, et al. A manifesto on improving cancer care in conflict-impacted populations. The Lancet. 2024;404(10451):427.

Figure 47.5

Pillars to strengthen health system resilience to mitigate impact of crises

PILLAR 1

Protect underlying population health

- Enhanced preventive care
- Population-based programmes

PILLAR 2

Fortify foundations of health systems

- Sufficient core equipment
- Well-harnessed health information (system)

PILLAR 3

Bolster frontline health workforce

- Sufficient health care professional
- Medical reserve

Footnote
Adapted from OECD Health Policy Studies. Ready for the Next Crisis? Investing in Health System Resilience.

BCE—18th Century

Hippocrates
Father of medicine

Christopher Columbus
Brings tobacco from America to Europe

Zacharias Janssen
Invented the compound microscope

Dr. John Hill
Published first report linking tobacco and cancer

First cancer hospital
Founded 1779

70–80 million years ago
Evidence of cancer cells in dinosaur fossils, found in 2003.

4.2–3.9 million years ago
The oldest known hominid malignant tumor was found in Homo erectus, or Australopithecus, by Louis Leakey in 1932.

3000 BCE
Egypt
Evidence of cancerous cells found in mummies.

1900–1600 BCE
Cancer found in remains of Bronze Age human female skull.

1750 BCE
Babylonian code of Hammurabi set standard fee for surgical removal of tumors (ten shekels) and penalties for failure.

1600 BCE
Egypt
The Egyptians blamed cancer on the gods. Ancient Egyptian scrolls describe eight cases of breast tumors treated by cauterization. Stomach cancer treated with boiled barley mixed with dates; cancer of the uterus by a concoction of fresh dates mixed with pig's brain introduced into the vagina.

1100–400 BCE
China
Physicians specializing in treating swellings and ulcerations were referred to in The Rites of the Zhou Dynasty.

500 BCE
India
Indian epic tale, the Ramayana, described treatment with arsenic paste to thwart tumor growth.

400 BCE
Peru
Pre-Colombian Inca mummies found to contain lesions suggestive of malignant melanoma.

400 BCE
Greece
Greek physician Hippocrates (460–370 BCE), the "Father of Medicine," believed illness was caused by imbalance of four bodily humors: yellow bile, black bile, blood, and phlegm. He was the first to recognize differences between benign and malignant tumors.

Circa 250 BCE
China
The first clinical picture of breast cancer, including progression, metastatis, and death, and prognosis approximately ten years after diagnosis, was described in The Nei Ching, or The Yellow Emperor's Classic of Internal Medicine. It gave the first description of tumors and five forms of therapy: spiritual, pharmacological, diet, acupuncture, and treatment of respiratory diseases.

50
Italy
The Romans found some tumors could be removed by surgery and cauterized, but thought medicine did not work. They noted some tumors grew again.

100
Italy
Greek doctor Claudius Galen (129–216 AD) removed some tumors surgically, but he generally believed that cancer was best left untreated. Galen believed melancholia the chief factor in causing breast cancer, and recommended special diets, exorcism, and topical applications.

500–1500
Europe
Surgery and cautery were used on smaller tumors. Caustic pastes, usually containing arsenic, were used on more extensive cancers, as well as phlebotomy (blood-letting), diet, herbal medicines, powder of crab, and symbolic charms.

1400–1500s
Italy
Leonardo da Vinci (1452–1519) dissected cadavers for artistic and scientific purposes, adding to the knowledge of the human body.

1492
Christopher Columbus returned to Europe from the Americas with the first tobacco leaves and seeds ever seen on the continent. A crew member, Rodrigo de Jerez, was seen smoking and imprisoned by the Inquisition, which believed he was possessed by the devil.

1500
Europe
Autopsies were conducted more often and understanding of internal cancers grew.

1595
Netherlands
Zacharias Janssen invented the first compound microscope.

17th century
Netherlands
Dutch surgeon Adrian Helvetius performed both lumpectomy and mastectomy, claiming this cured breast cancer.

Germany
Cancer surgery techniques improved, but lack of anesthesia and antiseptic conditions made surgery a risky choice. German surgeon Wilhelm Fabricius Hildanus (1560–1634) removed enlarged lymph nodes in breast cancer operations, while Johann Scultetus (1595–1645) performed total mastectomies.

Netherlands
Professor Hermann Boerhaave (1668–1738) believed inflammation could result in cancer.

17th–18th centuries
France
Physician Claude Gendron (1663–1750) concluded that cancer arises locally as a hard, growing mass, untreatable with drugs, and that it must be removed with all its "filaments."

Netherlands
Antony van Leeuwenhoek (1632–1723) refined the single lens microscope and was the first to see blood cells and bacteria, aiding the better understanding of cells, blood, and lymphatic system— major steps in improving the understanding of cancer.
France Physician Le Dran (1685–1770) first recognized that breast cancer could spread to the regional auxiliary lymph nodes, carrying a poorer prognosis.

