



HEALTH IN THE TROPICS



STATE OF
THE TROPICS

A STATE OF THE TROPICS REPORT 2019.

Published by James Cook University on behalf of the State of the Tropics Leadership Group

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FOREWARD



It is a crucial time for the Tropics.

Five years ago, the inaugural State of the Tropics report was launched on 29 June. This landmark report, the result of an international collaboration between leading research institutions from across the world's tropical zone, offered a different perspective on the world. It demonstrated that the Tropics is a geo-political and environmental entity in its own right, and highlights the increasing importance of the region and the global implications of the immense social, economic and environmental changes the Tropics are experiencing.

Since the report's release the world has embarked on an ambitious journey launching several major global initiatives to address the world's most pressing challenges. 2015 was a milestone year for global development with the United Nations 2030 Agenda for Sustainable Development, the Paris Agreement on climate change and the Addis Ababa Action Agenda on Financing for Development. These landmark agreements define a series of ambitious global goals that will guide actions on global development, economic policy, climate change and environmental protection in the coming decades.

Nations of the Tropics are at the forefront of these efforts. With almost half the world's population, more than half of its young people, many of its fastest growing economies, most of the world's biological and cultural diversity, and ecosystems services of global importance, what happens in the world's tropical zone over the coming decades will have global implications.

In 2016, in recognition of the great and growing importance of the Tropics, its people and places, the United Nations declared that June 29 each year would be recognised as the UN International Day of the Tropics.

Noting the critical relationship between the health and wellbeing of people and communities of the Tropics and progress in the region, we turn our attention in this report to these important issues.

The Tropics has long carried a heavier health burden than the rest of the world. The health challenges of the Tropics are different from those in other zones due

to several factors. Not only is the climate more favourable to parasitic and vector-borne diseases, but perhaps more importantly, social, nutritional, and educational factors associated with poverty have a profound impact. The rising prevalence of non-communicable diseases alongside infectious disease is placing pressure on already strained health systems.

Despite improvement in health indicators across the Tropics, there are warning signs that the progress demonstrated in the 2014 report since the turn of the century is beginning to slow or even stall. Undernourishment in the tropics has increased since 2013, improvements in maternal and child mortality have slowed and drug resistance is preventing disease eradication.

Despite these challenges, improvement in health and wellbeing across the Tropics should be celebrated: life expectancy continues to grow, fewer babies and children are dying of preventable causes, and diseases are being eradicated. A number of previously endemic tropical countries are now malaria free, with more expected to join them in just a few short years.

This report demonstrates that the health burden in the Tropics can be eased, but challenges remain. Focusing on the social and environmental determinants of health and disease will be essential in the Tropics moving forward and necessary for achieving the Sustainable Development Goals. It is more important than ever that we do not lose our focus on the tropical world.



Professor Sandra Harding
*Vice Chancellor & President, James Cook University
Convenor, State of the Tropics Project*

KEY MESSAGES

- * Human health and wellbeing is central to the prosperity, sustainability and stability of human communities particularly in the Tropics.**

This report takes stock of the current and historical status of health and wellbeing across different regions of the Tropics. It presents a broad ranging, statistical analysis of a set of indicators relating to health, based on data collated from existing datasets from several authoritative, multi-lateral sources including United Nations agencies, The World Bank, and World Health Organization. This report considers infectious disease, non-communicable disease, maternal and child health, mental illness, substance abuse, and accident and injury. It also explores the health workforce in the Tropics.
- * Life expectancy across the Tropics has improved markedly in recent decades despite lagging the rest of the world.**

Most tropical countries have a life expectancy at birth greater than 60 years of age, a significant improvement from last century. Across the world, most people die from non-communicable disease and cancers, although infectious disease remain important. In the Tropics, there is a greater burden of deaths from infectious disease and injuries.
- * Systems approaches to health care and research such as Planetary Health and OneHealth are particularly relevant in the Tropics where the environment has a greater impact on health and wellbeing, people are more likely to live with closer connection to the natural environment, and more likely to rely on ecosystems services for their livelihoods.**

The Tropics is at the nexus of biodiversity loss, climate change, emerging and persistent infectious diseases, rising non-communicable diseases, and globalisation.
- * The Tropics carries a heavier burden of disease than the rest of the world due to a complex interaction between social, economic, and environmental factors.**

The region's climate and ecological characteristics support a higher likelihood of disease transmission, while greater rates of poverty and inequality, which are associated with poorer nutrition, lower rates of education, poorer access to medical care and improved sanitation and water facilities, all contribute to the disproportionate impact of disease on tropical communities. Progress in prevention and treatment of infectious diseases such as HIV/AIDS, malaria, and tuberculosis has occurred across the Tropics although gains have been uneven. In some regions, progress has stalled or even regressed.

- ✿ **Although the risk of premature death from non-communicable diseases has declined marginally, it remains higher in the Tropics than rest of the world.**

The “double burden” of disease where rates of non-communicable disease continue to increase alongside high rates of infectious disease and undernourishment has been an issue in the Tropics for decades and will be an ongoing challenge for the region.
- ✿ **The consequences of poor maternal and child health are far reaching and intergenerational, including increased infant and child mortality, loss of economic and educational opportunities and spiralling cycles of poverty.**

In the Tropics, far too few women, children, and adolescents have access to essential, good quality health services and education. Despite this, there has been ongoing improvement in maternal, child, and infant mortality across the tropical regions. Pregnant women and children are more vulnerable to other health risks such as infectious diseases and natural disasters.
- ✿ **Undernourishment, substance abuse, mental illness, and accident and injury are important causes and mortality and morbidity in the Tropics.**

After several decades of progress in improving rates of undernourishment, there has been a reversal of trends since 2013, particularly in the Tropics. People in the Tropics generally consume less alcohol than the rest of the world, however consumption is very high in some parts with unrecorded alcohol use being an ongoing challenge. Injury and death from accident and self-harm are universal, although the Tropics faces additional challenges associated with governance and poor reporting. In 2013, although the Tropics accounted for only 27% of the world’s vehicles and 40% of the world’s population, it accounted for more than 50% of all recorded road accident deaths.
- ✿ **Despite a much higher health burden in the Tropics there are generally fewer resources in terms of both the health workforce and important health infrastructure.**

The Tropics has fewer than half the number of physicians per population than in the rest of the world. Nurses and midwives account for more than half of the professional health workforce and contribute to 90% of patient contact. There are far fewer nurses and midwives in the Tropics. Although there is some evidence that numbers are increasing there are far fewer nurses and midwives per population than the rest of the world. In addition to shortages, a key issue is geographical and vocational maldistribution of the health workforce. There are fewer hospitals and fewer hospital beds available to the tropical community compared with the rest of the world.

1

INTRODUCTION

1.1 TROPICAL HEALTH

Human health and wellbeing are central to the prosperity, sustainability and stability of human communities. Health is a fundamental human right; it enables people to live a life free of illness, pain and disability. Health reflects individual, family and community wellbeing as well as its numerous underlying social, economic and environmental factors. The World Health Organization (WHO) defines health as 'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity' (WHO 1948).

There has been incredible progress in the improvement of global health outcomes, particularly since the turn of the 21st century. The past two decades have been described as a 'golden age' for global health (Kruk et al. 2018). However, inequalities persist. Across the world, there are major disparities in life expectancy, causes of mortality and associated risk factors. These disparities are driven by social, economic, and environmental factors.

The Tropics have long carried a heavier health burden than other geographical zones as a result of complex interactions of factors both within and outside the region. However, improvements driven by economic development, increased advocacy, and funding for better health outcomes from governments and non-government organisations, alongside increased political will, are slowly closing the gap (Hemingway 2014).

This report will examine the improvements in health of recent decades across the Tropics and update the key indicators that were explored in the *State of the Tropics: 2014 Report*, with some additions (State of the Tropics 2014). It will also explore the underlying drivers of change in the Tropics.

1.2 LIFE EXPECTANCY AND CAUSES OF MORTALITY

Changes in health and wellbeing outcomes can be monitored by shifts in life expectancy and causes of mortality. Since the last century, life expectancy across the world has improved considerably. Global life expectancy increased by almost 24 years between 1950 and 2015 and exceeded 70 years of age between 2010 and 2015 (United Nations, Department of Economic and Social Affairs 2017). In the middle of the 20th century, life expectancy at birth in the majority of tropical countries was less than 50 years, with some national estimates not even reaching 30 years (Figure 1.1). However, despite still lagging behind the rest of the world, and with a few exceptions, in 2015 most tropical countries have a life expectancy at birth greater than 60 years of age (Figure 1.2). The tropical regions of Africa, particularly central and western Africa, have persistently high mortality rates, although life expectancy here has also improved dramatically.

The causes of these mortality rates are highly variable. While infectious disease remains lethal and prevalent (Table 1.1), most people around the world die of non-communicable diseases, including cardiovascular disease and cancers. There is clearly a greater burden of deaths from infectious diseases and injuries in the Tropics. Across the tropical regions, there is some variation in causes of mortality (Table 1.1). In the regions of Central and Southern Africa and that of Northern Africa and the Middle East, infectious diseases—particularly diarrhoeal and respiratory infections such as pneumonia and influenza—are the most common causes of premature mortality. Malaria and tuberculosis remain major causes of mortality and morbidity across a large proportion of the Tropics, especially in sub-Saharan Africa. The reporting of major causes of mortality often omits maternal mortality, as it affects only approximately 20% of the population. However, if these mortality data are disaggregated by gender and age, maternal mortality emerges as the most important cause of death globally in women aged 15–49. It is explored in detail in Chapter 3.

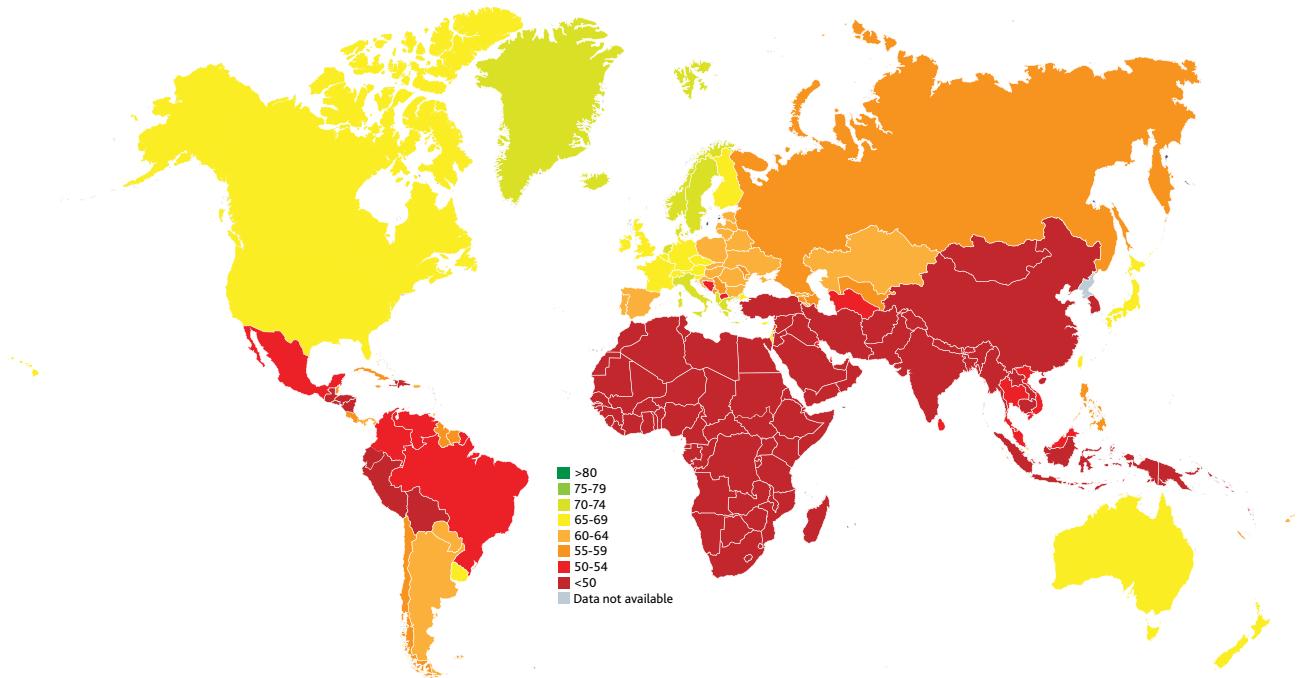


FIGURE 1.1 Life expectancy at birth in 1950

Source: United Nations, Department of Economic and Social Affairs (2017)

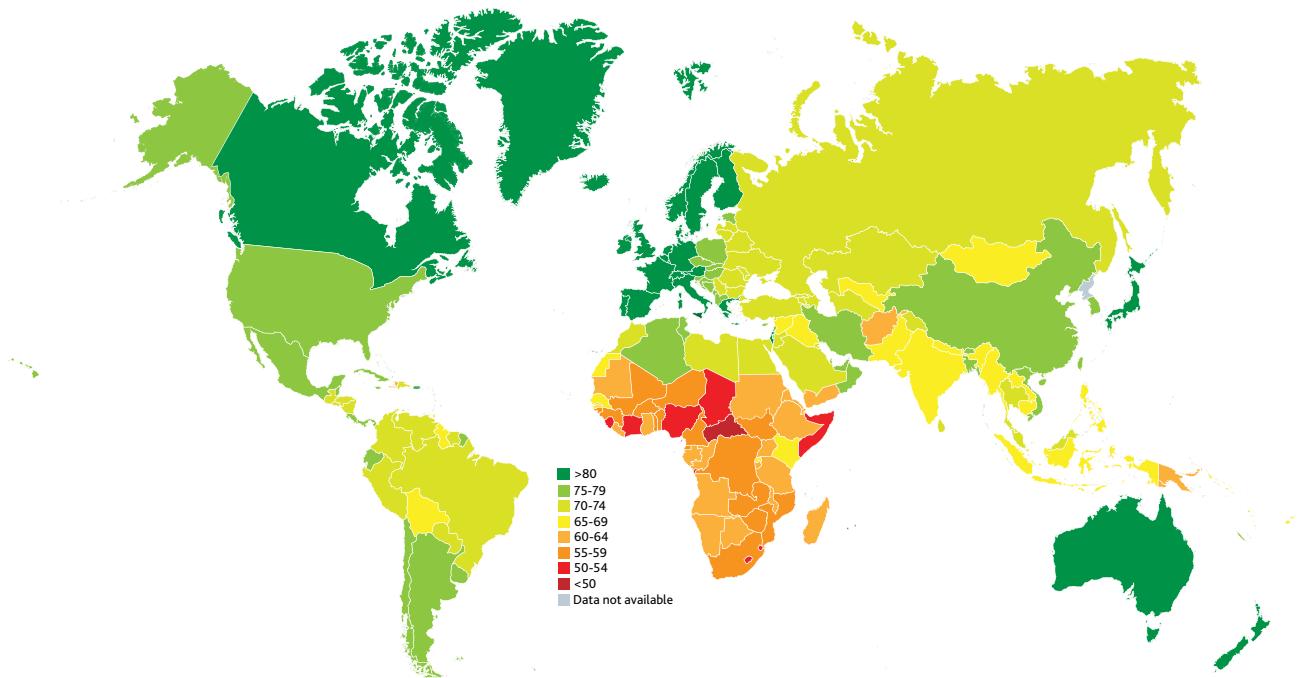


FIGURE 1.2 Life expectancy at birth in 2015

Source: United Nations, Department of Economic and Social Affairs (2017)

TABLE 1.1 Top ten global causes of mortality. Sourced from the Global Burden of Disease database (Institute of Health Metrics and Evaluation, 2018) nests various causes of death, however, for this analysis, some key infectious diseases were separated in order to demonstrate their importance in key regions of the tropics. For this visualization, Malaria, TB and HIV were counted separately from diarrhea, lower respiratory and other common infectious diseases.

	Rest of the World	Tropics	Central and Southern Africa	Northern Africa and Middle East	South Asia	South-East Asia	Caribbean	Central America	South America	Oceania
1	Cardiovascular diseases	Cardiovascular diseases	Diarrhoea, lower respiratory and other common infectious diseases	Diarrhoea, lower respiratory and other common infectious diseases	Cardiovascular diseases	Cardiovascular diseases	Cardiovascular diseases	Cardiovascular diseases	Neoplasms including cancer	Cardiovascular diseases
2	Neoplasms including cancer	Neoplasms including cancer	Cardiovascular diseases	Cardiovascular diseases	Diarrhoea, lower respiratory and other common infectious diseases	Neoplasms including cancer	Neoplasms including cancer	Diabetes, urogenital, blood and endocrine diseases	Diabetes, urogenital, blood and endocrine diseases	Neoplasms including cancer
3	Neurological disorders	Diarrhoea, lower respiratory and other common infectious diseases	Neonatal disorders	Neonatal disorders	Chronic respiratory diseases	Chronic respiratory diseases	Diabetes, urogenital, blood, and endocrine diseases	Neoplasms including cancer	Diarrhoea, lower respiratory and other common infectious diseases	Diabetes, urogenital, blood, and endocrine diseases
4	Diabetes, urogenital, blood and endocrine diseases	Chronic respiratory diseases	HIV/AIDS	Neoplasms including cancer	Neoplasms including cancer	Neurological disorders	Diarrhoea, lower respiratory and other common infectious diseases	Neurological disorders	Neurological disorders	Chronic respiratory diseases
5	Chronic respiratory diseases	Diabetes, urogenital, blood and endocrine diseases	Malaria	Malaria	Diabetes, urogenital, blood and endocrine diseases	Diabetes, urogenital, blood and endocrine diseases	Neurological disorders	Cirrhosis and other chronic liver diseases	Chronic respiratory diseases	Neurological disorders
6	Diarrhoea, lower respiratory and other common infectious diseases	Neonatal disorders	Neoplasms including cancer	Diabetes, urogenital, blood and endocrine diseases	Unintentional injuries	Diarrhoea, lower respiratory and other common infectious diseases	Chronic respiratory diseases	Diarrhoea, lower respiratory and other common infectious diseases	Interpersonal violence	Diarrhoea, lower respiratory and other common infectious diseases
7	Unintentional injuries	Unintentional injuries	Tuberculosis	Unintentional injuries	Tuberculosis	Road injuries	HIV/AIDS	Chronic respiratory diseases	Road injuries	Unintentional injuries
8	Cirrhosis and other chronic liver diseases	Neurological disorders	Unintentional injuries	Road injuries	Neonatal disorders	Unintentional injuries	Neonatal disorders	Interpersonal violence	Unintentional injuries	Digestive diseases
9	Digestive diseases	Tuberculosis	Diabetes, urogenital, blood and endocrine diseases	Tuberculosis	Road injuries	Cirrhosis and other chronic liver diseases	Unintentional injuries	Unintentional injuries	Cirrhosis and other chronic liver diseases	Cirrhosis and other chronic liver diseases
10	Road injuries	Road injuries	Nutritional deficiencies	Other non-communicable diseases	Self-harm	Digestive diseases	Road injuries	Digestive diseases	Digestive diseases	Self-harm

1.3 TROPICAL HEALTH AND THE SUSTAINABLE DEVELOPMENT GOALS

Human health and wellbeing are essential to achieving the Sustainable Development Goals (SDGs) that were adopted by the United Nations General Assembly in September 2015 (United Nations, General Assembly 2015) (Figure 1.3). Many of the 17 SDGs have targets related to health. Good health and wellbeing should be considered both the drivers for, and outcomes of, achieving the 2030 Agenda for Sustainable Development (2030 Agenda), particularly in the Tropics. Good health is also regarded as essential to achieving all three pillars of sustainable development: social, environmental, and economic (Hill et al. 2014; Nunes, Lee & Riordan 2016).

Unfortunately, there is evidence that progress on some key health indicators is beginning to slow and even stall at a time when it should be accelerating. Based on the current trajectories of some countries, particularly low- and middle-income countries—most of which are in the Tropics—these SDGs will not be achieved (Kruk et al. 2018).



FIGURE 1.3 The 17 SDGs adopted by the United Nations through the 2030 Agenda

Source: United Nations (2019)

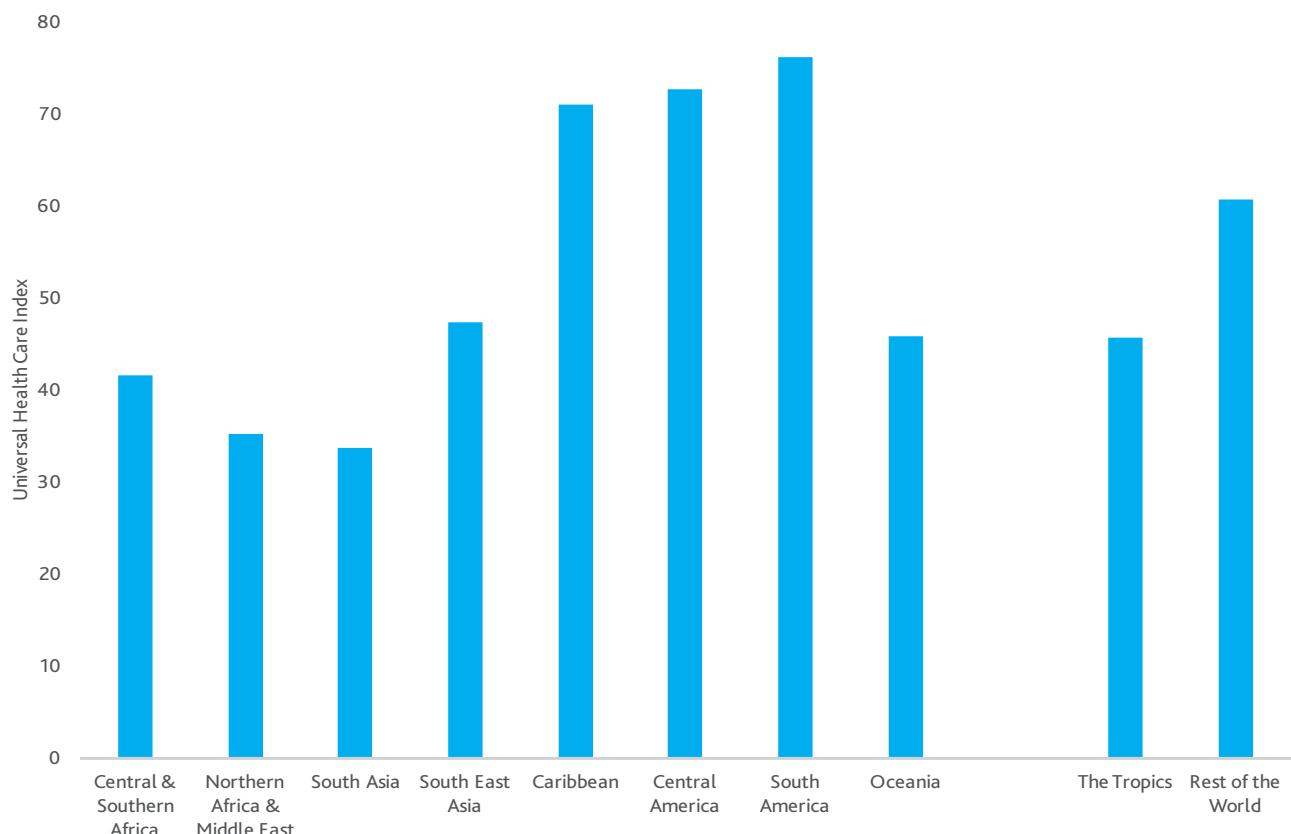


FIGURE 1.4 Universal Health Coverage Index weighted by population in regions across the Tropics and the rest of the world

Source: United Nations, Department of Economic and Social Affairs (2018)

Systems approaches to health care are particularly relevant in the Tropics where the environment has a greater influence on health and wellbeing, people are more likely to live in close connection with the natural environment and are more likely rely on ecosystem services for their livelihoods.

'Planetary Health' refers to 'the health of human civilisation and the state of the natural systems on which it depends' (Whitmee et al. 2015 pg. 1978). Therefore, planetary health is a new interdisciplinary and transdisciplinary approach that aims not only to investigate the effects of environmental change on human health, but also to study the political, economic and social systems that govern those effects. It acknowledges that human health is measurably better than it has ever been; however, to maintain these gains, the natural environment has been exploited at an unprecedented rate. Planetary health seeks to understand this human health-natural systems relationship and learn from it for future benefit—for the climate, natural environments and human communities (Whitmee et al. 2015).

'One Health' is an approach to designing and implementing programs, policies, legislation and research that engage multiple sectors of society to collaborate and explore the interface between humans, animals and the environment to collectively achieve better public health outcomes (Zinsstag et al., 2015).

The One Health approach is particularly relevant for food safety, controlling zoonoses (diseases that can spread between animals and humans, such as flu, rabies, and noroviruses) and combating antibiotic resistance (when bacteria change after being exposed to antibiotics and become more difficult to treat) (Zinsstag et al., 2015). This approach is also increasingly used to address challenges associated with non-communicable diseases and mental illness.

Both Planetary Health and One Health approaches focus on interdisciplinary and transdisciplinary techniques to solve complex health and environmental challenges; both will be essential to ongoing improvements in human health in the Tropics alongside the preservation and rehabilitation of essential natural environments.

1.4 UNIVERSAL HEALTH COVER IN THE TROPICS

A key target associated with the 2030 Agenda and SDGs is universal health coverage (UHC), which 'ensures that every individual and community, irrespective of their circumstances, should receive the health services they need without risking financial hardship' (WHO, 2017). UHC is both a logical means of ensuring progress and an end in itself. Despite there being good quality health care in many parts of the world, its costs can shift people into poverty. However, national-level data remains insufficiently comprehensive to estimate these costs in tropical countries.

According to the WHO, the newly developed UHC service coverage index is more predictive of life expectancy than gross national income (GNI), and remains predictive of life expectancy after controlling for GNI and mean years of adult education (WHO & World Bank 2017). The UHC service coverage index was developed from a feasible subset of indicators, including reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases, service capacity and access (WHO 2017).

Small differences in countries' rankings are not meaningful, as many countries are similarly ranked, and there is uncertainty in the measurement of tracer indicators, particularly for countries whose

data availability is limited. Therefore, in this analysis, we used regional estimates (Figure 1.4).

The UHC Index in many tropical regions remain low and are much lower than the rest of the world. Thus, in many regions of the Tropics where health burden is heavier, accessing health care is more likely to be difficult and involve greater costs. Globally, 800 million people spend more than 10% of their household budget on health care. For many, such an expenditure often means choosing health over other essentials such as food and education (WHO 2017).

1.5 ABOUT THIS REPORT

This report assesses the current and historical status of health and wellbeing across different regions of the Tropics. It presents a broad statistical analysis of a set of indicators relating to health, based on existing datasets from several authoritative multilateral sources, including various United Nations agencies, the World Bank, WHO and other repositories. The report considers the status of, and trends in, health and wellbeing related to infectious disease, non-communicable disease, maternal and child health, mental illness, substance abuse, and accident and injury. It assesses the available human resources and infrastructure for health needs and services

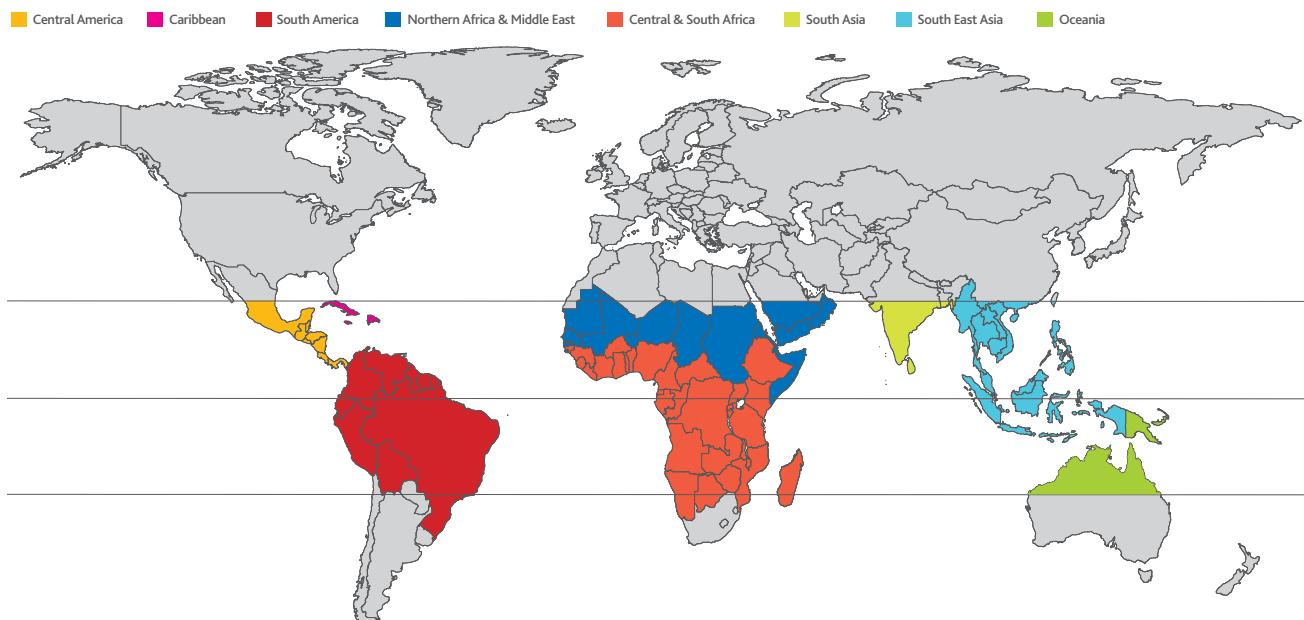


FIGURE 1.5 Tropical regions of the world (identified by the State of the Tropics)

Source: State of the Tropics (2014)

and includes case studies of health that are relevant to the Tropics.

Regions of the Tropics

With most of the world's biological and cultural diversity and a range of sociopolitical and economic systems, the world's tropical zone is defined by its diversity. Nonetheless, the regions in this zone are united by shared characteristics and challenges. To facilitate meaningful analyses and reporting, groupings can be developed in several ways, based on commonalities or internal homogeneity, including by climate (wet, dry or temperate Tropics) or by national borders.

As the majority of the available data are reported on a national basis, it makes sense to aggregate 'nations' into regional groups. The regional groups are listed below (the nations in each region are listed in Appendix A):

- Central and Southern Africa
- Northern Africa and Middle East
- the Caribbean
- Central America
- South America
- Oceania (including Pacific island countries and territories)
- South East Asia (including tropical China)
- South Asia.

Nations of the Tropics

Two processes were used to determine which nations and territories would be included in the report. The first process used a population-based decision tool to assess whether those nations that are partially in the Tropics should be included, and the second process reviewed data availability to assess whether there was

sufficient data to warrant a nation's inclusion.

The geographic area known as the Tropics is clearly defined as the region between the Tropic of Cancer and the Tropic of Capricorn. However, national borders do not neatly align along these latitudinal lines, with several nations and territories that straddle these latitudes.

The following criteria were applied to select nations and territories for inclusion in the report:

- nations that are wholly within the area bounded by the Tropic of Cancer and Tropic of Capricorn
- nations partially within the bounded area are included if—
 - the majority of its population (i.e., more than 50%) live in the Tropics (e.g., Brazil, India)
 - the proportion of its population living in the Tropics is 5% or more than the proportion of the region's population living in the Tropics (e.g., Australia, China).

Using this population-based decision tool, 134 nations and territories were assessed as being in the Tropics (see Appendix A).

1.6 ABOUT THE STATE OF THE TROPICS PROJECT

The State of the Tropics consortium identifies and addresses critical challenges and opportunities faced by nations in the Tropics. By bringing together communities and stakeholders of multiple institutions and sectors, the consortium aims to identify and facilitate critical research and action for sustainable development in the Tropics.

