



Health inequality in the tropics and its costs: a Sustainable Development Goals alert

Emily J. Callander^{a,*} and Stephanie M. Topp^b

^aSchool of Medicine, Griffith University Gold Coast Campus, G05 Room 2.44, Southport Queensland 4125 Australia; ^bCollege of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville Queensland 4811, Australia

*Corresponding author: Tel.: +61 7 56780001; E-mail: e.callander@griffith.edu.au

Received 2 April 2019; revised 10 September 2019; editorial decision 11 October 2019; accepted 11 October 2019

Background: It is known that health impacts economic performance. This article aims to assess the current state of health inequality in the tropics, defined as the countries located between the Tropic of Cancer and the Tropic of Capricorn, and estimate the impact of this inequality on gross domestic product (GDP).

Methods: We constructed a series of concentration indices showing between-country inequalities in disability-adjusted life years (DALYs), taken from the Global Burden of Disease Study. We then utilized a non-linear least squares model to estimate the influence of health on GDP and counterfactual analysis to assess the GDP for each country had there been no between-country inequality.

Results: The poorest 25% of the tropical population had 68% of the all-cause DALYs burden in 2015; 82% of the communicable, maternal, neonatal and nutritional DALYs burden; 55% of the non-communicable disease DALYs burden and 61% of the injury DALYs burden. An increase in the all-cause DALYs rate of 1/1000 resulted in a 0.05% decrease in GDP. If there were no inequality between countries in all-cause DALY rates, most high-income countries would see a modest increase in GDP, with low- and middle-income countries estimated to see larger increases.

Conclusions: There are large and growing inequalities in health in the tropics and this has significant economic cost for lower-income countries.

Keywords: inequality, macroeconomic costs, tropics

Introduction

Health is a universal human right and basic human need.¹ Indeed, the development status of countries and regions is often judged by the quality of population health outcomes and how fairly health is distributed across the social spectrum. In 2008 the World Health Organization's (WHO) Commission on Social Determinants of Health noted that 'inequities in health, (or) avoidable health inequalities, arise because of the circumstances in which people grow, live, work and age, and the systems put in place to deal with illness. The conditions in which people live and die are, in turn, shaped by political, social and economic factors'.²

The relationship between health and economic growth is well established. Through its contribution to human and social capital, the health of a population has been identified in multiple studies to influence economic growth, and vice versa.^{3–5} Health is thought to influence growth via the impact of health upon

working time⁶ and also through the influence of health on productivity.⁵ Yet this relationship between health and economic growth is more complicated than is often assumed. Theories of demographic transition suggest that economic growth may reduce the burden of communicable diseases but simultaneously increase the burden of non-communicable diseases. A growing evidence base also points to the way macroeconomic trends and global trade relations enable and promote unregulated commercialization, impacting differentially on population health in countries with stronger or weaker economies.⁷

Increasingly, the tropics is being recognized as a geopolitical and environmental entity in its own right.⁸ The tropics is defined as the region between the Tropic of Cancer and Tropic of Capricorn. Countries in this region are home to almost half of the world's population, >50% of its young people, many of the world's fastest-growing economies and most of the world's biological and cultural diversity.⁹ The trajectory of this region

will be central to whether or not the world meets ambitious goals for global prosperity and equality as embodied in the 2030 Agenda for Sustainable Development and associated Sustainable Development Goals.¹⁰

Although some health outcomes have improved in the past 20 y, the tropics has historical trends of poor health outcomes⁹ and weak economic performance and growth.¹¹ Gallup and Sachs¹² observed that macroeconomic growth varies greatly with geography, and Sachs¹³ postulated that the underperformance of economies in the tropics was related to inferior agricultural and health technology as well as high fertility and high mortality rates.¹³ Recent analysis demonstrates that 70% of the global infrastructure gap occurs in the tropics, 20% of people in the region to do not have access to clean water and 30% of people do not have access to reliable electricity.¹⁴ Despite these figures, few analyses have been conducted to better understand how trends in health and economic growth intersect in the tropics.

This study aims to give an overview of the current state of health equality in the geographically and demographically significant region of the tropics. Using the results from the Global Burden of Disease Study,¹⁵ we assess between-country health equality from 2000 to 2015. The article goes on to characterize the relationship between health and economic output in the tropics and estimate the level of gross domestic product (GDP) that could have been achieved had the current recorded levels of health inequality not been present.

Materials and methods

State of health inequalities

Using data from the Global Burden of Disease Study from 2000, 2005, 2010 and 2015,¹⁵ we identified the number of disability-adjusted life years (DALYs) lost due to all causes; communicable, maternal, neonatal and nutritional diseases; non-communicable diseases and injuries for each country located at least partially in the tropics. Communicable, maternal, neonatal and nutritional diseases include conditions such as lower respiratory infections, diarrhoeal disease, malaria, preterm birth complications, human immunodeficiency virus/acquired immune deficiency syndrome and neonatal encephalopathy; non-communicable diseases include ischaemic heart disease, stroke, chronic obstructive pulmonary disease, cancer, diabetes, chronic kidney disease and Alzheimer's disease.

We utilized the list of 105 tropical countries contained within the 2014 State of the Tropics report.⁹ To assess the level of economic-related inequality in health between countries within the tropics, as measured by DALYs lost, a series of concentration indices were constructed. A separate concentration index was constructed for each time point (2000, 2005, 2010 and 2015) to show the change in inequality over time. This was done separately for all-cause DALYs lost; communicable, maternal, neonatal and nutritional diseases DALYs lost; non-communicable diseases DALYs lost and injury DALYs lost.

The concentration index is a standard measure of health inequality, which assesses the distribution of health outcomes across economic groups.¹⁶ The measure of a country's economic status used in this study was GDP per capita. Total GDP in 2011 international purchasing power parity (PPP) dollars for 2000,

2005, 2010 and 2015 was utilized¹⁷ and divided by population estimates in the respective years¹⁸ to obtain GDP per capita. Each country was then ranked from lowest to highest based on GDP per capita.

The concentration index reflects the cumulative proportion of health held by the cumulative proportion of the population, ranked by economic status. The concentration index has a range of -1 to 1 , with a value of 0 denoting perfect equality in the distribution of the health outcome, a negative value denoting a distribution skewed towards groups of lower economic status and a positive value denoting a distribution skewed towards groups of higher economic status. The concentration index was computed as follows¹⁹:

$$\text{Concentration index} = (p_1L_2 - p_2L_1) + (p_2L_3 - p_3L_2) + \dots + (p_{t-1}L_t - p_tL_{t-1}) \quad (1)$$

where p_t is the cumulative percentage of the population in the tropics ranked by economic status (GDP per capita), L_t is the cumulative proportion of DALYs and t is the total number of countries.

The confidence intervals for the concentration index was calculated from the standard error and variance as follows²⁰:

$$\text{var (concentration index)} = \frac{1}{T} \left[\sum_{t=1}^T f_i a_t^2 - (1 + \text{concentration index})^2 \right], \quad (2)$$

where f_i is the cumulative proportion of the population in the i th group and

$$a_t = \frac{\mu_t}{\mu} (2R_t - 1 - \text{concentration index}) + 2 - q_{t-1} - q_t, \quad (3)$$

where μ_t is the DALY rate of the t th country, μ is the mean DALY rate of all countries, R_t is the cumulative proportion of the population up to the midpoint of each country's group interval (i.e. $\sum_{k=1}^{T-1} f_k + \frac{1}{2}f_t$) and q_t is the cumulate DALY rate divided by μ .²⁰

Cost of health inequalities

This study then undertook a counterfactual analysis to estimate the level of economic output (as measured by GDP) countries in the tropics could have achieved had they had the same all-cause DALYs rate as the best-performing country in the tropics.

Measure of economic growth

We used the aggregate production function approach to measuring GDP proposed by Bloom and Canning²¹:

$$\log Y_{ij} = \alpha_{ij} + \alpha \log K_{ij} + \beta (\log L_{ij} + \varnothing_s s_{ij} + \varnothing_h h_{ij}), \quad (4)$$

where Y_{ij} is the total GDP of country i at time j , where $i=1, \dots, 97$ and $j=1995, \dots, 2015$, α_{ij} is the level of total factor productivity (TFP), K_{ij} is the stock of physical capital, L_{ij} is the labour force, s_{ij} is years of schooling and h_{ij} is health. (In previous work in this field authors estimated TFP: however, TFP estimates are now available through the Penn World Tables.)

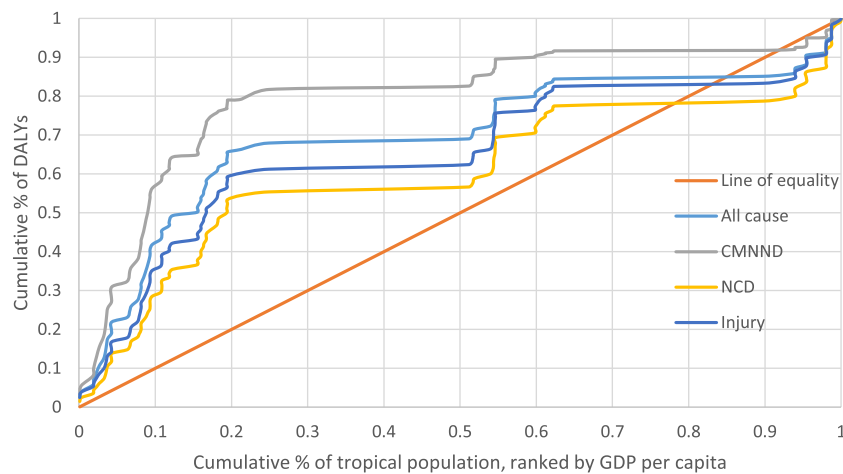


Figure 1. Concentration curve for DALYs in tropical countries, 2015. CMNND: communicable, maternal, neonatal and nutritional disease; NCD: non-communicable disease.