1713
Italy Dr. Bernardino Ramazzini (1633–1714), a founder of occupational/industrial medicine, reported the virtual absence of cervical cancer and relatively high incidence of breast cancer in nuns. This observation was an important step toward identifying hormonal factors such as pregnancy and infections related to sexual contact in cancer risk, and was the first indication that lifestyle might affect the development of cancer.

1733–88
France
Physicians and scientists performed systematic experiments on cancer, leading to oncology as a medical specialty. Two French scientists—physician Jean Astruc and chemist Bernard Peyrilhe— were key to these new investigations.

1761
Padua, Italy
Giovanni Morgagni performed the first autopsies to relate the patient's illness to the science of disease, laying the foundation for modern pathology.

United Kingdom
Dr. John Hill published "Cautions Against the Immoderate Use of Snuff," the first report linking tobacco and cancer.

1775
United Kingdom
Dr. Percival Pott of Saint Bartholomew's Hospital in London described cancer in chimney sweeps caused by soot collecting under their scrotum, the first indication that exposure to chemicals in the environment could cause cancer. This research led to many additional studies that identified other occupational carcinogens and thence to public health measures to reduce cancer risk.

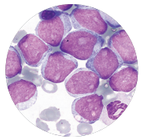
1779
France
First cancer hospital founded in Reims. It was forced to move from the city because people believed cancer was contagious.

18th century
Scotland
Scottish surgeon John Hunter (1728–93) stated that tumors originated in the lymph system and then seeded around the body. He suggested that some cancers might be cured by surgery, especially those that had not invaded nearby tissue.

19th Century

Joseph Recamier

Coined the term "metastasis"

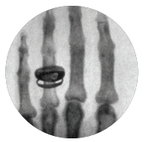


Leukemia described as a proliferation of blood cells

by John Hughes Bennett

William Stewart Halsted

Developed the radical mastectomy for breast cancer



First x-ray

Discovered by Wilhelm Konrad Roentgen

19th century

Scotland

In the early 1800s, Scottish physician John Waldrop proposed that "glioma of the retina," which typically appeared within the eyes of newborns and young children and was usually lethal, might be cured via early removal of affected organs.

1829

France

Gynecologist Joseph Recamier described the invasion of the bloodstream by cancer cells, coining the term metastatis, which came to mean the distant spread of cancer from its primary site to other places in the body.

1838

Germany

Pathologist Johannes Müller demonstrated that cancer is made up of cells and not lymph. His student, Rudolph Virchow (1821–1902), later proposed that chronic inflammation— the site of a wound that never heals— was the cause of cancer.

1842

Italy

omenico Antonio Rigoni-Stern undertook first major statistical analysis of cancer incidence and mortality using 1760–1839 data from Verona. This showed that more women than men died from tumors, and that the commonest female cancers were breast and uterine (each accounting for a third of total deaths). He found cancer death rates for both sexes were rising and concluded that incidence of cancer increases with age, that cancer is found less in the country than in the city, and that unmarried people are more likely to contract the disease.

1845

Scotland

John Hughes Bennett, the Edinburgh physician, was the first to describe leukemia as an excessive proliferation of blood cells.

1851–1971

United Kingdom

Decennial reports linked cancer death to occupation and social class.

1880

Earlier invention of general anesthesia (chloroform, ether, nitrous oxide) became more widespread, making cancer surgery more acceptable.

1881

United States

First practical cigarette-making machine patented by James Bonsack. It could produce 120,000 cigarettes a day, each machine doing the work of 48 people. Production costs plummeted, and— with the invention of the safety match a few decades later— cigarette smoking began its explosive growth.

1886

Brazil

Hereditary basis for cancer first suggested after Professor Hilario de Gouvea of the Medical School in Rio de Janeiro reported a family with increased susceptibility to retinoblastoma.

1890s

United States

Professor William Stewart Halsted at Johns Hopkins University developed the radical mastectomy for breast cancer, removing breast, underlying muscles, and lymph nodes under the arm.

1895

Germany

Physicist Wilhelm Konrad Roentgen (1845–1923) discovered X-rays, used in the diagnosis of cancer. Within a few years, this led to the use of radiation for cancer treatment.

Scotland

Dr. Thomas Beatson discovered that the breasts of rabbits stopped producing milk after he removed the ovaries. This control of one organ over another led Beatson to test what would happen if the ovaries were removed in patients suffering from advanced breast cancer, and then he found that oophorectomy often resulted in improvement. He thus discovered the stimulating effect of estrogen on breast tumors long before the hormone was discovered. This work provided a foundation for the modern use of hormones and analogs (e.g. tamoxifen, taxol) for treatment and prevention of breast cancer.