In early 2011, a group of leading research institutions with an interest in tropical issues identified a need to examine the conditions of life in the Tropics. The group met in Singapore in mid-2011 to scope a project that would draw on shared expertise and report trends across a broad range of environmental, social and economic indicators. The intent was to answer a simple question: is life in the Tropics getting better?

The key institutions involved in the project reflect its international scope. These institutions include:

- James Cook University—Australia
- Escuela Superior Politécnica del Litoral (ESPOL)—Ecuador
- Mahidol University—Thailand
- National Institute of Amazonian Research (Instituto Nacional de Pesquisas da Amazônia or INPA)—Brazil
- Liverpool School of Tropical Medicine—United Kingdom and Ghana
- Nanyang Technological University—Singapore
- Organization for Tropical Studies—Costa Rica
- University of Hawai'i at Mānoa—United States
- University of Nairobi—Kenya
- University of Papua New Guinea—Papua New Guinea
- University of the South Pacific—Fiji

On 29 June 2014, the inaugural *State of the Tropics: 2014 Report* was released. That report assessed a broad range of environmental, social and economic indicators. It shone a light on the people and issues of tropical regions, and contributed to ongoing efforts to improve the lives of people and environments in the Tropics.

That initial assessment clearly showed that there is much more to be done. Through analysis of available global datasets and detailed case studies, this report explores health and wellbeing in the Tropics: where we have been, where we are now and importantly, ideas on where we need to be.

The State of the Tropics project, through a series of workshops, events and ongoing assessment reports, will continue to focus attention on the world's tropical regions.

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BURDEN OF DISEASE IN THE TROPICS

SUMMARY

- Disease is the most common cause of human mortality and accounts for 92% of deaths globally.
- Non-communicable diseases are the most common causes of death and disability globally; however, the relative impact of infectious diseases is notably higher in the Tropics.
- As a result of progress in transmission prevention and the growing availability of antiretroviral therapies, new infections and deaths related to human immunodeficiency virus (HIV) or acquired immunodeficiency syndrome (AIDS) have declined since the turn of the century. In the Tropics, these gains are uneven in many places and vulnerable members of communities, including children, adolescent girls and young women, indigenous peoples, migrants and people living in poverty, are being left behind in some prevention and treatment programs.
- Global efforts to reduce malaria have been comprehensive, and in many cases, very successful. Nonetheless, malaria remains a heavy burden in the Tropics—as many as one in five people are affected—with progress stalling in some regions.
- Tuberculosis (TB) is believed to have killed more people throughout history than any other microbial pathogen. In 2016, 10.4 million people fell ill with TB, and 1.7 million died of TB. More than 60% of all new TB cases in 2016 (more than 6 million) occurred in the Tropics.
- Neglected tropical diseases (NTDs) are a group of 20 diseases and other maladies that affect more than 1 billion people each year. While not fatal in most instances, they cause widespread disability and are often underestimated. They occur predominantly in tropical nations.
- Although the risk of premature death from non-communicable diseases (NCDs) among people under 70 years of age has declined marginally, this risk remains higher in the Tropics relative to the rest of the world. Rising rates of lifestyle diseases and risk factors such as obesity are driving higher rates of death from NCDs.
- There is a 'double burden' of disease in the Tropics, where rates of NCDs continue to increase alongside rates of infectious disease and undernourishment. This double burden has been an issue for decades and will be an ongoing challenge for the region.
- The Tropics are at the nexus of biodiversity loss, climate change, emerging and persistent infectious diseases, rising prevalence of NCDs, and globalisation.



IMAGE: UNICEF

2

2.1 INTRODUCTION

Disease is broadly defined as an abnormal condition that impairs normal healthy functioning of the body. It is caused by infection or poor health rather than by accident or physical injury. Terms such as disease, disorder, illness or morbidity are often used interchangeably; however, we use the term ‘disease’ here to refer to the conditions that cause illness, morbidity and death. We distinguish between non-communicable diseases (NCDs) that are non-infectious and non-transmissible among people and infectious diseases caused by organisms such as bacteria, viruses, fungi or parasites, many of which can be passed from person to person.

Disease is an overwhelming cause of human mortality, accounting for 92% of all deaths globally in 2016 (Institute for Health Metrics and Evaluation [IHME] 2017). However, the relative influence of different types of diseases varies globally. In general, NCDs are the most important cause of disability, morbidity and premature death worldwide, accounting for 77% of all deaths in 2016, compared with 15% of deaths from infectious diseases (IHME 2018). However, the relative impact of infectious diseases is notably higher in the Tropics than in the rest of the world and is estimated

to cause between 20% (State of the Tropics 2014) to as much as 34% of all deaths in the Tropics (Ezzati et al. 2018).

The Tropics experience a higher burden of infectious diseases for several interrelated reasons. The region’s climate and ecological characteristics increase the likelihood of disease transmission while its greater rates of poverty and inequality—associated with poorer nutrition, lower rates of education, poorer access to medical care, and poor sanitation and water facilities—contribute to the disproportionate effect of infectious diseases on communities (State of the Tropics 2014). These effects are further compounded by rising rates of NCDs in the region, resulting in a double burden of diseases in many parts of the Tropics.

The Tropics also host a range of diseases known as neglected tropical diseases (NTDs) that are largely endemic to the region and a significant cause of death and disability (Box 2.3). NTDs affect more than 1 billion people worldwide, most of whom are in tropical nations or low socio-economic areas of developed nations (Hotez & Peiperl 2015). Some nations carry the burden of multiple NTDs. Although these diseases have comparatively lower mortality rates than other diseases, they are nonetheless responsible for high rates of disability in the community.

2030 Agenda—Relevant Sustainable Development Goals and Targets

BOX 2.1

Goal 3: Ensure healthy lives and promote well-being for all at all ages.

- Target 3.3** By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.
- Target 3.4** By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.
- Target 3.b** Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all.

Source: United Nations (2018)

2.2 INDICATORS

HIV prevalence and therapy coverage

AIDS is caused by HIV, which compromises the body's immune system until it can no longer protect itself from infection and disease (UNAIDS 2018a; WHO 2018b). It was first recognised in the early 1980s and has become a significant public health problem. HIV prevalence is the proportion of a population living with HIV and is used to measure the occurrence and extent of HIV infection.

Malaria prevalence

Malaria is a serious and sometimes fatal disease caused by several *Plasmodium* parasite species that are spread to people by *Anopheles* mosquitoes. The disease is strongly correlated with conditions of poverty and is widespread throughout the Tropics. Malaria prevalence is defined as the number of new cases of malaria per 1,000 people who live in at risk regions.

Incidence of tuberculosis and treatment success

Tuberculosis (TB) is a widespread bacterial infection and the ninth leading cause of death worldwide. In terms of deaths caused by a single infectious agent, TB is the leading cause—having taken over from HIV/AIDS in recent years (Joint United Nations Programme on HIV/AIDS [UNAIDS] 2018a; WHO 2017a).

The disease affects up to 10 million people worldwide every year. With timely diagnoses and the correct treatment, most people who develop TB can be cured. The incidence of TB is the estimated number of new and relapse cases of TB in a given year, expressed as the rate per 100,000 people. All forms of TB are included in the reported analyses, including cases of people who have TB and live with HIV (World Bank 2018).

Neglected tropical diseases and disability-adjusted life years

NTDs are a diverse group of communicable diseases that prevail in tropical and subtropical conditions and affect more than 1 billion people worldwide (World Health Organization [WHO] 2018f).

The data relating to NTDs are based on disability-adjusted life years (DALYs), which takes into account the years lost due to premature mortality and disability. One DALY is equivalent to one year of 'healthy life' that is lost (WHO 2018c). The sum of DALYs across a population is considered the gap between current health and ideal health status.

The analyses presented here are based on datasets on global burden of disease (IHME 2018) that include detailed DALY estimates for the NTDs with the highest rates of morbidity, including African trypanosomiasis, Chagas disease, cystic echinococcosis, cysticercosis, dengue, Ebola virus disease, foodborne trematodiases, Guinea worm disease, intestinal nematode infections, leishmaniasis, leprosy, lymphatic filariasis, onchocerciasis, rabies, schistosomiasis, trachoma, yellow fever and Zika virus.

Non-communicable diseases and risk of dying

NCDs, such as heart disease, stroke, cancer, chronic respiratory diseases and diabetes, are the leading cause of mortality in the world. NCDs refer to conditions other than injuries, maternal and perinatal conditions, and nutritional deficiencies that do not involve an acute infection or parasite and are not transmitted from person to person (Ezzati et al. 2018). Cardiovascular diseases, cancer, diabetes and chronic respiratory diseases are the four major NCDs globally. Measuring the risk of dying from these four diseases in a population is important for assessing their relative contribution to premature mortality (WHO 2018f).

The risk of dying from an NCD is the probability of dying between the ages of 30 and 70 from a cardiovascular disease, cancer, diabetes or chronic respiratory disease. This risk refers to the percentage of 30 year olds who will die before their 70th birthday from an NCD, assuming they experience current mortality rates at every age and do not die from any other cause of death (e.g., in an accident or from an infectious disease).

Prevalence of obesity

Overweight and obesity can lead to adverse metabolic effects, high blood pressure, increase in cholesterol and triglycerides and may result in insulin resistance. The risks of coronary heart disease, ischaemic stroke and type 2 diabetes mellitus increase steadily with increasing body mass index (BMI), a measure of weight relative to height (WHO 2018f). A person whose BMI is greater than 30 is considered obese. High BMI is a risk factor for premature mortality from NCDs.

2.3 TRENDS

Infectious diseases

HIV/AIDS

Although HIV/AIDS has spread throughout the world and affects people of all ethnic and socio-economic backgrounds, the majority of new infections are in tropical nations where lifesaving treatments are often not as readily available.

There is no preventive vaccine for HIV, but antiretroviral therapy suppresses the replication of HIV in the body and significantly increases the life expectancy of people afflicted by HIV. Globally, access to antiretroviral treatments has increased since the mid-1990s and has transformed HIV from a death sentence to a chronic manageable disease in many nations.

Transmission of HIV occurs in one of three ways. Sexual transmission accounts for most new infections. Blood transmission can occur through infected blood, such as through the use of inflected blood products or non-sterile injecting equipment. Finally, HIV transmission can occur from infected mothers to their babies in utero, during childbirth or breastfeeding.

As a result of advances in the prevention of transmission and the increasing availability of antiretroviral therapies, new infections and deaths related to HIV/AIDS have declined notably since the turn of the century.

However, these gains are uneven: the most vulnerable members of communities, including children, adolescent girls and young women, particularly pregnant women, indigenous peoples, migrants and those living in poverty or with low levels of education are being left behind by both prevention and treatment programs (UNAIDS 2018b). For example, in 2017, 180,000 children became infected with HIV and only half of all infected children under 15 years of age were treated (UNAIDS 2018b). There is global concern that the gains of the early 21st century are slowing; renewed effort is required to meet the target of eradicating the AIDS epidemic by 2030, particularly among the underserved populations of the Tropics (UNAIDS 2018a).

The number of people between the ages of 15 and 49 living with HIV in the Tropics is much higher than in the rest of the world. In 2015, an estimated 18.8 million 15 to 49 year olds in the Tropics were living with HIV, compared with 9.1 million in the rest of the world. While the total number of new HIV infections is estimated to have peaked in 1996, the number of 15- to 49-year old adults living with HIV continues to increase globally, growing 4% between 2010 and 2015. Some of this increase is a result of available death-preventing treatment.

Worldwide prevalence of HIV peaked around the turn of the century and has remained steady (Figure 2.1). Central and Southern Africa continue to have the highest prevalence of HIV. However, concerted efforts in this region are driving progress, as are efforts in Northern Africa and the Middle East. Over the past decade, increased domestic and international funding to support research and the expansion of prevention and treatment programs in these regions have reduced regional prevalence of HIV (UNAIDS 2018b).

By comparison, HIV prevalence in other tropical regions is lower, although there is regional variation (Figure 2.2). Most notably, while reductions have been achieved in most tropical regions, the prevalence of the disease has continued to increase in South America since its discovery, with young people and vulnerable populations being the most affected in this region (UNAIDS 2018b).

Malaria

Malaria has affected humans for thousands of years (WHO 2017c). At the height of its global distribution, 90% of the global population was exposed to malaria, extending almost as far north as the Arctic Circle in the Northern Hemisphere (Cibulskis et al. 2011). Since the discovery that mosquitoes transmit the disease in 1897, control efforts have dramatically reduced the global distribution of the disease. In 1900 around 77% of the global population was at risk of malaria; by 2013 around 43% of the world's population were directly exposed to the disease, the vast majority of whom are in the Tropics (WHO 2015). As limited

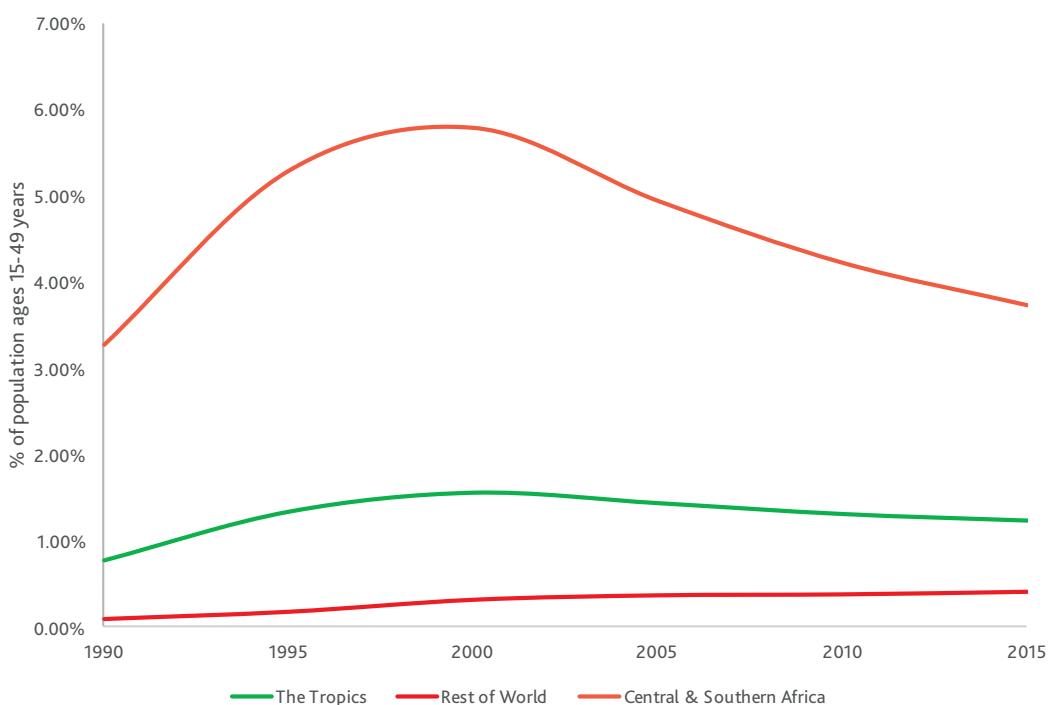


FIGURE 2.1 HIV prevalence in the Tropics, the rest of the world and Central and Southern Africa, where the rates are highest

Source: United Nations, Department of Economic and Social Affairs (UN DESA 2017), World Bank (2018)

Characteristics of the four species of the *Plasmodium* parasite that are known to be transmissible to humans and are carried by *Anopheles* spp. mosquitoes (Centers for Disease Control and Prevention 2018):

BOX 2.2

P. falciparum is found worldwide in tropical and subtropical areas. This species is the most common and the dominant form of malaria in Africa. It multiplies rapidly in the blood and can cause severe blood loss (anaemia). The parasite can also clog small blood vessels. A result of *P. falciparum* in the brain is cerebral malaria, a complication that can be fatal.

P. vivax is found mostly in Asia, Latin America and in some parts of Africa. It is often found in high densities, particularly in Asia, which makes it the region with the highest prevalence of human malaria parasite in terms of absolute numbers of people affected. *P. vivax* (as well as *P. ovale*) has a dormant liver stage ('hypnozoites') that can activate and invade the blood several months or years after the infecting mosquito bite, leading to a malaria 'relapse' in the human host.

P. ovale primarily occurs in Africa (especially West Africa), and the islands of the western Pacific. Although biologically and morphologically very similar to *P. vivax*, *P. ovale* can infect individuals who are negative for the Duffy blood group, which is common among many residents of sub-Saharan Africa and explains the greater prevalence of *P. ovale* (rather than *P. vivax*) in most of Africa.

P. malariae, found worldwide, is the only human malaria parasite species that has a three-day (quartan) cycle. If untreated, *P. malariae* can cause chronic infections that are long-lasting, and in some cases, last a lifetime. In some chronically infected patients, *P. malariae* can cause additional complications such as nephrotic syndrome.

Approximately 250 species of *Plasmodium* are believed to currently parasitise mammals, birds and reptiles; all species are transmitted by insect vectors (Ramasamy 2014). Of these, more than 30 species have been reported in non-human primates.

There are also malaria parasites that are transmitted between animals and humans—zoonotic malaria such as *P. knowlesi*. Recent evidence suggests that *P. knowlesi* can be transmitted from animals such as macaque monkeys to humans (Ramasamy 2014). As other forms of malaria are eradicated and humans continue to come into contact with diverse tropical ecosystems, there is growing concern that zoonotic malaria may proliferate in the Tropics (Ramasamy 2014).

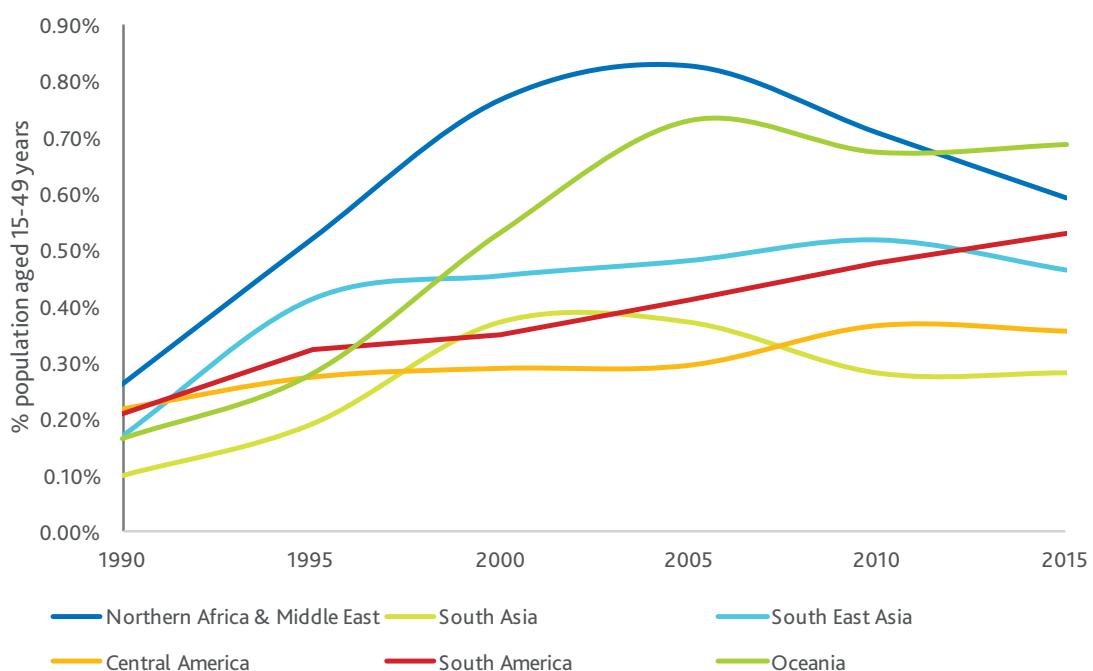


FIGURE 2.2 HIV prevalence across regions of the Tropics excluding Central and Southern Africa

Source: UN DESA (2017), World Bank (2018)



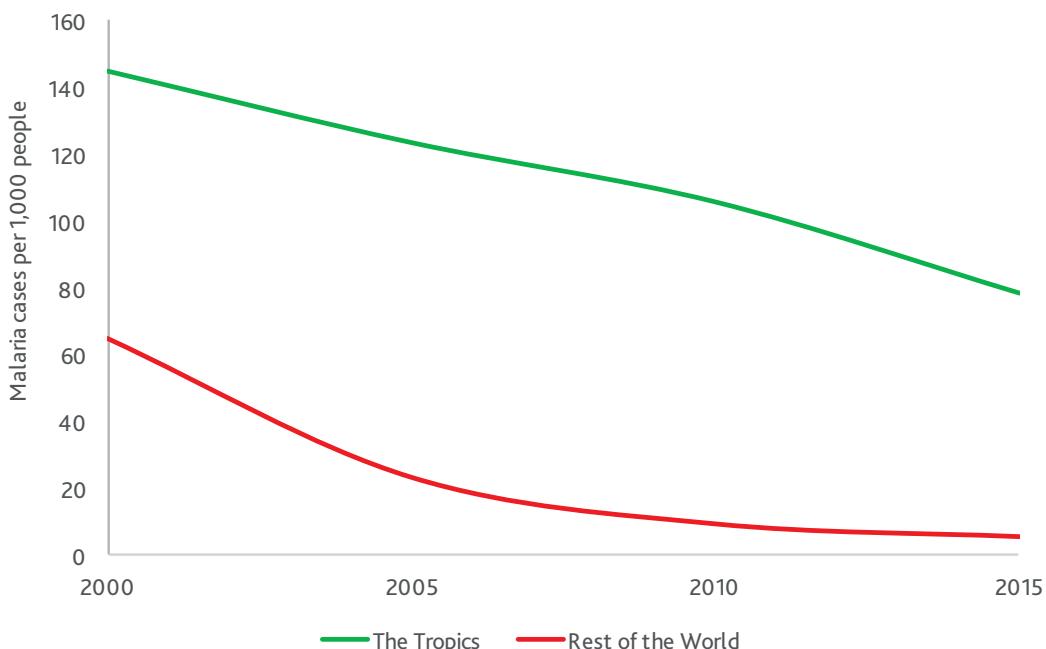


FIGURE 2.3 Prevalence of malaria in the Tropics and the rest of the world (data do not include nations where malaria is not endemic)

Source: UN DESA (2017, 2018)

surveillance data on the disease are available, estimates are derived from reported cases and modelled relationships between malaria transmission, incidence, mortality trends and intervention coverage (WHO 2017c).

Global malaria incidence rates fell 37% between 2000 and 2015, with the number of cases dropping from an estimated 260 million to 214 million (WHO 2017c). An estimated 96% of malaria cases occur in the Tropics (State of the Tropics 2014).

Some regions in the Tropics have made better than average progress in reducing the incidence of malaria (Figure 2.3). In Central and Southern Africa, the region carrying the greatest malaria burden, malaria incidence declined 50% between 2000 and 2015 (Figure 2.4). Nevertheless, one in every five people in the region were still affected by malaria in 2015, equating to almost 200 million people with the disease (WHO 2017c).

In 2000, Oceania had the second highest malaria prevalence in the Tropics, although this was concentrated in Melanesia. However, by 2015, this prevalence had declined by almost 60%, from 280 cases of infection per 1,000 people to 115 cases per 1,000 people. Progress in this region tends to be uneven and localised; Melanesia is a patchwork of different ecological zones with exceptional biological, cultural and linguistic diversity. Such diversity results in complex variations in vector ecology and malaria epidemiology (Müller et al. 2003).

Other tropical regions have had mixed results. Malaria prevalence in Northern Africa and Middle East declined by 30% between 2000 and 2015, the smallest improvement in the Tropics; in 2015, this region had a malaria prevalence higher than Oceania at 134 cases

per 1,000 people. Such a comparatively slower progress in the region is driven by a few countries with disproportionately higher malaria burdens, most notably Mali (449 cases per 1,000 people) and Niger (356 cases per 1,000 people), which have made little progress with malaria since the turn of the century.

Malaria prevalence in South Asia declined 59% between 2000 and 2015. In 2016, Bangladesh reported fewer than 5,000 cases for the first time, while both the Maldives and Sri Lanka were certified as malaria-free (WHO 2017c).

Although there was a slight increase in malaria prevalence in South East Asia between 2005 and 2010, renewed emphasis on its prevention in Indonesia, Myanmar, Lao People's Democratic Republic and particularly in Timor-Leste, has led to a significant decline since 2010. In Timor-Leste, increased political commitment, advances in diagnostic testing and treatment of malaria, as well as financial support from the Global Fund to Fight AIDS, Tuberculosis and Malaria, have led to a decrease in the incidence of malaria from 483 cases per 1,000 people in 2000 to fewer than one case per 1,000 in 2015.

While the burden of malaria in the regions of Central and South America and the Caribbean is generally lower than elsewhere, it remains prevalent in specific localities in these regions. Transmission in these regions is highly localised. For example, although Brazil has the highest number of reported cases, most of these cases are from just 15 localities in the states of Acre and Amazonas (WHO 2017c). Increased prevalence in other countries in the region has been attributed to improved surveillance as well as focal outbreaks (WHO 2017c). Since 2000, reductions

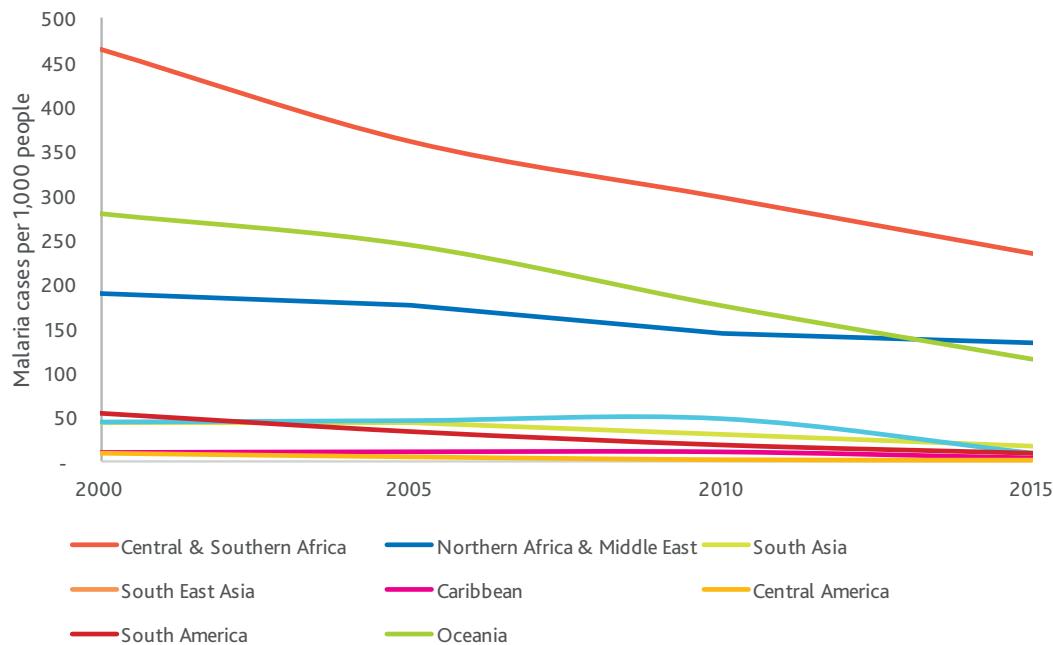


FIGURE 2.4 Prevalence of malaria across the regions of the Tropics (data do not include nations where malaria is not endemic)

Source: UN DESA (2017, 2018)

of malaria prevalence in the region have been large: 58% in the Caribbean, 92% in Central America and 83% in South America. Belize, Costa Rica, Ecuador, El Salvador and Mexico are all projected to eliminate malaria by 2020 (WHO 2017c). Malaria has virtually been eliminated in Suriname, which previously had the highest rate of transmission in the Americas (WHO 2018a).

Global efforts to reduce malaria have been comprehensive and in many cases, very successful. Nevertheless, many tropical nations are not on track to meet the targets of the 2030 Agenda. Inadequate funding, inadequate health systems, inefficient implementation of interventions, social conflict and other crises, and anomalous climate patterns continue to slow, and in some cases, reverse progress (WHO 2017c). There are also growing concerns that drug-resistant parasites and insecticide-resistant mosquitoes will reverse progress (Haldar, Bhattacharjee & Safeukui 2018; WHO 2018b).

Tuberculosis

Tuberculosis (TB), an infectious disease caused by the bacterium *Mycobacterium tuberculosis*, has potentially killed more people throughout history than any other microbial pathogen (Daniel 2006). In 2016, 10.4 million people fell ill with TB, and 1.7 million died from the disease. Since 2011, it has been the leading cause of death worldwide from a single infectious agent and was the leading cause of death in West Papua (Indonesia) in 2016 (Wang et al. 2016).

Deaths from TB can be prevented with early diagnosis and appropriate treatment, and millions of people are successfully treated every year (WHO 2017a). However, without treatment, an active infection is almost always fatal. Only 5–15% of people infected with the bacterium (believed to be around 1.7 billion)

will develop the disease during their lifetimes. Furthermore, the probability of the disease developing is much higher among those living with HIV or those affected by risk factors such as undernutrition, diabetes, smoking and alcohol consumption (WHO 2017a).

An estimated 62% of new TB cases in 2016 (more than 6 million people) occurred in the Tropics, where the incidence of TB is more than double that of the rest of the world (Figure 2.5). Although the incidence of TB in the Tropics has declined since 2000 at a rate slightly faster than that of the global rate (1.54% compared with 1.3%, respectively), improvements in the order of 4–5% of the 2016 rates are required by 2020 to meet global targets (WHO 2017a).

Although the incidence of new cases has generally declined throughout the Tropics, this decline is not evident in some regions; in some places, the incidence of TB has in fact increased. In 2016, South East Asia and Oceania had the greatest TB burden at 278 and 272 new cases per 100,000 people, respectively. In terms of incidence, the largest proportion of cases in the Tropics are in Central and Southern Africa, South Asia and South East Asia (19.2%, 16.7% and 21.5%, respectively).

Although there has been some decline in the incidence of TB in South-East Asia, very high rates of infection persist throughout the region, including in the Philippines, Indonesia, Myanmar and Timor-Leste. After Kiribati, the Philippines has the highest rate of TB infection in the world. In 2016, more than half a million new cases were recorded alongside a prevalence of more than one million people in the Philippines. Unlike tropical Africa, South-East Asian nations with a heavy TB burden have a relatively low prevalence of HIV, indicating that broader social and economic

factors are influential in these nations. These factors include undernourishment (which has increased or shown little change in the region in recent years), high rates of poverty, diabetes, smoking as well as low or poor health insurance cover and social protection (WHO 2017a). In the Philippines, for example, only 4% of the poorest quintile of the population has access to suitable health care (WHO 2017a).

Notably, although there are fewer total cases of TB in Oceania than in other parts of the Tropics, it is the only region of the world where the incidence of TB has increased consistently since the turn of the century. It now has one of the highest rates of infection in the world. The increased incidence of TB in Fiji, Kiribati, Marshall Islands, Micronesia, Palau and Tuvalu and the consistently high infection rates in Papua New Guinea (PNG), contribute to this trend. Several factors are responsible for this observed increase in the region, including risk factors associated with diabetes and the continued emergence of multidrug-resistant forms of TB (Marais 2016).

Nearly 20% of all new cases of TB in the world occur in Central and Southern Africa, despite reduced incidence in the region since 2000. Consistently high prevalence of TB in this region are related to the high prevalence of HIV, high rates of poverty and lack of access to health care. Although up to 80% of treatments in this region are successful (Figure 2.7), treatment coverage is estimated to be less than 50% of the population (WHO 2017a).