We obtained annual data on GDP, TFP, physical capital, labour force size and average years of schooling for countries in the tropics from 1990 to 2015. GDP data were obtained from the World Bank.¹⁷ TFP and physical capital data for each of the countries were obtained from the Penn World Tables version 9.0.²² GDP, TFP and physical capital data were all represented in 2011 international PPP dollars. Labour force data came from the World Bank and consisted of an estimated number of people in the labour force ≥ 15 y of age.²³ Education data for the average years of schooling were obtained from the United Nations Development Programme.²⁴ The measure of health was the all-cause DALY rate per 1000. Of the 105 countries located within the tropics, 97 had complete DALY data and were included in the analysis.

A non-linear least squares model of the log of GDP was constructed to estimate the coefficients of the independent variables log of capital, log of labour force, education and health, as shown in equation 4 above. Dummy time variables were included. Generalized method of moments was utilized to correct the models for heteroscedasticity,²⁵ and first-order autocorrelation structures for the errors were included in the model. This resultant equation was then used to estimate the counterfactual economic output (GDP) for all countries had they had the all-cause DALY rate of the best-performing country (Saudi Arabia, all-cause DALY rate of 170.56 per 1000).

All analysis was undertaken using SAS version 9.3 (SAS Institute, Cary, NC, USA).

Results

There were 97 countries located in the tropics who had data on the total number of DALYs lost. The rate of lost DALYs due to all causes; communicable, maternal, neonatal and nutritional diseases; non-communicable diseases and injuries in 2000, 2005, 2010 and 2015 for each of these 97 countries is shown in Table A1. Overall, the DALY rate per 100 000 for all causes declined between 2000 and 2015. However, rates of decline varied between countries. There was a clear differential in DALYs rates by country income classification. High-income countries

in the tropics had an average all-cause DALYs rate in 2015 of 25 438 per 100 000 (standard deviation [SD]=5719), upper-middle-income countries 30 785 (SD=11 547), lower-middle-income countries 36 626 (SD=11 648) and low-income countries 58 315 (SD=13 935).

The unequal distribution of DALY in 2015 within countries in the tropics is illustrated in the concentration curves shown in Figure 1. As can be seen in Figure 1, the cumulative percentage of DALY lost exceeds the cumulative proportion of the population living in the tropics for poorer countries. For example, the poorest 25% of the tropical population had 68% of the all-cause DALY burden in 2015; 82% of the communicable, maternal, neonatal and nutritional disease DALY burden; 55% of the non-communicable disease DALY burden and 61% of the injury DALY burden. Appendix 2 shows countries ranked by their GDP per capita and the cumulative proportion of DALY lost.

Table 1 shows the concentration index for the distribution of DALY in 2000, 2005, 2010 and 2015. For all four DALY classifications, inequality appears to be increasing over time from 2000 to 2015. In 2000, the concentration index for the all-cause DALYs burden was -0.30 (95% confidence interval [CI] -0.22 to -0.08), which by 2015 had increased to -0.39 (95% CI -0.44 to -0.35). There was little evidence of economic-related inequality in DALY burden for non-communicable diseases in 2000. However, inequality based on economic status appeared in 2010 and grew in 2015. The increase in injury-related DALY inequality in 2010 appears to be driven by the spike in Haiti's injury-related DALY rate in 2010 (Appendix 1).

To estimate the cost of unequal all-cause DALY rates for countries within the tropics, we initially constructed a model to estimate GDP, with the results shown in Table 2. The model fitted the data well with an adjusted R^2 value of 0.9667. The coefficient estimates shown in Table 2 relate to model 1 described in the Materials and methods section. This indicated that an increase in the all-cause DALY rate of 1 per 1000 resulted in a 0.03% decrease in GDP (from model 1 and coefficient estimates in Table 3, $(-0.00057 \times 0.673191) \times 100 = 0.03\%$); conversely, a decrease in the all-cause DALY rate of 1 per 1000 resulted in a 0.03% increase in GDP.

Table 1. Concentration index showing the inequality in the distribution of DALYs by country income, measured by GDP per capita

| DALY rate | Concentration index (95% CI) | | | |
|---|------------------------------|------------------------|------------------------|------------------------|
| | 2000 | 2005 | 2010 | 2015 |
| All cause | -0.30 (-0.22 to -0.08) | -0.32 (-0.35 to -0.29) | -0.38 (-0.43 to -0.33) | -0.39 (-0.44 to -0.35) |
| Communicable, maternal, neonatal and nutritional diseases | -0.47 (-0.51 to -0.45) | -0.52 (-0.64 to -0.40) | -0.57 (-0.69 to -0.45) | -0.60 (-0.72 to -0.47) |
| Non-communicable diseases | 0.00 (0.00 to 0.01) | -0.05 (-0.14 to 0.05) | 0.14 (-0.20 to -0.07) | -0.20 (-0.25 to -0.16) |
| Injury | -0.23 (-0.20 to -0.26) | -0.15 (-0.21 to -0.12) | -0.41 (-0.58 to -0.23) | -0.31 (-0.32 to -0.30) |

Table 2. Non-linear model of log GDP, tropical countries 1990–2015

| Parameter | Estimate | Standard error | t-Value | p-Value |
|-------------------------|----------|----------------|---------|---------|
| α | 0.256922 | 0.1709 | 1.5 | 0.1335 |
| β | 0.673191 | 0.1886 | 3.57 | 0.0004 |
| ϑ_s | 0.142548 | 0.1005 | 1.42 | 0.1566 |
| ϑ_h | -0.00057 | 0.00048 | -1.18 | 0.2393 |
| Adjusted R ² | 0.9667 | | | |

Dummy time variables not shown; model: $\log Y = a + \alpha \log K + \beta(\log L + \vartheta_s s + \vartheta_h h)$.

Based on this estimated impact of all-cause DALY rates on GDP, the estimated change in 2015 GDP if each country had an all-cause DALY rate of 170.56 per 1000 is shown in Table 3. Most high-income countries were estimated to see a modest increase in GDP, with middle-income and low-income countries were estimated to see larger increases. For example, if the Central African Republic had an all-cause DALY rate of 170.56 per 1000, then they were estimated to have a GDP 28% higher than their actual GDP in 2015.

Discussion

This study demonstrates large and growing economic-related inequalities in health in the tropics. The unequal distribution of poor health is such that populations in poorer countries experience a disproportionately larger burden of disease across most disease groups. Perhaps intuitively, economic-related inequalities in health were most pronounced in the communicable and maternal, neonatal and nutritional disease groups. However, of note, whereas in previous years (2000 and 2005) there was no related economic inequality for non-communicable diseases, inequality in this domain now exists and looks likely to increase.

Globally there has been a trend towards improvements in communicable and maternal, neonatal and nutritional disease DALY rates, a deterioration in non-communicable disease DALY rates and a stabilization of all-cause DALY rates between 1990 and 2015.²⁶ This study demonstrates more mixed results among countries in the tropics—with some seeing a decline in DALY rates in some domains and others seeing an increase. Such variation

makes it difficult to conclude whether the health status of the tropics, as measured by DALYs, is improving over time. What is clear, however, is that currently, health inequality in the region is increasing.

Findings from this study also demonstrate that health inequalities in the tropics come at a significant economic cost, probably compounding existing economic inequities. To our knowledge, this is the first study to use this framework to quantify the costs of health inequality and map them regionally. Results align with, but also extend, previous work such as that carried out by the Lancet Commission on Investing in Health, which noted that approximately 25% of economic growth from 2000 to 2011 in low- and middle-income countries was the result of value-added improvements to population health.²⁷ Health is a key form of human and social capital, and directly impacts upon the productivity of a nation's workforce, and thus economic growth.³ Furthermore, through the 'health transition' effect, better health leads to declining fertility rates and slowing of population growth, which also positively influences economic growth per capita.¹³ The WHO High-level Commission on Health Employment and Economic Growth stated that investment in health is an important pathway to economic growth, through increased life expectancy and healthier workers.²⁸

Combined with the extant literature, our findings reinforce the importance of investing in equity-promoting health systems capable of providing universal health coverage. The recent Sustainable Infrastructure in the Tropics report highlighted a US\$30 trillion deficit in infrastructure in the region,¹⁴ noting that the tropics has less health-related infrastructure per capita compared with non-tropical regions in all domains assessed

Table 3. Anticipated increase in GDP, based on the non-linear model of GDP shown in Table 2, had all countries had the same DALYs rate as the best-performing country, 2015

| Country | GDP 2015 | Increase in GDP | Growth in GDP, % |
|--------------------------------------|--------------------|-----------------|------------------|
| High-income countries | | | |
| Antigua and Barbuda | 2 009 826 596 | 53 973 653 | 3 |
| Australia | 1 042 740 000 000 | 19 733 135 417 | 2 |
| Barbados | 4 374 192 583 | 235 393 539 | 5 |
| Saudi Arabia | 1 600 700 000 000 | – | 0 |
| Singapore | 447 738 000 000 | 1 570 525 125 | >1 |
| Seychelles | 2 384 515 771 | 92 624 941 | 4 |
| Trinidad and Tobago | 42 548 380 978 | 2 615 256 373 | 6 |
| Upper-middle-income countries | | | |
| Angola | 173 593 000 000 | 28 445 172 261 | 16 |
| Belize | 2 896 339 797 | 100 610 214 | 3 |
| Brazil | 3 020 640 000 000 | 125 662 814 769 | 4 |
| Botswana | 33 925 440 081 | 5 095 779 561 | 15 |
| China | 18 607 300 000 000 | 563 322 801 665 | 3 |
| Colombia | 626 268 000 000 | 11 616 130 549 | 2 |
| Costa Rica | 71 705 298 733 | 821 713 412 | 1 |
| Dominica | 741 629 314 | 39 402 786 | 5 |
| Dominican Republic | 140 781 000 000 | 4 597 387 089 | 3 |
| Ecuador | 173 981 000 000 | 4 589 540 370 | 3 |
| Fiji | 7 811 978 867 | 694 874 614 | 9 |
| Gabon | 32 497 590 563 | 3 213 134 875 | 10 |
| Equatorial Guinea | 32 015 040 167 | 5 051 050 478 | 16 |
| Jamaica | 23 278 214 005 | 954 613 489 | 4 |
| St. Lucia | 1 892 096 825 | 79 873 600 | 4 |
| Maldives | 4 907 464 510 | 7 778 646 | >1 |
| Mexico | 2 098 330 000 000 | 47 022 618 882 | 2 |
| Marshall Islands | 194 651 519 | 12 323 663 | 6 |
| Mauritius | 23 817 914 130 | 1 053 349 777 | 4 |
| Malaysia | 767 736 000 000 | 16 189 392 513 | 2 |
| Namibia | 24 043 436 006 | 2 457 382 668 | 10 |
| Panama | 82 061 443 521 | 1 845 225 450 | 2 |
| Peru | 369 226 000 000 | 4 211 555 598 | 1 |
| Paraguay | 57 357 253 470 | 1 717 492 382 | 3 |
| Suriname | 8 169 111 441 | 433 845 843 | 5 |
| Thailand | 1 046 120 000 000 | 53 454 404 761 | 5 |
| Lower-middle-income countries | | | |
| Bangladesh | 504 973 000 000 | 27 430 182 038 | 5 |
| Bolivia | 70 048 618 747 | 2 959 509 956 | 4 |
| Cote d'Ivoire | 75 129 288 986 | 12 845 710 270 | 17 |
| Cameroon | 68 302 439 597 | 11 290 836 272 | 17 |
| Republic of the Congo | 27 690 345 067 | 3 588 867 666 | 13 |
| Djibouti | 2 911 406 226 | 313 743 482 | 11 |
| El Salvador | 49 522 384 600 | 1 914 747 565 | 4 |
| Federated States of Micronesia | 343 060 704 | 14 522 270 | 4 |
| Ghana | 108 392 000 000 | 10 165 289 089 | 9 |