20th Century

1897

United States

Walter B. Cannon (1871–1945) was still a college student when he fed bismuth and barium mixtures to geese, outlining their gullets on an X-ray plate (the forerunner of the Barium meal examination).

19th century

Invention and use of the modern microscope, which later helped identify cancer cells.

19th century

Germany

Johannes Müller's student Rudolph Virchow (1821–1902), "the founder of cellular pathology", determined that all cells, including cancer cells, are derived from other cells. He was the first to coin the term "leukemia" and believed that chronic inflammation was the cause of cancer.

Germany

Surgeon Karl Thiersch showed cancers metastasize through the spread of malignant cells.

1800s

United Kingdom

Surgeon Stephen Paget (1855–1926) first deduced that cancer cells spread to all organs of the body by the bloodstream, but only grow in the organ ("soil") they find compatible. This laid the groundwork for the true understanding of metastasis.

Before 1900

Lung cancer was extremely rare; now it is one of the most common cancers.

First cancer society

Founded 1910

Marie Curie

awarded Nobel Prize in recognition of her work in radioactivity

American Cancer Society

founded in 1913

Janet Lane-Claypon

Published risk factors in breast cancer

George Papanicolaou

Conducts first Pap smear

By 1900

Hundreds of materials, both man-made and natural, were recognized as causes of cancer (carcinogens).

1902

X-ray exposure led to skin cancer on the hand of a lab technician. Within a decade, many more physicians and scientists, unaware of the dangers of radiation, developed a variety of cancers.

1905

United Kingdom

Physicians at the Royal Ophthalmology Hospital reported the first case of "hereditary" retinal glioma, which presented in the child of a parent cured of the disease.

1907

United States

Epidemiological study found that meat-eating Germans, Irish, and Scandinavians living in Chicago had higher rates of cancer than did Italians and Chinese, who ate considerably less meat.

1910

Austria

First national cancer society founded: Austrian Cancer Society.

1911

France

Marie Curie was awarded a second Nobel Prize, this time in chemistry, in recognition of her work in radioactivity.

1900–1950

Radiotherapy— the use of radiation to kill cancer cells or stop them dividing— was developed as a treatment.

1911

United States

Peyotn Rous (1879–1970) proved that viruses caused cancer in chickens, for which he was eventually awarded the Nobel Prize in 1966.

1913
United States
The American Cancer Society was founded as the American Society for the Control of Cancer (ASCC) by 15 physicians and business leaders in New York City. In 1945, the ASCC was renamed the American Cancer Society. It remains the world's largest voluntary organization.

1915
Japan
Cancer was induced in laboratory animals for the first time by a chemical, coal tar, applied to rabbits' skin at Tokyo University. Soon many other substances were observed to be carcinogens, including benzene, hydrocarbons, aniline, asbestos, and tobacco.

1926
England
Physician and epidemiologist Janet Lane-Claypon (1877–1967) published results from a study that demonstrated some of the major contemporary risk factors for breast cancer among women, including not breastfeeding, being childless, and older age at first pregnancy.

1928
Greece
George Papanicolaou (1883–1962) identified malignant cells among the normal cast off vaginal cells of women with cancer of the cervix, which led to the Pap smear test.

1930
Germany
Researchers in Cologne drew the first statistical connection between smoking and cancer.

1930s
Puerto Rico
Dr. Cornelius Rhoads, a pathologist, allegedly injected his Puerto Rican subjects with cancer cells— 13 people died.

1933
The Union for International Cancer Control (UICC) founded.

Spain
First World Cancer Congress held in Madrid.

1930s–1950s
Classification of breast cancer introduced, enabling the planning of more rational treatment tailored to the individual.

1934
United Kingdom
Drs. W. Burton Wood and S. R. Gloyne reported the first two cases of lung cancer linked to asbestos.

1937
United States
National Cancer Institute inaugurated.

1939
United States
Drs. Alton Ochsner and Michael DeBakey first reported the association of smoking and lung cancer.

1939–45
During the Second World War, the United States Army discovered that nitrogen mustard was effective in treating cancer of the lymph nodes (lymphoma). This was the birth of chemotherapy— the use of drugs to treat cancer.

1943–45
Denmark, United Kingdom
First national cancer registries established.

1947
Canada
Dr. Norman Delarue compared 50 patients with lung cancer with 50 patients hospitalized with other diseases. He discovered that over 90% of the first group— but only half of the second— were smokers, and confidently predicted that by 1950 no one would be smoking.

United States
Sidney Farber (1903–73), one of the founders of the specialty of pediatric pathology, used a derivative of folic acid, methotrexate, to inhibit acute leukemia in children.