Despite declining incidence, the TB burden also remains high in South Asia, particularly in Bangladesh and India. While the incidence of TB has declined at an average of 2% per annum since 2000, more than 1.7 million new cases were reported in the region

in 2016. In terms of absolute numbers, this represents a relatively marginal improvement on the 2000 figure of just under 2 million new cases. The incidence of TB in tropical India alone accounted for more than 15% of new cases worldwide in 2016. India has recently invested heavily in TB prevention and has a goal of eradicating the disease by 2025 (WHO 2017a).

Progress has also been slow in Northern Africa and the Middle East. Food insecurity and conflict in the region, particularly in Somalia and South Sudan, are the most likely explanation for the limited progress.

Although the incidence of TB is generally lower in other tropical regions, there has similarly been relatively limited progress. South and Central America have the lowest rates of TB infection in the Tropics, lower than global rates. However, a significant number of new cases occur each year in Brazil, Peru and Colombia. There are generally very low rates of infection in the Caribbean. However, infection rates in Haiti are high and comprise 73% of all new TB cases in the Caribbean region.

The emergence of drug-resistant TB threatens goals to eradicate TB. Cases of multidrug-resistant TB (MDR-TB) and extensive drug-resistant TB (XDR-TB) are thought to be rising in some nations, but accurate assessments of global trends are hampered by limited data availability. The primary cause of drug-resistant TB is inappropriate treatment and noncompliance with treatment regimens (WHO 2017a). MDR-TB and XDR-TB have now been reported in more than 100 countries (Marais 2016). According to some estimates, four out of five people with MDR-TB do not receive appropriate treatment (Kasaeva et al. 2018). Compared with the treatment regime for normal TB, the treatment of MDR-TB and XDR-TB requires drugs that are more expensive and toxic and that

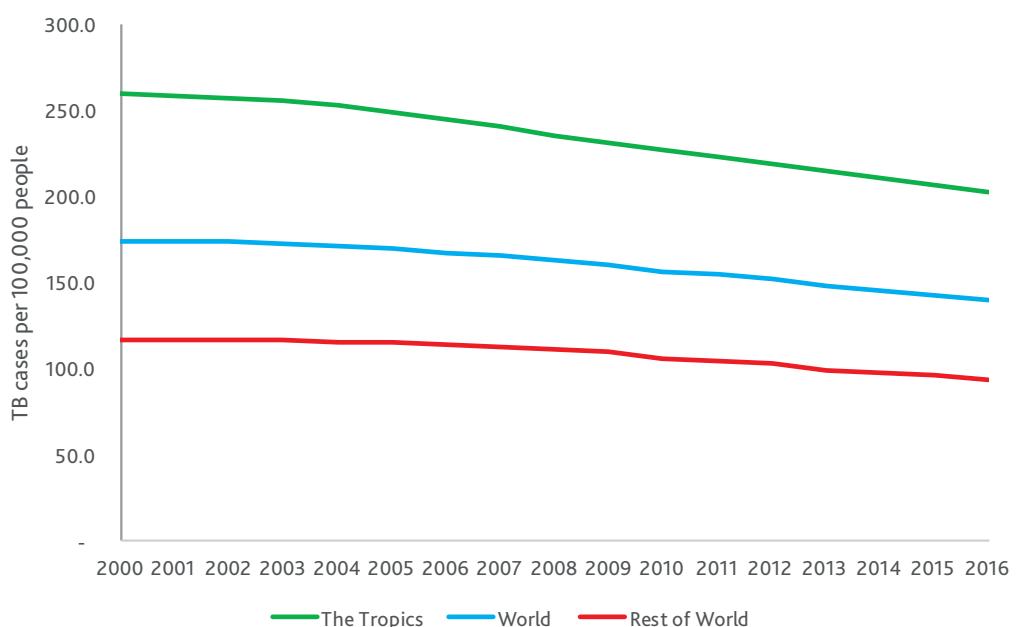


FIGURE 2.5 Incidence of tuberculosis in the Tropics and the rest of the world. Incidence of TB is defined as the estimated number of new and relapse TB cases in a given year, expressed as the rate per 100,000 people. All active forms of TB are included, including TB in people living with HIV.

Source: UN DESA (2017), World Bank (2018)

need to be taken for much longer periods. Cure rates for MDR-TB and XDR-TB are much lower, and their treatment can involve multiple serious side effects.

Treatment success rates refer to the percentage of active cases who were successfully treated for TB among those active cases who received treatment for TB. Treatment success rates range from 74% in South Asia to 87% in South East Asia (Figure 2.7). The lowest treatment success rates occur in South Asia and Oceania, likely

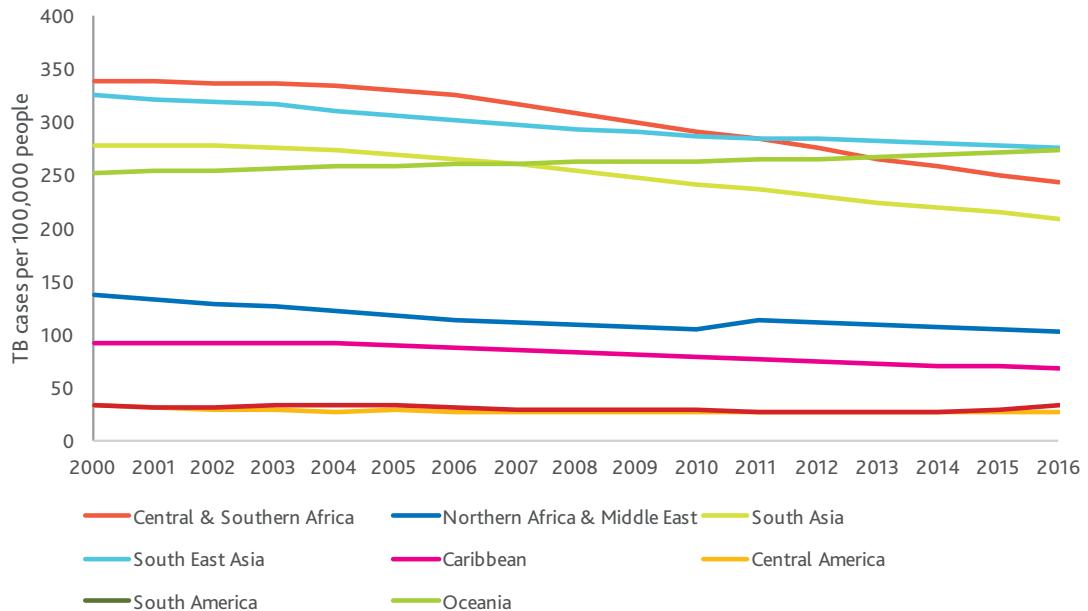


FIGURE 2.6 Incidence of tuberculosis (TB) across regions of the Tropics. Incidence of TB is the estimated number of new and relapse TB cases in a given year, expressed as the rate per 100,000 population. All active forms of TB are included, including TB in people living with HIV.

Source: UN DESA (2017), World Bank (2018)

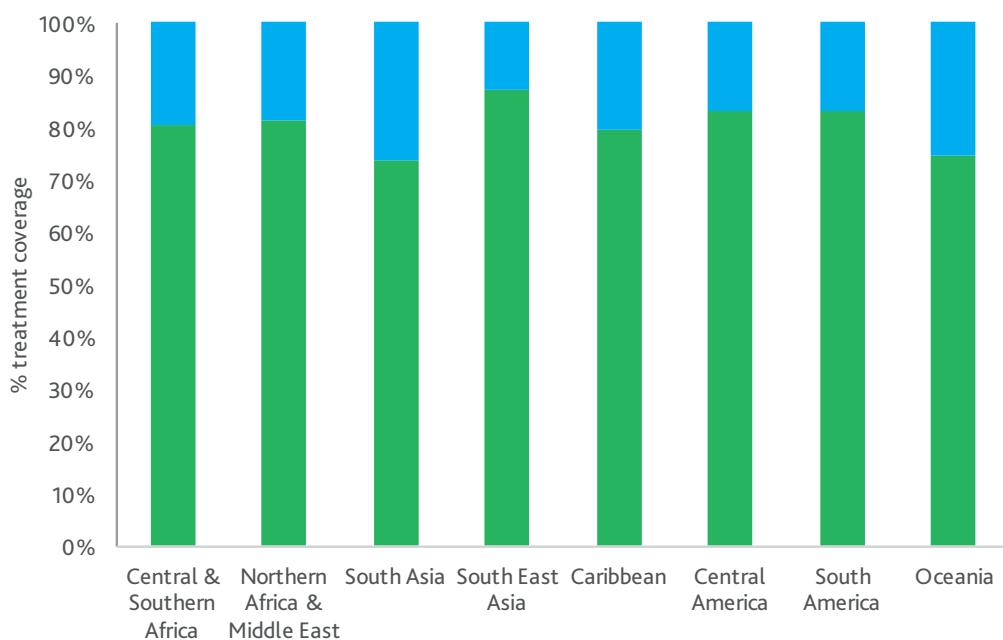


FIGURE 2.7 The gap in TB treatment success across regions of the Tropics, the rest of the world and across the world. The success rate of TB treatment is the percentage of all new TB cases (or new and relapse cases) registered under a national TB control program in a given year who successfully completed treatment, with or without bacteriological evidence of success ('cured' and 'treatment completed', respectively).

Source: World Bank (2018)

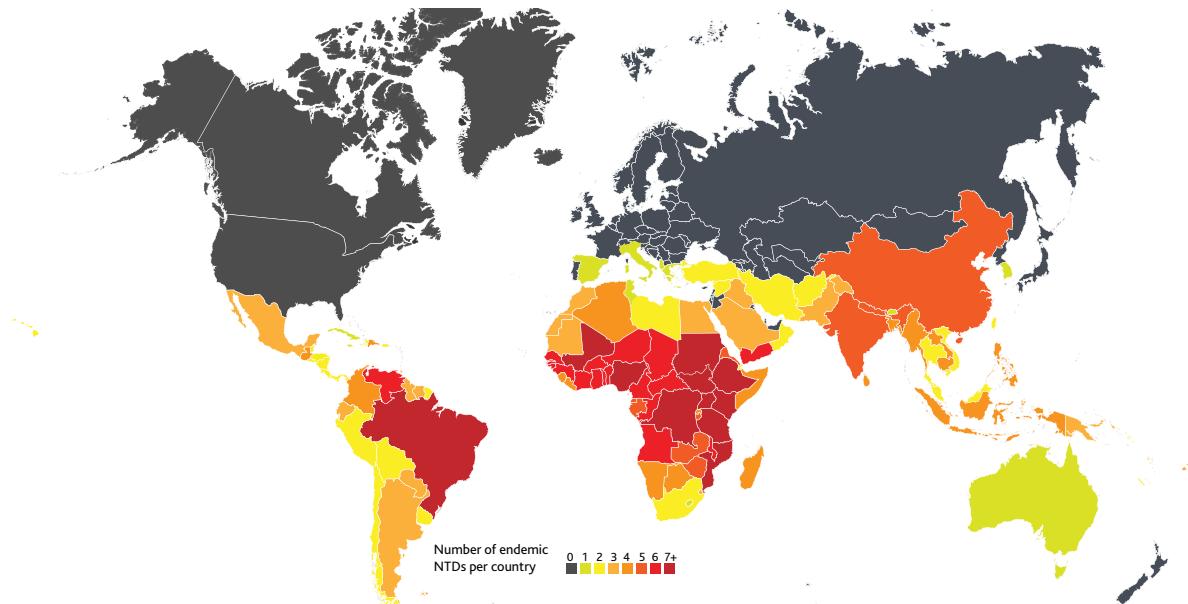


FIGURE 2.8 Worldwide occurrence of common neglected tropical diseases

Source: Uniting to Combat Neglected Tropical Diseases (2018)

attributable to an inability to access the ongoing care required to treat TB successfully and to the emergence of MDR-TB and XDR-TB. Throughout the Tropics, treatment success was generally lower than in the rest of the world in 2016.

However, rates of treatment success do not equate to rates of treatment coverage of TB sufferers. In 2016, treatment coverage for TB was estimated at around 60% worldwide but was 50% or less in Indonesia, Kenya, Lesotho, Liberia, Mozambique, Nigeria and Tanzania (WHO 2017a). These low rates of coverage are due to multiple factors, including under-diagnosis of people with TB and under-reporting of TB cases that are detected (WHO 2017a).

Although there has been a concerted global effort to address TB, issues of drug resistance, inadequate treatment and limited access to health care by many communities have hampered progress. Further, the increase in the prevalence of NCDs such as diabetes (see Case Study 3) and chronic obstructive pulmonary disease (Inghammar et al. 2010)—which increase vulnerability to TB—threaten to escalate existing rates of TB infection. Similarly, high rates of unreported infections in children are also concerning, particularly in communities already affected by HIV and other infectious diseases.

Neglected Tropical Diseases

NTDs commonly refer to a group of 20 infectious diseases and other maladies that affect more than 1 billion people each year (see Box 2.3). Although predominantly occurring in tropical nations (with especially high prevalence in equatorial Africa, South Asia and Brazil; Figure 2.8), several NTDs also occur outside the Tropics where poverty and conflict are prevalent, including in some parts of developed nations (Hotez et al. 2012).

These diseases are called 'neglected' because although they are widespread and debilitating in their effects, NTDs are characterised more by high rates of disability rather than mortality among sufferers. As diseases primarily suffered by the poor and vulnerable, NTDs have historically received little global attention (Hotez & Peiperl 2015). Beyond their direct effects on health, NTDs feed cycles of disease and poverty by affecting children's school attendance and compromising adults' ability to work or participate in their communities (Bergquist & Whittaker 2012).

Many NTDs are readily treatable, particularly in the early stages of the disease. However, as most sufferers are poor and have limited access to health care, the disease is often not addressed or treated until it has become chronic with potential long-term effects on health and wellbeing.

Recognising that NTDs have historically received less policy attention and funding than diseases such as HIV and malaria, in 2013 at the 66th World Health Assembly the global community resolved to intensify and integrate measures against NTDs and to plan investment in health services to improve the health and social wellbeing of affected populations (WHO 2018d). This integrated approach to NTDs has already delivered several positive results globally, including:

- an 80% reduction in new cases of human African trypanosomiasis from 2000 to 2014, to fewer than 4,000 cases (WHO 2016)
- a 75% reduction in the number of cases of visceral leishmaniasis in Bangladesh, India and Nepal from 2004 to 2014 (WHO 2016)
- the near eradication of dracunculiasis (Guinea worm disease) from 130,000 cases in 2000 to fewer than 130 cases in 2014 (WHO 2016).



IMAGE: MARIA CIERNA UNDP

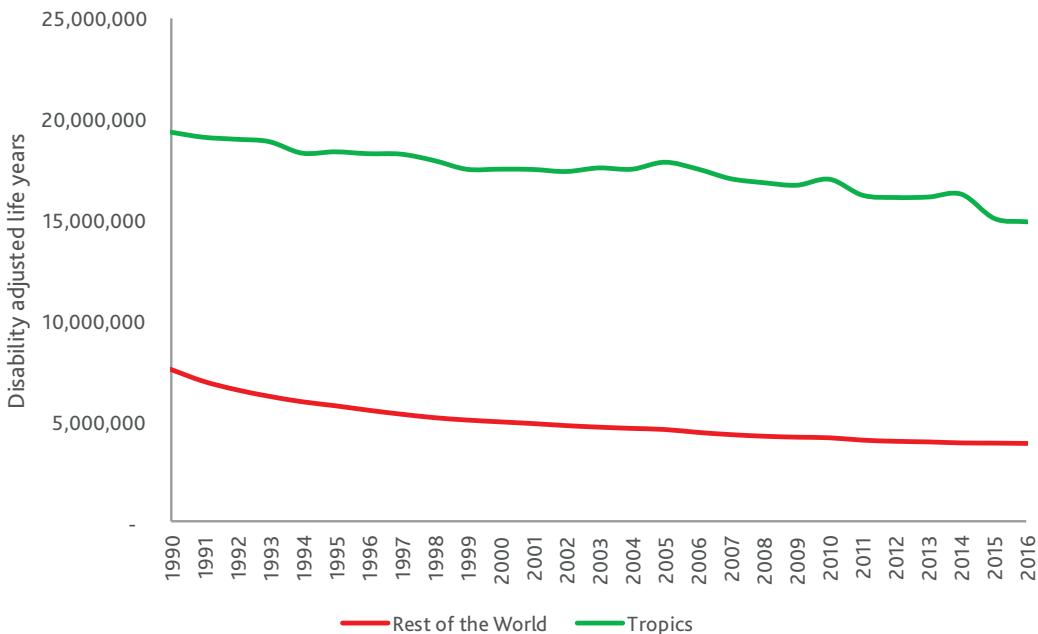


FIGURE 2.9 Total disability-adjusted life years attributable to neglected tropical diseases with data available in the Tropics and the rest of the world. These diseases include African trypanosomiasis, Chagas disease, cystic echinococcosis, cysticercosis, dengue, Ebola virus disease, foodborne trematodiases, Guinea worm disease, intestinal nematode infections, leishmaniasis, leprosy, lymphatic filariasis, onchocerciasis, rabies, schistosomiasis, trachoma, yellow fever and Zika virus.

Source of data: IHME (2018)

The grouping of these conditions under the umbrella 'NTDs' is proving effective for generating international awareness, support and funding. Additionally, although NTDs were overlooked in the Millennium Development Goals, they are formally included in the 2030 Agenda for Sustainable Development (Box 2.1).

Owing in part to their diversity and geographically localised and patchy distribution, the available data on each NTD is variable. Most NTDs lack adequate time series information to make meaningful assessments of global progress towards their elimination (Bergquist & Whittaker 2012). Nonetheless, recent assessments based on the best available information suggest significant progress has been made in the elimination of some NTDs, but little or no progress for other NTDs (Hotez & Aksoy 2017).

The Global Burden of Disease Study attempts to estimate mortality from some of the most important NTDs (Wang et al. 2016). According to this study, dengue deaths increased by 48.7% from 2005 to 2015, resulting in 18,400 deaths (Wang et al. 2016). Dengue's expanding geographic range and increasing transmission intensity (particularly in Latin America) are fuelling concerns that rates of other similar vector-transmitted viruses, such as the chikungunya and Zika viruses, may also rise (Wang et al. 2016).

Meanwhile, Chagas disease, which largely affects populations in Latin America, claimed 8,000 lives in 2015; deaths caused by leishmaniasis increased between 2005 and 2015, with 24,200 deaths in 2015 (Wang et al. 2016).

In an effort to quantify the effects of disease on people, the Global Burden of Disease Study developed a metric that estimates the number of years of life lost through mortality and disability, known as 'disability-adjusted life years' (DALYs). The estimate provides a comparative measure of the burden of NTDs across the world over time.

Estimates compiled for 1990 to 2016 clearly demonstrate the high burden of NTDs in the Tropics (Figure 2.9). In nations and provinces for whom DALYs have been estimated, almost 80% of years lost attributable to NTDs were in the Tropics. However, this figure is likely to be a conservative estimate because in the analyses of DALYs presented here, tropical China was excluded from the Tropics.

Between 1990 and 2016, the number of DALYs attributable to NTDs has declined steadily in the Tropics (Figure 2.9). Periodic spikes in DALYs (e.g., 2005, 2010 and 2014) are likely due to localised outbreaks of specific diseases. The overall pattern of decline is mostly a result of progress with treating African trypanosomiasis, visceral leishmaniasis and dracunculiasis, as discussed earlier.

Across tropical regions, progress with NTDs based on DALY estimates has been mixed with little general improvement since 1990 (Figure 2.10). Central and Southern Africa have the highest burden of NTDs, followed by South Asia. The spike in DALYs in Central and Southern Africa between 2013 and 2014 was driven by the devastating Ebola outbreak in West Africa, especially Guinea, Liberia and Sierra Leone. However, once it was under control the

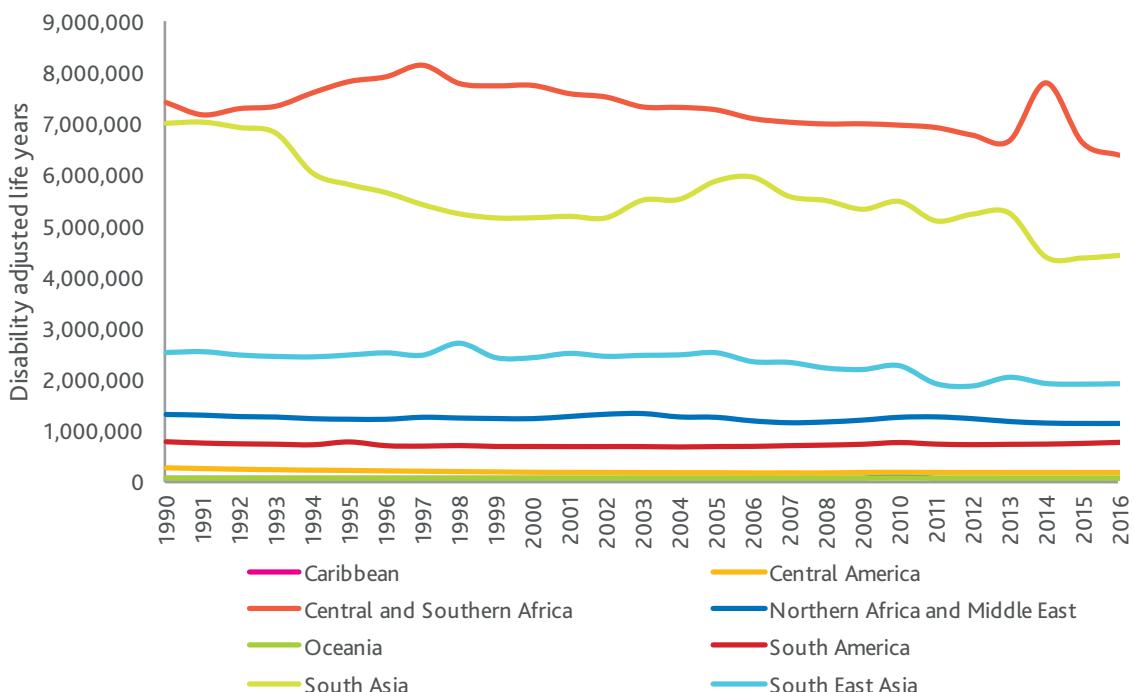


FIGURE 2.10 Total disability-adjusted life years attributable to neglected tropical diseases with available data in the Tropics. Diseases include African trypanosomiasis, Chagas disease, cystic echinococcosis, cysticercosis, dengue, Ebola virus disease, foodborne trematodiases, Guinea worm disease, intestinal nematode infections, leishmaniasis, leprosy, lymphatic filariasis, onchocerciasis, rabies, schistosomiasis, trachoma, yellow fever and Zika virus.

Source of data: IHME (2018)

overall pattern of decline in DALYs attributable to NTDs appears to have continued in the region. Future Ebola epidemics remain a risk in this region.

In South Asia, progress in the control of intestinal nematode infections and rabies have been offset somewhat by an increase in

the prevalence of dengue and trachoma. Nonetheless, the overall decline in DALYs from around 7 million in 1990 to 4.5 million in 2016 represents the greatest improvement in all regions of the Tropics. Dengue has increased across all tropical regions, except in the Caribbean.



Neglected Tropical Diseases

BOX 2.3

Neglected tropical diseases are grouped according to the level of progress that has been achieved to date: **losing the battle**, **minimal gains**, **significant gains**, **heading towards elimination** and **not yet classified**, according to Hotez and Aksoy (2017).

Dengue: A flu-like illness, caused by a mosquito-borne infection, that may develop into severe dengue with potentially lethal complications.

Chagas disease: A life-threatening illness transmitted to humans through contact with vector insects (triatomine bugs), ingestion of contaminated food, infected blood transfusions, congenital transmission, organ transplantation or laboratory accidents.

Leishmaniasis: Disease transmitted through the bites of infected female sandflies that, in its most severe form (visceral leishmaniasis) form, attacks the internal organs. In its most prevalent form (cutaneous leishmaniasis), the disease causes face ulcers, disfiguring scars and disability.

Echinococcosis: Infection is caused by the larval stages of tapeworm, which form pathogenic cysts in humans. The tapeworm is transmitted when food or water containing its eggs are ingested or by close contact with infected animals. The eggs are commonly released in the faeces of dogs and wild animals.

Foodborne trematodiases: Infection occurs by consuming fish, vegetables and crustaceans contaminated with larval parasites. Clonorchiasis, opisthorchiasis (which causes cancer) and fascioliasis are the main diseases.

Soil-transmitted helminthiases: Nematode eggs transmitted through soil contaminated by human faeces cause anaemia, vitamin A deficiency, stunted growth, malnutrition, intestinal obstruction and impaired child development.

Rabies: A preventable viral disease transmitted to humans through the bites of infected dogs. The disease is invariably fatal once symptoms develop.

Onchocerciasis (river blindness): This disease is transmitted by the bite of infected blackflies, and causes severe itching and eye lesions as the adult worm produces larvae. The disease causes visual impairment and permanent blindness.

Schistosomiasis: Trematode infections are transmitted when its larval forms are released by infected freshwater snails and penetrate human skin during contact with contaminated fresh water.

Leprosy: A complex, infectious, disabling disease caused by infection mainly of the skin, peripheral nerves, mucosa of the upper respiratory tract and eyes.

Taeniasis and neurocysticercosis: These are infections caused by adult tapeworms in human intestines. Cysticercosis results when humans ingest tapeworm eggs that then develop as larvae in tissues. It can cause epilepsy and death.

Trachoma: A chlamydial infection transmitted through direct contact with infectious eye or nasal discharge, or through indirect contact with unsafe living conditions and hygiene practices that, when left untreated, causes irreversible corneal opacities and blindness.

Yaws: A chronic disabling bacterial infection that affects mainly the skin and bone.

Human African trypanosomiasis (sleeping sickness): A parasitic infection, spread by the bites of tsetse flies, that is almost 100% fatal when not promptly diagnosed and treated to prevent the parasites invading the central nervous system.

Dracunculiasis (Guinea worm disease): A nematode infection transmitted exclusively through drinking water that is contaminated with parasite-infected water fleas.

Lymphatic filariasis: An infection transmitted by mosquitoes infected by filarial worms. As the adult worms inhabit and reproduce in the human lymphatic system, they cause abnormal enlargement of limbs and genitals, resulting in disability.

Buruli ulcer: A debilitating mycobacterial skin infection that causes severe destruction of the skin, bone and soft tissue.

Mycetoma* is a chronic, progressively destructive inflammatory disease. It is a disabling skin disease that usually affects the lower limbs. Infection is thought to be caused by the inoculation, through a thorn prick or skin damage, of fungi or bacteria into the subcutaneous tissue.

Scabies* is a parasitic infestation caused by *Sarcoptes scabiei* var. *hominis*. The microscopic mite burrows into the skin and lays eggs, eventually triggering a host immune response that leads to intense itching and rash. Scabies infestation may be complicated by a bacterial infection, leading to the development of skin sores that, in turn, develops more serious consequences such as septicaemia, heart disease, chronic kidney disease and death.

Snakebite envenomation* is a potentially life-threatening condition that typically results from the injection of a mixture of different toxins ('venom') from the bite of a venomous snake. Envenomation can also be caused by having venom sprayed into the eyes by a certain species of snakes that have the ability to spit venom as a defensive measure.

*In 2017 the 10th meeting of the Strategic and Technical Advisory Group for Neglected Tropical Diseases received proposals for the addition of diseases and, pursuant to the required procedure, chromoblastomycosis and other deep mycoses, scabies, other ectoparasites and snakebite envenoming have been added to the NTD portfolio (WHO 2018d).

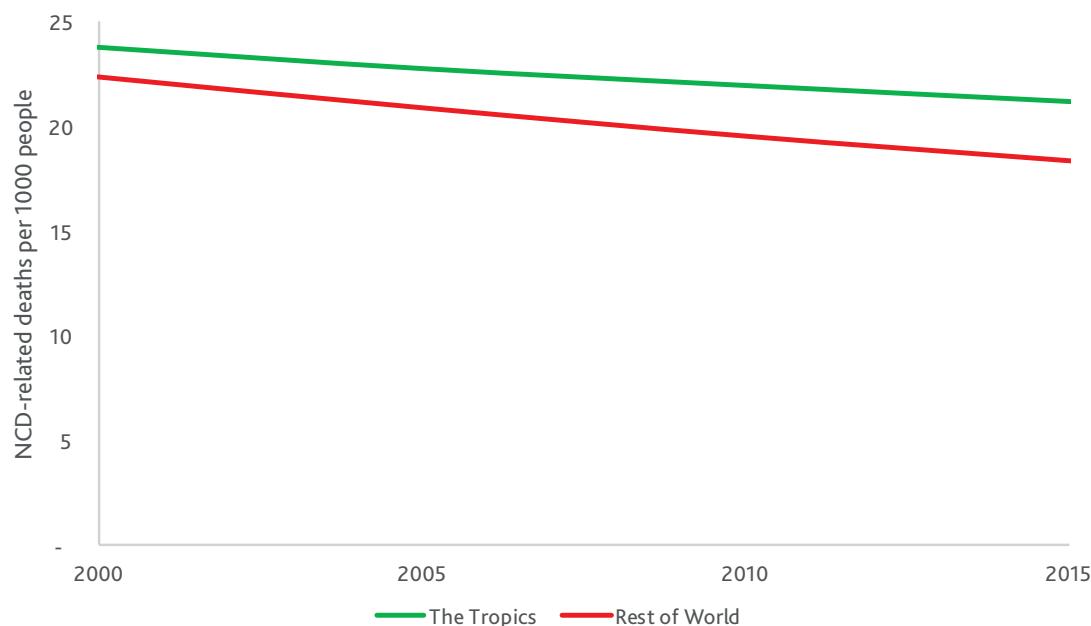


FIGURE 2.11 Risk of premature death from non-communicable diseases (cardiovascular disease, cancer, diabetes or chronic respiratory disease) in the Tropics and the rest of the world.

Source: UN DESA (2017, 2018)

Non-communicable diseases

Risk of premature death

Non-communicable diseases (NCDs) include heart disease, stroke, cancer, chronic respiratory disease and diabetes. Unlike infectious diseases, NCDs are not passed from person to person, are often long in duration and generally progress slowly. NCDs are now the major cause of disability and premature death globally. In addition to human costs, the economic costs of NCDs entrench poverty in low-income families and reduce national income.

While NCDs disproportionately affect poor communities, their prevalence is increasing rapidly among low- and middle-income countries (Ezzati et al. 2018). Poverty, food insecurity, globalisation of marketing, trade in health-harming products, urbanisation and changing population demographics (including population growth and ageing populations) are considered key drivers of the NCD epidemic (WHO 2017b).

Globally, the risk of premature death from NCDs declined marginally between 2000 and 2015 (Figure 2.11). In part, this was driven by ongoing health sector improvements and new treatments and technologies (WHO 2017b). The 4 percentage point decline in mortality rate in the rest of the world was greater than the 3 percentage point decline in the Tropics (from 24% to 21%), which also has a relatively higher NCD mortality rate. Other analyses confirm this finding: although the crude death rate from NCDs is higher in wealthy nations, NCDs are found to cause death at younger ages in tropical countries and thus, cause higher rates of death in the Tropics (Ezzati et al. 2018).

Across most tropical regions, improvement in the risk of premature

death from NCDs were small but in line with global decline (Figure 2.12). South America demonstrated the greatest reduction in NCD mortality rate, from 22% in 2000 to 16% in 2015. Within South America, the greatest reduction occurred in Brazil, a reflection of the general improvements across all health indicators in this country. In general, the regions of Central and South America now have the lowest NCD mortality rates in the Tropics and are lower than many developed nations.