(Continued)

Table 3. Continued

| Country | GDP 2015 | Increase in GDP | Growth in GDP, % |
|----------------------------------|-------------------|-----------------|------------------|
| Guatemala | 118 524 000 000 | 4 942 459 994 | 4 |
| Honduras | 38 631 714 481 | 1 157 206 360 | 3 |
| Indonesia | 2 676 550 000 000 | 124 903 764 801 | 5 |
| India | 7 532 380 000 000 | 621 597 105 048 | 8 |
| Kenya | 133 945 000 000 | 13 117 888 814 | 10 |
| Cambodia | 51 067 798 981 | 2 678 798 779 | 5 |
| Kiribati | 210 624 150 | 21 358 824 | 10 |
| Sri Lanka | 231 923 000 000 | 5 662 135 378 | 2 |
| Myanmar | 265 745 000 000 | 18 162 993 447 | 7 |
| Mauritania | 15 063 179 361 | 1 125 289 804 | 7 |
| Nigeria | 1 027 420 000 000 | 163 607 465 290 | 16 |
| Nicaragua | 30 172 442 923 | 383 426 213 | 1 |
| The Philippines | 699 258 000 000 | 31 178 728 457 | 4 |
| Papua New Guinea | 20 327 000 425 | 2 301 254 260 | 11 |
| Sudan | 165 813 000 000 | 14 070 340 054 | 8 |
| Solomon Islands | 1 206 358 337 | 85 108 034 | 7 |
| São Tomé and Príncipe | 575 391 345 | 36 326 731 | 6 |
| Timor-Leste | 2 669 474 380 | 141 488 592 | 5 |
| Tonga | 551 908 322 | 22 472 648 | 4 |
| Vietnam | 519 777 000 000 | 14 915 212 610 | 3 |
| Vanuatu | 742 684 971 | 56 686 547 | 8 |
| Samoa | 1 077 065 956 | 27 862 590 | 3 |
| Zambia | 58 400 082 027 | 9 635 621 355 | 16 |
| Low-income countries | | | |
| Burundi | 7 634 578 343 | 1 095 034 646 | 14 |
| Benin | 21 016 184 357 | 2 725 580 341 | 13 |
| Burkina Faso | 28 086 807 428 | 4 854 308 341 | 17 |
| Central African Republic | 2 847 726 468 | 793 488 968 | 28 |
| Comoros | 1 098 546 195 | 74 493 053 | 7 |
| Democratic Republic of the Congo | 57 185 360 031 | 9 917 760 608 | 17 |
| Ethiopia | 153 116 000 000 | 14 294 035 761 | 9 |
| Guinea | 14 316 884 358 | 2 597 619 016 | 18 |
| Guinea-Bissau | 2 521 743 681 | 557 976 038 | 22 |
| Haiti | 17 686 408 605 | 1 831 466 588 | 10 |
| Liberia | 3 533 313 381 | 447 191 582 | 13 |
| Madagascar | 33 354 200 458 | 3 672 896 561 | 11 |
| Mali | 33 524 899 739 | 7 151 030 656 | 21 |
| Mozambique | 31 322 101 897 | 5 654 370 746 | 18 |
| Malawi | 19 132 417 662 | 3 005 945 469 | 16 |
| Niger | 17 857 377 171 | 3 647 931 415 | 20 |
| Rwanda | 19 954 999 667 | 1 877 316 666 | 9 |
| Senegal | 34 398 281 018 | 3 152 976 316 | 9 |
| Sierra Leone | 9 524 359 831 | 1 909 663 417 | 20 |
| South Sudan | 21 484 823 398 | 4 415 171 988 | 21 |
| Chad | 28 686 194 920 | 6 807 892 037 | 24 |
| Togo | 10 018 697 437 | 1 367 702 899 | 14 |
| Tanzania | 130 298 000 000 | 14 773 052 968 | 11 |
| Uganda | 67 946 377 419 | 9 254 472 937 | 14 |
| Zimbabwe | 29 831 655 630 | 4 221 552 678 | 14 |

(hospitals, hospital beds and physicians). This deficit is also likely to be an underestimate since the report contained no measures of primary care infrastructure, which is more likely to reach the poorest populations. Of concern, there is currently also no consolidated measure or database to help assess and compare countries' health system capacity (beyond infrastructure).^{29,30} Together with our findings, these gaps in knowledge highlight a growing imperative to strengthen both our understanding of and investment in equity-promoting health systems.³¹

Beyond highlighting disturbing upward trends in economic-related health inequality in tropical countries, the impact of the 2010 Haiti earthquake on results reported in this study demonstrate how discrete environmental events can have long-lasting effects on the equity of health outcomes. Currently and moving forward it is predicted that countries within the tropics will bear an unequal burden of climate-induced natural disasters.¹⁴ It has been previously noted that poorer countries within the tropics have the highest human impact associated with natural disasters.^{32,33} Climate change-induced natural disasters are likely to increase in the tropics in coming decades,³⁴ contributing to and compounding health inequalities, particularly for injury-related health outcomes.

The results of the study must be considered in light of its limitations. The key source of uncertainty lies in the accuracy of the data utilized in this study. All macroeconomic data have a level of uncertainty associated with them and are reliant upon the accuracy of data collection institutions within each country.

Conclusions

This study has demonstrated an important relationship between health and macroeconomic outcomes and the macroeconomic costs associated with health inequity in a geographically and demographically significant region. The results highlight concerning increases in health inequality and flag the compounding effect of this inequality on individual countries' macroeconomic performance. Improving the overall well-being of populations in the tropics will require investment in health, and social and economic determinants, to ensure that 'no one is left behind'. The WHO recognizes that health, while being a discrete and important goal worthy of prominence,³⁵ is inextricably linked to many of the other Sustainable Development Goals.³⁶ A multisector approach is thus likely to be a key to driving any future improvements in both health and macroeconomic outcomes. The 2030 Agenda for Sustainable Development and associated Sustainable Development Goals provide an unprecedented opportunity to address these issues.

Authors' contributions: EC conceived the study and undertook the analysis. ST contributed to the interpretation of the results. Both authors drafted the manuscript and edited and approved the final version.

Acknowledgements: None.

Funding: EC received funding from the National Health and Medical Research Council under the Career Development Fellowship scheme (APP1159536). The funder played no role in any aspect of the study.

Competing interests: None declared.

Ethical approval: Not required.

References

- Marmot M. Commission on Social Determinants of Health. Achieving health equity: From root causes to fair outcomes. *Lancet*. 2007;370(9593):1153–1163.
- WHO Commission on Social Determinants of Health. Closing the gap in a generation: health equity through action on the social determinants of health: Commission on Social Determinants of Health final report. Geneva: World Health Organization, 2008.
- Bloom DE, Canning D, Sevilla J. The effect of health on economic growth: theory and evidence. Working paper 8587, National Bureau of Economic Research, Cambridge, MA; 2001.
- Bloom DE, Canning D, Sevilla J. Health and economic growth: reconciling the micro and macro evidence. Working paper 42, Center on Democracy, Development and the Rule of Law, Stanford, CA; 2005.
- Bloom DE, Canning D, Sevilla J. The effect of health on economic growth: a production function approach. *World Dev*. 2004;32(1):1–13.
- Grossman M. On the concept of health capital and the demand for health. *J Polit Econ*. 1972;80(2):223–255.
- Van Lerberghe W. The world health report 2008: primary health care: now more than ever. Geneva: World Health Organization, 2008.
- State of the Tropics. State of the tropics 2015 report. Townsville, QL, Australia: James Cook University, 2015.
- State of the Tropics. State of the tropics 2014 report. Townsville, QL, Australia: James Cook University, 2014.
- United Nations General Assembly. Transforming our world: the 2030 Agenda for Sustainable Development. New York: United Nations, 2015.
- Khawar M. Climate and economic development: further evidence in support of "the tropical effect". *J Econ*. 2014;2(4):77–89.
- Gallup JL, Sachs JD, Mellinger AD. Geography and economic development. *International regional science review* 1999;22(2):179–232.
- Sachs JD. Tropical underdevelopment. Working paper 8119, National Bureau of Economic Research, Cambridge, MA; 2001.
- State of the Tropics. Sustainable infrastructure in the tropics. Townsville, QL, Australia: James Cook University, 2017.
- Global Burden of Disease Study. Global Burden of Disease Study 2015 (GBD 2015). In: Results. Seattle, WA: Institute for Health Metrics and Evaluation, 2015.
- Wagstaff A, Van Doorslaer E. Equity in health care finance and delivery. In: Culyer AJ, Newhouse JP, editors. *Handbook of health economics*, Vol. 1. Oxford: Elsevier, 2000; p. 1803–1862.
- World Bank. GDP, PPP (current international \$). World Bank. International Comparison Program database. <http://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD?view=chart2017> [accessed 18 January 2019].
- World Bank. Population, total. World Bank Group. <https://data.worldbank.org/indicator/SP.POP.TOTL> [accessed 14 December 2019].
- Fuller MF, Lury DA. *Statistics workbook for social science students*. London: Phillip Allan, 1977.
- O'Donnell O, Van Doorslaer E, Wagstaff A, Lindelow M. Analyzing health equity using household survey data: a guide to techniques and their implementation. Washington, DC: World Bank, 2008.
- Bloom DE, Canning D, Sevilla J. Health and economic growth: reconciling the micro and macro evidence. Center on Democracy, Development and the Rule of Law Working Papers 2005;42.
- Feenstra RC, Inklaar R, Timmer MP. The next generation of the Penn World Table. *Am Econ Rev*. 2015;105(10):3150–3182.
- World Bank. Labour force, total. World Bank Group. <https://data.worldbank.org/indicator/SL.TLF.TOTL.IN> [accessed 14 December 2019].