Gertrude Elion
Created new leukemia treatment

Dr. Min Chiu Li
First demonstrated clinically that chemotherapy could cure a malignant disease

E. Cuyler Hammond and Daniel Horn
Launched the Hammod-Horn study

***H. Pylori* bacteria first identified**
by Barry Marshall and J. Robin Warren

1940s–1950s
United States
Dr. Charles B. Huggins' (1901–97) research on prostate cancer changed the way scientists regard the behavior of all cancer cells, and for the first time brought hope to the prospect of treating advanced cancers. He showed that cancer cells were not autonomous and self-perpetuating but were dependent on chemical signals such as hormones to grow and survive, and that depriving cancer cells of these signals could restore the health of patients with widespread metastases. He was awarded the Nobel Prize in 1966 (shared with Peyton Rous).

1950
United States
Gertrude Elion (1918–99) created a purine chemical, which she developed into 6-mercaptopurine, or 6-MP. It was rapidly approved for use in childhood leukemia. She received the Nobel Prize in 1988.

United States
The link between smoking and lung cancer was confirmed. A landmark article from The Journal of the American Medical Association appeared on May 27th, 1950: "Tobacco smoking as a possible etiologic factor in bronchogenic carcinoma" by E.L. Wynder and Evarts Graham. The same issue featured a full-page ad for Chesterfields with the actress Gene Tierney and golfer Ben Hogan; the journal accepted tobacco ads until 1953.

1951
United Kingdom
Dr. Richard Doll and Prof. Austin Bradford Hill conducted the first large-scale study of the link between smoking and lung cancer.

1953
United Kingdom
James Watson and Francis Crick described the double helical structure of DNA, marking the beginning of the modern era of genetics.

1954
United States
First tobacco litigation against the cigarette companies, brought by a widow on behalf of her smoker husband, who died from cancer. The cigarette companies won.

1956
United States
Dr. Min Chiu Li (–1980) first demonstrated clinically that chemotherapy could result in the cure of a widely metastatic malignant disease.

1960
Japan
Group cancer screening for stomach cancer began with a mobile clinic in Tohoku region.

1960
United States
Dr. Min Chiu Li published another important and original finding: the use of multiple-agent combination chemotherapy for the treatment of metastatic cancers of the testis. Twenty years later, it was demonstrated that combination chemotherapy, combined with techniques for local control, had virtually eliminated deaths from testicular malignancy.

1963
Japan
Cancer research programs were established by the Ministry of Health and Welfare and the Ministry of Education, Science, and Culture.

1964
United States
Physician Irving J. Selikoff (1915-1992) published the results from a study linking asbestos exposure to the development of mesothelioma.

1964
United States
First United States Surgeon General's report on smoking and health.

1965
WHO established International Agency for Research on Cancer (IARC), based in Lyon, France.

1966
International Association of Cancer Registries (IACR) founded.

1960s–1970s
Trials in several countries demonstrated the effectiveness of mammography screening for breast cancer.

1970s
United States, Italy
Bernard Fisher in the United States and Umberto Veronesi in Italy both launched long-term studies as to whether lumpectomy followed by radiation therapy was an alternative option to radical mastectomy in early breast cancer. These studies concluded that total mastectomy offered no advantage over either lumpectomy or lumpectomy plus radiation therapy.

1971
United States
The National Cancer Act in President Nixon's "War on Cancer" mandated financial support for cancer research, established a network of population-based cancer registries, outlined intervention strategies, and, in 1973, established the Surveillance, Epidemiology, and End Results (SEER) program.

1973
United States
Bone marrow transplantation first performed successfully on a dog in Seattle by Dr. E. Donnall Thomas (1920–). This led to human bone marrow transplantation, resulting in cures for leukemias and lymphomas. In 1990, Dr. Thomas won a Nobel Prize for his work.

1970s
Childhood leukemia became one of the first cancers that could be cured by a combination of drugs.

United States
Discovery of the first cancer gene (the oncogene, which in certain circumstances can transform a cell into a tumor cell).

1970s onwards
WHO, UICC, and others promoted national cancer planning for nations to prioritize and focus their cancer activities.

1980s
WHO Program on Cancer Control established.

United States
Kaposi's sarcoma and T-cell lymphoma linked to AIDS.

United States
Vincent DeVita developed a four-drug combination to significantly raise the cure rate of Hodgkin's disease to 80%.

Australia
Barry Marshall and J. Robin Warren identified bacterium H. pylori, noting it caused duodenal and gastric ulcers and increased the risk of gastric cancer.

1981
Japan Professor Takeshi Hirayama (1923–95) published the first report linking passive smoking and lung cancer in the non-smoking wives of men who smoked.

Italy Dr. G. Bonnadona in Milan performed the first study of adjuvant chemotherapy for breast cancer using cyclophosphamide, methotrexate, and 5-fluorouracil, resulting in reduction of cancer relapse. Adjuvant chemotherapy is now standard treatment for lung, breast, colon, stomach, and ovary cancers.