In all other tropical regions, the risk of premature death due to NCDs has changed little, possibly a result of the rising incidence of NCDs in the Tropics (Bygbjerg 2012; Ezzati et al. 2018). Oceania has the highest risk of premature death from NCDs, driven largely by PNG and Fiji whose mortality rates remain above 30%. Growing rates of cardiovascular disease and diabetes in the region are in large part to blame for this pattern. In addition, high rates of childhood stunting—a key risk factor for NCDs in adulthood—are also found in PNG (Rarau et al. 2017).

Obesity

As a public health problem, obesity has historically been limited to high-income nations. However, it has now reached epidemic proportions in many developing nations and is a factor in the increased prevalence of NCDs across all segments of society (WHO 2018e). Between 2010 and 2016, the global prevalence of obesity increased from 10.5% to 13%, with almost 650 million adults considered obese in 2016 (WHO 2018e). In the Tropics, the adult obesity rate increased from only 1% in 1975 to more than 9% in 2016, compared to 5% to 16% in the rest of the world over the same period (Figure 2.13).



FIGURE 2.12 Risk of premature death from non-communicable diseases (cardiovascular disease, cancer, diabetes or chronic respiratory disease) across regions of the Tropics.

Source: UN DESA (2017, 2018)

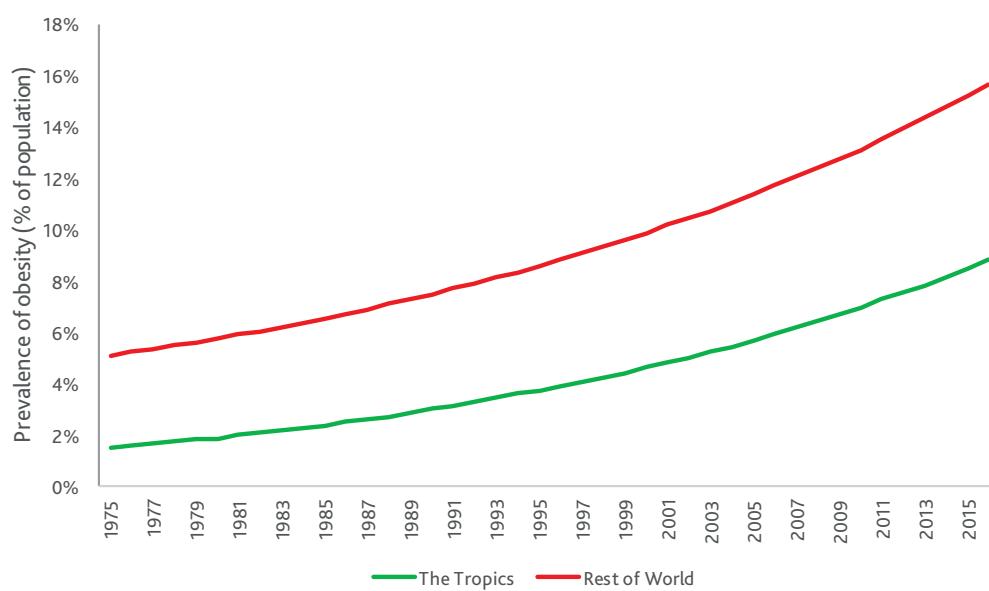


FIGURE 2.13 Prevalence of adult obesity (% of population) in the Tropics and the rest of the world

Source: UN DESA (2017), World Bank (2018)

In the 40 years to 2016, obesity rates have increased in all regions of the Tropics, and particularly since the turn of the century (Figure 2.14). The most significant increases since 2000 have been in the Caribbean (10% points); Central and South America (9% points and 8% points, respectively) and Oceania (8% points). Although there is some variation between countries within regions (e.g., 19% in PNG compared with 55% in Palau), the general pattern of increase

is similar across all nations. Not one tropical country has shown a decline in obesity rates since the 1970s.

At 4%, South Asia had the lowest rate of obesity in 2016, although this equates to more than 20 million obese adults in the region. Among the tropical regions, South-East Asia, Central and Southern Africa and Northern Africa and Middle East also have relatively low obesity rates.

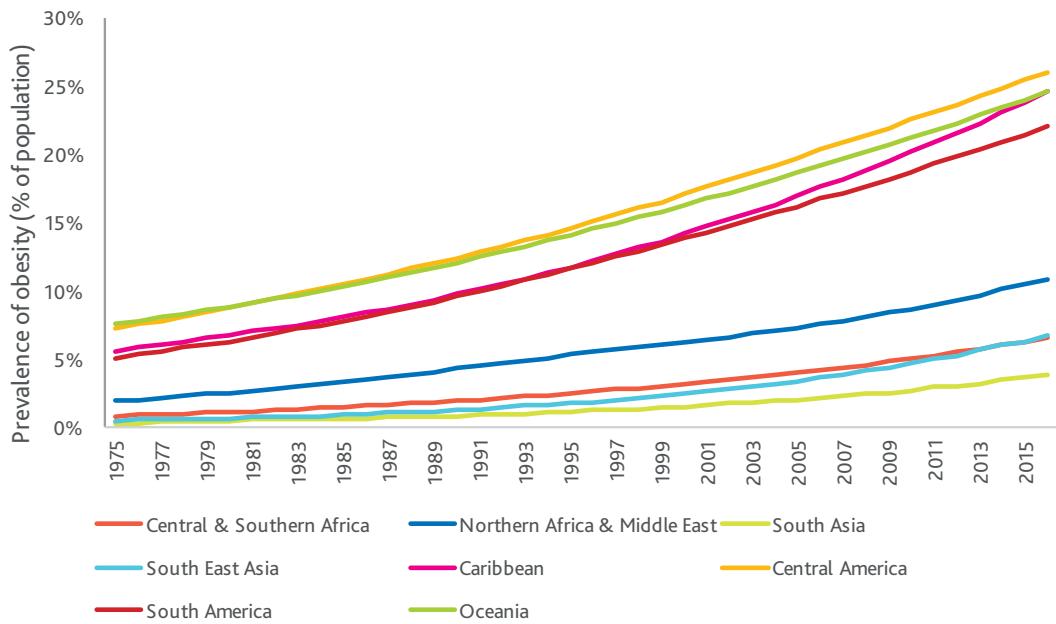


FIGURE 2.14 Prevalence of adult obesity (% of population) across regions of the Tropics

Source: UN DESA (2017), World Bank (2018)

Double burden of disease

The 'double burden of disease' refers to a situation where the prevalence of NCDs continue to increase alongside high rates of infectious disease and undernourishment (Ezzati et al. 2018). The analyses presented in this chapter support findings in other studies (Boutayeb 2006; Bygbjerg 2012; Min et al. 2017) that the double burden of disease in the Tropics has been an issue for decades, and will be an ongoing challenge for health systems in the region.

Although some tropical regions—particularly Oceania and the Caribbean—have some of the highest obesity rates in the world, several nations in these regions also have high rates of undernutrition, particularly among children (Figure 2.15). A low birth weight or undernutrition during childhood predisposes individuals to high blood pressure and obesity in adulthood, with greater risk of chronic diseases, such as diabetes or heart disease (De Boo & Harding 2006).

Similarly, the growing prevalence of NCDs, such as diabetes, increase the incidence and severity—and affect treatment outcomes—of a large number of infectious diseases, including TB, dengue and melioidosis (see Case Study 3). These diseases are all most prevalent in tropical countries (van Crevel, van de Vijver & Moore 2017).

Another instance of the compounding effects of infectious diseases and NCDs can be seen in diabetes that is induced by some HIV treatments and drugs to treat parasitic infections (van Crevel, van de Vijver & Moore 2017).

2.4 THE TROPICAL PERSPECTIVE

The burden of disease is influenced by ongoing demographic, environmental, climatic, social, technological and other factors in the way that people live. The effects of disease on public health predominate in the Tropics, and disease factors specific to the Tropics means that this region of the world faces unique challenges. A combination of multiple and interacting feedback loops in the Tropics from poverty, climate, ecology, infectious and tropical diseases, and poor nutrition mean that this region carries a considerably higher disease burden than does the rest of the world.

Biodiversity and disease

Humans coexist in complex relationships with animals and the environment and depend on them for food, livelihood and wellbeing. The Tropics account for around 80% of the world's terrestrial biodiversity (State of the Tropics 2014); inherent in this biodiversity is also diversity of parasites, bacteria and other diseases. The interface between humans, animals and the environment can be a source of diseases. It stands to reason that as interactions and activities at this interface increase through intensive agriculture, land clearing and other processes, humans come in close contact not only with animals and plants but also with diseases. Concepts of One Health and Planetary Health and their relevance to the Tropics are discussed in Chapter One.

Climate and disease

Human health and disease are profoundly affected by the weather and climate. There are multiple drivers of disease, but as for free-living organisms (i.e., nonparasitic species), so infectious agents have ecological niches that are constrained by temperature and

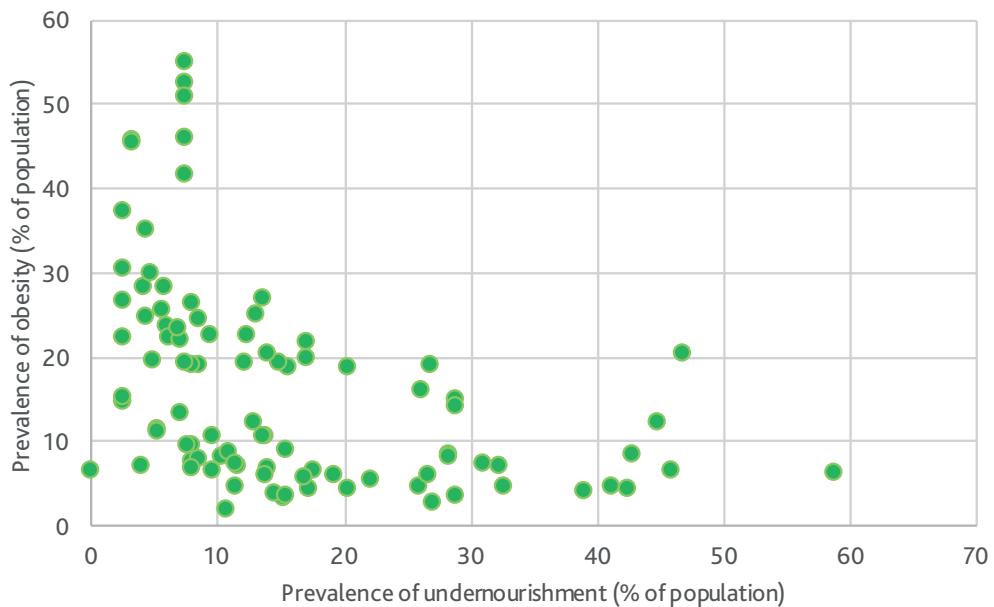


FIGURE 2.15 The double burden of malnutrition: prevalence of obesity and undernourishment in the Tropics

Source: UN DESA (2017, 2018), World Bank (2018)

moisture, which make the relationship between climate and disease complex (Wood et al. 2017). Climate change has the potential to affect hosts, vectors and parasites in a variety of ways that make climate effects difficult to predict (Wood et al. 2017).

As the climate warms, the risks of foodborne and waterborne diseases increase (Watts et al. 2017). Lowland disease vectors, such as mosquitoes, are expected to spread into tropical highlands and latitudes that are currently too cool to support them (Altizer et al. 2013). Vectors are also likely to spread further from the equator as conditions in subtropical and temperate areas become more favourable. For example, research suggests that as temperatures continue to rise and precipitation patterns change, the opportunities for wider distribution of the *Aedes* mosquito—the vector for dengue, chikungunya and Zika viruses—will increase (Ebi & Nealon 2016).

Although the connection between climate change and NCDs may not be obvious, they have common risk factors. Some of the risk factors for NCDs, such as air pollution, physical inactivity and poor diet, call for the same solutions as those for climate change (Beagley & Braithwaite 2016). Many interventions to combat climate change also present opportunities to address NCDs, such as scaling up renewable energy, investing in active transport systems that promote cycling and walking, promoting sustainable food and agricultural practices, constructing energy-efficient buildings and reducing industrial emissions (Beagley & Braithwaite 2016).

Biosecurity and emerging diseases

Pandemics in recent years have fuelled concern about the threat of infectious diseases to nations, regions and the world (Jones et

al. 2008). Epidemics such as severe acute respiratory syndrome, Middle East respiratory syndrome coronavirus, Ebola virus, swine flu virus, avian influenza, the spread of diseases such as dengue and the emergence of new and often highly pathogenic infections of zoonotic origin contribute to this concern.

The possibility that the next major pandemic will emerge from the Tropics is very high, and the consequences will disproportionately affect the most disadvantaged countries and populations in the region. Weak human and animal health systems, population movements and changes, climatic and environmental changes, and poor water and sanitation services all drive the potential for new and dangerous outbreaks (Coker et al. 2011; Counahan et al. 2018).

Moving forward, tropical countries should make health and biosecurity a key focus, a challenge that requires cooperation between levels of government both within and between countries and territories in the Tropics.

2.5 LOOKING FORWARD

The future of disease in the Tropics is complex and difficult to predict. Epidemics from highly pathogenic diseases such as the Ebola virus, avian influenza, and Zika virus can compromise the ability of health systems to cope with ongoing layers of disease burden. A single epidemic may not only slow progress for many years to come but also entail a considerable economic burden.

Given the already heavy burden on health systems in the Tropics caused by high rates of disease, both infectious and non-communicable, it will be essential to consider solutions from a systems perspective. Complications common to both NCDs and tropical infections may suggest opportunities for shared services; for example, services for eye health (trachoma and onchocerciasis), ulcer care (leprosy) or renal support (schistosomiasis) may be integrated and streamlined to ensure effective allocation of health resources (van Crevel, van de Vijver & Moore 2017). There are also opportunities for cross-disciplinary learning and innovation. For example, parasitic worms can potentially be used to combat metabolic syndrome, a condition related to obesity that often leads to diabetes (Loukas 2018).

Gains in health outcomes have been made by targeting individual causes of mortality and morbidity through concerted campaigns (e.g., malaria and HIV). However, the gains in NTDs show that treating the underlying causes of premature death (e.g., poverty, poor nutrition, and poor or lack of access to sanitation and clean water) tends to have the best results. Understanding and addressing the premature causes of death in a system has the potential for the most effective and sustainable outcomes in the Tropics.

The Tropics are the geographical nexus of multiple simultaneous processes of biodiversity loss, climate change, emerging and persistent infectious diseases, rising non-communicable diseases and globalisation. To continue the gains of the past and increase positive outcomes for the future, strategies to address the region's ongoing disease burden must include options to combat both infectious and non-communicable diseases.

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MALARIA FREE SRI LANKA

MALARIA IN THE TROPICS

Malaria, a disease caused by a parasite, and transmitted by mosquitos is one of the biggest killers in the Tropics. In 2016, it was the fifth largest cause of mortality in tropical Africa and remains endemic throughout the Tropics (See Chapter 2 for more detail). According to the latest available data, some 3.2 billion people are at risk of the disease, which disproportionately affects poor and disadvantaged people (World Health Organization 2015). Malaria is preventable and treatable, but continues to have a profound impact on livelihoods and wellbeing across the Tropics.

The WHO Global Technical Strategy for malaria 2016-2030 adopted by the World Health Assembly in 2015 endorses an ambitious new target of reducing the global malaria burden by 90% by 2030 (World Health Organization 2015).

Malaria is an ancient disease and has been endemic to Sri Lanka for millennia (Dissanayake 2016). It was once one of the most important communicable diseases in the country and has had devastating social and economic costs. In 2016, the World Health Organization certified the country as malaria free and Sri Lanka became the first country to be officially certified by WHO as malaria free after the launch of the WHO strategy (World Health Organization 2017). It is the largest lower middle income country in the Tropics to achieve elimination. Additionally notable, is that this success occurred despite the major challenges posed by nearly 30 years of civil war between 1983 and 2009 (Abeyasinghe et al. 2012).

REGIONAL EXPANSION – LOCAL INTERVENTIONS

Prior to 1989, the Anti-malaria campaign (AMC) in Sri Lanka, run by the Ministry of Health, Nutrition, and Indigenous Medicine had a very centralised structure (World Health Organization 2017). However, from 1989, the program moved to provincial programmes under the guidance of the AMC. Under this new model, regional offices conducted anti-malarial activities under national guidance (World Health Organization 2017, Abeyasinghe et al. 2012). This direction also moved from single vector-control methods such as indoor residual spraying (IRS) to more integrated methods which according to Senaratne and Singh (2016) included:

- Vector control in major irrigation and agricultural projects
- More rigorous entomological surveys
- Targeted spraying in high risk areas
- New insecticides
- Distribution of insecticide treated nets
- Rapid response to active case detection

Despite this widespread action, epidemics continued throughout Sri Lanka in the 1980s and 1990s, particularly in the districts affected by the civil conflict (Abeyasinghe et al. 2012). However, in the late 1990's the Sri Lankan government's commitment was reinforced and reinvigorated by the Roll Back Malaria Partnership (Senaratne and Singh 2016), which is now known as the RBM Partnership to End Malaria, a global platform providing technical support and advocating for coordinating action against malaria (End Malaria 2019).

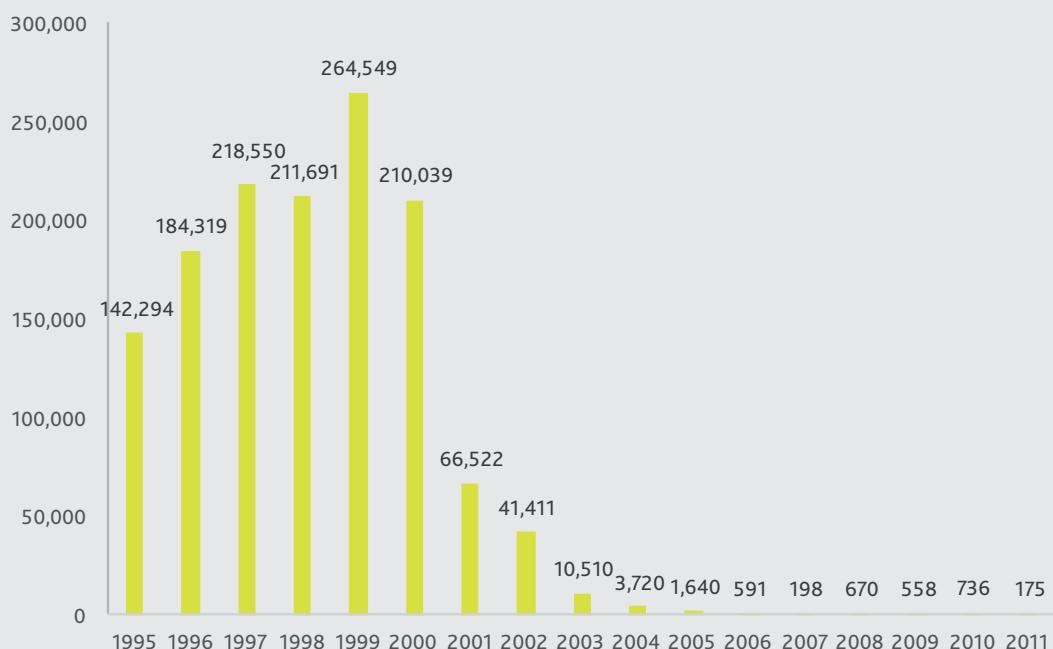


FIGURE CS1.1 Number of confirmed infections from active and passive case detection, Sri Lanka, 1995–2001. From (Abeyasinghe et al. 2012)

Across Sri Lanka, vector control (spraying), monitoring and surveillance, and treatment interventions were intensified, which resulted in a 68% decrease between 2000 and 2001 alone (Figure CS1.1) although the population living in conflict zones remained at risk. A key factor in further success was regional malaria teams working in partnership with the military and non-government organisations in conflict affected provinces (Senaratne and Singh, 2016). Both sides of the conflict were affected by malaria and thus supported malaria control measures (Abeyasinghe et al. 2012). Non-government organisations, supported by the government program, were particularly important in the regions controlled by the separatist Liberation Tigers of the Tamil Eelam (Dissanayake 2016).

Technology associated with active case detection and passive case detection was essential in understanding the epidemiology of malaria in Sri Lanka (World Health Organization 2017). Additional laboratory support meant that mobile malaria clinics with microscopic examination facilities could analyse blood smears on the day they were collected, thus providing opportunity for rapid response (World Health Organization 2017).

Armed conflict in Sri Lanka ended in May 2009, and in October 2012, Sri Lanka recorded its last case of indigenous malaria (Abeyasinghe et al. 2012, World Health Organization 2017). Rapid socioeconomic development of the country, alongside the ongoing malaria control program, particularly after the end of the civil conflict contributed to success.

IMPLICATIONS FOR THE BROADER TROPICS

Sri Lanka remains at risk from a resurgence of malaria but has ongoing plans in place in order to prevent re-introduction of the virus. The decentralised model remains in place, although now focused on surveillance and response. The Anti-malaria Campaign continues to conduct door to door testing in former endemic areas of the country, given the high numbers of mosquito vectors and other risk factors (Dissanayake 2016, World Health Organization, 2017). Refugees returning from camps in India now undergo compulsory testing as part of the reintegration program (Dissanayake 2016).

Sri Lanka's success demonstrates that malaria elimination is possible, particularly in the Asia Pacific. As Sri Lanka is an island, this approach has relevance for other island nations, particularly in Melanesia.

Malaria eradication in other nations will require governments, NGOs, businesses, technical agencies and grant makers work together with one common objective. For nations in continental Asia and Africa with shared borders, it will also require international cooperation. Sri Lanka was able to utilise existing measures of prevention, surveillance and treatment, that were dispersed yet coordinated. Several countries in South and South East Asia are close to the elimination stages as well and thus information sharing will be important (Dissanayake 2016).

Despite challenging circumstances, Sri Lanka demonstrates that eradicating malaria is possible, making the pathway to achieving complete eradication worldwide not only clearer, but a real possibility.



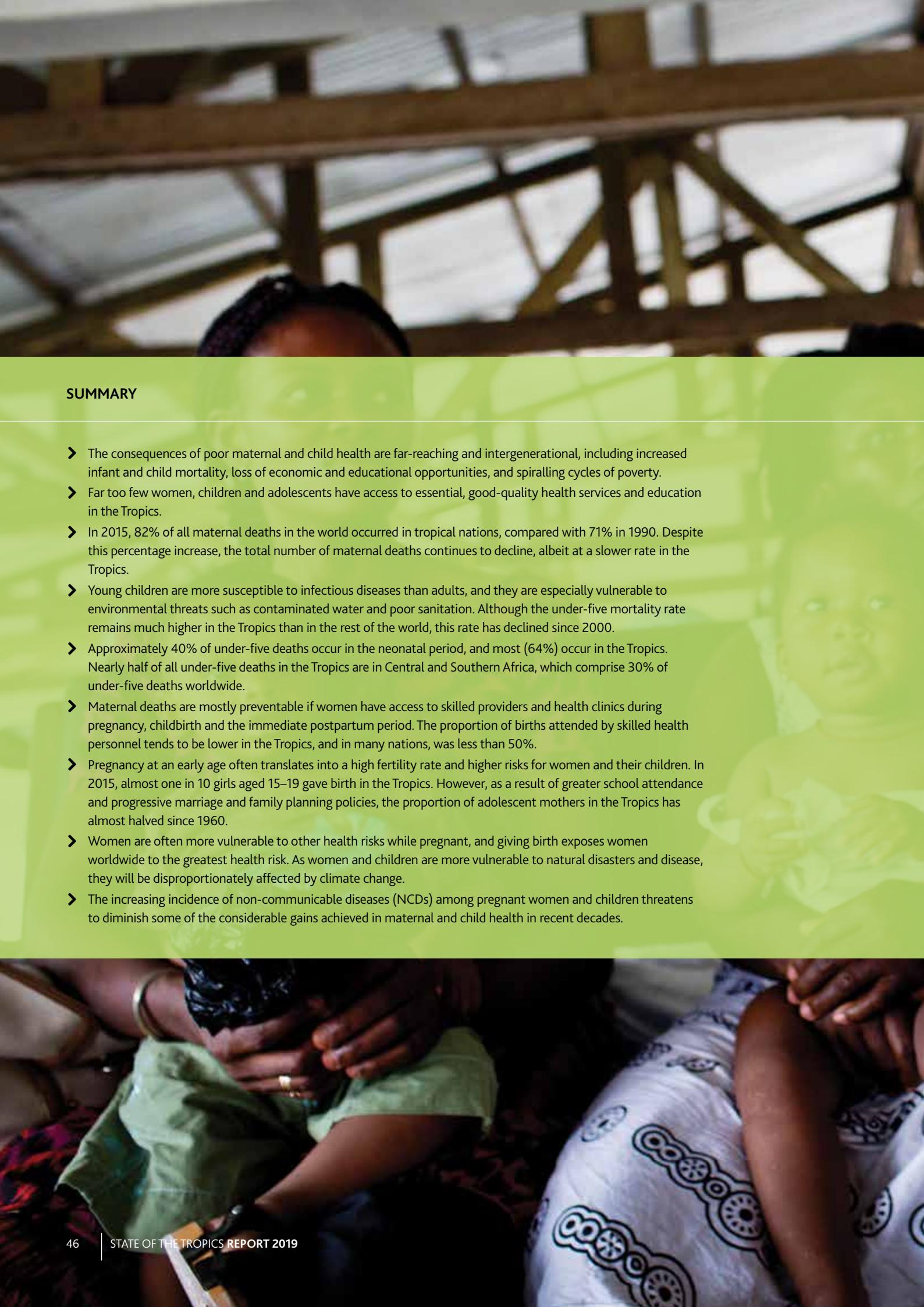
IMAGE: PAN AMERICAN HEALTH ORGANIZATION

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3

WOMEN AND CHILDREN IN THE TROPICS

A photograph showing a woman from behind, wearing a bright green dress. She is holding a small child, likely a newborn, in her arms. The background is blurred, showing what appears to be a wooden structure or a porch. The overall tone is warm and suggests a moment of care and connection.

SUMMARY

- The consequences of poor maternal and child health are far-reaching and intergenerational, including increased infant and child mortality, loss of economic and educational opportunities, and spiralling cycles of poverty.
- Far too few women, children and adolescents have access to essential, good-quality health services and education in the Tropics.
- In 2015, 82% of all maternal deaths in the world occurred in tropical nations, compared with 71% in 1990. Despite this percentage increase, the total number of maternal deaths continues to decline, albeit at a slower rate in the Tropics.
- Young children are more susceptible to infectious diseases than adults, and they are especially vulnerable to environmental threats such as contaminated water and poor sanitation. Although the under-five mortality rate remains much higher in the Tropics than in the rest of the world, this rate has declined since 2000.
- Approximately 40% of under-five deaths occur in the neonatal period, and most (64%) occur in the Tropics. Nearly half of all under-five deaths in the Tropics are in Central and Southern Africa, which comprise 30% of under-five deaths worldwide.
- Maternal deaths are mostly preventable if women have access to skilled providers and health clinics during pregnancy, childbirth and the immediate postpartum period. The proportion of births attended by skilled health personnel tends to be lower in the Tropics, and in many nations, was less than 50%.
- Pregnancy at an early age often translates into a high fertility rate and higher risks for women and their children. In 2015, almost one in 10 girls aged 15–19 gave birth in the Tropics. However, as a result of greater school attendance and progressive marriage and family planning policies, the proportion of adolescent mothers in the Tropics has almost halved since 1960.
- Women are often more vulnerable to other health risks while pregnant, and giving birth exposes women worldwide to the greatest health risk. As women and children are more vulnerable to natural disasters and disease, they will be disproportionately affected by climate change.
- The increasing incidence of non-communicable diseases (NCDs) among pregnant women and children threatens to diminish some of the considerable gains achieved in maternal and child health in recent decades.



3

3.1 INTRODUCTION

A healthy and sustainable future in the Tropics depends on the health and wellbeing of women and children (State of the Tropics 2014; United Nations [UN] 2016a). Every year, over 210 million women become pregnant; maternal health is not a marginal issue (Graham et al. 2016). Additionally, the consequences of maternal death are far-reaching and intergenerational, including increased infant and child mortality, loss of economic and educational opportunities, and spiralling cycles of poverty (Miller & Belizán 2015). When women can give birth safely to healthy babies, with skilled personnel present, the outcomes for poverty, development and sustainability improve for families, communities and nations.

Women and children have disproportionately poorer access to adequate health services and education. While there has been progress (State of the Tropics 2014), far too few women, children and adolescents have access to essential good-quality health services and education in the Tropics. Given the region's disproportionate disease burden (Bergström 2016) and the greater vulnerability of women and children to health issues (UN 2016), a better understanding of risks before, during, and after birth, how they are changing and the effects of health policy interventions is required. Significant improvements in health outcomes in developed nations and local successes in several developing nations indicate that the vast majority of maternal and child deaths can be prevented by implementing interventions (UN 2016).

Women and children's health was a key target of the Millennium Development Goals (MDGs), which included the reduction of under-five mortality by two thirds from 1990 to 2015. Indeed, the improvements in health care, education, access to contraception and general health and wellbeing during this period have saved millions of lives (UN 2016). However, only 57 of the 195 countries and territories worldwide met or exceeded the pace of progress required to meet these goals.

To achieve the Sustainable Development Goals (SDGs) in the Tropics (Box 3.1), nations and communities will need to continue to focus on the health and wellbeing of women and children by providing appropriate education and health care.

Relevant Sustainable Development Goals and Targets in the 2030 Agenda	BOX 3.1
<p>Goal 3: Ensure healthy lives and promote well-being for all at all ages</p> <p>Target 3.1 By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births.</p> <p>Target 3.2 By 2030, end preventable deaths of newborns and children under five years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-five mortality to at least as low as 25 per 1,000 live births.</p> <p>Goal 5: Achieve gender equality and empower all women and girls</p> <p>Target 5.1 End all forms of discrimination against all women and girls everywhere.</p> <p>Target 5.2 Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation.</p>	
<p>Source: United Nations (2018)</p>	

This chapter focuses on the most vulnerable members of the tropical community and traces health indicators from birth through to adolescence and into middle age.

3.2 INDICATORS

Maternal mortality ratio

More than 800 women die every day from preventable causes related to pregnancy and childbirth (UN 2016). Most of these women live in tropical countries and territories (State of the Tropics 2014). The maternal mortality ratio is the annual number of female deaths per 100,000 live births from any cause related to, or aggravated by, pregnancy or its management (including accidental

or incidental causes). Maternal mortality ratio reflects the risk of maternal death from a single live birth (therefore, it is independent of fertility trends). Maternal health is generally considered a proxy indicator of access to health care and the strength of the health care system in general.

Under-five mortality rate

The under-five mortality rate is defined as the probability of dying between birth and five years of age, expressed as a rate per 1,000 live births. This indicator is used in addition to neonatal mortality as it reflects different aspects of health care and socio-economic contexts. For example, children whose mothers have been educated for more than five years are 40% more likely to live past five years of age (United Nations Inter-agency Group for Child Mortality Estimation [UN IGME] 2017).

Neonatal mortality rate

The neonatal mortality rate is the probability of dying during the first 28 days of life, expressed as a rate per 1000 live births. Lower life expectancy in tropical nations reflects high mortality rates at younger ages, especially in infancy. The risk of death among children under the age of five is highest at birth and decreases steadily every year onwards. Globally, 2.6 million children died during their first month of life in 2016—approximately 7,000 newborn deaths every day. Most of these deaths occurred in the child's first week, with about 1 million dying on the first day and close to 1 million dying within the next six days.

Proportion of births attended by skilled health personnel

In addition to a number of interventions before, during and after pregnancy, attendance at a child's birth by a skilled health worker reduces maternal and infant mortality. Skilled health personnel refers to 'an accredited health professional—such as a

midwife, doctor or nurse—who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns' (World Health Organization [WHO] 2004). This indicator also reflects coverage of health care services and health workforce capacity.