- 24 United Nations Development Programme. Human development data (1990–2015): mean years of schooling (years). United Nations Development Programme. <http://hdr.undp.org/en/content/expected-years-schooling-children-years> [accessed 14 December 2019].
- 25 Erdman D, Little M. Nonlinear regression analysis and nonlinear simulation models. Cary, NC: SAS Institute. <https://support.sas.com/rnd/app/ets/papers/nonlinearmodels.pdf>.
- 26 Kassebaum NJ, Arora M, Barber RM, *et al.* Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet*. 2016;388(10053):1603–1658.
- 27 Jamison DT, Summers LH, Alleyne G, *et al.* Global health 2035: a world converging within a generation. *Lancet*. 2013;382(9908):1898–1955.
- 28 World Health Organization. Working for health and growth: investing in the health workforce. In: Report of the High-Level Commission on Health Employment and Economic Growth. Geneva: World Health Organization, 2016.
- 29 Kruk ME, Pate M, Mullan Z. Introducing the Lancet Global Health Commission on high-quality health systems in the SDG era. *Lancet Glob Health*. 2017;5(5):E480–E481.
- 30 Abimbola S, Topp S, Palagyi A, Marais B, Negin J. Global health security: where is the data to inform health system strengthening? *BMJ Glob Health*. 2017;2:e000481.
- 31 Kieny MP, Bekedam H, Dovlo D, *et al.* Strengthening health systems for universal health coverage and sustainable development. *Bull World Health Org*. 2017;95(7):537–539.
- 32 Alcantara-Ayala I. Geomorphology, natural hazards, vulnerability and prevention of natural disasters in developing countries. *Geomorphology* 2002;47(2–4):107–124.
- 33 Kahn ME. The death toll from natural disasters: the role of income, geography, and institutions. *Rev Econ Stat*. 2005;87(2):271–284.
- 34 van Aalst MK. The impacts of climate change on the risk of natural disasters. *Disasters*. 2006;30(1):5–18.
- 35 Hill PS, Buse K, Brolan CE, Ooms G. How can health remain central post-2015 in a sustainable development paradigm? *Glob Health*. 2014;10:18.
- 36 World Health Organization. Health in 2015: from MDGs to SDGs. Geneva: World Health Organization, 2015.

Appendix A

Table A1. DALYs rate per 100 000 for all tropical countries: 2000, 2005, 2010 and 2015

| Country | All-cause | | | | | DALYs, Communicable, maternal, neonatal and nutritional diseases | | | | | Non-communicable diseases | | | | | Injuries | | | | |
|-------------------------------|-----------|----------|----------|----------|----------|--|-----------|-------------|----------|----------|---------------------------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 |
| High-income countries | | | | | | | | | | | | | | | | | | | | |
| Antigua and Barbuda | 26 524.9 | 25 024.6 | 24 057.6 | 24 054.1 | 5596.42 | 4297.29 | 3671.97 | 3412.40838 | 18 877.2 | 18 658.2 | 18 502.9 | 18 945.5 | 2051.32 | 2069.08 | 1882.7 | 1696.26 | 2051.32 | 2069.08 | 1882.7 | 1696.26 |
| Australia | 23 650.7 | 22 627.5 | 22 029.4 | 21 987.4 | 1289.12 | 1247.63 | 1169.33 | 1073.80217 | 20 151.1 | 19 456.9 | 19 118.1 | 19 241.5 | 2210.51 | 1922.91 | 1741.6 | 1672.54 | 2210.51 | 1922.91 | 1741.6 | 1672.54 |
| Barbados | 30 207.7 | 29 564.8 | 30 350.2 | 31 079.9 | 5313.37 | 4339.17 | 4031.33 | 3708.01725 | 22 879.3 | 23 036.6 | 24 191.6 | 25 339.7 | 2015.94 | 2188.94 | 2127.24 | 2032.24 | 2015.94 | 2188.94 | 2127.24 | 2032.24 |
| Bermuda | 25 116.6 | 23 117.1 | 22 335.7 | 22 344.5 | 3720.71 | 2778.94 | 2470.83 | 2312.32345 | 19 405.3 | 18 270.7 | 18 011.7 | 18 427.9 | 1990.59 | 2068.2 | 1853.12 | 1604.3 | 1990.59 | 2068.2 | 1853.12 | 1604.3 |
| Guam | 24 430.6 | 26 793.1 | 31 000.6 | 32 404.5 | 3285.84 | 3659.81 | 4025.57 | 3802.48614 | 18 377.8 | 20 273.6 | 23 778.4 | 25 362.7 | 2766.99 | 2859.55 | 3196.72 | 3239.28 | 2766.99 | 2859.55 | 3196.72 | 3239.28 |
| Puerto Rico | 28 628.3 | 28 001.4 | 28 029.4 | 27 233.4 | 3791.11 | 3275.03 | 2858.26 | 2575.54054 | 21 633.8 | 21 743.1 | 22 137.5 | 21 976.4 | 3203.33 | 2983.33 | 3033.2 | 2681.5 | 3203.33 | 2983.33 | 3033.2 | 2681.5 |
| Saudi Arabia | 20 433.6 | 18 409.4 | 17 427.7 | 17 055.6 | 4708.18 | 3351.36 | 2649.51 | 2154.27876 | 12 370.4 | 12 069.2 | 12 098.8 | 12 468.6 | 3354.99 | 2988.84 | 2679.36 | 2432.69 | 3354.99 | 2988.84 | 2679.36 | 2432.69 |
| Seychelles | 29 242.4 | 28 238.4 | 27 683.7 | 27 178.7 | 4303.69 | 4187.7 | 3943.67 | 3662.45322 | 21 243.6 | 20 589.9 | 20 427.2 | 20 746.2 | 3694.72 | 3460.71 | 3312.8 | 2770.03 | 3694.72 | 3460.71 | 3312.8 | 2770.03 |
| Singapore | 18 263.1 | 17 681.8 | 17 535.9 | 17 969.7 | 1953.31 | 1805.02 | 1808.14 | 1897.71205 | 14 637.2 | 14 383.9 | 14 450.1 | 14 855.6 | 1672.64 | 1492.89 | 1277.38 | 1216.38 | 1672.64 | 1492.89 | 1277.38 | 1216.38 |
| Trinidad and Tobago | 32 696.1 | 32 344.2 | 32 881.2 | 33 073.9 | 6676.01 | 5133.24 | 4546.38 | 4134.96085 | 22 772.1 | 23 096.4 | 24 179.8 | 25 227.8 | 3247.93 | 4114.39 | 4155.77 | 3711.11 | 3247.93 | 4114.39 | 4155.77 | 3711.11 |
| Upper-middle-income countries | | | | | | | | | | | | | | | | | | | | |
| American Samoa | 24 512.2 | 23 982.9 | 22 737.5 | 22 415.9 | 4417.97 | 3846.9 | 3258.61 | 2957.75179 | 17 210.8 | 17 367.8 | 17 024.5 | 17 196.7 | 2883.41 | 2768.21 | 2454.39 | 2261.49 | 2883.41 | 2768.21 | 2454.39 | 2261.49 |
| Angola | 101 982.7 | 84 178.7 | 71 493.9 | 59 759.9 | 71 206.6 | 57 053.5 | 44 072.1 | 34 373.3549 | 20 895.7 | 19 470.6 | 19 718.6 | 18 843.4 | 9880.19 | 7655.1 | 7703.26 | 6542.25 | 9880.19 | 7655.1 | 7703.26 | 6542.25 |
| Belize | 29 803.4 | 27 241.3 | 26 561.8 | 26 108.3 | 8475.31 | 7381.97 | 6242.76 | 5811.18316 | 16 466.2 | 15 347.2 | 16 062.8 | 16 320.4 | 4861.89 | 4512.08 | 4256.72 | 3976.72 | 4861.89 | 4512.08 | 4256.72 | 3976.72 |
| Botswana | 85 872.9 | 81 345.3 | 63 415.8 | 56 200.2 | 60 656.4 | 55 118.6 | 38 923.32 | 32 051.19 | 19 316.2 | 19 971.3 | 18 967.9 | 19 077.5 | 5900.6255 | 6255.5524 | 5071.5071 | 5071.5071 | 5900.6255 | 6255.5524 | 5071.5071 | 5071.5071 |
| Brazil | 30 475.8 | 28 571.1 | 27 784.4 | 27 897.2 | 7121.69 | 5473.82 | 4523.49 | 3966.66974 | 18 419.2 | 18 477.1 | 18 834.6 | 19 803.8 | 4934.91 | 4620.19 | 4426.74 | 4126.74 | 4934.91 | 4620.19 | 4426.74 | 4126.74 |
| China | 29 492.6 | 27 931.3 | 26 031.7 | 24 945.3 | 4629.02 | 3142.74 | 2396.49 | 2036.21872 | 20 783.1 | 21 170.3 | 20 502.7 | 20 273.1 | 4080.49 | 3618.22 | 3132.92 | 2635.92 | 4080.49 | 3618.22 | 3132.92 | 2635.92 |
| Colombia | 26 229.9 | 23 900.8 | 22 958.8 | 21 889.3 | 4763.09 | 4078.78 | 3439.89 | 2763.48963 | 14 709.7 | 14 867.2 | 15 243.7 | 15 507.7 | 6757.11 | 4954.79 | 4275.86 | 3618.15 | 6757.11 | 4954.79 | 4275.86 | 3618.15 |