1982
United States
Nobel Laureate Baruch S. Blumberg was instrumental in developing a reliable and safe vaccine against hepatitis B (which causes primary liver cancer).

Mid-1980s
Human Genome Project was initiated to pinpoint location and function of estimated 50,000–100,000 genes that make up the inherited set of "instructions" for functions and behavior of human beings.

1988
Global First WHO World No Tobacco Day, subsequently an annual event.

1989
European Network of Cancer Registries (ENCR) established.

United States National Institutes of Health researchers performed the first approved gene therapy, inserting foreign genes to track tumor-killing cells in cancer patients. This project proved the safety of gene therapy.

1991
Evidence linking specific environmental carcinogens to telltale DNA damage emerged, e.g. ultraviolet radiation was found to produce change in tumor suppressor genes in skin cells, aflatoxin (a fungus poison) or hepatitis B virus to cause a mutation in the liver, and chemicals in cigarette smoke to switch on a gene that makes lung cells vulnerable to the chemicals' cancer-causing properties.

1994
United States, Canada, United Kingdom, France, Japan
Scientists collaborated and discovered BRCA1, the first breast and ovarian cancer predisposing gene.

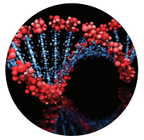
United States
National Program of Cancer Registries (NPCR) established.

1995
Gene therapy, immune system modulation, and genetically engineered antibodies used to treat cancer.

1999
Netherlands, United States
Jan Walboomers of the Free University of Amsterdam and Michele Manos of Johns Hopkins provided evidence that the human papillomavirus is present in 99.7% of all cases of cervical cancer.

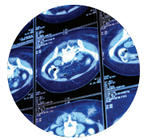
United States
The Bill & Melinda Gates Foundation awarded a five-year, $50 million grant to the Alliance for Cervical Cancer Prevention (ACCP), a group of five international organizations with a shared goal of working to prevent cervical cancer in developing countries.

21st Century



Human genome is mapped

First HPV vaccine



CT Scan screening for lung cancer

2000
53rd World Health Assembly presided over by Dr. Libertina Amathila (Namibia) endorsed "Global strategy for non-communicable disease (NCD) prevention and control," which outlined major objectives for monitoring, preventing, and managing NCDs, with special emphasis on major NCDs with common risk factors and determinants— cardiovascular disease, cancer, diabetes, and chronic respiratory disease.

The entire human genome is mapped.

Charter of Paris against Cancer is signed.

2001
Luxembourg International Childhood Cancer Day was launched, its aim to raise awareness of the 250,000 children worldwide who get cancer every year. Some 80% of these children have little or no access to treatment. The first annual event in 2002 was supported in 30 countries around the world and raised over US$100,000 for parent organizations to help children in their own countries.

2004
Geneva, Switzerland
WHO cancer prevention and control resolution approved by World Health Assembly.

2005
WHO Framework Convention on Tobacco Control came into force, using international law to further public health and prevent cancer.

2006
United States
The United States Federal Drug Administration approved the first HPV vaccine to prevent infections that cause cervical cancer.

2011
Lung cancer deaths reduced by low-dose computed tomography (CT) scanning of people at high risk.

United Nations High Level Meeting on Non-communicable Diseases in New York, United States.

2013
WHO launched the Global Action Plan for the Prevention and Control of NCDs (2013-2020), including strategies to reduce cancer incidence and mortality by promoting prevention and early detection.

2014
The International Cancer Control Partnership (ICCP) was co-convened by the NCI and WHO to support governments in developing and implementing evidence-based national cancer control plans.

2015
WHO launched initiatives to introduce and expand HPV vaccination in low- and middle-income countries to reduce cervical cancer incidence.

2018
WHO launched the initiative to provide universal access to cancer diagnosis, treatment, and care for children by 2030, aiming to increase survival rates globally to at least 60%.

2024
The NCI and WHO renewed their collaboration to enhance global cancer control efforts, focusing on governance, accountability, and cancer plan implementation research.

Trials began for personalized cancer vaccines using mRNA technology to reduce recurrence risk by training the immune system to target specific cancer cells, with expectations to complete by 2027

2025
United States
United States Surgeon General issued an advisory sharing how alcohol increases cancer risk, calling for a new health warning label on alcoholic beverages.

Glossary

Aflatoxin B1 (AFB1)
A harmful, cancer-causing chemical made by certain types of Aspergillus mold that may be found on poorly stored grains and nuts. Consumption of foods contaminated with aflatoxin is an important risk factor for hepatocellular (liver) cancer.

Age-specific rate
A rate for a specified age group, in which the numerator and denominator refer to the same age group.

Age-standardization
A technique that allows comparison of incidence (or mortality) rates between populations, adjusting for any differences in their respective age distributions.