Adolescent birthrate

Reducing adolescent pregnancy is an important factor in the promotion of women's education and social and economic development. Early motherhood compounds disadvantage by disrupting school and limiting livelihood opportunities (Nove et al. 2014). In many parts of the world, adolescents face higher risk of complications and death from pregnancy than older women, particularly because they have more frequent pregnancies (Conde-Agudelo, Belizán & Lammers 2005). Adolescent females are also far less likely to access appropriate health care in relation to their pregnancy (McDougall, Campbell & Graham 2016).

The adolescent birth rate is a measure of the annual number of live births to women aged 15–19, per 1,000 women in that age group. It represents the risk of childbearing among adolescent women in that age group and is also referred to as the age-specific fertility rate of women aged 15–19.

3.3 TRENDS

Maternal mortality ratio

Death during pregnancy, or within 42 days of the end of a pregnancy, from any cause related to or aggravated by the pregnancy or its management, is the leading cause of death among females aged 15–49 years worldwide (WHO et al. 2015).

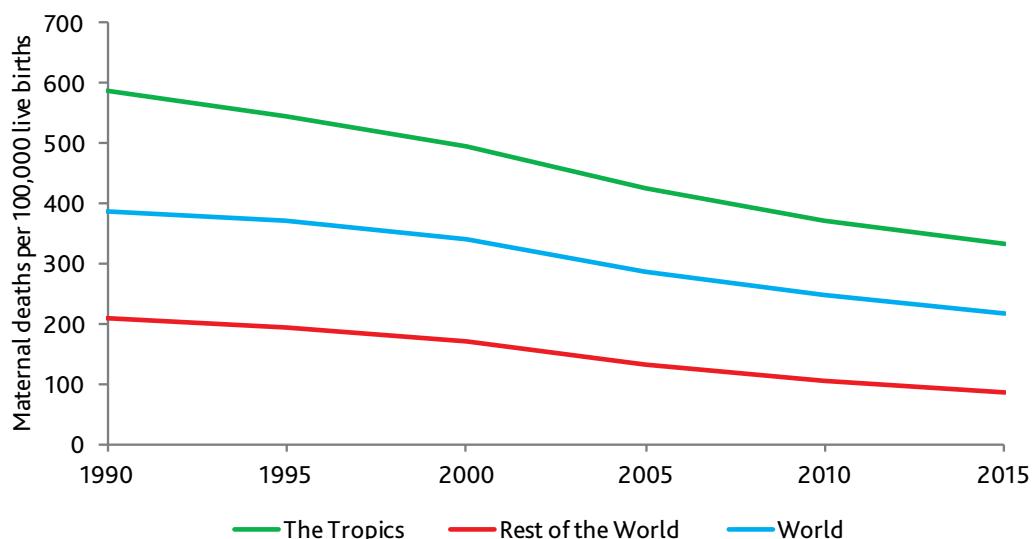


FIGURE 3.1 Maternal mortality ratio in the Tropics and the rest of the world

Source: United Nations, Department of Economic and Social Affairs (UN DESA; 2015, 2017), WHO et al. (2015)

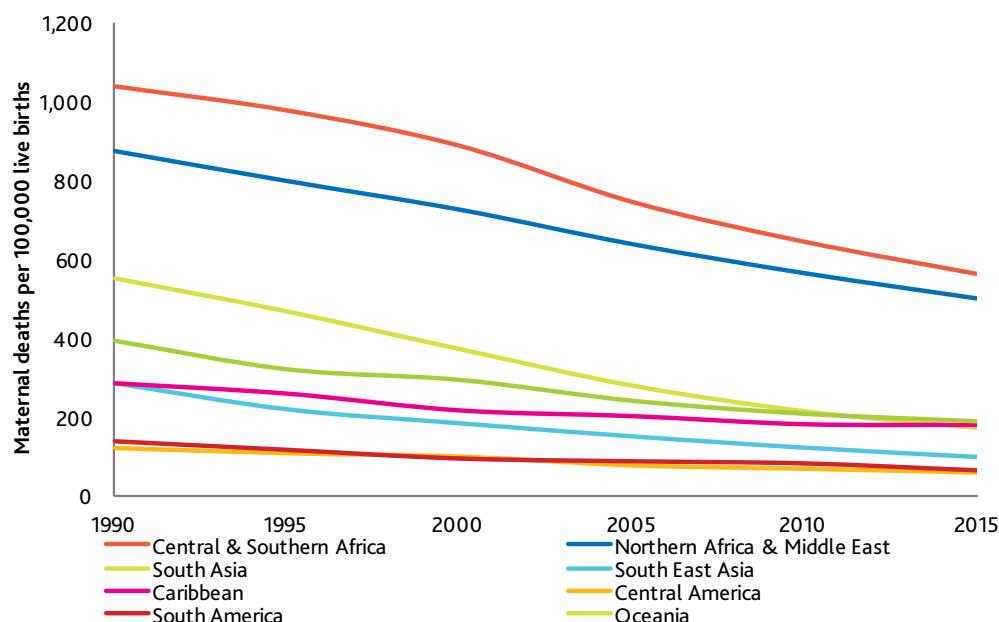


FIGURE 3.2 Maternal mortality ratio across regions of the Tropics

Source: UN DESA (2015), WHO et al. (2015)

According to the WHO, the primary causes of maternal death are haemorrhage, hypertension, infections, and indirect causes, mostly due to interaction between pre-existing medical conditions and pregnancy (WHO et al. 2015).

Through the SDGs of the 2030 Agenda for Sustainable Development, the global community has agreed to work towards reducing the global maternal mortality ratio (MMR) to 70 deaths per 100,000 live births by 2030 (Fullman et al. 2017). Previous targets of this nature have been difficult to achieve, particularly in the Tropics. For example, the MDG to reduce maternal mortality by three quarters between 1990 and 2015 was not achieved.

Despite improvement in the global MMR over the past few decades, at the commencement of the 2030 Agenda for Sustainable Development in 2015, it was close to 250 maternal deaths per 100,000 live births. In the Tropics, the rate was notably higher at 373 (Figure 3.1).

The proportional contribution of tropical nations to global MMR has increased in recent decades. In 2015, 82% of all maternal deaths in the world occurred in tropical nations, compared with 71% in 1990. However, despite this increase, the total number of maternal deaths has continued to decline, albeit at a slower rate in the Tropics. Since 1990, MMR has declined in the Tropics by 34% compared with 64% in the rest of the world. The region of Northern Africa and Middle East has had the smallest reduction in MMR with only a 6% decline in maternal deaths over the past 25 years, while maintaining a high fertility rate.

Between 1990 and 2015, the most considerable improvements in maternal health in the Tropics have occurred in South Asia and South-East Asia, with 72% and 67% decline in the number of

maternal deaths respectively (Figure 3.2). The improvements in South Asia were in part driven by institutional changes in countries like India, where up to 80% of mothers are now giving birth in hospitals compared with 40% only a decade earlier (Ministry of Statistics and Programme Implementation, Government of India 2016). Nevertheless, the overall numbers of women dying in India remain very high. Social and economic inequality may mask high rates of MMR in specific communities and classes when women do not access any health care and give birth at home and are thus unrecorded.

While the region of Oceania began this period with a relatively lower MMR, it has shown little improvement since 1990—a trend that is likely driven by poor health outcomes in Melanesian communities. MMR in the Caribbean has also shown little improvement, even increasing slightly between 2010 and 2015, possibly caused by the rising incidence of non-communicable diseases (NCDs) in pregnant women in that region.

In 2015, more than half of all maternal deaths worldwide occurred in the region of Central and Southern Africa. The highest MMR in the world is in Sierra Leone (1360) followed by the Central African Republic (882). As a result of the size of its population, Nigeria alone accounted for 19% of global maternal deaths in 2015—58,000 deaths.

These estimates (Figures 3.1 and 3.2) are considered the most accurate and recently available maternal mortality figures. Importantly for the Tropics, new data available for the highly populated tropical nations of the Democratic Republic of Congo, Nigeria and Sierra Leone, indicate that the MMRs were much higher than previously estimated for those countries (WHO et al. 2015).



IMAGE: STEPHEN GLADIEU, WORLD BANK.

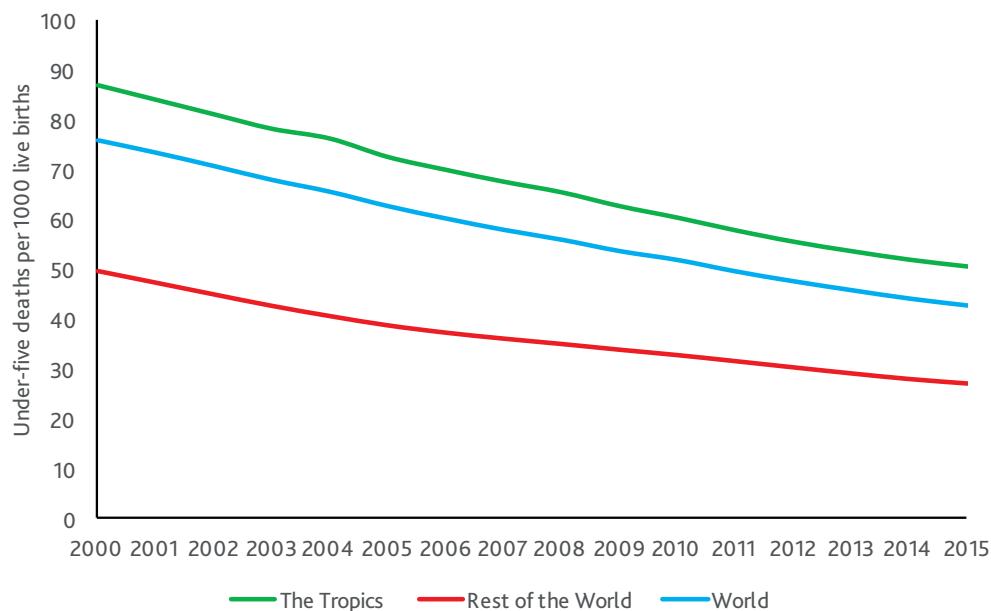


FIGURE 3.3 Under-five mortality rates worldwide, in the Tropics and the rest of the world

Source of data: UN IGME (2017a)

To improve maternal health, MDG 5 established a target of reducing the 1990 global MMR by 75% in 2015. Although there is a range of uncertainty around country-level estimates, it is clear that few tropical nations have achieved this goal. Of the tropical nations for which data is available on this indicator (86 nations), only five have achieved a reduction of MMR greater than 75%: Rwanda; Republic of Cabo Verde; Lao People's Democratic Republic (PDR), Timor-Leste and Cambodia. It is worth noting that while these nations have made significant progress, they also started from very high MMR baselines with MMRs that remain high, particularly in Rwanda (290), Cambodia (161), Timor-Leste (215) and Lao PDR (197).

Overall, there have been notable, albeit patchy, improvements in the MMRs of most countries worldwide. Instances of limited improvements, or in some cases even regression, suggest vigilance and continued effort is required. The gains of recent decades may be undermined by a broad range of contributing factors, many of which are increasing in intensity and distribution, such as NCDs in developing countries, changing demographic patterns and the effects of global environmental and climate change (Graham et al. 2016).

Under-five mortality

Almost six million children die every year, mostly from preventable causes such as malaria, malnutrition, diarrhoea and pneumonia. Young children are more susceptible to infectious diseases than adults and are especially vulnerable to environmental threats such as contaminated water and poor sanitation, which are prevalent in the Tropics. Under-five mortality directly relates to child survival and reflects the social, economic and environmental conditions in which children live. An under-five mortality rate of 40 or more is

considered 'high' by the international community (United Nations Children's Fund [UNICEF] 2017).

Globally, the number of under-five deaths has declined by 46% since 2000, equating to a decline in the under-five mortality rate from 76 to 43 per 1,000 live births. In the period 1950 to 1965, under-five mortality was higher in the rest of the world than in the Tropics at around 11 million deaths per year, before falling dramatically to 5.9 million per year by the period 1975–80 (State of the Tropics 2014). This rapid improvement is attributed to several factors—including sharp declines in the effects of some infectious diseases, public health measures and better nutrition—driven mainly by improvements in central and northern China (State of the Tropics 2014).

However, the under-five mortality rate has remained consistently and relatively higher in the Tropics. Although it has declined since 2000, it was almost double that of the rest of the world in 2015 (Figure 3.3) and has only fallen marginally since 2010.

Since the turn of the century, the under-five mortality has declined consistently across all tropical regions, with the greatest reductions in the regions of Central and South Africa and South Asia (Figure 3.4). The Caribbean experienced a notable increase in child deaths between 2009 and 2010, but this was driven by a major earthquake in Haiti that further limited access to maternal and child health services, worsened poor sanitation and led to infectious disease outbreaks (Amibor 2013). Oceania has had one of the smallest reductions since 1990, declining from 57 to 44 deaths per 1,000 live births. High mortality rates in the region are largely driven by Papua New Guinea, although Tonga, Vanuatu and Samoa have had little to no reduction since 2000.

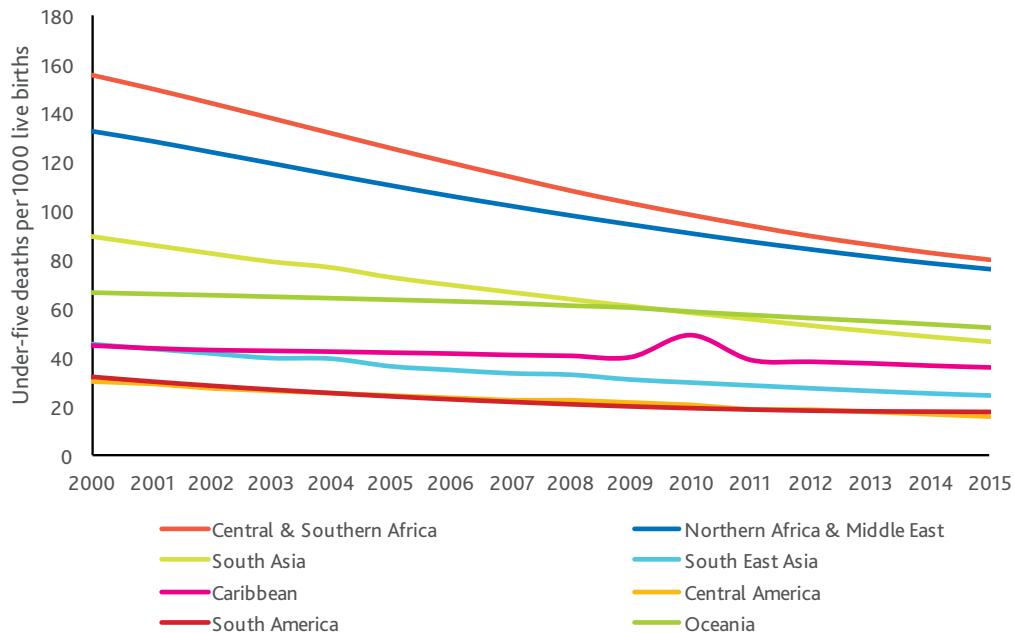


FIGURE 3.4 Under-five mortality rates across regions of the Tropics

Source of data: UN IGME (2017a)

Neonatal mortality

The first 28 days of life—the neonatal period—is the most vulnerable period of a child's life. The risk of death among children under the age of five is highest at birth and thereafter decreases steadily. Generally, progress in reducing neonatal mortality rates has been slower than that in reducing mortality rates in children older than a month (UN IGME 2017). Approximately 70% of all under-five deaths occur in the first year of life, and 40% occur within the neonatal period.

Globally since 2000, the number of deaths per 1,000 live births has declined by just over one third (Figure 3.5), and the total number of deaths has declined by just under 40%. Nevertheless, in recent years, the world has averaged more than 2.7 million newborn deaths each year.

In the Tropics, the neonatal death rate has declined from 35 to 23 deaths per 1,000 live births from 2000 and 2015 (Figure 3.5). This decline equates to almost 600,000 fewer newborn deaths in 2015.

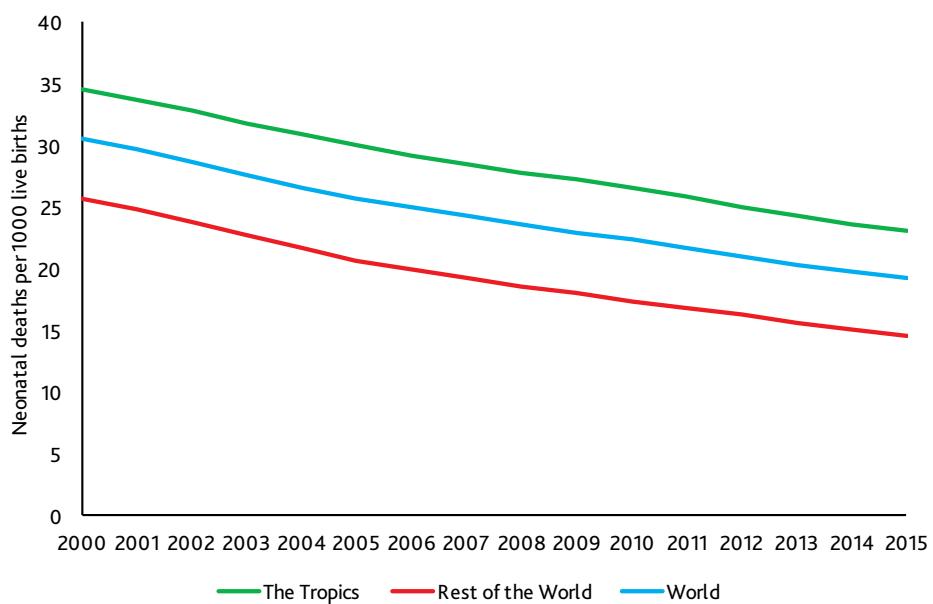


FIGURE 3.5 Neonatal mortality rates worldwide, in the Tropics and the rest of the world

Source: UN IGME (2017b)

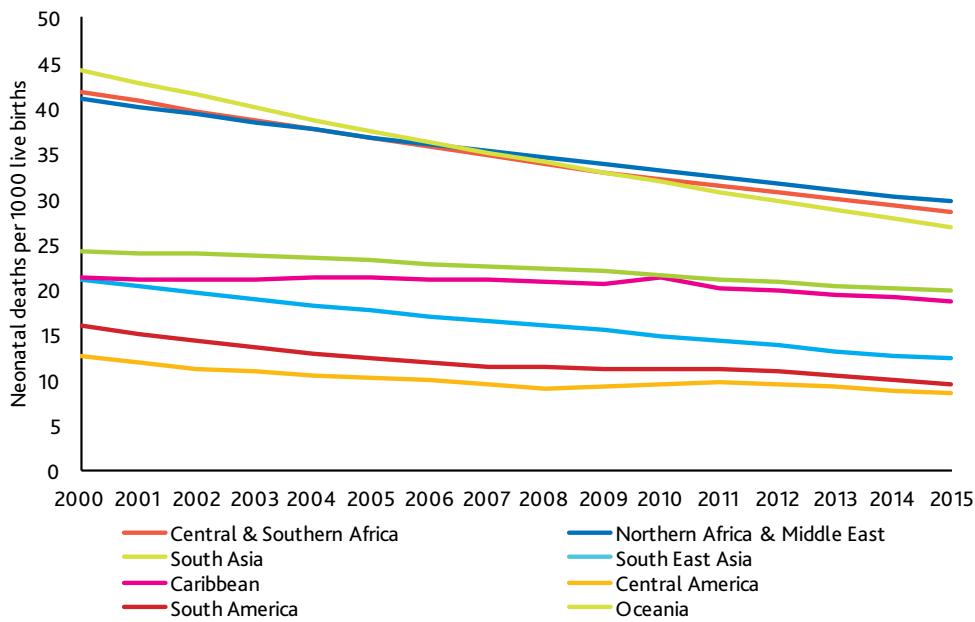


FIGURE 3.6 Neonatal mortality rates in regions of the Tropics

Source: UN IGME (2017b)

While neonatal deaths have declined universally, rates of change vary significantly between and within tropical regions (Figures 3.6 and 3.7). The greatest reduction in mortality rate has occurred in South America, where the total number of deaths has declined by 61% since 2000. Neonatal death rates have also declined notably in South Asia and Central America by 60% and 44% respectively. In South Asia, this equates to 365,000 fewer deaths in 2015 than in 2000. In the region of Northern Africa and the Middle East, the rate

of neonatal death has declined from 41 to 30 deaths per 1,000 live births, but the actual number of deaths in 2015 was only 1% less than that in 2000. While Central and Southern Africa have reduced neonatal mortality by approximately 30% over this five-year period, this region still had almost 850,000 deaths in 2015—equating to nearly half of all neonatal deaths in the Tropics and more than 30% of neonatal deaths in the world.

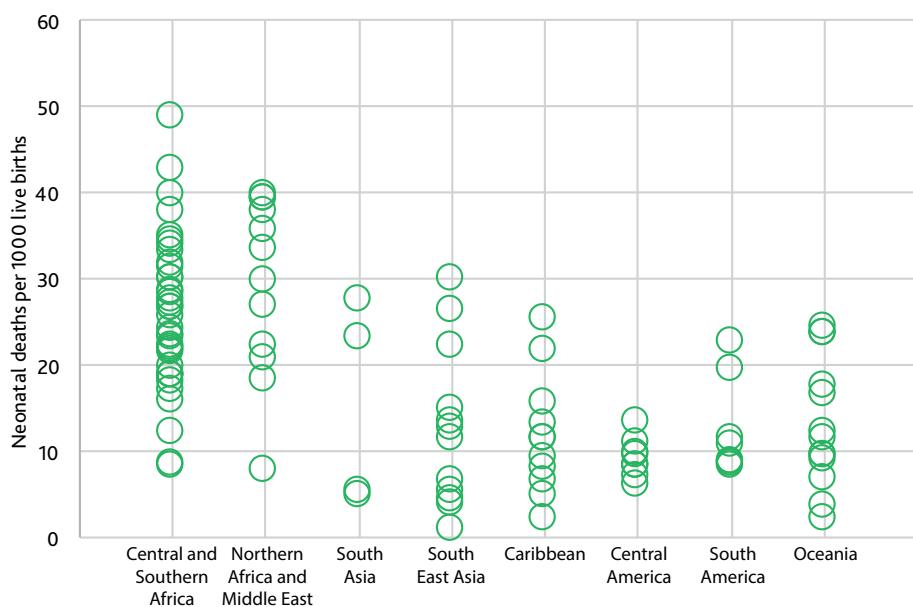


FIGURE 3.7 Neonatal mortality rates across regions and countries of the Tropics in 2015

Source: UN IGME (2017b)

While there are generally more neonatal deaths in the Tropics than the rest of the world, there is significant intra-regional variability (Figure 3.7). For example, although the region of Central and Southern Africa has the highest infant mortality rate in the world, nations such as Rwanda, Namibia and Uganda have achieved remarkable progress in recent years. Similarly, in the regions of South Asia and South-East Asia, Sri Lanka, Thailand and Malaysia now have neonatal mortality rates well under the global rate. Success in these countries illustrates that reductions in neonatal mortality can be achieved in a relatively short time period, and provide models of progress for other tropical nations.

Proportion of births attended by skilled health personnel

Access to health care is an influential factor in both maternal and child mortality. There are key health services and interventions that remain limited in many tropical countries, including family planning information; antenatal, newborn and postnatal care; emergency obstetrics; vaccination and immunisation services; and access to nutritional and rehydration supplements (UN 2016). In particular, maternal deaths are largely preventable if women have access to skilled health providers and clinics during pregnancy, childbirth and in the immediate postpartum period.

The trend data for this indicator (attendance at birth) are incomplete for many tropical nations; therefore, the most recent and available data for these nations were used and compared with corresponding MMR data for the period 2010–2016. This comparison revealed a strong relationship between MMR and the proportion of births attended by skilled health personnel in the Tropics (Fig 3.8). The highest burden of maternal mortality and morbidity tends to occur where health systems are weakest—particularly in fragile states (Graham et al. 2016).

Adolescent pregnancy

The presence of skilled health workers and clinics alone is often not enough to overcome barriers to maternal and child health and wellbeing. Social and cultural contexts are also highly influential. Pregnancy at an early age often translates into a high fertility rate and higher risks for the woman and her children (Nagata 2017). Poor education and poverty is a factor contributing to adolescent pregnancy. Early motherhood further compounds this disadvantage, disrupting schooling and limiting future opportunities to generate income (Nove et al. 2014). Adolescent mothers are also less likely to access health care for various reasons, increasing the risk of mortality and morbidity associated with childbirth (Nove et al. 2014).

In 2015, almost one in 10 girls aged 15–19 gave birth in the Tropics (Figure 3.9), a rate much higher than in non-tropical areas. However, the proportion of adolescent mothers in the Tropics has almost halved since 1960—mostly attributable to progressive marriage and family planning policies in many countries and to the fact that more girls are remaining longer in school.

Nonetheless, progress has been much slower in certain tropical countries. Despite reductions in adolescent pregnancy, it remains very high in Central and Southern Africa, which is closely followed by Northern Africa and the Middle East. In both regions, the rate of adolescent pregnancy has declined by just over a third since 1960—a much slower improvement than that seen in other regions, particularly in South Asia (73% reduction) and South East Asia (57% reduction). Reductions in adolescent pregnancy during this period in the Caribbean, Central America, South America and Oceania have all been comparable (49%, 48%, 40% and 46% respectively).

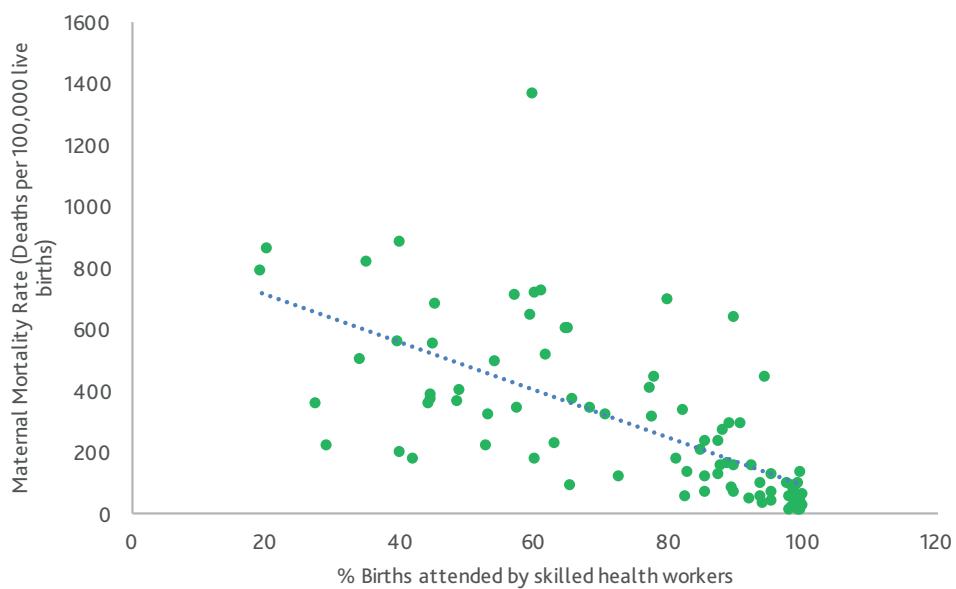


FIGURE 3.8 The relationship between maternal mortality ratio and birth attendance by a skilled health worker in tropical countries and territories (based on latest available data)

Source: Joint UNICEF/WHO database (2018), UN IGME (2017b)



IMAGE: MARCO DORMINO, UN PHOTO



IMAGE: DOMINIC CHAVEZ, WORLD BANK

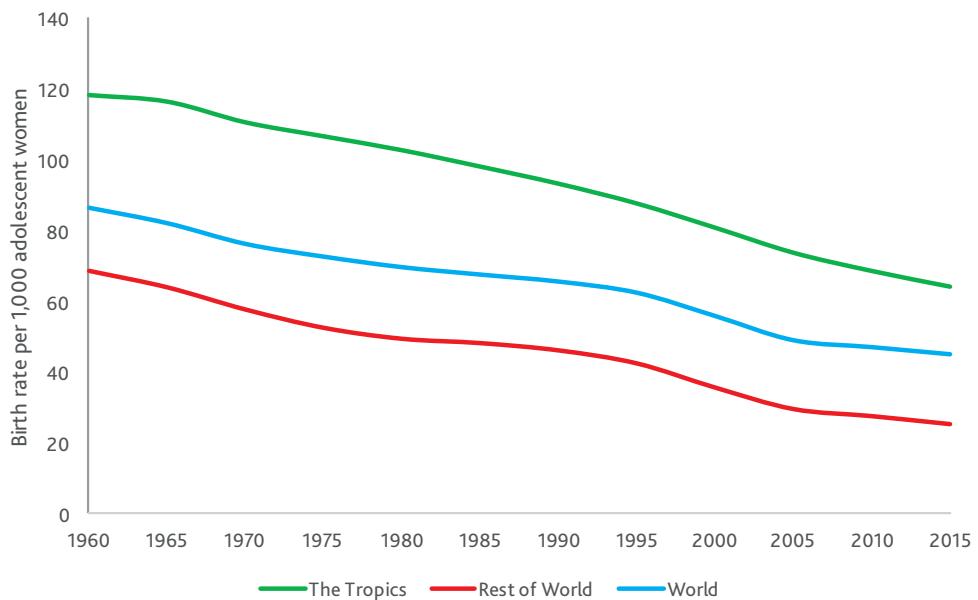


FIGURE 3.9 Birthrate per 1,000 adolescent women (aged 15–19) in the Tropics and the rest of the world

Source of data: World Bank (2018)

The reductions in adolescent pregnancy in South Asia since 1990 have been particularly impressive. Since its peak in the early 1980s, the adolescent fertility rate for the region is now just over 30 births per 1,000 adolescent women, the lowest in all tropical regions and comparable to high-income countries. This improvement, driven primarily by efforts in India, is largely attributed to dedicated campaigns to improve education for girls and increase awareness of, and access to, contraceptive technology including pharmaceuticals (Aguayo & Paintal, 2017).

Although there has been an overall decline in adolescent pregnancies in South East Asia since 1960, the trend of decline has stalled since the early 2000s. These trends have largely been driven by Thailand and the Philippines. In Thailand, a lack of knowledge of sexual intercourse, reproductive health and contraceptive methods, alongside changing social expectations and more permissive attitudes towards dating and premarital sex relative to previous generations, are thought to be contributory factors (UNICEF 2015). Similar factors may be involved in the Philippines, where the age of consent is only 12 years of age, even though girls younger than 18 require parental permission to access contraception (United Nations Population Fund et al. 2015).

economic, social, and cultural factors to drive disparities between the nations of the Tropics and the rest of the world.

Disease

Women are more vulnerable to disease when pregnant. In the Tropics, particularly in tropical Africa, women face a cycle of risk after becoming pregnant, with increased vulnerability to acquiring malaria and HIV infection (see Chapter 2). Additionally, HIV positive women are at increased risk of developing complications from malaria while pregnant, such as extreme levels of anaemia (Bailey et al. 2015). HIV infection during pregnancy has been demonstrated to increase the risk of maternal death by up to eight times, suggesting that programs to improve maternal health should pay special attention to women who are HIV positive and to the prevention of HIV infection during pregnancy (Zaba et al. 2013).