(Continued)

Table A1. Continued

| Country | All-cause | | | DALYs, Communicable, maternal, neonatal and nutritional diseases | | | Non-communicable diseases | | | Injuries | | | | | | |
|--------------------|-----------|----------|----------|--|----------|----------|---------------------------|-------------|----------|----------|----------|----------|-----------|---------|---------|---------|
| | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | | | | |
| Costa Rica | 20 047.7 | 19 566.4 | 19 673.4 | 20 042.0 | 3048.71 | 2507.47 | 2164.96 | 1913.08409 | 14 522.8 | 14 738.7 | 15 212.7 | 16 001.9 | 2476.21 | 2320.51 | 2295.76 | 2177.04 |
| Cuba | 25 461.3 | 25 282.9 | 26 079.9 | 27 490.9 | 2617.79 | 2371.93 | 2283.26 | 2278.35849 | 19 936.2 | 20 539.3 | 21 612.7 | 23 001.6 | 2907.29 | 2370.85 | 2183.86 | 2210.95 |
| Dominica | 27 223.2 | 27 485.9 | 29 101.7 | 30 901.6 | 5313.58 | 5022.5 | 5042.69 | 5076.78539 | 19 518.6 | 19 917.6 | 21 284.4 | 23 032.6 | 2390.98 | 2545.88 | 2774.61 | 2792.28 |
| Dominican Republic | 28 580.8 | 28 773.1 | 26 844.9 | 25 566.7 | 10 636.2 | 10 219.3 | 7858.27 | 6080.3175 | 14 786.6 | 15 254.6 | 15 782.4 | 16 439.9 | 3157.98 | 3299.13 | 3204.22 | 3045.86 |
| Ecuador | 27 829.7 | 26 169.7 | 24 829.2 | 23 930.3 | 8671.8 | 6899.8 | 5418.18 | 4446.45323 | 15 069.9 | 15 406.4 | 15 688.5 | 16 107.5 | 4088.03 | 3864.34 | 3723.06 | 3376.27 |
| Equatorial Guinea | 92 090.3 | 78 330.3 | 68 391.9 | 58 171.9 | 61 164.5 | 50 299.8 | 40 850.8999 | 32 887.8999 | 23 067.6 | 20 545.1 | 20 709.9 | 19 786.6 | 7858.21 | 7485.4 | 6831.05 | 5497.42 |
| Fiji | 38 527.2 | 39 901.4 | 39 888.3 | 40 236.6 | 9041.51 | 8556.44 | 7809.67 | 7123.74151 | 25 773.9 | 27 468.7 | 28 623.7 | 29 652.6 | 3711.82 | 3876.27 | 3454.94 | 3460.22 |
| Gabon | 59 449.4 | 56 499.8 | 50 122.8 | 42 822.6 | 33 433.6 | 31 225.6 | 26 915.2584 | 20 336.2584 | 21 287.2 | 20 700.9 | 19 037.8 | 18 567.7 | 47 29.18 | 45 72.5 | 4170.64 | 3918.64 |
| Jamaica | 26 920.8 | 26 360.6 | 27 085.1 | 27 742.8 | 6105.78 | 5412.25 | 5024.39 | 4529.49628 | 18 557.1 | 18 220.4 | 19 411.1 | 20 675.7 | 2257.87 | 2727.86 | 2649.62 | 2537.55 |
| Malaysia | 21 881.2 | 21 451.5 | 22 131.5 | 22 551.6 | 4589.85 | 4090.32 | 4004.4 | 3681.16722 | 14 572.9 | 14 822.3 | 15 533.7 | 16 351.8 | 2718.43 | 2538.97 | 2593.41 | 2518.09 |
| Maldives | 25 687.2 | 20 711.7 | 18 483.6 | 17 468.6 | 6815.65 | 4869.59 | 3692.63 | 2960.09723 | 14 823.6 | 12 904.8 | 12 354.9 | 12 417.3 | 4047.88 | 2937.24 | 2436.05 | 2091.22 |
| Marshall Islands | 39 291.6 | 38 547.7 | 35 650.6 | 33 555.6 | 13 336.1 | 11 253.9 | 8633.62 | 6796.83611 | 21 559.8 | 22 987.1 | 23 167.1 | 23 274.4 | 4395.66 | 4306.83 | 3849.59 | 3484.18 |
| Mauritius | 27 300.2 | 27 460.9 | 28 411.2 | 28 580.9 | 3246.34 | 2639.53 | 2503.04 | 16537.16537 | 21 645.7 | 22 573.2 | 23 680.5 | 24 330.3 | 2408.02 | 2248.19 | 2227.63 | 1992.52 |
| Mexico | 23 882.4 | 22 854.5 | 23 030.3 | 22 895.6 | 5531.94 | 4332.64 | 3498.53 | 2890.28809 | 15 270.4 | 15 721.5 | 16 426.2 | 17 260.2 | 3080.02 | 2800.36 | 3105.74 | 2745.12 |
| Namibia | 65 188.7 | 68 829.4 | 50 115.4 | 43 691.2 | 41 308.3 | 47 401.4 | 32 030.6 | 26 257.0083 | 17 771.6 | 16 228.7 | 13 861.8 | 13 611.7 | 6108.86 | 5199.31 | 4223.04 | 3822.49 |
| Panama | 23 136.1 | 22 789.4 | 23 373.3 | 22 915.5 | 5383.13 | 5165.76 | 4756.2 | 4140.57449 | 14 564.2 | 14 748.4 | 15 361.2 | 15 850.1 | 3188.76 | 2875.3 | 3255.95 | 2924.86 |
| Paraguay | 25 170.1 | 24 913.5 | 24 921.1 | 24 859.1 | 7447.37 | 6163.75 | 5115.17 | 4394.9943 | 14 551.5 | 15 516.7 | 16 463.4 | 17 161.5 | 3171.3171 | 3233.07 | 3342.44 | 3302.58 |
| Peru | 25 938.9 | 22 569.2 | 21 162.2 | 20 028.2 | 8597.56 | 6413.25 | 5121.79 | 4226.66632 | 14 168.9 | 13 688.7 | 13 702.2 | 13 749.9 | 3172.44 | 2467.33 | 2338.08 | 2051.58 |
| St. Lucia | 28 693.6 | 27 610.9 | 27 906.9 | 28 056.9 | 5493.24 | 4852.78 | 4409.86 | 3865.68569 | 20 199.3 | 19 606.9 | 20 432.3 | 21 474.7 | 3001.05 | 3150.36 | 3064.7 | 2716.52 |

(Continued)