Asbestos
A natural material that is made of tiny fibers and used in insulation and as a fire retardant. Asbestos exposure is an important risk factor for cancer, especially mesothelioma (lining of the chest, abdomen and heart) and also lung cancer.

Benign tumor
An abnormal growth that is not cancer and does not spread to other areas of the body.

Beta-naphthylamine
A synthetic organic compound formerly used as an intermediate in some manufacturing processes, and an important risk factor for bladder cancer. Its production and commercial use, with the exception of limited laboratory use, has been banned in most countries.

Body mass index (BMI)
A measure of a person's weight in relation to his or her height, calculated as weight in kilograms divided by height in meters squared.

Cancer
A disease in which abnormal cells divide uncontrollably. Cancer cells can invade nearby tissues and spread through the bloodstream and lymphatic system to other parts of the body.

Cancer registry
An institution that performs the systematic collection and maintenance of a file or register of all cancer cases occurring in a defined population. Registries continuously and systematically collect information from various data sources on the personal characteristics of cancer patients (e.g. age, sex, and race) and the clinical and pathological characteristics (e.g. stage, histologic classification) of the cancers.

Cancer screening programs
Programs organized at a national or regional level that aim to decrease the incidence and mortality of a specific type of cancer by identifying precancerous lesions or tumors at an early stage, when they can be effectively treated. Programs usually have: 1) an explicit policy; 2) a team responsible for organizing the screening and delivering appropriate healthcare; and 3) a structure for assuring quality screening and follow-up of abnormal screening tests.

Carcinogen
Any agent —chemical, physical or biological— that causes cancer. Examples include tobacco smoke, asbestos, human papillomavirus (HPV), and ultraviolet (UV) radiation.

Carcinoma
A cancerous tumor that begins in the lining layer (epithelial cells) of organs. At least 80% of all cancers are carcinomas.

Chemotherapy
Treatment with a drug or drugs to destroy cancer cells. Chemotherapy may be used, either alone or in combination with surgery or radiation treatment, to treat cancer when it is at an early stage, when the cancer has spread, when the cancer has come back (recurred), or when there is a strong chance that the cancer could recur.

Colonoscopy
Examination of the large bowel with a long, flexible, lighted tube called a colonoscope. The physician looks for polyps or early cancers during the exam, and removes them using a wire passed through the colonoscope.

Computerized tomography (CT)
A series of detailed pictures of areas inside the body taken from different angles; the pictures are created by a computer linked to an x-ray machine. Also called computerized axial tomography (CAT) scan. A special kind of CT machine, the spiral CT, has been used to look for early lung cancer.

Diagnosis
The process of identifying a disease by its signs and symptoms, as well as medical tests and tissue sampling and examination as needed.

Dioxins
Organic chemical byproducts of industrial processes; considered highly toxic environmental pollutants due to their effects on the immune and endocrine systems and on encouraging tumor growth.

Direct costs
Expenditures for medical procedures and services associated with the treatment and care of people with cancer.

Electron accelerator machines
Used in medical radiation therapy, these machines accelerate tiny charged particles called electrons, and deliver uniform doses of high-energy x-rays to the region of the patient's tumor. These x-rays can destroy the cancer cells while sparing the surrounding normal tissue.

Endometrial cancer
Cancer of the layer of tissue that lines the uterus.

Epidemic
Occurrence of an illness, condition, or behavior that affects many people in the same region during a specified period of time. To constitute an epidemic, this occurrence must exceed normal occurrence of the disease in the region.

Fecal occult blood test (FOBT)
A test used to screen for large bowel cancer. It looks for blood in the stools, the presence of which may be a sign of cancer.

Hazard vs. Risk
An agent is considered a cancer hazard if it is capable of causing cancer under some circumstances. However, it does not indicate the level of risk associated with exposure. The cancer risk associated with substances or agents assigned the same classification may be very different, depending on factors such as the type and extent of exposure and the strength of the effect of the agent.

Helicobacter pylori (H. pylori)
A type of bacterium that causes inflammation and ulcers in the stomach or small intestine. People with H. pylori infections may be more likely to develop cancer in the stomach.

Hematopoietic system
Organs and tissues involved in the production of blood, including the bone marrow, lymph nodes, spleen, and tonsils.

Hepatitis B and C viruses (HBV and HCV)
Viruses that cause hepatitis, a condition that is characterized by inflammation of the liver. Long-term infection may lead to cirrhosis (scarring of the liver) and liver cancer. Persons infected with HCV may also have an increased risk for certain types of non-Hodgkin lymphoma.

Hepatocellular carcinoma
The most common type of cancer originating in the liver.

Hormone replacement therapy (HRT)
Hormones (estrogen, progesterone, or other types) given to women after menopause to replace the hormones no longer produced by the ovaries. HRT can be a risk factor for cancers of the endometrium and breast.