Zika virus, a mosquito-borne tropical disease that can also be sexually transmitted, originated in Africa but has since spread throughout the Tropics as well as several regions outside it. It almost exclusively threatens the health of pregnant women and their foetuses (Krow-Lucal et al. 2018). Symptoms of infection in adults generally appear mild, and individuals who carry the virus may not realise they are infected. The relationship between a Zika virus infection during pregnancy and serious birth defects, including brain abnormalities and microcephaly, was only recognised in 2016 following a widespread epidemic in Latin America (Krow-Lucal et al. 2018). Efforts to address this problem have only served to highlight the contradictions between global and national health policies and women's reproductive rights, which are limited in many Latin American countries (Johnson 2017). For example, women in El Salvador were advised to avoid pregnancy for 2–3 years or until the epidemic was under control. However, in a country with limited access to contraception, where abortion is illegal, and women have

3.4 THE TROPICAL PERSPECTIVE

While the health and wellbeing of women and children have been identified for global attention, there are specific conditions and challenges unique to the Tropics that further exacerbate their inherent vulnerability. Higher disease burdens, specific environmental conditions, risk from natural disasters and the inherent vulnerability of tropical communities to climate change all combine with

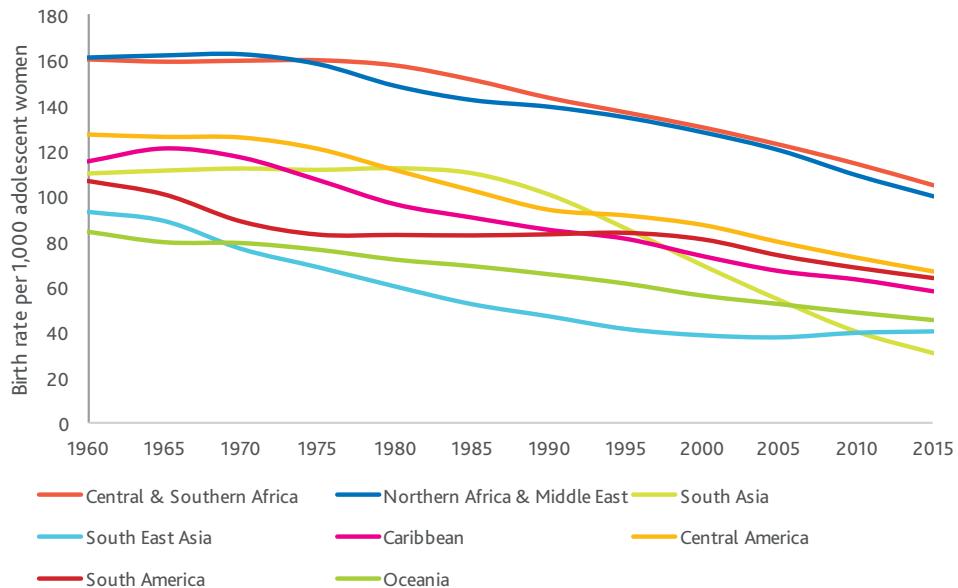


FIGURE 3.10 Birthrate per 1,000 adolescent women (aged 15–19) across regions of the Tropics

Source of data: World Bank (2018)

limited family planning options, such a policy was unlikely to be effective (Johnson 2017).

Risk of natural disaster

In addition to a higher disease burden, the Tropics also has unique environmental conditions and climate with potentially significant effects on maternal and child health and wellbeing. For example, floods are one of the most common forms of natural disaster worldwide. However, as a result of high rainfall and tropical storms, floods are often more frequent in the Tropics where their impact is also disproportionate because of the high levels of poverty in tropical communities. Tropical regions of Asia, for example, experienced nearly 50% of all flood-related fatalities between 1975 and 2000 (Jonkman & Kelman 2005).

Women and children are especially vulnerable to both direct and indirect effects of tropical weather disasters. The direct effects include injury and drowning. For example, children have the highest rates of mortality from drowning, with those under five years of age being particularly vulnerable (WHO 2014). The indirect effects of such weather disasters causing mortality and morbidity in children and women include microbial contamination (sewage), chemical contamination (fertiliser, pesticides, heavy metals), mould growth, malnutrition, water-dependent vector-borne diseases and effects on mental health (Mallett & Etzel 2017).

Floods and tropical storms can also have notable impacts on the physical and mental health of pregnant women: they prevent women from accessing health care and place greater stress on pregnant mothers that may lead to anxiety and depression, which are associated with poorer pregnancy outcomes (Mallett & Etzel 2017). Prenatal flood exposure has a strong correlation with poor pregnancy outcomes (Mallett & Etzel 2017).

Climate change

Climate change is likely to affect women and children disproportionately, particularly in the Tropics. Infants and children are vulnerable to dehydration and heat stress because they have a greater surface to volume ratio: heat-related deaths during heatwaves involve more infants and children than other age demographic (Stanberry, Thomson & James 2018). In addition, children's underdeveloped respiratory and immune systems and higher rates of respiration mean that they are more likely to be affected by respiratory disease, allergens and air pollution (Stanberry, Thomson & James 2018).

Further, given that pregnant women and children are more susceptible to infectious diseases, it is likely that climate change could broaden the range of infectious diseases to which they are susceptible and therefore, increase risk of infection.

3.5 LOOKING FORWARD

The critical importance of women and children to global development is explicitly recognised by the global community in the 2030 Agenda and specifically enshrined in the targets of SDGs 3 and 5. To ensure that the gains of recent decades are not undermined by changing economic, social and environmental conditions, women and children should be the focus of strategies to improve health in the Tropics.

In the Tropics, it is essential that more girls and women are supported to access higher levels of education to enable them to plan for their futures. Women who have a secondary school education are more likely to delay marriage and pregnancy

until later in life, have fewer children, and have better maternal outcomes. Additionally, ensuring that a properly trained health workforce of skilled physicians, nurses and midwives is available to support women throughout pregnancy and early motherhood should be a focus of universal health care programs worldwide.

Allowing families, and women, in particular, to determine freely the number and spacing of their children and to select how this may be achieved, can reduce poverty and child and maternal mortality, empower women and contribute to environmental sustainability (Cleland et al. 2006). The children of women who have access to family planning and health services are healthier and better educated than those without such access (Canning & Schultz 2012).

Many tropical countries have appropriate population and family planning policies but are not receiving sufficient encouragement and funds for their implementation (Cleland et al. 2006). Going

forward, family planning will be essential to improving the health outcomes of women and children and thus, whole families and communities in the Tropics.

An important focus for future strategies to improve maternal and child health in the Tropics and worldwide will be to combat the rising incidence of NCDs, particularly in low- and middle-income nations. The increasing incidence of NCDs among pregnant women, particularly in the Caribbean and Oceania, threatens to diminish some of the considerable gains in recent decades in maternal mortality and morbidity.

Finally, acknowledging the vital contribution that global environmental change—including a warming planet—has and will have on the health and wellbeing of women and children is essential for sustainability planning and ensuring future health in the Tropics.

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COMBATING CHILDHOOD DIARRHOEA IN BANGLADESH

KEY MESSAGES

Innovation, a dedicated hospital and research centre, political commitment, and socio-economic improvement means that Bangladesh has become a world leader in combating childhood diarrhoeal diseases.

- Sustained political commitments over time to address the endemic problem of diarrhoea have been assisted by support from the health, education and infrastructure sectors
- Government and non-government actors were important
- The development of Oral Rehydration Solution (ORS) by icddr,b is considered a 'game changer' in global diarrhoeal illness management.
- Therapeutic Zinc can shorten the duration of diarrhoea and prevent future cases

DIARRHOEAL DISEASE IN THE TROPICS

In 2016, diarrhoeal disease was the fifth leading cause of death among children younger than 5 and kills just under half a million children every year (Global Burden of Disease Collaborative Network, 2017). In some regions of the Tropics, particularly in tropical Africa it is the leading cause of death in children (See Chapter 2). A number of pathogens cause diarrhoeal diseases including bacteria (cholera, shigella, salmonella, *Escherichia coli*) and viruses (rotavirus) (Walker et al., 2013). Risk factors include undernutrition, inadequate water, sanitation and hygiene, and overcrowding. Childhood diarrhoeal is an enormous health burden in the Tropics, particularly in low and low middle income countries.

Bangladesh is one of the most populous countries in the Tropics and historically suffered a heavy health burden and notably high rates of child mortality. Between 1993 and 2015 however, Bangladesh successfully reduced the incidence of under-five diarrhoeal disease substantially and was one of only a few nations that achieved the Millennium Development Goal for maternal and child health. Child mortality rates in Bangladesh fell more than 75% during that period.

A MULTI LAYERED APPROACH: WOMEN, INFRASTRUCTURE AND THERAPEUTIC INTERVENTIONS

The success demonstrated by Bangladesh is the result of a number of interconnected drivers and initiatives including economic growth, education, medical innovations, infrastructure improvements, sustained political commitment, and non government actors to improving outcomes for women and children.

Since becoming independent in 1971, Bangladesh has experienced impressive economic growth, particularly since the beginning

of the twenty-first century. Alongside sustained improvement in economic conditions, female education and women's empowerment have paralleled improved maternal health and childhood nutrition indicators. Adult female literacy rates in Bangladesh have increased dramatically (from 18% in 1981 to 70% in 2016). Ongoing women's empowerment programs such as micro-finance have also played a role.

Other drivers external to the health system include upgrades to water and sanitation infrastructure and education and infrastructure supporting improved hygiene – particularly among slum dwellers. Diarrhoea causing pathogens such as cholera are often waterborne, while others can be food borne (Salmonella, E-Coli), and the most common cause of diarrhoeal disease, Rotavirus, is spread through human contact.

Therapeutic interventions have also taken place particularly Oral Rehydration Solution (ORS) – the innovative mixture of water, sugar and salt which was developed by scientists at the International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b). In the 1970s, the Bangladesh Rural Advancement Committee(BRAC), a Bangladeshi NGO which has become the largest in the world, in collaboration with icddr,b devised a process to teach mothers to make the mixture at home. Beginning in 1980, more than 12 million Bangladeshi mothers were taught to make Oral Rehydration Solution at home, a step which is believed to have saved countless lives. A key aspect of this program included large investments for the deployment of community health workers (particularly women) by BRAC, which helped achieve a rapid uptake of community-based interventions like ORS (Perry et al., 2013).

Additionally, a number of public sector health initiatives were introduced including the establishment of a communicable disease control program in 1970; WHO's control of diarrhoeal disease (CDD) in 1989, and the adoption of the integrated management of childhood illness (IMCI) strategy under the Health and Population Sector Programme (1997-2002).

It is impossible to credit a single one of these actions with the comparative success of Bangladesh of dealing with this problem. Committed public policy, a dedicated hospital and research centre, programs targeting women, and ongoing socio-economic improvement have all contributed to undeniable success.

IMPLICATIONS FOR THE BROADER TROPICS

The health and wellbeing of our community's most vulnerable should be used as an indicator of the health system in general. This case study clearly demonstrates that improvements in education (particularly of women), infrastructure, and community health outreach are all necessary to show clear improvements in child health outcomes.

Other tropical regions would benefit from the Bangladesh model, particularly in many parts of sub-Saharan Africa where diarrhoeal diseases persist as a major contribution to death and disability in children. Bangladesh shows clearly that this is a problem than cannot be solved by medical intervention alone but can be solved.

Improving education outcomes for women and girls; ensuring that economic growth provides appropriate opportunities for many and not just a few, and delivering person to person interactions are all part of combating this tropical health challenge.

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IMAGE: LAURA ELIZABETH, BREAD FOR THE WORLD

4

NON-DISEASE HEALTH BURDEN IN THE TROPICS



SUMMARY

- Undernourishment, substance abuse, mental health and accident and injury are important causes of mortality and morbidity globally and in the Tropics.
- After several decades of progress with improving rates of undernourishment, there has been a reversal of trends since 2013. Between 2013 and 2015, the number of people in the Tropics experiencing undernourishment increased by 15.4 million.
- People in the Tropics generally consume less alcohol than the rest of the world; however, consumption is high in South America, Oceania and Central and Southern Africa. Unrecorded alcohol use is an ongoing challenge, particularly in tropical Africa and South-East Asia.
- The reported suicide rate in the Tropics is generally lower than in the rest of the world. However, the number of deaths from suicide in the Tropics has increased since 2000. As a result of the stigmatisation of suicide in many nations, many suicide-related deaths and injuries are unreported or reported as other causes of death and disability.
- Road traffic-related injuries are the leading cause of death among young people aged 15–29. The mortality rate from road traffic accidents has increased in the Tropics since 2000. In 2013, the Tropics accounted for more than 50% of all recorded road accident deaths despite only representing 27% of the world's registered vehicles.





4

4.1 INTRODUCTION

Although disease is the ultimate cause of death for most people, several other notable health issues and risk factors can cause death and disability. While these health issues and risk factors occur globally, they vary regionally because of environmental, socio-economic, and cultural factors.

Undernourishment, a condition often caused by external factors such as conflict and drought, is a major risk factor for health conditions. Undernourishment leads to greater vulnerability to infectious diseases and is a risk factor for non-communicable diseases such as cardiovascular disease and cancer.

Death and disability due to injury, whether through violence, accident or self-harm, have considerable consequences on people and communities. Globally, Almost one-quarter of injury-related deaths are the result of self-harm and homicide, while road traffic injuries account for a further 25% (Chandran, Peek-Asa & Hyder 2010). Other causes of injury-related deaths include falls, drowning, burns, poisoning (including alcohol poisoning), and conflict.

Death and disability caused by accident and injury can also indicate governance issues and poor or lack of access to quality emergency trauma care and rehabilitation services (Chandran, Peek-Asa & Hyder 2010).

2030 Agenda—Relevant Sustainable Development Goals and Targets

BOX 4.1

Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Target 2.1: By 2030, end hunger and ensure access by all people, in particular, the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round

Goal 3: Ensure healthy lives and promote well-being for all at all ages

Target 3.4: By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.

Target 3.5: Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol

Target 3.6: By 2020, halve the number of global deaths and injuries from road traffic accidents

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Target 11.2. By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

Source: United Nations [UN] 2017

4.2 INDICATORS

Food security (Undernourishment)

Undernourishment occurs when a person's diet does not provide sufficient energy to perform daily tasks. The prevalence of undernourishment is a measure of the proportion of the population who have a caloric (dietary energy) intake that is insufficient to meet the minimum energy requirements defined as necessary for a given population (Food and Agriculture Organization of the United Nations [FAO] et al. 2018). Undernourishment is often driven by factors such as weather patterns, especially drought, and conflict.

Substance abuse (Alcohol consumption)

Alcohol consumption can affect the incidence of disease, injuries and other health conditions. It has been identified as having direct and indirect impacts on maternal and child health, infectious diseases, non-communicable diseases, mental health, injuries, accidents and poisonings (World Health Organization [WHO] 2018a). It is quantified as per capita alcohol consumption per year. Per capita alcohol consumption is widely accepted as the best possible indicator of alcohol exposure in a population and a key variable for estimating both the disease burden and deaths that are attributable to alcohol (WHO 2018a).

Mental Health (Suicide rate)

Suicide mortality rate is defined as the number of suicide deaths in a year, per 100,000 population. Mental illness and disorder occur in all nations and cultures, the most prevalent being depression and anxiety, which affect 1 in 10 people. At its worse, depression can lead to suicide. Suicide is the second leading cause of death in young people (aged 15–29) after road traffic accidents. This

indicator was selected as mental illness is generally not diagnosed in many cases and thus poorly reported.

Accident and injury (Road traffic accidents)

The death rate due to road traffic injuries is defined as the number of deaths from road traffic accidents per 100,000 people. Road traffic injuries are the leading cause of accidental deaths among young people globally and the 10th most common cause of mortality in the Tropics (see Chapter 1). It may be considered a proxy indicator of the quality of governance and infrastructure and the ability of health systems to manage trauma and injury.

4.3 TRENDS

Food security (Undernourishment)

Nutrition is the basis of good health and wellbeing. Undernourishment, which occurs when a person's diet does not provide sufficient energy and nutrients to perform daily tasks, can compromise the immune system, increase the risk of illness and diminish the body's ability to absorb food and nutrients (Burgess & Danga 2012). Growing populations, poor governance, political instability, changes in food production and land use, and consumption patterns, alongside the impacts of climate change can affect food prices and the availability of food in the Tropics (State of the Tropics 2014). Producing and distributing enough food to satisfy growing populations will be a significant challenge for all nations in the future.

After several decades of progress in reducing rates of undernourishment, there have been a reversal of trends in recent

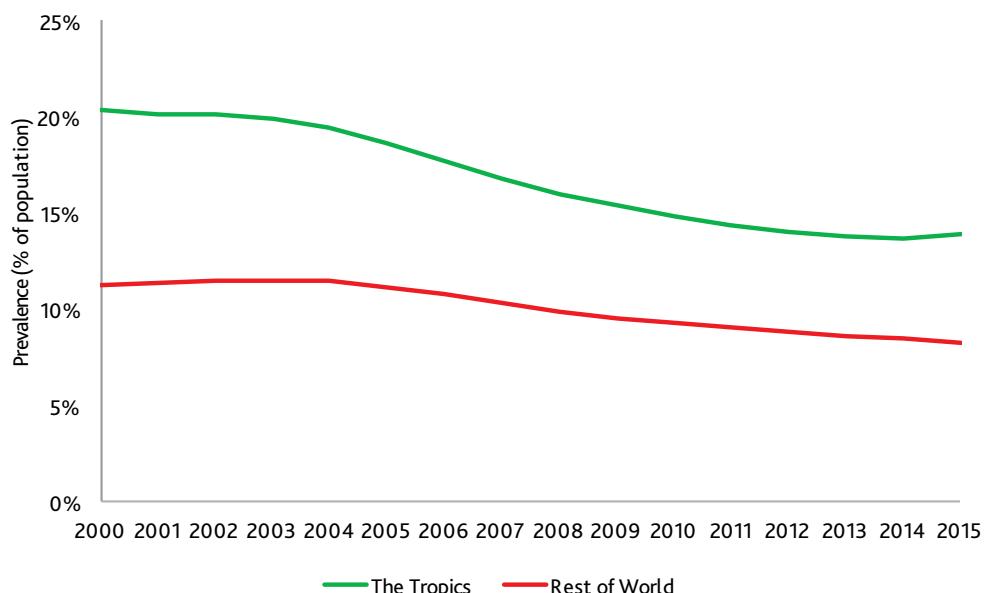


FIGURE 4.1 Prevalence (% of population) of undernourishment globally, in the Tropics and the rest of the world

Source: United Nations, Department of Economic and Social Affairs (UN DESA; 2017), World Bank (2018)

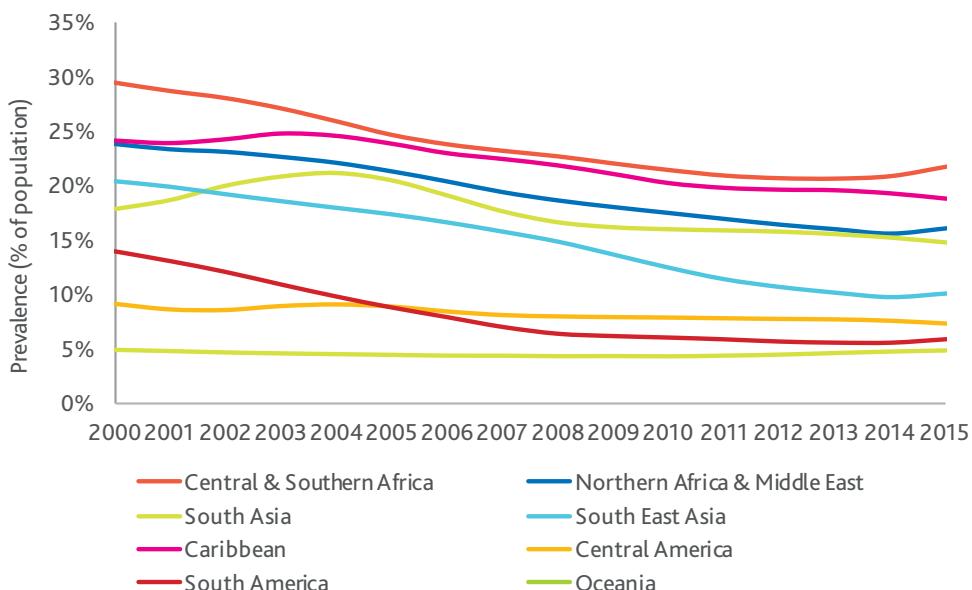


FIGURE 4.2 Prevalence of undernourishment across regions of the Tropics

Source: UN DESA (2017), World Bank (2018)

years, particularly in the Tropics (Figure 4.1). The total number of people affected by undernourishment around the world is estimated to have increased from around 804 million in 2016 to nearly 821 million in 2017 (FAO et al. 2018). Evidence suggests that much of this increase has occurred in the Tropics.

Globally, the prevalence of undernourishment was estimated to be around 11% of the world's population in 2015—down compared with 15% in 2000. Since 2010, however, there has been a change of less than one percentage point in worldwide prevalence (Figure 4.1). When population growth is considered, this represents a substantial increase in the absolute number of undernourished people since 2010.

In the Tropics, the proportion of the population experiencing undernourishment decreased from 20.3% in 2000 to 13.9% in 2015. However, between 2013 and 2015, the prevalence of undernourishment increased in the region, equating to an additional 15.4 million people who are undernourished. In the rest of the world, undernourishment has continued to decrease, albeit at a slower rate of decline since 2010.

Although all tropical regions today have a smaller proportion of undernourished people than at the turn of the century, progress has been mixed. The recent increases in undernourishment in the Tropics are driven by Central and Southern Africa, Northern Africa and Middle East, South East Asia and South America (Figure 4.2). Progress has also been slow in the remaining tropical regions, changing very little since 2010.

Several factors—internal and external to this geographical zone—contribute to food insecurity and undernourishment in the Tropics. Increased undernourishment in Central and Southern Africa, in the context of rapid population growth, reflect the effects of drought,

conflict, rising food prices and slowing economic growth (FAO et al. 2018; United Nations Office for the Coordination of Humanitarian Affairs 2016). In the region of Northern Africa and Middle East, rising undernourishment is primarily driven by the ongoing conflict in Yemen. However, data are not available for Sudan, South Sudan and Somalia, which are likely affect the regional data. If such data were available, the estimates are likely to be higher.

In South Asia and South-East Asia, adverse climatic conditions, including drought and floods, are believed to be responsible for recent increases in food insecurity and undernourishment. Dry conditions in some regions and floods in others, associated with El Niño weather patterns, affected cereal production in Thailand, Myanmar and Timor-Leste between 2014 and 2015 (FAO 2017). In Indonesia, the late onset of the rainy season and erratic precipitation due to El Niño reduced and delayed planting, resulting in significant localised production losses, particularly in eastern parts of the country where poverty rates are high (FAO 2017).

In South Asia, drought in some Indian provinces and floods in Bangladesh were responsible for poor outcomes between 2013 and 2015 (FAO 2017). However, evidence suggests more favourable conditions since 2015 have reversed some of the negative trends in this region (FAO 2017).

The patterns presented here demonstrate the powerful effects of climatic conditions on undernourishment in the Tropics (FAO et al. 2018). It is clear that despite ongoing reductions in the number of undernourished people, a significant number of people in the Tropics do not have access to adequate food. Such undernourishment increases their vulnerability to preventable diseases like diarrhoea, pneumonia and measles.

Substance abuse (Alcohol consumption)

Alcoholic beverages are an important part of the social and cultural landscape of many societies. However, excess consumption can have direct and indirect effects on maternal and child health, vulnerability to infectious and non-communicable diseases, mental health, injuries, accidents, and poisonings (WHO 2018a). According to the Global Burden of Disease Study, alcohol use is a leading risk factor for the global disease burden, and the harmful use of alcohol resulted in almost three million deaths (5.3% of all deaths) globally in 2016 (Griswold et al. 2018; WHO 2018a).

Although alcohol is consumed worldwide, consumption varies significantly. Overall, most people abstained from drinking in 2016 and almost half (44.5%) of all people aged 15 or older have reportedly never consumed alcohol (WHO 2018a). Gender, age, health status, wealth, religion and culture all affect alcohol use.

Globally in 2016, adults (aged 15 years or older) consumed on average 6.4 litres of pure alcohol—which equates to 13.9 grams of pure alcohol per day. Generally, alcohol consumption is much lower in the Tropics than in the rest of the world, likely a reflection of both affluence and culture (Figure 4.3). However, there are several regions in the Tropics where alcohol consumption is high and likely to rise with growing affluence and globalisation.

Worldwide, the highest consumption of alcohol occurs in Eastern Europe and the lowest in Muslim majority countries in Africa and the Middle East. In the regions of the Tropics, the highest rate of alcohol consumption occurs in South America. There is less variation between the countries of this region than in countries of other regions. In 2016, alcohol consumption in South America ranged from 5 litres per person in Colombia to 9 litres per person in Brazil, Guyana and Peru. In Central and Southern Africa, consumption was generally high but varied from 0.2 litres per person in Guinea to as high as 11.8 litres per person in Uganda and Namibia.

In Oceania, outside of Australia and the United States (where consumption is high), alcohol consumption is generally low. In several Pacific island nations, kava, a beverage made from the root of a native plant, is used ceremonially and increasingly in social contexts often in place of alcohol (FAO & WHO 2016). Traditionally prepared kava beverages are characterised by a state of mild intoxication, followed by muscle relaxation and eventually sleepiness (FAO & WHO 2016).

There is no global consensus on daily limits on alcohol consumption to minimise health and injury risks; therefore, guidelines vary between nations and regions. Very few tropical countries have formal guidelines, although national guidelines in Australia, Hong Kong, Namibia and Singapore recommend no more than 20 grams of pure alcohol per day, which equates to two standard drinks (Kalinowski & Humphreys 2016). In Fiji, the government recommends fewer than 60 grams per day (6 standard drinks) for men and 40 grams per day for women (Kalinowski & Humphreys 2016).

Recent research suggests that most national consumption guidelines are too lenient and that the consumption threshold for the lowest risk of harm from alcohol is approximately 100 grams or less per week—this equates to fewer than 15 grams per day (Wood et al. 2018). However, results from the Global Burden of Disease Study recommend that no amount of alcohol consumption is safe (Griswold et al. 2018).

Using 20 grams per day as a guide, only 10 tropical countries exceeded this amount in 2016. Excluding Australia and the United States, all of these countries are in the tropical region of Central and Southern Africa. In contrast, almost 40% of the countries in the rest of the world exceeded this rate of consumption.

Although alcohol consumption appears to be less of a health issue in the Tropics than in other parts of the world such as Eastern Europe (Bobak et al. 2016), high levels of consumption are still reported in many tropical countries. High levels of alcohol consumption in regions such as Central and Southern Africa, which have significant existing health burdens from high rates of infectious diseases and diabetes, can be a costly additional health issue. Further, the perception that alcohol overconsumption is primarily a problem of developed countries may lead governments to allocate fewer resources to address alcohol-related challenges in their own countries (Jernigan & Indran 1997).

Additionally, unrecorded alcohol that is produced, distributed and sold outside formal channels is a problem in some tropical regions. Outbreaks of poisoning often occur from producing and consuming adulterated counterfeits or informally produced spirits (WHO 2018a). Such drinks are often sold in unlabelled containers in markets and in illegal drinking venues. Illicitly or informally produced alcohol may also be sold in legitimate bars, particularly in some tourist areas. Consumers may choose these drinks because they are more affordable than commercial alcohol, which is normally taxed (WHO 2014).

It is estimated that more than a quarter (25.5%) of all alcohol that is consumed worldwide is unrecorded alcohol (WHO 2014a). Within the Tropics, South-East Asia, and some countries in tropical Africa have the highest consumption of unrecorded alcohol: more than 50% (and often much higher) of all alcohol consumed in this region has informal sources (WHO 2018a). The magnitude of the problems of unrecorded alcohol is illustrated by the recent spikes in the numbers of deaths caused by poisoning from unrecorded alcohol in Kenya, Uganda, Malaysia, Cambodia, and Indonesia (WHO 2014b).

Generally, alcohol consumption is lower in the Tropics than in the rest of the world, although there are some exceptions. The challenge in the Tropics is to understand better the impacts of unrecorded alcohol and how alcohol consumption interacts with and compounds other health issues.

Suicide rate

Mental health is an integral part of a person's overall health and wellbeing. Its importance cannot be overestimated: it overlaps and



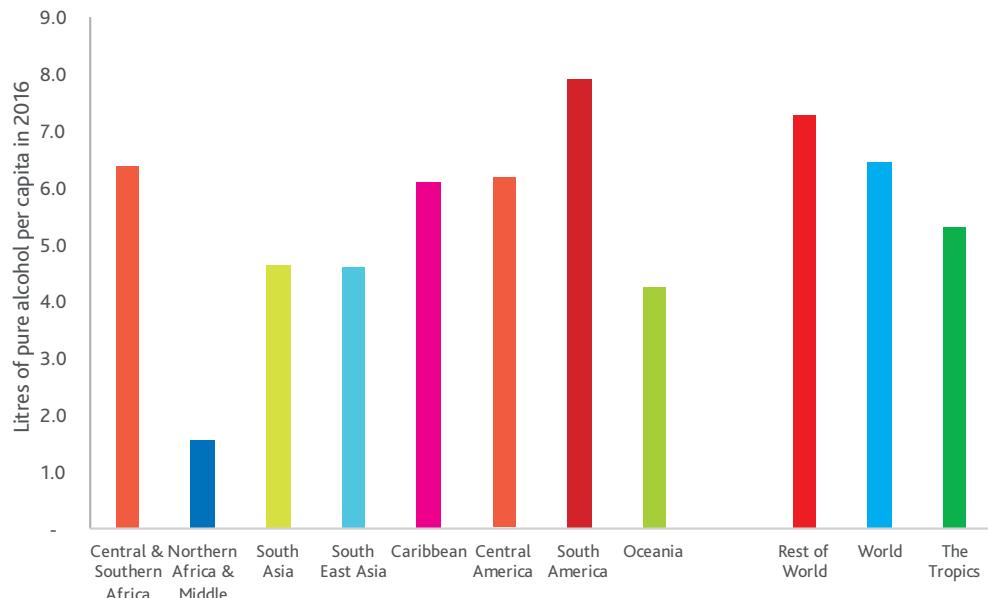


FIGURE 4.3 Litres of pure alcohol consumed per capita in 2016, in regions across the Tropics, the world and rest of the world

Source: UN DESA (2015), WHO (2018b)

is influential to the achievement of Sustainable Development Goals such as gender equality and empowerment of women, reduction in child mortality, improvement of maternal health, and reversal of the spread of HIV/AIDS.

One of the most devastating consequences of mental illness and other forms of emotional distress is self-harm and suicide. Death by suicide is an inherently complex issue that affects millions of people around the world.

Despite an acknowledgement that it contributes significantly to the global burden of disease, mental health has been relatively

neglected. Developing countries tend to prioritise the control and eradication of infectious diseases and the improvement of maternal and child health; developed countries focus on non-communicable diseases that cause early death (such as cancer and heart disease) (Prince et al. 2007). Given that over 800,000 people die from suicide every year, mental health is an important public health issue that should arguably receive considerably more attention than it has to date.