Table A1. Continued

| Country | All-cause | | | DALYs, Communicable, maternal, neonatal and nutritional diseases | | | Non-communicable diseases | | | | | Injuries | | | | |
|--------------------------------|--------------|--------------|--------------|--|--------------|--------------|---------------------------|-----------------|--------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|
| | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 |
| Suriname | 33 619. 1 | 33 646. 8 | 32 457 7 | 30 895. 9 | 10 044. 4 | 8807. 47 | 7734. 23 | 6624. 38348 | 19 242. 6 | 20 262. 1 | 20 305. 2 | 20 268. 3 | 4332. 06 | 4577. 26 | 4417. 54 | 4003. 24 |
| Thailand | 32 124 4 | 29 747. 4 | 29 348. 3 | 30 372 25 | 5835. 25 | 4737. 21 | 4412. 96 | 4209. 14851 | 20 594. 2 | 19 663. 7 | 20 452. 5 | 22 122. 8 | 5694. 55 | 5346. 51 | 4482. 75 | 4040. 09 |
| Lower-middle-income countries | | | | | | | | | | | | | | | | |
| Bangladesh | 45 932. 9 | 38 902. 7 | 34 071. 7 | 31 211. 8 | 22 710 7 | 16 259. 7 | 11 725. 9 | 8971. 99065 | 17 883. 5 | 18 243. 9 | 18 672. 6 | 18 915. 7 | 5339. 38 | 4399. 11 | 3673. 23 | 3324. 07 |
| Bolivia | 41 372. 6 | 34 451 4 | 30 426. 3 | 28 066. 1 | 17 914. 2 | 12 919 83 | 9669. 83 | 7506. 91444 | 17 272. 7 | 16 412. 8 | 16 331. 1 | 16 678. 7 | 6185. 64 | 5119. 17 | 4425. 39 | 3880. 41 |
| Cambodia | 53 353. 8 | 41 764. 4 | 35 342. 4 | 30 725. 9 | 28 121. 1 | 18 337. 4 | 13 106. 5 | 9675. 06915 | 19 414. 5 | 18 682. 1 | 18 050. 7 | 17 538. 3 | 5818. 17 | 4744. 89 | 4185. 19 | 3512. 58 |
| Cameroon | 84 288. 4 | 79 463. 5 | 68 428. 1 | 60 135. 7 | 61 454. 2 | 57 659. 6 | 46 931. 9 | 38 887. 7988 | 18 205. 7 | 17 602 1 | 17 339. 1 | 17 062. 7 | 4628. 55 | 4201. 86 | 4157. 08 | 4185. 13 |
| Congo, Rep. | 81 550. 4 | 68 485 4 | 55 872. 2 | 50 832. 2 | 52 712 5 | 44 360. 5 | 32 562. 1 | 28 148. 6094 | 21 777. 7 | 19 233. 1 | 18 837. 4 | 18 691. 3 | 7060. 72 | 4891. 37 | 4472. 61 | 3992. 24 |
| Cote d'Ivoire | 90 286. 1 | 83 152. 4 | 71 229. 9 | 61 614. 6 | 65 902. 7 | 61 023. 5 | 50 342. 6 | 40 709. 9932 | 19 234 6 | 17 807. 6 | 16 944. 4 | 17 085. 2 | 5149. 33 | 4321. 35 | 3942. 83 | 3819. 36 |
| Djibouti | 57 669. 7 | 53 551. 5 | 48 695. 3 | 45 139. 5 | 35 347. 5 | 30 838. 1 | 25 631. 2 | 21 712. 3538 | 17 390. 4 | 17 963. 4 | 18 481. 1 | 18 990. 2 | 4931. 76 | 4750. 01 | 4582. 98 | 4436. 98 |
| El Salvador | 30 353. 6 | 28 336 8 | 27 436. 8 | 27 131. 8 | 7432. 17 | 5164. 61 | 4075. 3 | 3625. 69317 | 16 350. 5 | 16 612. 4 | 17 137. 1 | 17 631. 4 | 6570. 91 | 6558. 95 | 6224. 32 | 5874. 63 |
| Federated States of Micronesia | 31 351. 4 | 29 361. 4 | 28 458. 5 | 28 087. 5 | 8024. 07 | 5883. 62 | 4803. 15 | 4166. 35275 | 19 743. 4 | 20 118. 9 | 20 470. 5 | 20 799 5 | 3583. 97 | 3358. 96 | 3184. 92 | 3122. 06 |
| Ghana | 59 019. 7 | 55 264. 9 | 49 022. 2 | 41 496 4 | 39 098. 4 | 35 453. 5 | 29 513. 5 | 21 870. 1989 | 16 512. 7 | 16 515. 9 | 16 445. 1 | 16 578. 3 | 3408. 61 | 3295. 57 | 3063. 63 | 3047. 56 |
| Guatemala | 37 949. 6 | 34 347 6 | 30 505. 9 | 27 922. 9 | 18 271. 3 | 14 178. 4 | 10 514. 8 | 8080. 30516 | 14 934. 8 | 14 831. 3 | 15 037. 6 | 15 195. 5 | 4743. 45 | 5337. 24 | 4953. 39 | 4647. 12 |
| Honduras | 30 190. 8 | 27 507 8 | 25 925. 3 | 24 862 72 | 9317. 72 | 7284. 06 | 5812. 59 | 4721. 93882 | 16 989. 8 | 16 291. 1 | 15 993. 6 | 16 395 27 | 3883. 27 | 3931. 83 | 4119. 11 | 3745. 03 |
| India | 52 838. 3 | 47 216. 6 | 42 267 7 | 38 561. 7 | 27 343. 9 | 22 812. 7 | 18 055. 8 | 14 351. 8686 | 20 458. 6 | 19 868. 6 | 20 110. 1 | 20 390. 4 | 5035. 83 | 4535. 35 | 4101. 06 | 3819. 53 |
| Indonesia | 34 725. 3 | 32 489. 6 | 30 681. 5 | 29 217 9 | 13 963. 9 | 11 574 29 | 9554. 15976 | 7765. 15976 | 17 959. 6 | 18 319 3 | 18 705. 3 | 19 213. 2 | 2801. 81 | 2596. 54 | 2421. 86 | 2238. 7 |
| Kenya | 68 301. 2 | 62 412. 6 | 48 603. 4 | 42 578. 1 | 52 058. 7 | 46 478. 5 | 32 794. 1 | 26 612. 1447 | 12 900. 3 | 12 773. 6 | 12 649. 5 | 12 881. 5 | 3342. 21 | 3160. 43 | 3159. 79 | 3084. 46 |

(Continued)

Table A1. Continued

| Country | All-cause | | | | DALYs, Communicable, maternal, neonatal and nutritional diseases | | | | Non-communicable diseases | | | | Injuries | | | |
|-----------------------|--------------|--------------|--------------|---------|--|---------|---------|---------|---------------------------|---------|---------|---------|----------|-------|-------|-------|
| | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 |
| Kiribati | 51 888. 6 | 48 855. 5 | 46 289. 8 | 43 483 | 21 926. | 19 402. | 16 650. | 13 957. | 25 464. | 24 919. | 25 071 | 25 210. | 4498. | 4533. | 4568. | 4314. |
| Mauritania | 54 921. 5 | 48 741. 6 | 41 514 | 36 524. | 35 849. | 30 975 | 24 525. | 19 527. | 15 264. | 14 292. | 13 941 | 14 135. | 3807. | 3474. | 3047. | 2860. |
| Myanmar | 50 600. 4 | 44 678. 3 | 38 381. 9 | 34 867. | 24 660. | 19 208 | 13 295. | 9590. | 22 230. | 22 029. | 21 865. | 22 261. | 3709. | 3440. | 3221. | 3015. |
| Nicaragua | 24 640. 6 | 22 211. 5 | 20 824. 5 | 20 367. | 8793. | 6207. | 4592. | 3555. | 12 778. | 13 223. | 13 744. | 14 457. | 3068. | 2779. | 2487. | 2354. |
| Nigeria | 96 329. 5 | 87 680. 4 | 72 288. 9 | 58 555 | 74 128. | 68 051. | 54 088. | 40 929. | 17 822. | 16 128. | 15 028. | 14 366. | 4379. | 3500. | 3171. | 3258. |
| Papua New Guinea | 58 681. 4 | 56 298. 4 | 51 681. 8 | 46 559. | 26 797. | 24 088. | 20 000. | 16 086. | 25 380. | 25 919. | 25 833. | 25 188. | 6503. | 6290 | 5847. | 5284. |
| Philippines | 32 085. 3 | 31 140. 9 | 30 078. 4 | 28 675. | 12 751. | 11 052. | 9224. | 7532. | 16 099 | 17 000. | 18 041. | 18 523. | 3234. | 3088 | 2813. | 2619. |
| Samoa | 25 681. 7 | 24 977. 3 | 24 252. 3 | 23 797. | 5517. | 4830. | 4122. | 3572. | 17 343. | 17 547. | 17 652. | 17 909. | 2821. | 2599. | 2477. | 2315. |
| São Tomé and Príncipe | 49 629. 5 | 43 500. 7 | 37 504 7 | 33 508. | 26 733. | 21 538. | 16 792. | 13 712. | 19 409. | 18 792. | 17 898. | 17 252. | 3486. | 3169. | 2812. | 2544. |
| Solomon Islands | 40 735. 4 | 40 654. 4 | 38 166. 5 | 35 441. | 13 320. | 12 466. | 10 066 | 7820. | 22 499. | 23 469. | 23 631. | 23 480. | 4915. | 4718. | 4468. | 4140. |
| Sri Lanka | 28 599. 6 | 26 703. 2 | 26 112. 7 | 23 418 | 4828. | 4442. | 3315. | 2653. | 17 577. | 17 888. | 17 432. | 17 515. | 6192. | 4372. | 5364. | 3248. |
| Sudan | 59 603. 6 | 50 482. 2 | 44 325. 9 | 39 169. | 32 150. | 24 844. | 19 559. | 15 498. | 20 301 | 19 425. | 18 930. | 18 485. | 7152. | 6212. | 5836. | 5185. |
| Timor-Leste | 69 235. 5 | 42 718. 4 | 36 547. 6 | 30 868. | 41 289. | 24 303 | 18 035. | 13 421. | 15 600. | 14 488 | 15 022. | 14 502. | 12 345. | 3927. | 3489. | 2943. |
| Tonga | 30 700 6 | 30 354. 6 | 29 090. 9 | 27 667 | 7707. | 7076. | 6407. | 5401. | 19 169. | 19 545. | 19 194. | 19 062. | 3823. | 3732. | 3488. | 3203. |
| Vanuatu | 40 640. 8 | 40 375. 8 | 38 655. 9 | 36 946. | 13 148. | 12 524. | 10 163. | 8350. | 22 760. | 23 219. | 24 053 | 24 261. | 4731. | 4631. | 4439. | 4334. |
| Vietnam | 27 148. 2 | 26 044. 2 | 25 039. 7 | 24 533. | 7211. | 5713. | 4544. | 3662. | 16 372. | 16 848. | 17 182. | 17 793. | 3564. | 3481. | 3312. | 3078. |
| Zambia | 11 0822 4 | 95 243. 4 | 73 234. 8 | 60 054 | 86 367. | 70 677. | 49 598. | 37 715. | 19 129. | 19 305. | 18 681. | 17 874. | 5324. | 5259. | 4954. | 4463. |
| | | | | | 9 | 8 | 6 | 9298 | 6 | 9 | 3 | 2 | 79 | 77 | 84 | 91 |

(Continued)