Human development index (HDI)
A measure of health, education and income at the country level produced by the United Nations Development Programme (UNDP). It can be used as a ranking or in categories of very high, high, medium, and low. All 2020 estimates of cancer burden use HDI based on the UNDP's Human Development Report 2021-2022.

Human herpesvirus 8 (HHV-8)
A type of virus that causes Kaposi sarcoma. Patients with acquired immunodeficiency syndrome frequently suffer from HHV-8-associated diseases. Infection with HHV-8 can also cause certain types of lymphoma and severe lymph node enlargement, known as Castleman's disease. HHV-8 is also known as Kaposi sarcoma-associated herpesvirus, or KSHV.

Human immunodeficiency virus (HIV)
The virus that causes acquired immune deficiency syndrome (AIDS). It is transmitted through blood and other body fluids, and infants born to infected mothers may also become infected. Infection with both HIV and HHV-8 increases the risk of developing Kaposi sarcoma.

Human papillomavirus (HPV)
A type of virus that can cause abnormal tissue growth (for example, warts) and other changes to cells. Long-term infection with certain types of human papillomavirus (e.g., types 16 and 18) can cause cervical cancer. HPV is also a risk factor for anal, vaginal, vulvar, penile, oropharyngeal, and squamous cell skin cancers. It is transmitted through sexual contact.

Incidence
The number of new cases arising in a given period in a specified population. This information, collected routinely by cancer registries, can be expressed as an absolute number of cases per year or as a rate per 100,000 persons per year.

Kaposi sarcoma
A type of cancer characterized by the abnormal growth of blood vessels that develop into lesions on the skin, lymph nodes, lining of the mouth, nose, and throat, and other tissues of the body. It is caused by human herpesvirus-8 (HHV-8). The risk of developing Kaposi sarcoma in a person who has HHV-8 increases significantly if the person is also infected with human immunodeficiency virus (HIV).

Keratinocyte (nonmelanoma) skin cancer
Also known as basal or squamous cell skin cancer. A cancer that occurs in keratinocyte cells, which are located in the epidermis (top layer of skin) and are responsible for producing keratin. Keratinocytes are divided into squamous cells on the surface of the epidermis and basal cells located within the deeper basal layer of the epidermis.

Leukemia
A cancer of the blood or blood-forming organs.

Lead time bias
Lead time bias occurs when survival time appears extended simply because the disease was detected earlier—such as through screening—without actually prolonging the patient's life.

Lumpectomy
Surgery to remove a breast lump or tumor and a small amount of surrounding normal tissue.

Lymphoma
A cancer of the lymphatic system. The lymphatic system is a network of thin vessels and nodes throughout the body. The two main types of lymphoma are Hodgkin lymphoma (or disease) and non-Hodgkin lymphoma.

Malignant tumor
A mass of cancer cells that may invade surrounding tissues or spread (metastasize) to distant areas of the body. Synonymous with cancer.

Melanoma
A cancerous (malignant) tumor that begins in the cells that produce the skin coloring (melanocytes). Melanoma is almost always curable in its early stages. However, it is likely to spread, and once it has spread to other parts of the body the likelihood of cure decreases.

Menarche
The first menstrual period, usually occurring during puberty.

Menopause
The time period marked by the permanent cessation of menstruation, usually occurring between the ages of 45 and 55 years.

Metastasis
The distant spread of cancer from its primary site to other places in the body.

Morbidity
Any departure from physiological or psychological well-being. Measures of morbidity for people living with cancer may include disability, pain, time away from work, or days spent in the hospital.

Mortality
The number of deaths occurring in a given period in a specified population. It can be expressed as an absolute number of deaths per year or as a rate per 100,000 persons per year.

Net survival
The probability of surviving cancer in the absence of other causes of death.

Neoplasm
An abnormal growth (tumor) that starts from a single altered cell; a neoplasm may be benign or malignant. Cancer is a malignant neoplasm.

Neuroblastoma
Cancer that arises in immature nerve cells; affects mostly infants and children.

Overweight/obese
Persons who are considered overweight have a body mass index (BMI) greater than 25; a BMI greater than 30 is considered obese.

Particulate matter
Microscopic solid or liquid particles associated with the atmosphere that can penetrate the lungs and cause damage that can lead to lung cancer. Particulate matter can be naturally occurring (e.g. originating from volcanoes or dust storms) or synthetic (e.g. vehicle emissions). The smallest class of particulate matter (<2.5 micrometers diameter) is the deadliest.

Palliative care
An approach that aims to improve the quality of life for patients and families facing the problems associated with life-threatening cancers. It provides for prevention and relief of suffering through treatment for pain and other symptoms as well as through spiritual and psychosocial support, at the time of cancer diagnosis, through the end of life, and during family bereavement.

Prevalence
The number of persons in a defined population who have been diagnosed with a specific type of cancer, and who are still alive at the end of a given year (the survivors). Five-year prevalence limits the number of patients to those diagnosed in the past 5 years. It is a particularly useful measure of cancer burden because for most cancers, patients who are still alive five years after diagnosis are usually considered cured. However, exceptions to this include breast cancer patients, who continue to die from the disease 5 years after diagnosis.

Prognosis
Prediction of the course of cancer, and the outlook for a cure of the cancer.

Radiotherapy
The use of radiation treatment to kill cancer cells or stop them from dividing.

Radon
A radioactive gas that is released by uranium—a substance found in soil and rock—and is an important risk factor for lung cancer.

Rate
see *Incidence and Mortality.*

Rate ratio
A measure to compare the incidence rates, person-time rates, or mortality rates of two groups.

Retinoblastoma
A rare form of eye cancer that affects the retina of infants and young children.

Sarcoma
A cancer of the bone, cartilage, fat, muscle, blood vessels, or other connective or supportive tissue.

Sigmoidoscopy
An examination to help find cancer or polyps within the rectum and distal part of the colon. A slender, hollow, lighted tube is placed into the rectum, allowing the physician to look for polyps or other abnormalities. The sigmoidoscope is shorter than the colonoscope.

Solar irradiation
See *Ultraviolet (UV) radiation*.

Solid fuels
Solid materials burned usually for heating purposes, including wood, peat, charcoal, coal, and grains. In certain conditions, excess exposure can be an important risk factor for lung cancer.

Survival (rate, estimate)
The proportion (or percentage) of persons with a given cancer who are still alive after a specified time period (e.g., 1, 3, or 5 years) following a diagnosis.

Targeted therapy
A cancer treatment that uses drugs or other substances to identify and attack cancer cells while avoiding harm to normal cells better than many other cancer treatments. Some targeted therapies block the mechanisms involved in the growth and spread of cancer cells. Other types of targeted therapies help the immune system kill cancer cells or deliver toxic substances directly to cancer cells.

Ultraviolet (UV) radiation
Invisible rays that are part of the energy that comes from the sun. UV radiation also comes from sun lamps and tanning beds. UV radiation can damage the skin, lead to premature aging, and cause melanoma and other types of skin cancer.

United Nations (UN) Regions
UN regions are defined by the UN Statistical Division for statistical purposes, grouping countries based on geography and shared cultural characteristics. GLOBOCAN reports cancer statistics according to the UN's geographical classifications (World Population Prospects, 2019 revision: https://population.un.org/wpp/) among others, with the exception of Cyprus, which is included in Southern Europe. A full list of UN-defined countries and regions is available in IARC's Global Cancer Observatory, under Today Data & Methods (https://gco.iarc.fr/today/en/data-sources-methods).

Vital registration
The continuous, permanent, compulsory and universal recording of the occurrence and characteristics of vital events (e.g., births and deaths) pertaining to the population, as provided through decree or regulation in accordance with the legal requirements of a country.

Wilms tumor
A type of kidney cancer that usually occurs in children younger than 5 years of age.

World Bank income groups
The World Bank Group assigns the world's economies to four income groups based on the gross national income (GNI) per capita of the previous calendar year. For the 2025 fiscal year, economies are classified by 2023 GNI per capita as follows: low-income (≤ $1,145), lower-middle-income ($1,146–$4,515), upper-middle-income ($4,516–$14,005), and high-income (>$14,005).

World Health Organization (WHO) Regions
WHO regions are established by member states and structured around the organization's six regional offices: Africa, the Americas, South-East Asia, Europe, Eastern Mediterranean, and Western Pacific. They are based on practical considerations for governance and coordination (https://www.who.int/about/who-we-are/regional-offices).

Please refer to the U.S. National Cancer Institute's "Dictionary of Cancer Terms" for additional definitions (http://www.cancer.gov/dictionary).

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RISK FACTORS

2. Overview

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THE BURDEN

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Map 42.2
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"Close to half of cancer deaths globally are preventable by modifiable risk factors. This calls for concerted and coordinated efforts between local governments, health departments, community leaders, civic societies, and donors to implement proven interventions broadly in every community."

— William Dahut
Chief Scientific Officer, American Cancer Society

The Cancer Atlas, Fourth Edition presents a comprehensive global overview of the cancer burden, the associated risk factors, and the tools and prospects for cancer prevention and control. The *Atlas* presents this information in a user-friendly and accessible format for advocates, government and public health agencies, policymakers, survivors, and the general public to promote cancer prevention and control at local, regional and national levels. Continuing the *Atlas'* signature visual format, using maps, charts, and figures, the fourth edition presents the most current global data in an accessible, informative format, making it a clear and practical resource for guiding cancer control efforts worldwide.

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