The suicide rate in the Tropics is lower than in the rest of the world (Figure 4.4). Higher rates in the rest of the world are driven by very high rates in Eastern Europe and Northern Asia, but may also

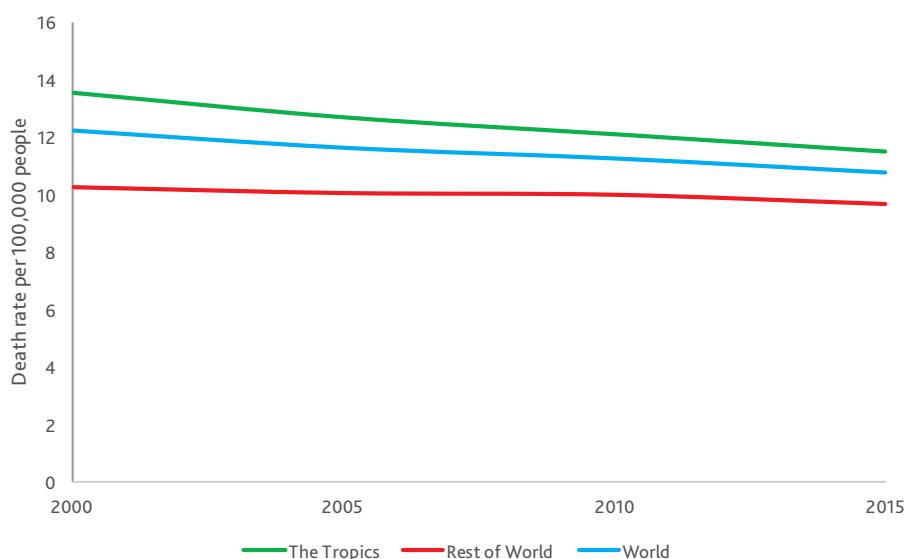


FIGURE 4.4 Suicide rates worldwide, in the Tropics and the rest of the world

Source: UN (2018), UN DESA (2017)

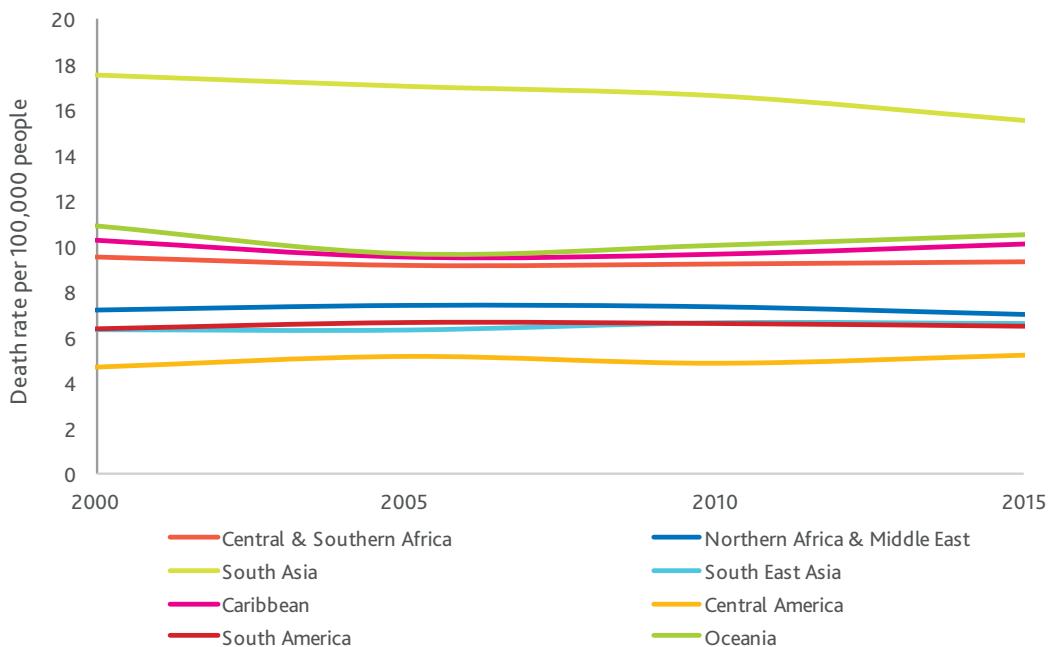


FIGURE 4.5 Suicide rates across regions of the Tropics

Source: UN (2018), UN DESA (2017)

reflect better reporting systems, particularly in North America and Europe (WHO 2014b). The suicide rate in the rest of the world decreased between 2000 and 2015, but remained constant in the Tropics over the same period.

There is considerable variation in suicide rates across the Tropics (Figure 4.5). Despite a small decline since 2000, suicide rates in the region of South Asia remain the highest in the Tropics (Figure 4.5). Indeed, the rates in most countries of this region are high, particularly in Sri Lanka. According to the WHO (2017), in 2015 Sri Lanka recorded the highest suicide rate in the world based on available data; however, a recent study suggests the rate here is much lower than WHO's estimates (Knipe, Metcalfe & Gunnell 2015). In South Asia and Oceania, self-harm is one of the top ten causes of mortality (Institute for Health Metrics and Evaluation [IMHE] 2017; see Chapter 1 Table 1.1.). Although other regions of the Tropics generally have lower suicide rates than the rest of the world, there has been little to no change since 2000. Given population growth since 2000, such relative stagnation reflects higher total deaths from suicide in all tropical regions.

Suicide is stigmatised, and in some nations officially legislated as illegal. Consequently, many suicide-related deaths and injuries are either unreported or reported as resulting from other causes, such as accident or misadventure. Of the world's 23 nations with explicit legislation that makes suicide illegal, 13 are in the Tropics (Mishara & Weisstub 2016).

Suicide is a complex issue that may be influenced by numerous interrelated causes. Mental health, particularly depression, is widely recognised as the most influential risk factor. However, a number of other factors also correlate with suicide rates, including economic

recession, gun availability, daylight patterns (in zones of high latitudes only), divorce laws, media coverage of suicide, and alcohol abuse (Lee, Roser & Ortiz-Ospina 2018). Given the complexity and variability in suicidal behaviour between communities, across demographic groups and over time, interventions need to occur at every level, from the global to the individual level.

Road traffic accidents

More than 1.2 million people are killed in road traffic accidents each year (WHO 2015). As cities and people's incomes grow and technology improves, more people are using motorised transport than at any time in history, putting themselves at greater risk of accident. In addition to those travelling in motor vehicles, pedestrians and users of non-motorised transport are also at increased risk, particularly in fast-growing and poorly planned cities. Road traffic accidents are the leading cause of death among young people aged 15–29 years worldwide (IMHE 2018).

Despite the increasing rates of urbanisation and vehicle ownership, the rate of deaths worldwide caused by road traffic accidents has remained relatively constant since 2000. Between 2007 and 2014, the number of registered vehicles worldwide grew by 16%; by comparison, the global population grew 4% in the same period (WHO 2015).

In the Tropics, the mortality rate from road traffic accidents increased marginally between 2000 and 2013: this represents an overall increase in deaths of nearly 150,000 deaths per year by 2013 (Figure 4.4). The mortality rate in the Tropics is significantly higher than that in the rest of the world, despite there being fewer vehicles per head of population in the Tropics. Although this zone has 27% of the world's registered vehicles and 40% of its

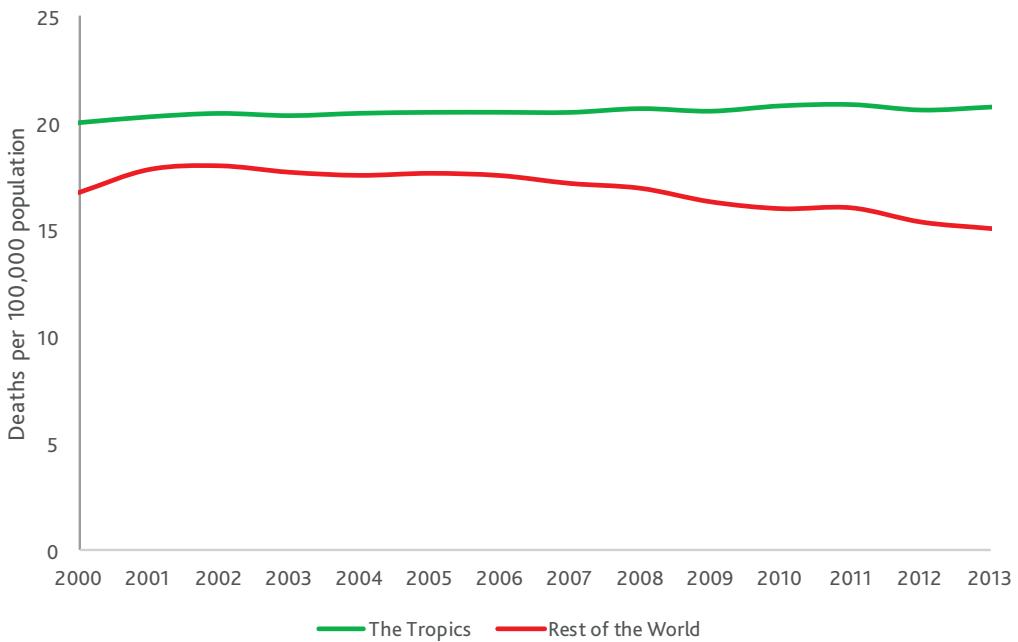


FIGURE 4.6 Number of deaths caused by road accidents per 100,000 people in the Tropics and in the rest of the world

Source: UN DESA (2017), WHO (2015)

population, it had more than 50% of all recorded road accident deaths in 2013 (WHO 2018b).

The region of Central and Southern Africa has the highest mortality rate of all the tropical regions, despite having fewer registered vehicles than South Asia, South East Asia and Central and South America (Figure 4.7). The region of Northern Africa and Middle East also has high road traffic mortality rates. Many of the nations

in these regions have poor road infrastructure, limited capacity to effectively enforce road rules and often lack comprehensive rules and/or regulations on urban speed limits, wearing of seat belts, wearing of motorcycle or bicycle helmets or driving under the influence of alcohol (Haagsma et al. 2016).

The increase in road traffic mortality in South America (Figure 4.7) is likely a result of the growth of motorised transport use and

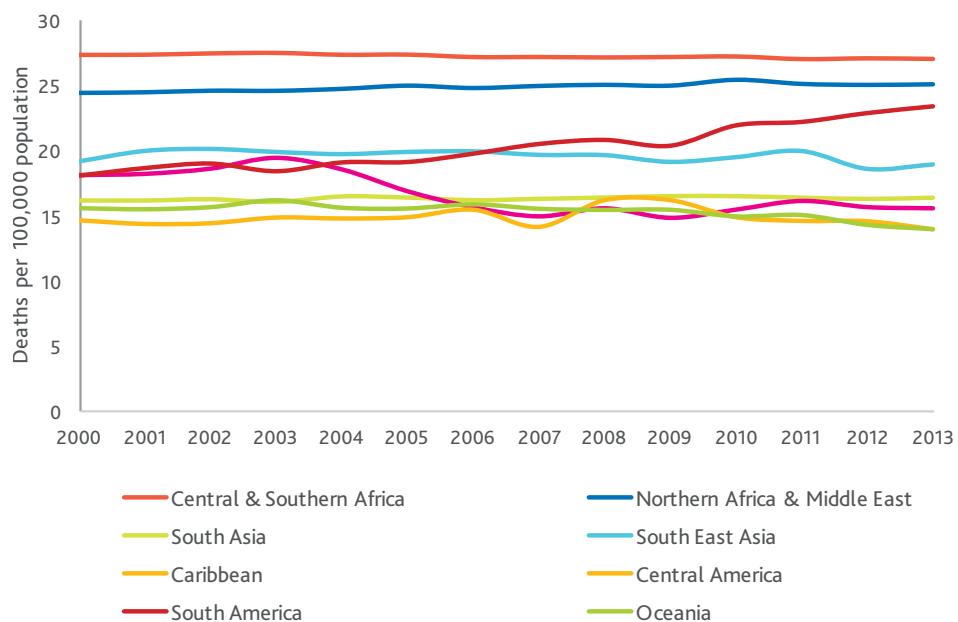


FIGURE 4.7 Number of deaths caused by road accidents per 100,000 people in regions of the Tropics

Source: UN DESA (2017), WHO (2015)

traffic density outpacing infrastructure development and poor law enforcement (Haagsma et al. 2016). Brazil is an example where poor or lack of pedestrian safety has persisted and a rise in motorcycle ownership has led to a greater number of related deaths since the turn of the century (Chandran et al. 2012).

In South-East Asia, the number of deaths due to road traffic accidents have remained consistently high at around 20 deaths per 100,000 people between 2000 and 2013 (Figure 4.7), with increasing industrialisation and motorisation the likely causes of such high rates across the region. Mortality rates in this region are highest in Thailand, Vietnam and Malaysia. All of these nations have high proportions of two- and three-wheeled vehicles, a factor that increases the risk of death on the road. Although there are laws in place for compulsory helmets, there is poor adherence. In Thailand, where the death rate is the highest, 74% of mortalities are motorcycle riders (Berecki-Gisolf et al. 2015).

Mortality rates in the Caribbean, Oceania, Central America and South Asia are comparable. However, the data on South Asia are expected to underestimate mortality rates in this region because pedestrians, bicyclists and motorcyclists are underrepresented in the data on India (Bhalla et al. 2017). Analysis suggests that police methods of reporting these deaths mean they are not consistently recorded or included in national databases as mortalities from road traffic accidents and thus, these databases under-record the number of road traffic mortalities (Bhalla et al. 2017).

4.4 THE TROPICAL PERSPECTIVE

Non-disease causes of mortality and morbidity are complex and often affected by issues outside the scope of the health system. Nevertheless, mortality and morbidity from these causes reflect wider social infrastructure and governance issues and the ability of health systems to cope with trauma. Most of the challenges discussed in this chapter have global relevance, although some aspects are unique to the Tropics.

Undernourishment in the Tropics especially is influenced by factors specific to the region, including climate effects and social conflict. Recent increases in the prevalence of undernourishment in South Asia and South East Asia has been driven by severe weather conditions associated with the El Niño–Southern Oscillation (ENSO) phenomenon. ENSO is a natural phenomenon centred in the tropical Pacific that affects ecosystems, agriculture and freshwater supplies by increasing the likelihood of hurricanes and severe weather. The consequences are vast in scale, with the lives of millions of people affected. It is particularly important in the Tropics because it affects tropical cyclone development and rainfall patterns, resulting in failed or delayed wet seasons in some parts of the Tropics.

Mortality associated with traffic accidents and self-harm is a global issue; however, it disproportionately affects young people. For people aged 5–44 years, injuries from accidents, violence, or self-harm, are one of the top three causes of death, and in those aged 15–29, road traffic injuries are the most common cause of death



IMAGE: SESE

and disability. As tropical countries generally have a much younger population than the rest of the world, they are disproportionately affected by these risks.

As mentioned in Chapter 3, drowning is a key risk in the Tropics, particularly in children aged less than five years. The majority of drownings occur in low and middle income countries where people have close daily contact with water for work, transport, and agriculture (World Health Organization 2014a). In some parts of the Tropics where flooding associated with tropical storms is an almost yearly event, drowning is a key public health issue (World Health Organization 2014a).

Rapid rates of urbanisation in tropical cities (particularly of Africa, Asia and South America) are playing an important role in accident and injury. The growth in personal vehicle ownership and high densities of motorcycles in tropical cities contribute to an increasing number of accidents. However, in many of these cities, a slow transition from motorcycles to cars is occurring, which may result in fewer serious traffic accidents and subsequently, fewer traffic-related deaths.

Urbanisation also has a known effect on suicide rates—generally a positive one. As a result of social factors in rural areas, such as higher rates of unemployment and poverty combined with greater access to means for self-harm (firearms and pesticides), people in rural areas are more likely than those in cities to attempt and succeed in self-harm.

4.5 LOOKING FORWARD

This chapter has highlighted the challenges for tropical countries concerning non-disease causes of mortality and morbidity. Given the high burden of disease in the Tropics, it is not unexpected that the health systems in these regions focus on disease prevention and cure. However, strengthening systems of health care and governance will have widespread positive impacts on causes of death and disability, whether they are disease-based or not.

Going forward, urban planning should consider public health and safety in road infrastructure, including stronger rules regarding helmets, seatbelts and alcohol consumption. Pedestrians, cyclists and motorcyclists make up almost half of global road traffic deaths. Non-motorised transport is encouraged in many locations for health and sustainability reasons; however, they are often not included in road safety considerations. These forms of transport, such as walking and cycling, are often safer with several additional health benefits associated with physical exercise and reduced emissions.

In regions where suicide rates are high, access to firearms, pesticides and some medications can be more effectively regulated. Improvements in the quality of care for people who seek help can ensure that early interventions are effective. Additionally, communities play a critical role in preventing suicide; building individual resilience and social support within communities can help protect vulnerable persons from suicide.

Finally, rising rates of undernourishment in some tropical countries is a great concern and could be indicative of global environmental and climate change that can reverse the gains of previous decades.

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THE DOUBLE BURDEN OF DIABETES IN THE TROPICS

A GROWING DIABETES BURDEN IN THE TROPICS

Diabetes is a non-communicable disorder where the body does not produce insulin or does not use it efficiently. There are two types of diabetes identified; type 1 where the pancreas fails to produce insulin which is essential for survival and type 2 where the body progressively becomes resistant to the normal effects of insulin and or gradually loses the capacity to produce enough insulin. Both types of diabetes are complex diseases caused by multiple genetic mutations, as well as by environmental factors (World Health Organization 2019). It is considered the most common non-communicable disease (NCD) globally with more than 400 million people living with the disease in 2014 (Sobngwi and Mbanya 2015, World Health Organization 2016). Some 85–95% of the global prevalence of diabetes is attributed to type 2 diabetes (Hodgson et al. 2015).

Importantly for the Tropics, people with diabetes are at greater risk of infection from bacteria, viruses, and fungi and the condition often complicates treatment options (Dunachie and Chamnan, 2018). Diabetes affects the immune system and gut microbiome and there is evidence that hyperglycaemia may favour pathogen growth thus making sufferers more susceptible to a range of infections (Alim et al. 2017, Dunachie and Chamnan, 2018, Jenja-roen et al. 2015).

TUBERCULOSIS

Diabetes triples the risk of developing tuberculosis (TB) and increases the risk of death or treatment failure (Dunachie and Chamnan 2018). Growing rates of diabetes in the Tropics are slowing progress on TB control. Although prevalence of diabetes is higher in high income countries and TB prevalence is higher in low income countries, the diabetes burden among patients with TB is much higher (Amberbir 2019). Diabetes was estimated to account

for more than 10% of global tuberculosis deaths in 2016 (Noubiap et.al. 2019). A global study of 2.3 million TB patients estimated a prevalence of more than 15% (Noubiap et.al. 2019).

OTHER INFECTIONS

It is also recognised that people with diabetes are at greater risk of infection and other complications such as diabetic foot infection, urinary tract infections, cellulitis and various other bacterial and fungal infections (Dunachie and Chamnan 2018) including *Strongyloides* (Hays et al., 2017) and melioidosis . People with diabetes have a twelve fold increased risk of melioidosis and over half of all cases of melioidosis have diabetes (Jenjaroen et al. 2015).

Although the evidence is not as strong, there is also a known association between diabetes and dengue, where diabetes appears to increase the severity of dengue symptoms (Dunachie and Chamnan, 2018). Similar relationships have been found with West Nile fever and chikungunya disease (Dunachie and Chamnan, 2018). There is also evidence that risk of contracting malaria increases with diabetes. Research in Ghana found that patients with type 2 diabetes had a 46% increased risk for malaria infection (Ina et al. 2010).

MATERNAL EFFECTS

There is also a relationship between diabetes and maternal health. There is evidence that rising rates of type 2 diabetes in pregnancy could lead to increasing numbers of complications in pregnancy, for both mothers and foetuses (Feig and Palda 2002). Pregnant women with type 2 diabetes are more likely to be diagnosed with gestational diabetes and potentially given incorrect treatment plans (Feig and Palda 2002). Some evidence suggests that type 2 diabetes increases the risk of pre-eclampsia and peri-natal



IMAGE: MARK ZIEMBICKI

mortality and pre-term delivery (Feig and Palda, 2002). There is also evidence that diabetes in pregnancy may lead to increased prevalence of diabetes in children in at risk populations (Dabelea et al. 1998). Populations particularly at risk include Indigenous peoples of north and south America, Indigenous Australians, Micronesians, and rural Fijians (King and Rewers 1992).

IMPLICATIONS FOR THE TROPICS

There is a clear and growing collision occurring between diabetes and the world's infectious diseases. Mechanisms are in place in many tropical countries to tackle infectious diseases such as HIV, TB, and malaria, however they are often treated separately from chronic NCDs such as diabetes (Sobngwi and Mbanya 2015). Suggestions for dealing with this growing health challenge in the Tropics include: high quality, large prospective epidemiology studies to truly quantify the problem (Dunachie and Chamnan 2018); establishing joint clinics for both NCDs and infectious diseases especially in rural populations (Sobngwi and Mbanya 2015); and work on the underlying social, economic and environmental factors leading to the increase in diabetes worldwide (Amberbir 2019).

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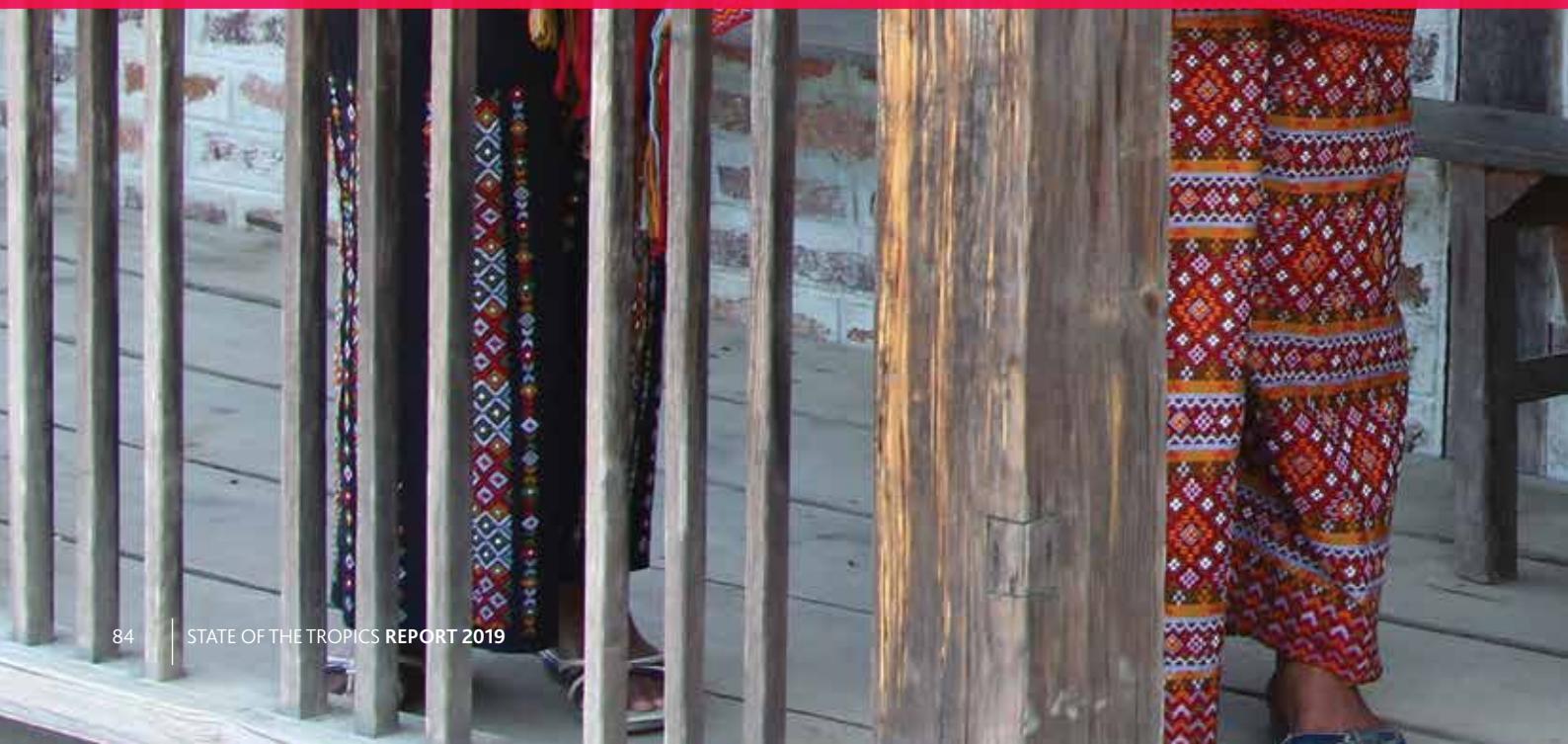
5

HUMAN CAPACITY AND INFRASTRUCTURE



SUMMARY

- Despite having a much higher health burden, the Tropics has fewer resources in terms of both human and infrastructure capacity to address this burden.
- The unbalanced distribution of health personnel is particularly acute in the tropical regions of Africa, South Asia and South America.
- The Tropics has fewer than half the number of physicians per 1,000 population than in the rest of the world. Of note, the region of Central and Southern Africa has the lowest density of physicians of all tropical regions, despite experiencing the greatest health burden.
- In addition to the shortage of skilled health personnel, a key issue is geographical and vocational maldistribution of the health workforce.
- Nurses and midwives account for more than half of the professional health workforce and are involved in about 90% of patient contact. The Tropics have far fewer nurses and midwives per 100 of population than the rest of the world. While time series data are not available, evidence suggests the number of health workers in the Tropics is increasing, although remaining below the numbers required to achieve the Sustainable Development Goals (SDGs).
- There are fewer hospitals, and fewer hospital beds available in them, in the Tropics compared with the rest of the world. The World Health Organization (WHO) recommends 3.5–5 beds per 1,000 people. Not one tropical region has reached this goal.





5

5.1 INTRODUCTION

A well-trained, fit for purpose workforce that is geographically distributed throughout a country or region is essential for any health system and is the cornerstone for universal health care. Unfortunately, many of the places with the greatest disease burden and need—and most being in the Tropics—have the fewest health workers. There is a well-known geographic imbalance in the number of health workers both within and between countries.

On 28 May 2016, the World Health Assembly adopted the global strategy of human resources for health, *Workforce 2030*, which recognises that 'health workers are integral to building strong and resilient health systems that contribute to the achievement of the Sustainable Development Goals (SDGs) and targets related to nutrition, health, education, gender, employment, and the reduction of inequalities' (World Health Assembly 2016). This statement supports the importance of strengthening the health workforce, ensuring that their skills match population need and acting to ensure more equitable access to health professionals.

The health workforce is central to the effectiveness of every health system. Higher numbers of qualified and skilled health workers are positively associated with infant, child and maternal care outcomes, immunisation coverage and effectiveness of primary care outreach (WHO 2006). The healthcare workforce is a rapidly

growing sector of the world economy and likely to continue to grow in the future (Aluttis, Bishaw & Frank 2014). In 2006, the WHO stated that there was a global shortage of almost 4.3 million doctors, midwives, nurses and other health workers (WHO 2006), and projected a potential shortfall of 18 million health workers by 2030 that needed to be addressed if universal health coverage was to be attained. The bulk of this shortfall was borne by low- and middle-income countries, many of which are in the Tropics (WHO 2006).

In addition, a High-Level Commission on Health Employment and Economic Growth report in 2016 indicated that training and financing an adequate and appropriate health workforce make excellent economic sense (WHO 2016a). For example, there is ample evidence in both high-, lower- and middle-income countries that health systems that provide good access to strong primary health care produce better outcomes at a lower cost (High-Level Commission on Health Employment and Economic Growth 2016; Starfield, Shi & Macinko 2005). This has important implications for strengthening health systems, including the training, education and continuing professional development of their workforce, their governance and the appropriate remuneration of all health workers. Extending the reach of personnel with generalist skills into rural and underserved regions is an important part of this focus.

While the previous chapters describe substantial progress in the

2030 Agenda—Relevant Sustainable Development Goals and Targets

BOX 5.1

Goal 3: Ensure healthy lives and promote wellbeing for all at all ages

Target 3b: Support the research and development of vaccines and medicines for communicable and non-communicable diseases that primarily affect developing countries.

Target 3c: Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in the least developed countries and small island developing States.

Target 3d. Strengthen the capacity of all countries for early warning, risk reduction and management of national and global health risks.

Source: United Nations [UN] 2017.

Topics on several health and wellbeing indicators, they also highlight the disproportionate health burden in this geographical zone, often in the context of health systems that are weak, unresponsive and inequitable (WHO 2006). This chapter examines the status of the health workforce and infrastructure of health systems in the Tropics.

5.2 INDICATORS

Density of physicians

The density of physicians is defined as the number of physicians, including generalists and specialist medical practitioners, per 1,000 population in the given national and/or subnational area.

Density of nursing and midwifery personnel

Density of nursing and midwifery personnel is defined as the number of nursing and midwifery personnel per 1,000 population in a given national and/or subnational area.

Health Infrastructure (Number of hospitals and hospital beds)

Health infrastructure in terms of hospitals, hospital beds, clinics and doctors directly and positively contributes to health outcomes. Data on the number of hospitals are generally only presented for developing nations and are available only for 46% of the tropical population; data for nations such as Nigeria, India, China and Brazil are not available. Despite this, the data that are available can still inform healthcare accessibility in smaller nations of these tropical regions.

In their recent reports on the health workforce, the WHO, in collaboration with the International Labour Organization and

the Organisation for Economic Co-operation and Development (OECD), has highlighted the need to consider additional issues to monitor, such as gender equity in the health workforce; integration between health, education and economic sectors; and transformative health workforce education and workforce support. However, routine measurement of these issues in all settings remains aspirational (High-Level Commission on Health Employment and Economic Growth 2016; WHO 2014, 2016b). Participation in National Health Workforce Accounts of Regional Health Workforce Observatories may also be indicative that the health system is strengthening. In addition, potentially preventable hospital admissions—assuming adequate access to primary care—is another useful aspirational indicator that reflects progress towards universal health coverage (High-Level Commission on Health Employment and Economic Growth 2016, WHO 2016b).

5.3 TRENDS

Density of physicians

A key target of the United Nations' 2030 Agenda is to strengthen the capacity of all countries for early warning, risk reduction and management of national and global health risks. Such strengthening requires both physical infrastructure and appropriate human capital. A lack of trained healthcare workers is a significant barrier to positive health outcomes worldwide (Hoyler et al. 2014). Health workers are diverse and include physicians, nurses, midwives, dentists, pharmacists, laboratory staff, environmental health workers and community and traditional health workers. As a result of limited data availability, information only on physicians, nurses and midwives are presented; however, a diversity of health workers with expertise in their fields, collaborating in integrated

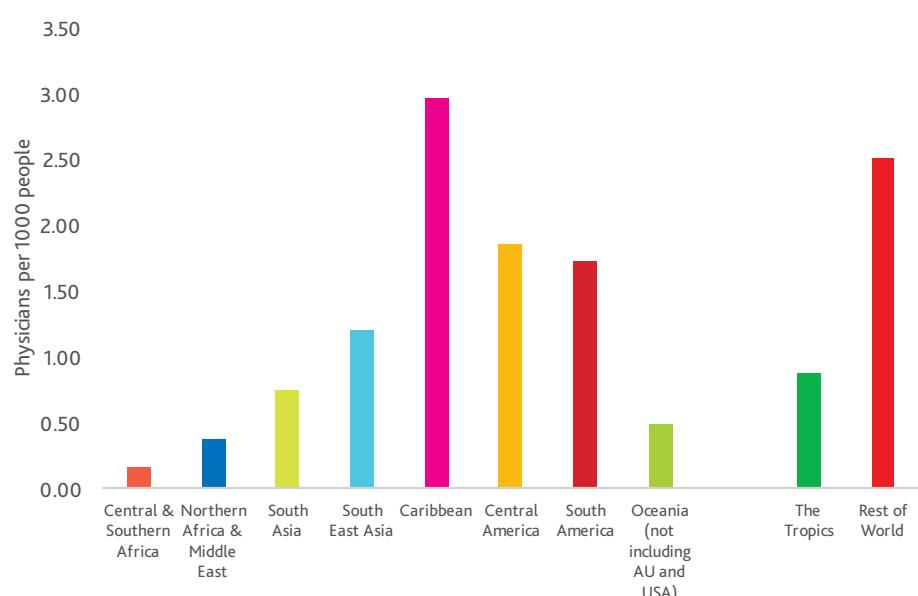


FIGURE 5.1 Number of physicians per 1,000 people in the Tropics, the rest of the world and across regions of the Tropics (based on latest available data, 2010–2016)

Source: World Bank (2018)

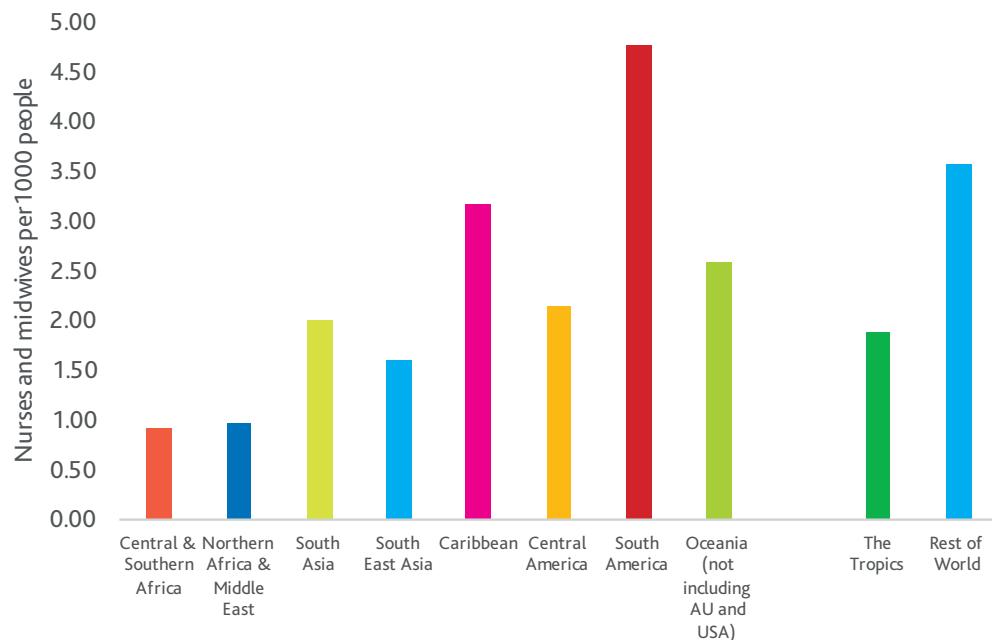


FIGURE 5.2 Nurses and midwives per 1,000 people in the Tropics, the rest of the world and across regions of the Tropics (based on latest available data, 2012–2016)

Source: World Bank (2018)

teams are required for a functional health system.

The analyses presented here are based on the latest available data from the WHO for the period 2010–2016 (Figure 5.1). There are more than double the number of physicians per 1,000 population in the rest of the world compared to the Tropics, although there is considerable variation within the Tropics (Figure 5.1). Notably, the region of Central and Southern Africa has the lowest density of physicians in the Tropics, despite carrying the greatest health burden. The Caribbean, however, has a very high density of physicians—higher than the global density—largely driven by high densities in Cuba where there has been significant and ongoing investment in health care and training since the 1950s (Cooper, Kennelly & Orduñez-Garcia 2006). The regions of Northern Africa and the Middle East, South Asia and Oceania (excluding tropical Australia and Hawaii) also have very low physician densities. Central and South America (driven by Mexico and Brazil, respectively) have higher physician density but remain lower than the rest of the world.

Two limitations in the health workforce worldwide are geographical and vocational maldistribution (Strasser & Neusy 2010): dramatically decreasing densities of physicians outside major metropolitan centres and low and declining rates of generalist health professionals throughout the OECD countries (OECD 2016).

Density of nurses and midwives

Nurses and midwives account for more than half of the professional health workforce globally, and are estimated to be involved in 90% of the contacts between patients and health professionals (Crisp, Brownie & Refsum 2018).

As for physicians, there are far fewer nurses and midwives per 1,000 population in the Tropics (excluding South America and the Caribbean) than in the rest of the world (Figure 5.2). In South America, higher densities are driven by Brazil, which has invested in growing a skilled health workforce and in 2013 launched a campaign to recruit health workers outside the country (WHO 2014). Brazil aside, based on South American countries for which data is available, the density of nurses and midwives is much lower throughout South America.

The tropical regions of Central and Southern Africa and Northern Africa and Middle East have persistently lower densities of nurses and midwives. Although there are insufficient regional data for time series estimates, there is some evidence that health worker densities have increased throughout the Tropics since the turn of the century. However, they still remain well below the densities required to achieve the SDGs (WHO 2014). Nurses and midwives have a vital role to play in the Tropics and often live in the communities they serve. When they are from those communities, nurses and midwives can understand the local customs and culture and have a patient-centred practice (Crisp, Brownie & Refsum 2018). Ongoing investment in, and training of, nurses and midwives are essential for universal health care in the Tropics.

Number of hospitals

Central America—driven by a high hospital density in Mexico—has the highest number of hospitals per capita of all tropical regions (Figure 5.3). There is high demand for doctors and health care in Mexico, given its large resident population and the fact that a significant proportion of the large Latin American population in the United States (particularly in the south) seek medical services



IMAGE: ROWENA HARBRIDGE, DFAT



IMAGE: LORRIE GRAHAM, DFAT

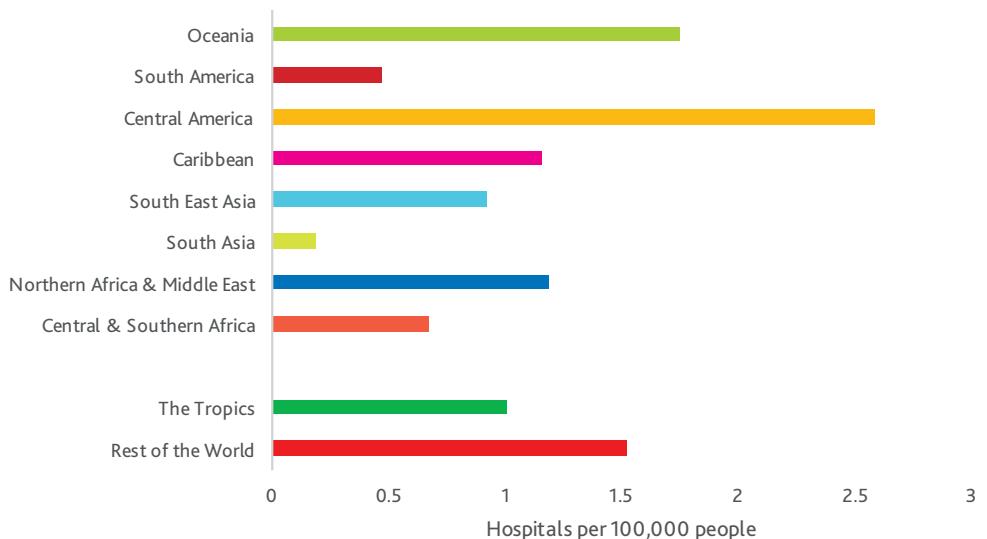


FIGURE 5.3 Number of hospitals per 100,000 people in the Tropics, the rest of the worlds and across regions of the Tropics (based on latest available data 2012-2016)

Source: WHO (2017)

in Mexico (De Jesus & Xiao 2013). A lack of continuous health insurance coverage in the United States, perception of higher quality of care in Mexico, and low English proficiency contribute to the increased likelihood of seeking health care in Mexico (De Jesus & Xiao 2013).

By comparison, Oceania appears to have a relatively high hospital density; however, its small population, distributed across a large geographical area, can frustrate access to health care. For example,

2.4 hospitals per 100,000 people in Vanuatu means that in reality, there are six hospitals spread across 65 inhabited islands.

South Asia has the lowest number of hospitals per capita in the Tropics. Despite increased investment in health infrastructure (particularly in India) in this region, health infrastructure improvements have lagged behind other regions in the Tropics (State of the Tropics 2014).

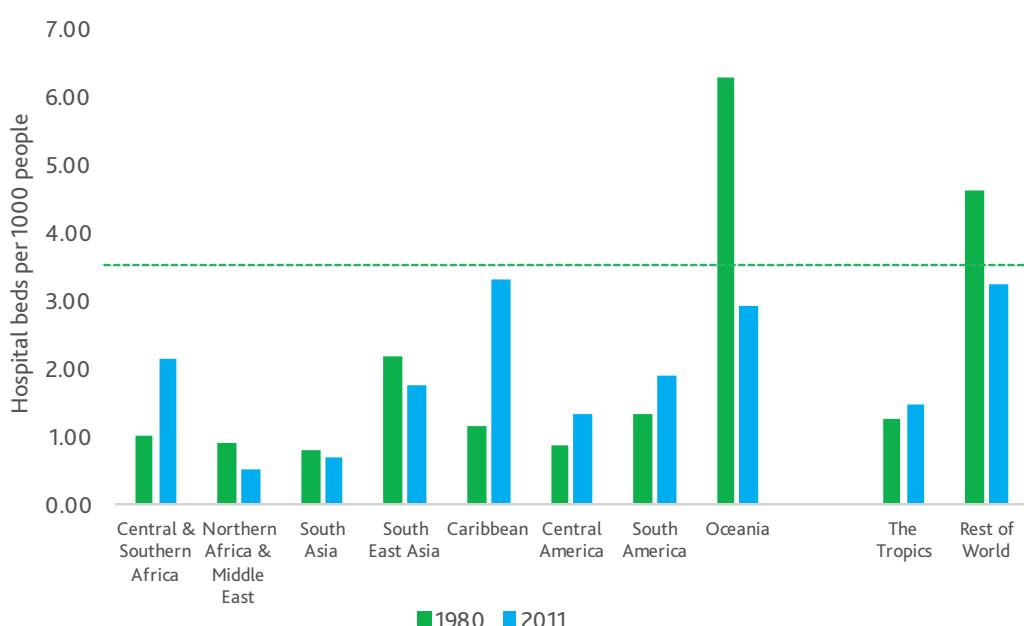


FIGURE 5.4 Number of hospital beds per 1,000 people in the Tropics, the rest of the world and across regions of the Tropics (the green dashed line represents WHO's recommendation of 3.5 beds for developing countries)

Source: World Bank (2018)

Number of hospital beds

Though the number of hospital beds per 1,000 people is an indicator of accessibility of the health infrastructure and availability of inpatient services, it does not capture access to quality health care (Figure 5.4). Although there is no global norm for the suitable number of hospital beds per 1,000 population, the WHO recommends between 3.5 to 5 beds per 1,000 people. Notably, not one tropical region reached this goal in 2011.

As an indicator, the density of hospital beds should be interpreted with caution. Fewer hospital beds per 1,000 people can reflect a strong health care system, particularly one with quality primary care. For example, in Australia, the number of beds per 1,000 people declined from 11 in 1970 to less than 4 in 2011. Rather than a lack of capacity in the health care system, this pattern reflected an improvement in preventative and primary health care necessitating fewer beds on a per capita basis. This decline in hospital beds in Australia accounted for the decline between 1980 and 2011 in Oceania.

The number of hospital beds per 1,000 population also declined in the regions of Northern Africa and the Middle East, South Asia and South-East Asia. This pattern perhaps reflects some growth in outpatient services in these regions, but more likely suggest that the development of health infrastructure has not kept pace with population growth. The increase in the region of Central and Southern Africa was driven somewhat by significant improvements in Ethiopia and Burundi, although gaps in the data make trends difficult to discern and interpret. In South Asia, the decline in the number of hospital beds has been small and occurred despite concerted efforts by the Indian government to invest in health infrastructure since the turn of the century (Gudwani et al. 2012). The large improvement in the Caribbean is driven by growth in the number of beds in Cuba and Barbados.

in the number of migrant doctors and nurses working in OECD countries over the past decade, indicating that much of the increase is sourced from countries outside of the OECD (WHO 2019). There is often impassioned policy debate around health worker migration, particularly in relation to regions with heavy health burdens. This migration is frequently referred to as a 'crisis' (Chen et al. 2004). However, quantifying this flow of health workers in a global context is difficult, as data is unreliable or anecdotal (Aluttis, Bishaw & Frank 2014; Clemens & Pettersson 2008, High-Level Commission on Health Employment and Economic Growth 2016; WHO 2016a). Where this migration has been quantified, evidence suggests these movements are significant. In 2008, 652 doctors and 3,467 nurses and midwives who were born in the Pacific were working in Australia and New Zealand (Negin 2008). There were almost as many Fijian-born doctors working in Australia and New Zealand as there were doctors in Fiji (Negin 2008).

There is consensus that health worker migration has negative effects on the source country and its health care systems; however, complexities arise in the context of increasingly globalised approaches to health care and finance. Health worker migration has been reviewed extensively elsewhere (Aluttis, Bishaw & Frank 2014; Clemens & Pettersson 2008; WHO 2014, 2019).

Although the problem of health worker migration is not specific to the Tropics, many of the major source nations (e.g., Philippines, India, Bangladesh, Nigeria) are in the Tropics and sustained international health worker migration will have long-term adverse effects on source countries, where health systems are already under pressure and understaffed. However, circular migration or the return of highly skilled migrants to their home country can mitigate some of these impacts (Aluttis, Bishaw & Frank 2014). Migration will continue to be an important and complex issue for the strengthening and sustainability of health systems.

5.4 THE TROPICAL PERSPECTIVE

The tropical imbalance

Based on the data presented here and in earlier chapters, it is clear that despite a heavier health burden in the Tropics, there are far fewer resources in its health systems, in terms of human and infrastructure capacity, to address that burden. Such an imbalance in the distribution of health personnel and infrastructure between and within countries is a worldwide, longstanding and serious problem (Dussault & Franceschini 2006), and is particularly acute in tropical countries of Africa, South Asia and to some extent South America.

Globalisation in the past few decades has led to greater mobility, particularly among those in professional occupations. There is evidence that migratory flows of health professionals from poor- and middle-income countries to more affluent countries are increasing (Aluttis, Bishaw & Frank 2014; Dussault & Franceschini 2006). The WHO estimates that there has been a 60% increase

Within-country imbalance

The urban and rural divide in the density of healthcare personnel and health outcomes is significant. Despite rapid urbanisation in some tropical regions, there remain large rural populations whose access to health care and whose health outcomes are disproportionately poor and lacking. For example in 2000, 50% of all health personnel in Nicaragua were concentrated in its capital city of Managua, even though the city was home to only 20% of the national population (Nigenda & Machado 2000). While the metropolitan areas of Bangladesh are home to only 20% of the national population, they are serviced by 35% and 30% of the nation's doctors and nurses, respectively, primarily in government roles. Even fewer health workers operate as private providers outside urban areas (WHO 2006). In Indonesia, difficult and remote locations present significant challenges for health systems: it is difficult to place doctors in remote islands, mountains, or forest locations with few amenities, little opportunity for private practice and poor communication with the rest of the country (Chomitz et al. 1998). These challenges of geography are echoed throughout the Tropics, including Oceania, Central and Southern Africa and

rural South America. For example, in Papua New Guinea a severe shortage of physicians, nurses and other health workers, coupled with challenges of data collection and reliability, compromise the delivery of healthcare services through a complex decentralised system (Grundy et al. 2019).

A multifaceted approach is required to ultimately reduce the inequitable distribution of health workers (Strasser & Neusy 2010). Most governments have some form of incentive program (incorporating a mix of financial and non-financial incentives) to recruit and retain doctors and other health workers to rural areas. In Australia, research has demonstrated young doctors generally prefer to work in urban areas, but that non-financial incentives such as larger practice size, fewer hours on call and opportunities for professional development can be greater incentives for moving to a rural area than the financial reward (Holte et al. 2015). Further, attention to appropriate selection, training and support of medical students and young health professionals can help to ameliorate these challenges (Larkins et al. 2015, Woolley, Larkins & Gupta 2019). In Botswana however, financial incentives were appealing, alongside greater opportunities for professional development, and the opportunity to live and work near family (Arscott-Mills et al., 2016).

Apart from incentives, there is also strong evidence that a rural background, or significant rural exposure in the clinical school of training, increases the likelihood of future rural practice (Kondalsamy-Chennakesavan et al. 2015). This finding suggests that creating more opportunities for rural students to pursue medical or health care careers and enabling rural practices to undertake clinical training of students in the health professions, increases the potential for a sustainable rural health workforce.

in demand, and training and support of these workers is a cost-effective health strategy. The available suggested strategies to address the skills shortage in the Tropics should improve work conditions, provide professional development opportunities and financial incentives to retain health workers. Specifically, strategies should also seek to retain those with the knowledge, skills and expertise in rural, remote and tropical health to address those health challenges unique to the Tropics.

Improving technology and communication in remote areas will facilitate the support of health workers working in isolated communities in the Tropics; however, this must be coupled with essential on-ground staff and appropriate infrastructure. There is also huge potential among the non-physician health workforce, particularly nurses, midwives, pharmacists and community health workers. With appropriate training and support, they can perform more complex procedures and broaden their scope of practice to meet local population needs. Health extension and community health workers have been shown to be vital additions to health systems, providing important stability and vital community linkages (see Case Study 4).

Tropical nations need a fit for purpose health workforce with the appropriate local knowledge, including language and culture, who are committed to remaining in the region and are equipped with the necessary infrastructure and technology to meet the unique and varied challenges of tropical health.

5.5 LOOKING FORWARD

Tropical countries and communities need more health workers with diverse skills, training and expertise, as well as training institutions that can build the required human capital for a such a workforce. It is clear that despite concerted investment and international attention to building the health workforce (World Health Assembly 2016; WHO 2006), there remains a deficit of health workers in the Tropics. There are several complex reasons for this deficit, including a lack of training opportunities and difficulties with retaining those who are trained. Further, the maldistribution of health workers across geographies and skill sets exacerbate this problem. There is no doubt that in a globalised world where health workers are in demand—particularly in the context of ageing populations in many wealthy countries—it is difficult for poorer tropical nations to provide the level of remuneration and work conditions that are equivalent to those offered in high-income countries.

Given the changing nature of health needs in the Tropics, where infectious diseases persist alongside increasing prevalence of non-communicable diseases, healthcare workers will always be

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COMMUNITY HEALTH WORKERS IN THE TROPICS

BACKGROUND

The Alma Ata Declaration on Primary Health Care in 1978 (World Health Organization, 1978) identified community health workers as one of the cornerstones of comprehensive primary health care (Lehmann and Sanders 2007). This declaration remains relevant in the pursuit of Universal Health Coverage worldwide.

The term "Community Health Worker" covers a variety of community health aides, selected, trained and working in the community from which they come (Lehmann and Sanders 2007). Often they do not have formal qualifications – many have not completed high school. Nonetheless, they are an essential part of health delivery throughout the Tropics.

Community health workers and volunteers play a key role in supplying and supporting essential health services particularly in regions where populations are non-urbanised, often without access to traditional health services, and culturally diverse. The roles and activities of community health workers are enormously diverse, sometimes changing within and between countries, being program specific or providing general support (Lehmann and Sanders 2007).

They can work on preventative, curative and or developmental work or perhaps be appointed for very specific interventions. They provide services in environments where formal health services are inaccessible and people live in poverty (Lehmann and Sanders 2007). Community health worker programs from across the Tropics can range from generalist village health workers to more specialized workers such as rehabilitation facilitators, traditional birth attendants, tuberculosis supporters and HIV/AIDS communicators (Haines et al. 2007).

Many countries and territories in the Tropics have a larger rural than urban population, however skilled healthcare personnel are generally concentrated in urban areas (See Chapter 5). Although definitions of what a community health worker is varies, a key and almost universal characteristic is that they come from the communities they serve. Using strategies to support community health workers can strengthen health delivery services (Reich et al. 2016).

There has been a strong focus on developing community health worker programs throughout the Tropics in recent decades. A campaign conducted jointly by United Nations agencies, civil societies, the private sector, and academia is currently underway to train one million community health workers in Africa (<http://1millionhealthworkers.org/>).

ETHIOPIA HEALTH EXTENSION PROGRAM

There are hundreds of examples from around the world and over decades where community health worker programs have had success (Lehmann and Sanders 2007). Conservative estimates suggest there were more than 5 million community health workers

globally in 2014 (Perry et al. 2014). The Health Extension Program in Ethiopia is considered one of the most successful examples.

Ethiopia is one of the least urbanised countries in the world; almost 80% of its population lived in rural areas in 2018 (United Nations 2019). Following almost two decades of conflict which ended in 1991, the health delivery system in Ethiopia was essentially destroyed and the country faced serious economic challenges (Banteyerga 2011). Maternal and child mortality at the turn of the century were close to the highest in East Africa (Maternal Mortality Estimation Inter-agency Group 2017) and the disease burden due to malaria, HIV/AIDS, tuberculosis, waterborne diseases, and respiratory infections was heavy (Banteyerga, 2011).

In 2003, the Federal Ministry of Health (FMOH) of Ethiopia launched the Health Extension Program (HEP) which became operational in 2004-2005 (Banteyerga 2011). In 2005, just over 7000 Health Extension Workers (HEWs) were trained to work in disease prevention and health promotion in rural villages (Banteyerga 2011). By 2020, there is expected to be over 50,000 HEWs in Ethiopia, making up almost half the health workforce in the country (Jackson 2015). HEWs are almost all women under 30 who have at least grade 10 education, making them among the highest educated women in Ethiopia (Jackson 2015).

Although it is impossible to attribute improvement in health outcomes to a single program, there have been clear improvements in key health indicators in Ethiopia since HEP's implementation (Table CS1.1). Global initiatives such as the Global Fund to fight HIV/AIDS, Tuberculosis and Malaria; the Presidents Emergency Plan for AIDS Relief and the World Bank have also contributed substantially and have helped with the implementation of HEP (Banteyerga 2011). The success of the program has received praise from international institutions including the World Bank, USAID and the World Health Organization (Jackson, 2015)

TABLE CS1.1 Progress in key health indicators in Ethiopia 2000-2015
(Maternal Mortality Estimation Inter-agency Group 2017,
Inter-agency Group for Child Mortality Estimation 2017, World
Bank 2018, United Nations 2018)

	2000	2015
Maternal mortality ratio (deaths per 100,000 live births)	1080	353
Under 5 mortality rate (deaths per 1000 live births)	145	59
HIV prevalence (%)	3.5%	1.1%
Malaria incidents (per 1000 population)	662	59

There are other notable community health worker programs across the Tropics including the village health team strategy in Uganda and Village Health Workers in Rwanda (Perry et al. 2014). Indonesia supports around 1.5 million community health workers across health, nutrition and family planning, the Rural Health Mission in

India involves 800,000 Accredited Social Health Activists; and there are more than 240,000 Community Health Agents in Brazil (Perry et al. 2014).

THE FUTURE OF COMMUNITY HEALTH WORKERS IN THE TROPICS

It is clear that non-traditional points of entry particularly for workers from rural and underserved communities, provide important resources for health care going forward and complement existing health care worker education and deployment (Reich et al. 2016). However, it is also important to avoid perceptions of second class health systems which could erode trust in community health worker programs. Primary care delivered by community health workers should be perceived to complement secondary and tertiary systems (Perry et al. 2014).

Challenges for community health worker programs going forward are scale and sustainability. Few community health worker programs have achieved the sustainability envisioned by the Alma-Ata declaration. As they are often working on the periphery of health care portfolios and donors tend to support disease or location specific initiatives, it is difficult to obtain long term funding and career aspirations (Tukengo et al. 2013). There are few career options for community health workers and lack of flexibility in where they are able to work, despite being some of the most educated members of the community (Jackson 2015). The Ethiopia experience demonstrates that providing opportunities for community health workers to expand their career options and perhaps move into more professional roles is highly desirable and might prevent attrition while building an ever more professional health workforce (Jackson 2015).

Community health workers are an essential aspect of health delivery in the Tropics. In order to achieve the necessary scale and sustainability needed in the Tropics to address its health challenges, programs have needed long term funding and training, and opportunities for the workers themselves to progress in their career and achieve greater responsibility and professionalism.

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REGIONS AND NATIONS OF THE TROPICS

The geographic area that is the Tropics is clearly defined as the region between the Tropics of Cancer and Capricorn. However, national borders do not neatly align with these lines and there are a number of nations and territories which straddle the zone. To determine which nations and territories to include in this analysis used the same two processes developed for the State of the Tropics 2014 Report. The first uses a population-based decision tool to assess whether nations partially in the Tropics be included in the Report, and the second reviews data availability to assess whether sufficient data are available to warrant a nation's inclusion in the Report. Excluded nations account for 0.1% of the tropical population.

Tropical nations to be included in the analysis, arranged by region and population estimated in 2015

*tropical population only

REGION/Nation	Population (000s)	REGION/Nation	Population (000s)
CENTRAL AND SOUTHERN AFRICA		NORTHERN AFRICA AND MIDDLE EAST	
Angola	25 022	Zambia	16 212
Benin	10 880	Zimbabwe	15 603
Botswana	2 262	Djibouti	888
Burkina Faso	18 106	Chad	14 037
Burundi	11 179	Eritrea	5 228
Cameroon	23 344	Mali	17 600
Cape Verde	521	Mauritania	4 068
Central African Republic	4 900	Niger	19 899
Comoros	788	Saudi Arabia*	12 940
Democratic Republic of the Congo	77 267	Senegal	15 129
Congo	4 620	Somalia	10 787
Cote d'Ivoire	22 702	South Sudan	12 340
Equatorial Guinea	845	Sudan	40 235
Ethiopia	99 391	Yemen	26 832
Gabon	1 725	SOUTH ASIA	
Gambia	1 991	Bangladesh*	58 829
Ghana	27 410	India*	752 424
Guinea	12 609	Maldives	364
Guinea-Bissau	1 844	Sri Lanka	20 715
Kenya	46 050	SOUTH EAST ASIA	
Liberia	4 503	Brunei Darussalam	423
Madagascar	24 235	Cambodia	15 578
Malawi	17 215	China*	162 069
Mauritius	1 273	China, Hong Kong SAR	7 288
Mozambique	27 978	China, Macao SAR	588
Namibia	2 459	Indonesia	257 564
Nigeria	182 202	Lao People's Democratic Republic	6 802
Rwanda	11 610	Malaysia	30 331
Sao Tome and Principe	190	Myanmar	53 897
Seychelles	96	Philippines	100 699
Sierra Leone	6 453	Singapore	5 604
Tanzania	53 470	Thailand	67 959
Togo	7 305	Timor-Leste	1 185
Uganda	39 032	Vietnam	93 448

REGION/Nation	Population (000s)
CARIBBEAN	41,264
Antigua and Barbuda	92
Barbados	284
Cuba	11 390
Dominica	73
Dominican Republic	10 528
Haiti	10 711
Jamaica	2 793
Puerto Rico	3 683
Saint Kitts and Nevis	56
Saint Lucia	185
Saint Vincent and the Grenadines	109
Trinidad and Tobago	1 360
CENTRAL AMERICA	144,625
Belize	359
Costa Rica	4 808
El Salvador	6 127
Guatemala	16 343
Honduras	8 075
Mexico*	98 903
Nicaragua	6 082
Panama	3 929
SOUTH AMERICA	316,808
Bolivia	10 725
Brazil*	177 916
Colombia	48 229
Ecuador	16 144
Guyana	767
Peru	31 377
Suriname	543
Venezuela	31 108
OCEANIA	13,275
Australia*	1 354
Fiji	892
French Polynesia	283
Kiribati	112
Marshall Islands	53
Micronesia (Fed. States of)	104
New Caledonia	263
Palau	21
Papua New Guinea	7 619
Samoa	193
Solomon Islands	584
Tonga	106
Tuvalu	10
United States of America*	1 414
Vanuatu	265

For large straddling nations, subnational regions to be included in the analysis

AUSTRALIA

Queensland	Western Australia	Northern Territory
Central West	Kimberley	
Far North	Pilbara	
Fitzroy		
Mackay		
Northern		
North West		

BANGLADESH

Barisal	Chittagong	Kulna
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BRAZIL

Acre	Goias	Pernambuco
Alagoas	Maranhao	Rio de Janeiro
Amapa	Mato Grosso	Rio Grande di Norte
Amazonas	Mato Grosso do Sul	Rondonia
Bahia	Minas Gerais	Roraima
Ceara	Para	Sao Paulo
Distrito Federal	Paraiba	Sergipe
Espirito Santo	Piaui	Tocantins

CHINA

Guangdong	Guangxi	Hainan
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INDIA

Andaman & Nicobar Islands	Gujarat	Mizoram
Andhra Pradesh	Jharkhand	Orrisa
Chhattisgarh	Karnataka	Pondicherry
Dadra & Nagar Haveli	Kerala	Tamil Nadu
Damon	Lakshadweep	West Bengal
Dui	Madhya Pradesh	
Goa	Maharashtra	

MEXICO

Aguascalientes	Jalisco	Quintana Roo
Campeche	Mexico	San Luis Potosi
Chiapas	Michoacan	Tabasco
Colima	Morelos	Tlazcala
Federal District	Nayarit	Veracruz
Guanajuato	Oaxaca	Yucatan
Guerrero (Warrior)	Puebla	Zacatecas
Hidalgo (Noble)	Queretaro	

SAUDI ARABIA

Asir	Jizan	Najran
Baha	Makkah	

UNITED STATES

Hawaii

ACRONYMS

ADB	Asian Development Bank	OCHA	United Nations Office for the Coordination of Humanitarian Affairs
CDC	Center for Disease Control and Prevention	OECD	Organisation for Economic Co-operation and Development
CIA	Central Intelligence Agency (USA)	PNG	Papua New Guinea
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)	SDG	Sustainable Development Goals
DALY	Disability adjusted life years	SPC	Secretariat of the Pacific Community
DFAT	Department of Foreign Affairs and Trade (Australia)	TB	Tuberculosis
ECOSOC	United Nations Economic and Social Council	UHC	Universal Health Care
ENSO	El Niño Southern Oscillation	UN	United Nations
FAO	Food and Agricultural Organisations of the United Nations	UN AIDS	Joint United Nations Programme of HIV/AIDS
GBD	Global Burden of Disease	UN CCD	United Nations Convention to Combat Desertification
GNI	Gross National Income	UN DESA	United Nations Department of Economic and Social Affairs
HIV/AIDS	Human immunodeficiency virus/Acquired immune deficiency syndrome	UN ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
IBGE	Instituto Brasileiro de Geografia e Estatística	UN HABITAT	United Nations Human Settlements Programme
IBRD	International Bank for Reconstruction and Development	UN REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation
IFAD	International Fund for Agricultural Emergency	UN WTO	United Nations World Tourism Organisation
IFPRI	International Food Policy Research Institute	UNAIDS	Joint United Nations Programme on HIV/AIDS
ILO	International Labour Organisation	UNCTAD	United Nations Conference on Trade and Development
IMF	International Monetary Fund	UNDP	United Nations Development Programme
INEGI	Instituto Nacional de Estadística y Geografía (Mexico)	UNEP	United Nations Environment Programme
IPCC	Intergovernmental Panel on Climate Change	UNESCO	United Nations Scientific, Educational and Cultural Organisation
IUCN	International Union for the Conservation of Nature	UNFCCC	United Nations Framework Convention on Climate Change
MDG	Millennium Development Goals	UNGEI	United Nations Girls Education Initiative
MDR-TB	Multi-drug resistant tuberculosis	UNHCR	United Nations High Commissioner for Refugees
MMEIG	Maternal Mortality Estimation Inter-agency Group	UNICEF	United Nations Children's Fund
MMR	Maternal mortality ratio	UNIFEM	United Nations Development Fund for Women
NASA	National Aeronautics and Space Administration (USA)	UNIGME	United Nations Interagency for Child Mortality Estimation
NHMRC	National Health and Medical Research Council (Australia)	WHA	World Health Assembly
NOAA	National Oceanic and Atmospheric Administration	WHO	World Health Organization
NSF	National Science Foundation	XDR-TB	Extensively drug resistant tuberculosis
NTD	Neglected tropical disease		

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