Table A1. Continued

| Country | All-cause | | | DALYs, Communicable, maternal, neonatal and nutritional diseases | | | Non-communicable diseases | | | Injuries | | | | | | |
|----------------------------------|-----------|-----------|-----------|--|----------|----------|---------------------------|----------|----------|----------|----------|----------|-----------|---------|------------|---------|
| | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | 2000 | 2005 | 2010 | 2015 | | | | |
| Low-income countries | | | | | | | | | | | | | | | | |
| Benin | 80 646.1 | 69 702.4 | 58 762.8 | 50 853.6 | 57 861.6 | 48 652.9 | 38 334.8 | 30 293.3 | 17 508.1 | 16 817.9 | 16 587.5 | 16 865.7 | 5276.38 | 4231.54 | 3840.47 | 3694.52 |
| Burkina Faso | 10 2890.1 | 88 377.7 | 73 301.5 | 62 096.9 | 81 970.7 | 69 628.5 | 55 308.9 | 43 456.0 | 16 079.6 | 14 566.6 | 14 185.1 | 14 658.2 | 4839.96 | 4182.06 | 3807.47 | 3982.67 |
| Burundi | 10 7396.1 | 77 060.9 | 59 089.9 | 54 434.7 | 79 638.8 | 55 135.8 | 39 647.2 | 33 872.5 | 19 715.9 | 16 624.2 | 15 237.8 | 16 013.8 | 8041.22 | 5300.05 | 4205.73 | 4548.36 |
| Central African Republic | 11 4723.3 | 10 9973.3 | 98 280.3 | 89 671.1 | 83 101.9 | 79 072.1 | 66 544.7 | 57 371.9 | 23 828.6 | 23 449.2 | 23 878.2 | 24 141.4 | 7792.5 | 7451.91 | 7857.44 | 8158.14 |
| Chad | 11 3487.3 | 10 3286.7 | 89 623.3 | 78 903.7 | 89 948.8 | 81 418.2 | 66 928.7 | 56 914.3 | 16 635.1 | 16 029.5 | 16 576.9 | 16 249.2 | 6903.24 | 5838.47 | 6118.12 | 5740.11 |
| Comoros | 53 569.6 | 43 926.8 | 38 006.8 | 34 727.5 | 33 666.7 | 26 294.8 | 20 876.2 | 17 463.1 | 15 987.6 | 14 231.2 | 14 109.1 | 14 373.1 | 3914.71 | 3400.59 | 3021.55 | 2891.29 |
| Democratic Republic of the Congo | 96 698.3 | 84 675.7 | 73 007.3 | 62 253.2 | 73 746.7 | 63 482.8 | 52 356.3 | 41 068.3 | 17 087.2 | 16 290.2 | 16 146.4 | 16 673.2 | 5864.56 | 4902.73 | 4504.47 | 4511.64 |
| Eritrea | 147 296.7 | 84 675.1 | 53 433.1 | 49 227.8 | 37 620.9 | 34 286.2 | 32 201.7 | 27 990.4 | 14 578.2 | 15 614.8 | 16 194.8 | 16 466.1 | 95 097.79 | 5134.79 | 5036.6 | 4771.16 |
| Ethiopia | 91 781.4 | 55 035.8 | 51 540.7 | 41 384.4 | 68 520.7 | 50 186.2 | 32 643.5 | 23 087.9 | 17 960.1 | 16 482.1 | 15 187.6 | 14 970.6 | 5300.57 | 4425.34 | 3709.64 | 3327.02 |
| Guinea | 96 183.2 | 71 093.7 | 73 001.1 | 64 339.5 | 71 104.3 | 61 571.9 | 50 557.6 | 42 202.4 | 19 964.7 | 18 543.3 | 18 423.3 | 18 395.1 | 5114.21 | 4256.71 | 4020.26 | 3742.01 |
| Guinea-Bissau | 96 538.7 | 84 371.9 | 82 888.8 | 74 719.1 | 70 317.4 | 63 816.9 | 55 242.7 | 48 023.9 | 20 016.6 | 20 832.4 | 21 252.7 | 20 932.7 | 6204.66 | 6367.91 | 6393.47 | 5762.61 |
| Haiti | 60 968.6 | 91 017.7 | 187 344.4 | 44 042.2 | 32 998.5 | 29 190.1 | 23 011.9 | 17 138.1 | 22 022.1 | 21 553.9 | 21 933.5 | 21 751.9 | 5947.93 | 5420.19 | 142 398.94 | 5151.94 |
| Liberia | 90 101.9 | 56 164.1 | 59 506.9 | 50 039.2 | 70 426.3 | 55 887.3 | 41 285.1 | 32 470.2 | 15 258.8 | 14 714.9 | 14 871.7 | 14 561.7 | 4416.83 | 3593.55 | 3350.47 | 3007.21 |
| Madagascar | 67 233.6 | 74 195.3 | 50 353.3 | 45 753.1 | 45 882.4 | 35 340.6 | 30 285.3 | 25 391.1 | 17 797.2 | 16 968.2 | 17 106.6 | 17 456.4 | 3554.16 | 3039.77 | 2961.67 | 2905.6 |
| Malawi | 115 647.6 | 55 348.3 | 73 752.2 | 58 000.3 | 93 996.4 | 75 419.9 | 55 477.0 | 39 821.8 | 16 885.4 | 15 609.5 | 14 759.4 | 14 719.3 | 4765.8 | 3938.15 | 3515.86 | 3459.93 |
| Mali | 10 9769.5 | 94 967.8 | 82 559.8 | 72 644.4 | 85 293.9 | 74 473.9 | 62 405.6 | 53 393.3 | 17 595.1 | 15 648.1 | 15 385.7 | 14 895.8 | 6880.13 | 4976.42 | 4768.58 | 4355.29 |
| Mozambique | 98 628.9 | 95 098.5 | 76 691.8 | 64 101.3 | 76 310.1 | 67 542.8 | 55 877.6 | 43 459.3 | 17 205.9 | 16 365.5 | 16 680.7 | 16 677.7 | 5112.88 | 4195.85 | 4133.49 | 3964.93 |

(Continued)

Table A1. Continued

| Country | All-cause | | | | | DALYs, Communicable, maternal, neonatal and nutritional diseases | | | | | Non-communicable diseases | | | | | Injuries | | | | |
|--------------|-----------|---------|---------|---------|---------|--|---------|---------|---------|---------|---------------------------|---------|-------|-------|-------|----------|-------|-------|-------|-------|
| | 2000 | 2005 | 2010 | 2015 | 2020 | 2000 | 2005 | 2010 | 2015 | 2020 | 2000 | 2005 | 2010 | 2015 | 2020 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Niger | 12 6772 | 88 104. | 82 349. | 70 292. | 10 4637 | 81 977. | 63 758. | 51 265. | 16 073. | 15 189. | 14 305. | 14 467. | 6061. | 5117. | 4286. | 6061. | 5117. | 4286. | 4559. | 4559. |
| | | 2 | 9 | 8 | | 7 | 2 | 8835 | 9 | 9 | 1 | 6 | 11 | 46 | 63 | 11 | 46 | 63 | 3 | 3 |
| Rwanda | 96 403. | 102 285 | 46 763. | 41 572. | 68 421. | 43 716. | 27 811. | 22 324. | 19 282. | 14 660 | 13 918 | 14 560 | 8699. | 6056. | 5033. | 8699. | 6056. | 5033. | 4687. | 4687. |
| | 2 | | 2 | 9 | 5 | 4 | 6 | 9808 | 6 | | | | 1 | 43 | 57 | 1 | 43 | 57 | 83 | 83 |
| Senegal | 67 156. | 64 432. | 47 345. | 40 943. | 47 840. | 37 410 | 29 067. | 22 734. | 15 323. | 15 153. | 14 928. | 15 035. | 3992. | 3745. | 3349. | 3992. | 3745. | 3349. | 3173. | 3173. |
| | 2 | 9 | 7 | 1 | 8 | | 5 | 1145 | 3 | 4 | 7 | 9 | 19 | 85 | 52 | 19 | 85 | 52 | 01 | 01 |
| Sierra Leone | 115 035 | 56 309. | 82 915. | 69 308. | 84 772. | 72 121. | 56 975. | 44 685. | 23 178. | 22 351. | 21 461 | 20 514. | 7082. | 4917. | 4479. | 7082. | 4917. | 4479. | 4108. | 4108. |
| | | 3 | 8 | 1 | 9 | 7 | 7 | 0449 | 9 | 7 | | 1 | 81 | 85 | 13 | 81 | 85 | 13 | 97 | 97 |
| Somalia | 104 699 | 99 391. | 94 454. | 78 851. | 78 099. | 69 011. | 67 654 | 53 115. | 19 119. | 17 892. | 18 344. | 17 757. | 7480. | 6732. | 8456. | 7480. | 6732. | 8456. | 7978. | 7978. |
| | | 3 | 7 | 2 | 5 | 2 | 0699 | 6 | 6 | 7 | 7 | 8 | 4 | 02 | 1 | 4 | 02 | 1 | 36 | 36 |
| South Sudan | 86 956. | 93 635. | 73 398. | 70 610. | 65 322 | 57 992. | 51 906 | 46 476. | 16 517. | 16 009. | 16 559. | 17 215. | 5116. | 4684. | 4933. | 5116. | 4684. | 4933. | 6918. | 6918. |
| | 7 | 9 | 9 | 9 | | 8 | | 6532 | 8 | 9 | 8 | 3 | 88 | 29 | 17 | 88 | 29 | 17 | 89 | 89 |
| Tanzania | 81 186. | 78 686. | 56 858. | 46 603 | 62 093. | 51 378. | 37 906. | 27 531. | 15 455. | 15 302. | 15 430 | 15 672. | 3637. | 3546. | 3521. | 3637. | 3546. | 3521. | 3399. | 3399. |
| | 3 | 9 | 1 | | 9 | 2 | 2 | 1709 | 4 | 5 | | 3 | 09 | 49 | 89 | 09 | 49 | 89 | 45 | 45 |
| Togo | 73 669 | 70 227. | 62 911. | 52 632. | 51 510. | 49 387. | 42 394. | 32 456. | 17 899. | 17 169. | 16 790. | 16 708. | 4259. | 4444. | 3726. | 4259. | 4444. | 3726. | 3467. | 3467. |
| | | 2 | 3 | 4 | 4 | 2 | 2 | 2669 | 5 | 9 | 1 | 7 | 05 | 52 | 96 | 05 | 52 | 96 | 38 | 38 |
| Uganda | 97 965. | 71 001. | 65 370. | 52 551 | 74 556. | 58 373. | 44 575. | 31 735. | 17 875. | 17 206. | 16 189. | 16 436. | 5533. | 5060. | 4605. | 5533. | 5060. | 4605. | 4378. | 4378. |
| | 8 | 5 | 3 | | 4 | 6 | 7 | 2265 | 8 | 7 | 2 | 9 | 53 | 41 | 44 | 53 | 41 | 44 | 81 | 81 |
| Zimbabwe | 82 571. | 80 640. | 81 502. | 53 934. | 63 658. | 72 972. | 61 351. | 36 162. | 15 274 | 16 383. | 16 223. | 14 367. | 3638. | 3842. | 3926. | 3638. | 3842. | 3926. | 3405. | 3405. |
| | 3 | 8 | 2 | 8 | 8 | 8 | 8 | 1499 | 15 274 | 16 383. | 16 223. | 14 367. | 3638. | 3842. | 3926. | 3638. | 3842. | 3926. | 3405. | 3405. |

Table A2. Cumulative proportion of the population living in the tropics and cumulative proportion of the DALYs burden, 2015

| Country | Cumulative % of tropical population | Cumulative % of DALYs, all | Cumulative % of DALYs, communicable, maternal, neonatal and nutritional diseases | Cumulative % of DALYs, non-communicable diseases | Cumulative % of DALYs, injury |
|----------------------------------|-------------------------------------|----------------------------|--|--|-------------------------------|
| Central African Republic | 0.0009 | 0.0249 | 0.0348 | 0.0148 | 0.0249 |
| Burundi | 0.0029 | 0.0400 | 0.0554 | 0.0246 | 0.0388 |
| Democratic Republic of the Congo | 0.0182 | 0.0573 | 0.0804 | 0.0349 | 0.0526 |
| Liberia | 0.0191 | 0.0712 | 0.1001 | 0.0438 | 0.0618 |
| Niger | 0.0231 | 0.0907 | 0.1312 | 0.0527 | 0.0758 |
| Malawi | 0.0266 | 0.1068 | 0.1554 | 0.0617 | 0.0863 |
| Mozambique | 0.0322 | 0.1246 | 0.1818 | 0.0720 | 0.0985 |
| Guinea | 0.0346 | 0.1424 | 0.2074 | 0.0832 | 0.1099 |
| Sierra Leone | 0.0361 | 0.1617 | 0.2346 | 0.0958 | 0.1225 |
| Togo | 0.0375 | 0.1763 | 0.2543 | 0.1061 | 0.1331 |
| Madagascar | 0.0424 | 0.1890 | 0.2697 | 0.1168 | 0.1419 |
| Comoros | 0.0425 | 0.1986 | 0.2803 | 0.1256 | 0.1508 |
| Guinea-Bissau | 0.0429 | 0.2193 | 0.3095 | 0.1385 | 0.1684 |
| Ethiopia | 0.0629 | 0.2308 | 0.3235 | 0.1477 | 0.1786 |
| Burkina Faso | 0.0665 | 0.2481 | 0.3499 | 0.1567 | 0.1907 |
| Haiti | 0.0686 | 0.2603 | 0.3603 | 0.1700 | 0.2065 |
| Uganda | 0.0767 | 0.2749 | 0.3796 | 0.1801 | 0.2199 |
| Rwanda | 0.0790 | 0.2864 | 0.3932 | 0.1890 | 0.2342 |
| South Sudan | 0.0814 | 0.3060 | 0.4214 | 0.1996 | 0.2553 |
| Kiribati | 0.0814 | 0.3181 | 0.4299 | 0.2151 | 0.2685 |
| Zimbabwe | 0.0846 | 0.3330 | 0.4518 | 0.2239 | 0.2789 |
| Mali | 0.0880 | 0.3532 | 0.4843 | 0.2330 | 0.2923 |
| Benin | 0.0902 | 0.3673 | 0.5027 | 0.2434 | 0.3035 |
| Chad | 0.0930 | 0.3892 | 0.5372 | 0.2533 | 0.3211 |
| Solomon Islands | 0.0931 | 0.3991 | 0.5420 | 0.2678 | 0.3337 |
| Timor-Leste | 0.0933 | 0.4076 | 0.5501 | 0.2767 | 0.3427 |
| Senegal | 0.0963 | 0.4190 | 0.5640 | 0.2859 | 0.3524 |
| Tanzania | 0.1071 | 0.4319 | 0.5807 | 0.2955 | 0.3628 |
| Papua New Guinea | 0.1087 | 0.4449 | 0.5905 | 0.3110 | 0.3790 |
| Vanuatu | 0.1087 | 0.4551 | 0.5955 | 0.3259 | 0.3922 |
| Kenya | 0.1182 | 0.4669 | 0.6117 | 0.3338 | 0.4017 |
| São Tomé and Príncipe | 0.1182 | 0.4762 | 0.6200 | 0.3443 | 0.4094 |
| Cameroon | 0.1228 | 0.4929 | 0.6436 | 0.3548 | 0.4222 |
| Bangladesh | 0.1550 | 0.5016 | 0.6491 | 0.3664 | 0.4324 |
| Djibouti | 0.1552 | 0.5141 | 0.6623 | 0.3781 | 0.4460 |
| Cote d'Ivoire | 0.1598 | 0.5312 | 0.6870 | 0.3886 | 0.4576 |
| Federated States of Micronesia | 0.1599 | 0.5390 | 0.6895 | 0.4013 | 0.4672 |
| Cambodia | 0.1630 | 0.5475 | 0.6954 | 0.4121 | 0.4779 |
| Mauritania | 0.1638 | 0.5577 | 0.7073 | 0.4208 | 0.4867 |
| Zambia | 0.1670 | 0.5743 | 0.7302 | 0.4317 | 0.5003 |
| Marshall Islands | 0.1670 | 0.5837 | 0.7343 | 0.4460 | 0.5110 |
| Ghana | 0.1726 | 0.5952 | 0.7476 | 0.4562 | 0.5203 |
| Sudan | 0.1803 | 0.6060 | 0.7570 | 0.4675 | 0.5361 |
| Honduras | 0.1821 | 0.6129 | 0.7599 | 0.4776 | 0.5476 |
| Nicaragua | 0.1833 | 0.6186 | 0.7620 | 0.4865 | 0.5548 |

(Continued)

Table A2. Continued

| Country | Cumulative % of tropical population | Cumulative % of DALYs, all | Cumulative % of DALYs, communicable, maternal, neonatal and nutritional diseases | Cumulative % of DALYs, non-communicable diseases | Cumulative % of DALYs, injury |
|-----------------------|-------------------------------------|----------------------------|--|--|-------------------------------|
| Myanmar | 0.1938 | 0.6283 | 0.7679 | 0.5001 | 0.5640 |
| Tonga | 0.1938 | 0.6360 | 0.7711 | 0.5118 | 0.5738 |
| Republic of the Congo | 0.1948 | 0.6501 | 0.7882 | 0.5233 | 0.5860 |
| Samoa | 0.1948 | 0.6567 | 0.7904 | 0.5343 | 0.5931 |
| Vietnam | 0.2132 | 0.6635 | 0.7926 | 0.5452 | 0.6025 |
| Nigeria | 0.2494 | 0.6797 | 0.8175 | 0.5540 | 0.6124 |
| India | 0.5113 | 0.6904 | 0.8262 | 0.5666 | 0.6241 |
| Angola | 0.5169 | 0.7070 | 0.8471 | 0.5781 | 0.6441 |
| Bolivia | 0.5190 | 0.7148 | 0.8517 | 0.5884 | 0.6560 |
| Philippines | 0.5393 | 0.7228 | 0.8562 | 0.5997 | 0.6640 |
| Guatemala | 0.5426 | 0.7305 | 0.8611 | 0.6090 | 0.6782 |
| El Salvador | 0.5439 | 0.7380 | 0.8633 | 0.6199 | 0.6961 |
| Belize | 0.5439 | 0.7453 | 0.8669 | 0.6299 | 0.7083 |
| Jamaica | 0.5445 | 0.7530 | 0.8696 | 0.6426 | 0.7160 |
| Paraguay | 0.5458 | 0.7599 | 0.8723 | 0.6531 | 0.7261 |
| Fiji | 0.5460 | 0.7711 | 0.8766 | 0.6713 | 0.7367 |
| Namibia | 0.5465 | 0.7832 | 0.8926 | 0.6797 | 0.7484 |
| Dominica | 0.5465 | 0.7918 | 0.8956 | 0.6938 | 0.7569 |
| Indonesia | 0.5982 | 0.7999 | 0.9004 | 0.7056 | 0.7638 |
| St. Lucia | 0.5982 | 0.8077 | 0.9027 | 0.7188 | 0.7721 |
| Ecuador | 0.6014 | 0.8143 | 0.9054 | 0.7286 | 0.7824 |
| Sri Lanka | 0.6056 | 0.8208 | 0.9070 | 0.7394 | 0.7923 |
| Peru | 0.6119 | 0.8264 | 0.9096 | 0.7478 | 0.7986 |
| Maldives | 0.6120 | 0.8312 | 0.9114 | 0.7555 | 0.8050 |
| Colombia | 0.6216 | 0.8373 | 0.9131 | 0.7650 | 0.8161 |
| Dominican Republic | 0.6237 | 0.8444 | 0.9168 | 0.7751 | 0.8254 |
| China | 0.8980 | 0.8513 | 0.9180 | 0.7875 | 0.8334 |
| Brazil | 0.9392 | 0.8590 | 0.9204 | 0.7997 | 0.8460 |
| Suriname | 0.9393 | 0.8676 | 0.9244 | 0.8121 | 0.8583 |
| Costa Rica | 0.9403 | 0.8732 | 0.9256 | 0.8219 | 0.8648 |
| Thailand | 0.9540 | 0.8816 | 0.9282 | 0.8355 | 0.8771 |
| Botswana | 0.9545 | 0.8972 | 0.9476 | 0.8472 | 0.8926 |
| Barbados | 0.9545 | 0.9058 | 0.9499 | 0.8628 | 0.8988 |
| Mexico | 0.9797 | 0.9122 | 0.9516 | 0.8733 | 0.9072 |
| Gabon | 0.9801 | 0.9241 | 0.9640 | 0.8847 | 0.9192 |
| Mauritius | 0.9803 | 0.9320 | 0.9654 | 0.8997 | 0.9253 |
| Antigua and Barbuda | 0.9804 | 0.9387 | 0.9674 | 0.9113 | 0.9305 |
| Panama | 0.9812 | 0.9450 | 0.9699 | 0.9210 | 0.9394 |
| Malaysia | 0.9873 | 0.9513 | 0.9722 | 0.9311 | 0.9471 |
| Seychelles | 0.9873 | 0.9589 | 0.9744 | 0.9438 | 0.9556 |
| Equatorial Guinea | 0.9875 | 0.9750 | 0.9944 | 0.9559 | 0.9724 |
| Trinidad and Tobago | 0.9878 | 0.9842 | 0.9969 | 0.9714 | 0.9837 |
| Australia | 0.9926 | 0.9903 | 0.9975 | 0.9832 | 0.9888 |
| Saudi Arabia | 0.9989 | 0.9950 | 0.9988 | 0.9909 | 0.9963 |
| Singapore | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |