UC San Diego

UC San Diego Previously Published Works

Title

Measuring performance on the Healthcare Access and Quality Index for 195 countries and territories and selected subnational locations: a systematic analysis from the Global Burden of Disease Study 2016

Permalink

https://escholarship.org/uc/item/6mp5f7s9

Journal

The Lancet, 391(10136)

ISSN

0140-6736

Authors

Collaborators, GBD 2016 Healthcare Access and Quality

Fullman, Nancy

Yearwood, Jamal

et al.

Publication Date

2018-06-01

DOI

10.1016/s0140-6736(18)30994-2

Copyright Information

This work is made available under the terms of a Creative Commons Attribution License, available at https://creativecommons.org/licenses/by/4.0/

Peer reviewed

eScholarship.org Powered by the California Digital Library
University of California

Measuring performance on the Healthcare Access and Quality Index for 195 countries and territories and selected subnational locations: a systematic analysis from the Global Burden of Disease Study 2016

*GBD 2016 Healthcare Access and Quality Collaborators**

Lancet 2018; 391: 2236–71
Published Online
May 23, 2018
http://dx.doi.org/10.1016/S0140-6736(18)30994-2

See Comment page 2190

*Collaborators listed at end of the Article

Correspondence to:
Prof Rafael Lozano, Institute for Health Metrics and Evaluation, University of Washington, Seattle, WA 98121, USA
rlozano@uw.edu

Summary

Background A key component of achieving universal health coverage is ensuring that all populations have access to quality health care. Examining where gains have occurred or progress has faltered across and within countries is crucial to guiding decisions and strategies for future improvement. We used the Global Burden of Diseases, Injuries, and Risk Factors Study 2016 (GBD 2016) to assess personal health-care access and quality with the Healthcare Access and Quality (HAQ) Index for 195 countries and territories, as well as subnational locations in seven countries, from 1990 to 2016.

Methods Drawing from established methods and updated estimates from GBD 2016, we used 32 causes from which death should not occur in the presence of effective care to approximate personal health-care access and quality by location and over time. To better isolate potential effects of personal health-care access and quality from underlying risk factor patterns, we risk-standardised cause-specific deaths due to non-cancers by location-year, replacing the local joint exposure of environmental and behavioural risks with the global level of exposure. Supported by the expansion of cancer registry data in GBD 2016, we used mortality-to-incidence ratios for cancers instead of risk-standardised death rates to provide a stronger signal of the effects of personal health care and access on cancer survival. We transformed each cause to a scale of 0–100, with 0 as the first percentile (worst) observed between 1990 and 2016, and 100 as the 99th percentile (best); we set these thresholds at the country level, and then applied them to subnational locations. We applied a principal components analysis to construct the HAQ Index using all scaled cause values, providing an overall score of 0–100 of personal health-care access and quality by location over time. We then compared HAQ Index levels and trends by quintiles on the Socio-demographic Index (SDI), a summary measure of overall development. As derived from the broader GBD study and other data sources, we examined relationships between national HAQ Index scores and potential correlates of performance, such as total health spending per capita.

Findings In 2016, HAQ Index performance spanned from a high of 97·1 (95% UI 95·8–98·1) in Iceland, followed by 96·6 (94·9–97·9) in Norway and 96·1 (94·5–97·3) in the Netherlands, to values as low as 18·6 (13·1–24·4) in the Central African Republic, 19·0 (14·3–23·7) in Somalia, and 23·4 (20·2–26·8) in Guinea-Bissau. The pace of progress achieved between 1990 and 2016 varied, with markedly faster improvements occurring between 2000 and 2016 for many countries in sub-Saharan Africa and southeast Asia, whereas several countries in Latin America and elsewhere saw progress stagnate after experiencing considerable advances in the HAQ Index between 1990 and 2000. Striking subnational disparities emerged in personal health-care access and quality, with China and India having particularly large gaps between locations with the highest and lowest scores in 2016. In China, performance ranged from 91·5 (89·1–93·6) in Beijing to 48·0 (43·4–53·2) in Tibet (a 43·5-point difference), while India saw a 30·8-point disparity, from 64·8 (59·6–68·8) in Goa to 34·0 (30·3–38·1) in Assam. Japan recorded the smallest range in subnational HAQ performance in 2016 (a 4·8-point difference), whereas differences between subnational locations with the highest and lowest HAQ Index values were more than two times as high for the USA and three times as high for England. State-level gaps in the HAQ Index in Mexico somewhat narrowed from 1990 to 2016 (from a 20·9-point to 17·0-point difference), whereas in Brazil, disparities slightly increased across states during this time (a 17·2-point to 20·4-point difference). Performance on the HAQ Index showed strong linkages to overall development, with high and high-middle SDI countries generally having higher scores and faster gains for non-communicable diseases. Nonetheless, countries across the development spectrum saw substantial gains in some key health service areas from 2000 to 2016, most notably vaccine-preventable diseases. Overall, national performance on the HAQ Index was positively associated with higher levels of total health spending per capita, as well as health systems inputs, but these relationships were quite heterogeneous, particularly among low-to-middle SDI countries.

Interpretation GBD 2016 provides a more detailed understanding of past success and current challenges in improving personal health-care access and quality worldwide. Despite substantial gains since 2000, many low-SDI and middle-SDI countries face considerable challenges unless heightened policy action and investments focus on advancing

access to and quality of health care across key health services, especially non-communicable diseases. Stagnating or minimal improvements experienced by several low-middle to high-middle SDI countries could reflect the complexities of re-orienting both primary and secondary health-care services beyond the more limited foci of the Millennium Development Goals. Alongside initiatives to strengthen public health programmes, the pursuit of universal health coverage hinges upon improving both access and quality worldwide, and thus requires adopting a more comprehensive view—and subsequent provision—of quality health care for all populations.

Funding Bill & Melinda Gates Foundation.

Copyright © 2018 The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY 4.0 license.

Introduction

Providing access to quality health care is among the foremost objectives of health systems,[1,2] because the receipt of effective personal health care can substantially improve many health outcomes and avert premature mortality. The advancement of population health was elevated to global agendas with the Alma Ata Declaration of 1978, wherein WHO called for the achievement of "health for all" by 2000.[3] Such aspirations garnered new momentum in the Sustainable Development Goal (SDG)

Research in context

Evidence before this study

Improving, and subsequently measuring, health-care access and quality has emerged as an increasing priority alongside a heightened emphasis on universal health coverage in the Sustainable Development Goal era. Nevertheless, few studies have sought to assess personal health-care access and quality across a wide range of key health service dimensions and the development spectrum. Primarily focused on high-income countries, past analyses have used amenable mortality—deaths from causes that should not occur in the presence of high-quality health care—to approximate national levels of personal health-care access and quality. Drawing from the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015), the GBD collaboration used this amenable mortality framework in developing the Healthcare Access and Quality (HAQ) Index, and subsequently offered several advances from previous work. First, the extensive cause-of-death standardisation processes that occur as part of GBD enabled better comparisons across locations and over time. Second, risk-standardising death rates for environmental and behavioural risk factors helped isolate differences in health-care access and quality from variations in death rates due to background risk exposure. Third, estimating the HAQ Index for 195 countries and territories from 1990 to 2015, allowed for a broader investigation of trends in personal health-care access and quality across the development spectrum. Despite these methodological strengths, additional areas for improvement were identified, including the consideration of health outcomes that more directly reflect the progression of disease onset to mortality for amenable causes and examining subnational inequalities.

Added value of this study

Based on updated cause of death and risk factor estimates from the GBD 2016 study, our analysis offers an improved assessment of national levels of personal health-care access and quality from 1990 to 2016. For the first time, we report subnational levels and trends on the HAQ Index for seven countries: Brazil, China, England, India, Japan, Mexico, and the USA. Because of major improvements in cancer estimation and data availability, we used mortality-to-incidence ratios rather than risk-standardised death rates from cancer, ultimately providing a more robust approximation of cancer detection and treatment effects across countries. To improve index stability, we used percentiles (ie, first and 99th percentile) for transforming HAQ Index components to a scale of 0–100. Finally, we did an exploratory analysis of national HAQ Index levels and potential correlates of performance, examining relationships between the HAQ Index and some indicators such as health financing (eg, total health spending per capita).

Implications of all the available evidence

Globally, personal health-care access and quality improved since 1990, with many countries in sub-Saharan Africa and southeast Asia accelerating their pace of progress from 2000 to 2016. Such gains in the more recent time period could reflect the catalytic effects of the Millennium Development Goals and their focus on a subset of health service areas (ie, vaccine-preventable diseases, infectious diseases, and maternal and child health). Nonetheless, inequalities increased in some parts of the world, which might be related to many low-to-middle income countries recording much slower gains for cancers and other non-communicable diseases. Large disparities in subnational levels of personal health-care access and quality emerged for several countries, especially China and India. These results emphasise the urgent need to improve both access to and quality of health care across service areas and for all populations; otherwise, health systems could face widening gaps between the health services they provide and the disease burden experienced by local communities. Going forward, the HAQ Index can provide a robust measure for both informing and monitoring the effects of policy action on health-care access and quality, a key component of achieving universal health coverage. To deliver health systems for the next generation and hasten progress in the Sustainable Development Goal era, now is the time to align investments for improving access and quality across the full range of health-care needs.

era,[4] with a heightened emphasis on attaining universal health coverage in this pursuit. Making progress on universal health coverage entails all people having access to quality health services they need without incurring financial hardship.[5] To advance toward this ambition, it is crucial to monitor where improvements in health-care access and quality have occurred, and where progress must be accelerated, across the development spectrum.

Measuring health-care access and quality has become an increasingly important priority alongside its ascent in global health policy. In particular, the use of amenable mortality—deaths from causes that should not occur in the presence of effective medical care—to approximate national levels of personal health-care access and quality has gained greater traction.[6–15] Amenable mortality metrics are thought to provide a strong signal of what can or should be addressed by the receipt of effective health care, and thus performance on overall personal health-care access and quality. Combining such measures with those capturing avertable or preventable health outcomes (ie, burden that can be avoided through public health programmes or policies implemented outside the immediate health sector) can offer a more complete set of potential pathways for improving health.[1,16] The Nolte and McKee list of causes amenable to health care[6–9] remains the most widely used framework to quantify national levels of health-care access and quality on the basis of amenable mortality. This is particularly true for Europe,[11,15,17] the Organisation for Economic Co-operation and Development (OECD),[12] and the USA,[13] but increasingly also for other country-specific analyses (eg, Brazil,[14] China,[18] and Mexico[19]). As part of the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015),[20] the GBD collaboration applied this framework to develop a novel measure, the Healthcare Access and Quality (HAQ) Index, to track gains and gaps in personal health-care access and quality in 195 countries and territories over time.

The HAQ Index offered several strengths and insights into personal health-care access and quality across countries, which has prompted calls for further improvements. First, 32 causes considered amenable to health care comprise the HAQ Index, representing a range of health service areas: vaccine-preventable diseases; infectious diseases and maternal and child health; non-communicable diseases, including cancers, cardiovascular diseases, and other non-communicable diseases such as diabetes; and gastrointestinal conditions from which surgery can easily avert death (eg, appendicitis). Other than in high-income countries, past research rarely accounts for this array of services,[21] even though effective preventive interventions, treatment, and medical technologies exist; instead, these studies often focus on infectious diseases and maternal and child health, and do not shed light on potential challenges across service areas. Second, because GBD quantifies risk exposure and risk-attributable deaths, we could account for local variations in risk exposure and better isolate differences in mortality related to health care. Nonetheless, challenges can still exist in ensuring that these measures provide a strong signal on health-care access and quality. For instance, in the absence of stronger monitoring systems, low rates of cancer mortality could actually represent inadequate detection and treatment of cancer rather than good access to cancer screening and high-quality care.[22] Third, although some insights into the relationship between the HAQ Index and sociodemographic development were explored in GBD 2015,[20] further examination of how health financing and system measures are related to the HAQ Index has yet to occur. Fourth, considerable debate continues about how well the current cause list represents the range of causes amenable to health care, particularly non-fatal outcomes, as well as the ages at which health care can substantially improve outcomes. Finally, GBD 2015 highlighted sizeable inequalities across countries[20] but did not capture subnational differences in personal health-care access and quality, a crucial need in light of the magnitude by which health outcomes can vary within countries.[23–30]

In this study, we provide updated estimates from 1990 to 2016 for the HAQ Index in 195 countries and territories, as well as at global and regional levels. For the first time, we report subnational estimates of the HAQ Index for seven countries, allowing for a more in-depth examination of inequalities in personal health-care access and quality. With the improved estimation of cancers in GBD 2016,[31–33] we use mortality-to-incidence ratios (MIRs) for cancers to better reflect potential differences in cancer diagnostic and treatment capacity across locations. Finally, we do an exploratory analysis of the associations between the HAQ Index and potential correlates of performance.

Methods

Overview

Drawing from methods established in GBD 2015,[20] our analysis involved four steps: mapping the Nolte and McKee cause list to GBD causes; constructing MIRs for cancers and risk-standardising non-cancer deaths to remove variations in mortality not directly amenable to health care; calculating the HAQ Index on the basis of principal components analysis (PCA), providing an overall score of personal health-care access and quality on a scale of 0–100; and examining associations between national HAQ Index scores and potential correlates of performance.

Our study draws from GBD 2016 results,[31–33] which entail several improvements since GBD 2015, including 169 new country-years of vital registration data, 528 new cancer-registry years with a total of 92 countries' cancer registries,[31] five new risk factors,[32] and cause-specific mortality modelling updates (eg, cancers, tuberculosis).[31] Further information can be found in the appendix (pp 12–89) and the GBD 2016 capstone series.[31–33]

See Online for appendix

In addition to national and aggregated HAQ Index results, we report estimates at the subnational level for Brazil (26 states and the Federal District), China (33 provinces and special administrative regions), England (nine regions and 150 local government areas), India (31 states and union territories), Japan (47 prefectures), Mexico (32 states), and the USA (50 states and the District of Columbia).

As with all GBD revisions, GBD 2016 HAQ Index estimates for the full time series published here supersede previous iterations. This analysis complies with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER);[34] additional information is found in the appendix (pp 5–7).

Mapping the Nolte and McKee amenable cause list to GBD causes

We mapped 32 of 33 causes from the Nolte and McKee cause list[6–9] to GBD causes in accordance with International Classification of Diseases codes (table 1; appendix p 156). GBD includes thyroid diseases within a larger residual category, and only non-fatal outcomes are estimated for benign prostatic hyperplasia; consequently, these causes were not included in our analyses. GBD provides separate estimates for diphtheria and tetanus, so we disaggregated these causes from the original Nolte and McKee list.

Mortality-to-incidence ratios for cancers

GBD cancer mortality estimates are informed by MIRs, which are derived from incidence and mortality data recorded in cancer registries; more detail on MIR estimation is in the appendix (pp 41–49).[31] MIRs provide a good approximation of cancer survival and have been used to identify countries with higher or lower cancer mortality relative to incidence.[22,35] Because of the improved quantity and quality of cancer registry data from GBD 2016, we used cancer-specific MIRs instead of risk-standardised death rates. As detailed in the appendix (pp 10–11), cancer-specific MIRs were more strongly correlated with the Socio-demographic Index (SDI), a measure of overall development, than were risk-standardised death rates. These results, and the distribution of MIRs by SDI quintile (appendix pp 96–111), showed that cancer MIRs provide a more robust signal of cancer care access and quality than do risk-standardised death rates.

Risk-standardisation of death rates for non-cancer causes

To better isolate differences in mortality associated with health-care access and quality from differences associated with underlying risk exposure, we risk-standardised cause-specific deaths to global levels of risk exposure.[32] We did not risk-standardise differences in exposure to three metabolic risk factors (high systolic blood pressure, high total cholesterol, and high fasting plasma glucose) given their amenability to health care (eg, diagnosis and treatment of hypertension in primary care). For the

	Amenable age range (years)
Communicable, maternal, neonatal, and nutritional diseases	
Tuberculosis	0–74
Diarrhoea, lower respiratory, and other common infectious diseases	
Diarrhoeal diseases	0–14
Lower respiratory infections	0–74
Upper respiratory infections	0–74
Diphtheria	0–74
Whooping cough	0–14
Tetanus	0–74
Measles	1–14
Maternal disorders	0–74
Neonatal disorders	0–74
Non-communicable diseases	
Neoplasms	
Colon and rectum cancer	0–74
Non-melanoma skin cancer (squamous-cell carcinoma)	0–74
Breast cancer	0–74
Cervical cancer	0–74
Uterine cancer	0–44
Testicular cancer	0–74
Hodgkin's lymphoma	0–74
Leukaemia	0–44
Cardiovascular diseases	
Rheumatic heart disease	0–74
Ischaemic heart disease	0–74
Cerebrovascular disease	0–74
Hypertensive heart disease	0–74
Chronic respiratory diseases	1–14
Digestive diseases	
Peptic ulcer disease	0–74
Appendicitis	0–74
Inguinal, femoral, and abdominal hernia	0–74
Gallbladder and biliary diseases	0–74
Neurological disorders	
Epilepsy	0–74
Diabetes, urogenital, blood, and endocrine diseases	
Diabetes	0–49
Chronic kidney disease	0–74
Other non-communicable diseases	
Congenital heart anomalies	0–74
Injuries	
Unintentional injuries	
Adverse effects of medical treatment	0–74

Although 0 (at birth) to 1 are listed as the lower bound of age ranges, age restrictions are applied for many causes such that mortality estimates are not produced before a given age group (eg, 15–19 years for many non-communicable diseases). Causes are ordered on the basis of the GBD cause list and corresponding group hierarchies. GBD=Global Burden of Disease.

Table 1: **Causes for which mortality is amenable to health care, mapped to GBD causes, and amenable age range**

24 non-cancer causes, we risk-standardised deaths by removing the joint effects of location-specific behavioural and environmental risk exposure, and replaced these estimates with the global level of joint risk exposure (appendix pp 9–10).

Joint population attributable fraction (PAF) estimation accounts for effects of multiple risks combined, including the mediation of different risk factors through each other. More detail on the PAF calculations and risk-standardisation is provided in the appendix (pp 9–10). Since GBD 2015,[36] five risk factors were added, most notably low birthweight and short gestation,[32] which enabled the risk-standardisation of neonatal disorder deaths. Risk-standardised deaths equalled observed deaths for causes in which no risk–outcome pairs have met evidence thresholds for inclusion in GBD (eg, diphtheria, appendicitis).

Age-standardisation

Using the GBD world population data,[37] we age-standardised risk-standardised death rates, as well as cancer mortality and incidence estimates, before producing MIRs. We rescaled age weights to equal 1, by cause, a necessary step since included age groups represented a subset of the age groups comprising the world population standard.

Constructing the HAQ Index

By cause, we log-transformed age-standardised risk-standardised death rates (or MIRs for cancers) and scaled them from 0 to 100 across locations from 1990–2016. Zero was determined by the first percentile observed (ie, highest death rates or MIRs), and 100 was applied to the 99th percentile (ie, lowest death rates or MIRs). This scaling approach differs somewhat from that of GBD 2015,[20] wherein maximum values determined zero and minimum values set 100. Using a percentile-based approach more closely aligns with other index construction methods used in GBD,[38] and is less sensitive to outliers or fluctuations in estimates over time. We then applied cause-specific thresholds set by the national level to subnational locations.

We used PCA to construct the HAQ Index on the basis of scaled cause values, resulting in an overall score on a scale of 0–100. The GBD 2016 HAQ Index differed in three main ways from GBD 2015. First, no cause had negative PCA weights (ie, implying that higher death rates were associated with access to higher-quality health care), so all causes contributed to the final index. In GBD 2015, colon and breast cancers had negative PCA weights in the first PCA iteration, so their weights were ultimately set to zero. Second, some cancers had PCA weights more similar to communicable, maternal, and neonatal causes, which meant these causes were weighted more equally (appendix p 157). Finally, we derived PCA weights from country-level estimates and applied them to subnational results; this approach provides greater stability across GBD iterations, particularly as the GBD continues to expand its subnational assessments.

Examining correlates of HAQ Index performance

The HAQ Index reflects many factors that affect service access and quality across the continuums of care and therapeutic areas, and thus it is challenging to distinguish the unique contribution of access versus quality from other potential drivers.[39] To provide an initial examination of correlates with HAQ Index performance, we ran Pearson correlations between location-specific HAQ Index values with financial measures (eg, total health spending per capita),[40] and health system inputs and outputs (eg, outpatient and inpatient utilisation).[33] We selected these indicators on the basis of data availability in relation to GBD locations, and thus they do not represent all possible correlates.

Comparing performance on the HAQ Index across the development spectrum

As well as examining global patterns, we report differences in the HAQ Index across levels of development. To do this, we used SDI, a summary measure of overall development based on average income per capita, educational attainment, and total fertility rates.[41] Countries are grouped by SDI quintiles, as established in GBD 2016, on the basis of their 2016 SDI values.[31]

Uncertainty analysis

GBD aims to propagate uncertainty throughout its estimation process, which results in uncertainty intervals (UIs) accompanying each estimate. We estimated the HAQ Index for each location-year on the basis of 1000 draws from the posterior distribution for each included cause of death. 95% UIs were based on the 2·5th and 97·5th quantiles of the draws for each measure.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

National and subnational patterns in personal healthcare access and quality

The HAQ Index performance followed distinct geographical patterns in 2016 (figure 1), with most countries in the highest decile clustered in Europe or nearby (ie, Iceland), and almost all countries in the lowest decile located in sub-Saharan Africa. Exceptions to this pattern included Canada, Japan, Australia, and New Zealand in the tenth decile, and Afghanistan in the first decile. More heterogeneity emerged among the next deciles of performance (eg, USA, UK, Malta, Lebanon, Singapore, and South Korea, in the ninth decile; Cuba, Chile,

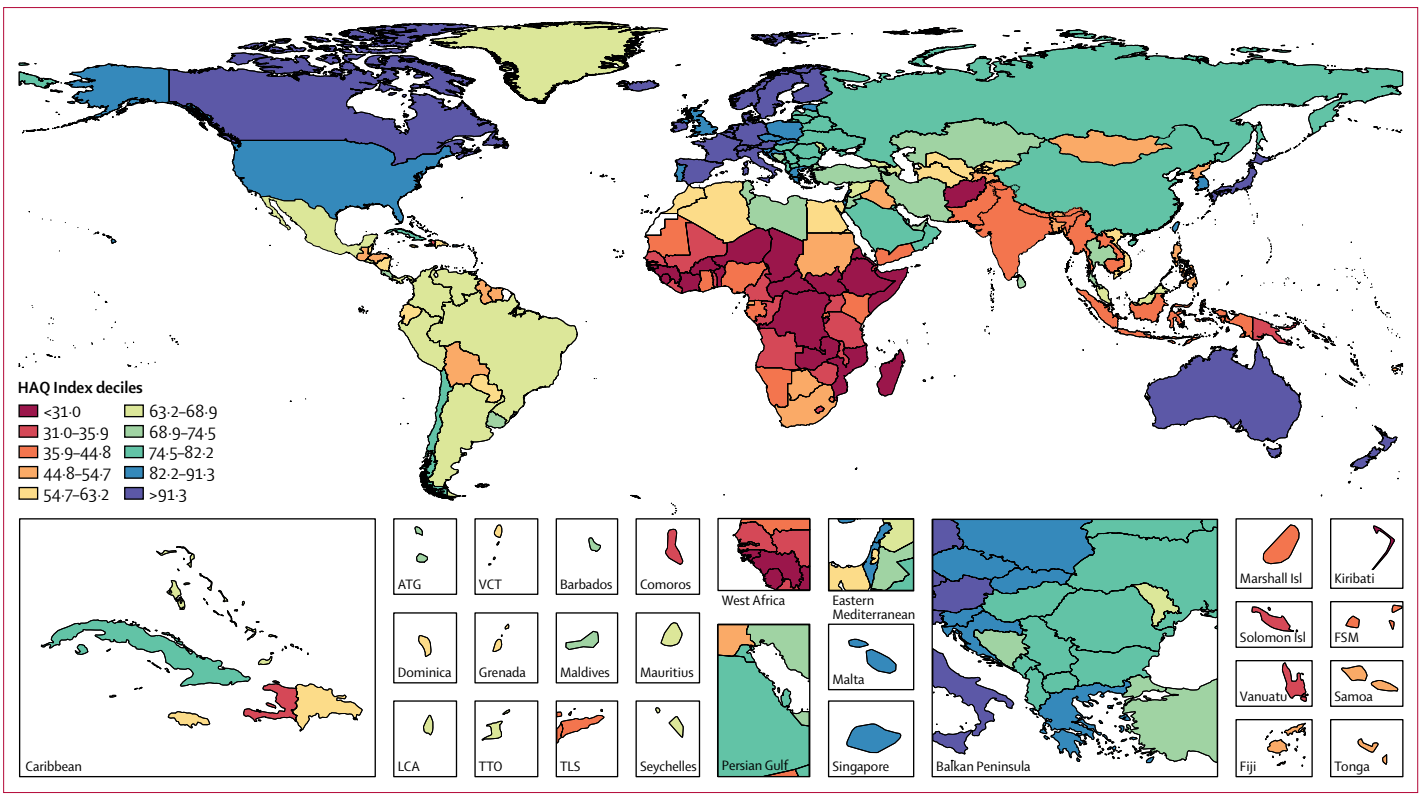


Figure 1: **Map of HAQ Index values, by decile, in 2016**
Deciles are based on the distribution of HAQ Index values in 2016. Where lower and upper bounds of deciles appear to overlap, they should be interpreted as values up to but not equalling the upper bound in the preceding decile (ie, exclusive of the upper bound value) and values equalling the lower bound of the following decile (ie, inclusive of the lower bound value). HAQ Index=Healthcare Access and Quality Index. ATG=Antigua and Barbuda. VCT=Saint Vincent and the Grenadines. LCA=Saint Lucia. TTO=Trinidad and Tobago. FSM=Federated States of Micronesia. TLS=Timor-Leste.

Saudi Arabia, and Russia, in the eighth decile). Most Latin American countries scored between the fourth and sixth deciles, whereas southeast Asia featured a broader range, spanning from the seventh (Thailand and Sri Lanka) to third deciles (Cambodia, Indonesia, Laos, Myanmar, and Timor-Leste). By 2016, many sub-Saharan African countries improved their performance from 1990 and 2000 (appendix pp 113–14), such as South Africa and Botswana rising to the fourth decile, and several locations moving to the third decile (eg, Kenya, Rwanda, Namibia, Nigeria, Ghana). African countries that remained in the first decile since 1990 were generally concentrated in central and eastern sub-Saharan Africa.

We applied the deciles set by national HAQ Index scores in 2016 to subnational locations (figure 2), and a more nuanced landscape surfaced regarding inequalities in personal health-care access and quality. China was in the eighth decile in 2016, and had provinces spanning from the tenth decile (Beijing 91·5, 95% UI 89·1–93·6) to the fourth decile (Tibet 48·0, 43·5–53·2), with a higher performance (ie, eighth and ninth deciles) among eastern provinces and lower (ie, fifth and sixth deciles) in western provinces. For India, which was in the third decile in 2016, subnational performance ranged from the sixth (Goa 64·8, 59·6–68·8; Kerala 63·9, 58·6–67·0) to the second deciles (Assam 34·0, 30·3–38·1; and Uttar Pradesh 34·9, 31·1–38·4). Brazil and Mexico, each in the sixth decile nationally for 2016, had variable subnational patterns. In Brazil, performance was as high as the eighth decile for the Federal District (75·4, 72·3–78·1), but most states, particularly northern ones, were in the fifth decile. Conversely, Mexico featured six states in the seventh decile, whereas most others were in the sixth decile; four states, all along Mexico's southern border, fell within the fifth decile. Both occupying the ninth decile nationally, England and the USA had subnational locations spanning from the tenth to seventh deciles in 2016; Blackpool (79·7 [76·6–82·8]) had the lowest HAQ Index score in England and Mississippi (81·5 [78·6–84·2]) had the lowest score in the USA. The USA's highest HAQ Index scores were limited to a subset of northeastern states, Minnesota, and Washington state, and higher performance was primarily dispersed across southern England. Nearly all Japanese prefectures occupied the top decile of HAQ Index performance in 2016. The appendix contains a more in-depth exploration of subnational trends over time by country (pp 115–28).

Patterns of performance on the overall HAQ Index and health areas varied considerably across countries in

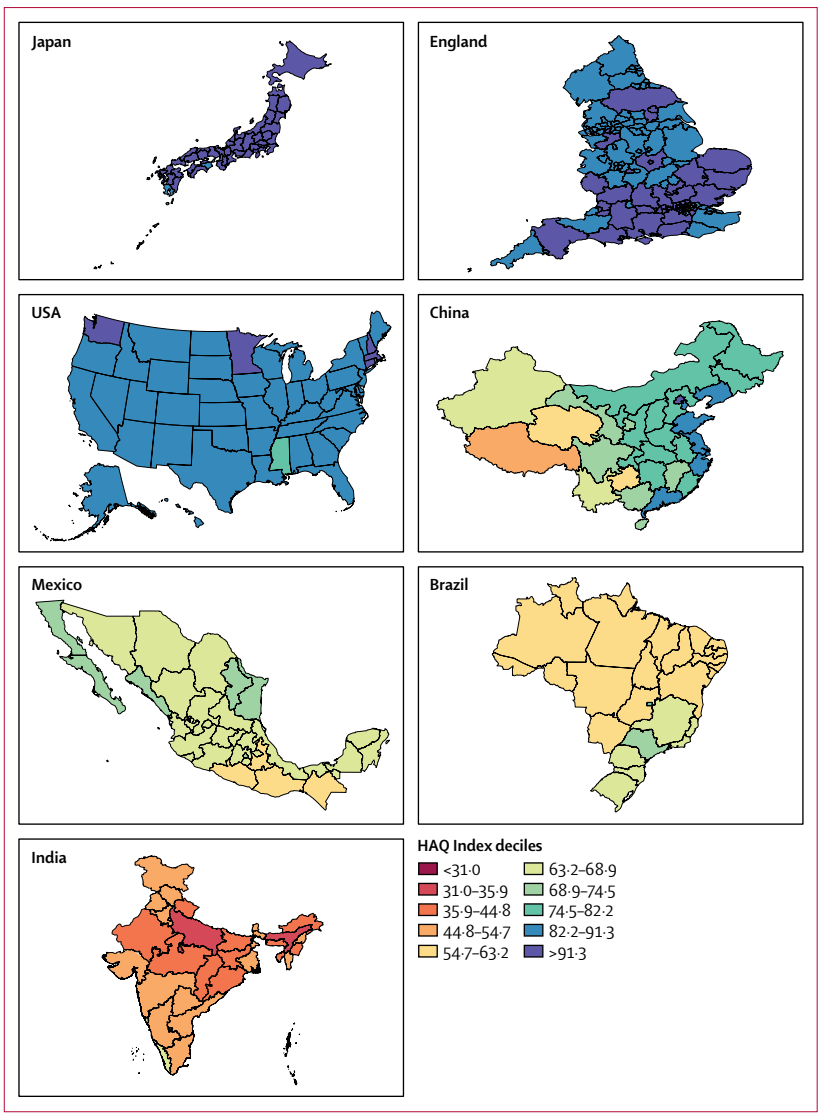


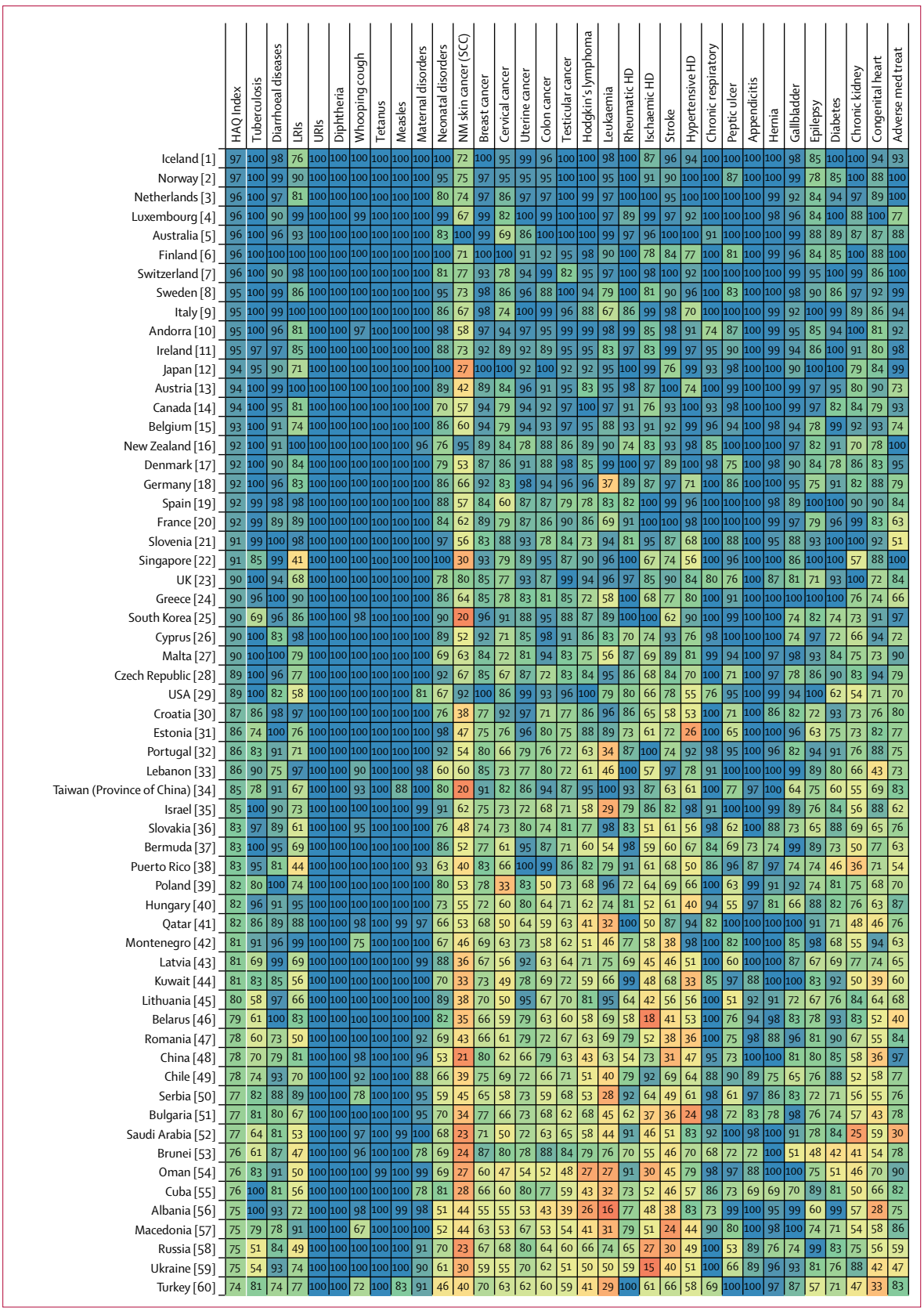
Figure 2: **Map of HAQ Index values for selected subnational locations in 2016**
Deciles are based on the distribution of HAQ Index values for countries and territories in 2016 (as shown in figure 1), and then applied for subnational locations. Where lower and upper bounds of deciles appear to overlap, they should be interpreted as values up to but not equalling the upper bound in the preceding decile (ie, exclusive of the upper bound value) and values equalling the lower bound of the following decile (ie, inclusive of the lower bound value). HAQ Index=Healthcare Access and Quality Index.

2016 (figure 3). Locations that scored approximately 90 or higher on the HAQ Index had generally high scores across broader causes, including vaccine-preventable diseases, infectious diseases and maternal and child health, and causes that require complex case management (eg, epilepsy, diabetes, and chronic kidney disease). Nonetheless, many of these countries had lower scores for cancers and some non-communicable diseases. Greater heterogeneity occurred across causes for countries that scored below 90 on the HAQ Index, though many locations achieved greater consistency, and high scores, for vaccine-preventable diseases and gastrointestinal causes for which surgery could avert death. For these countries, a mixture of relatively low values on cancers and some non-communicable diseases, and then comparably better performance on other health areas, was commonplace. Among countries with lower HAQ Index scores in 2016 (ie, lower than approximately 50), most fared poorly across health areas and recorded particularly low scores on cancers, some infectious causes like tuberculosis, and maternal and child health. Nonetheless, many still exceeded a score of 90 for some causes (eg, diphtheria, upper respiratory infections).

Progress on personal health-care access and quality

Although global gaps between the highest and lowest HAQ Index values slightly widened over time (from 76·4 in 1990 to 78·5 in 2016), changes by SDI quintile showed more diverse trends (figure 4A). Low-middle-SDI countries saw some differences increase since 1990, with HAQ Index scores ranging from 29·0 to 67·2 by 2016. Conversely, disparities considerably narrowed among middle-SDI countries from 1990 (a 46·8-point difference) to 2016 (a 30·6-point difference). Among countries with subnational HAQ Index estimates (figure 4B), there was variation in when and how much local inequalities changed. In the USA, state-level differences decreased since 1990, but then comparably little progress occurred from 2000 to 2016. On the other hand, in Japan, absolute differences between prefectures narrowed to a 4·8-point difference between 2000 and 2016. In England, disparities slightly increased since 1990, from a 13·7-point difference in 1990, to a 16·9-point difference in 2016. China's overall gains quickened since 2000, though absolute differences between Chinese provinces remained high in 2016 (a 43·5-point gap). Mexico's progress on the HAQ Index was much faster from 1990 to 2000, than from 2000 to 2016, although absolute inequalities somewhat narrowed by 2016 (ie, a 20·9-point difference to a 17·0-point difference). Brazil's state-level disparities slightly widened after 2000, rising from an absolute difference of 17·2 in 1990, to 20·4 in 2016. However, compared with Mexico, Brazil's overall progress was more consistent across time periods. Although India's improvements on the HAQ Index hastened from 2000 to 2016, the gap between the country's highest and lowest scores widened (23·4-point difference in 1990, and 30·8-point difference in 2016).

From 1990 to 2016, 186 of 195 countries and territories significantly increased their HAQ Index score, with several middle-SDI countries, including China, the Maldives, Equatorial Guinea, Peru, and Thailand achieving among the most pronounced gains (table 2; appendix p 130). South Korea, Taiwan (Province of China), and Cyprus recorded the largest improvements among high-SDI countries, and Lebanon, Turkey, and Saudi Arabia had the most progress for high-middle-SDI countries. For many low-middle-SDI and low-SDI countries, advances in the HAQ Index either primarily took place or accelerated from 2000 to 2016 (figure 5; appendix pp 133–35). Bangladesh, Myanmar, Bhutan,



	HAQ Index	Tuberculosis	Diarrhoeal diseases	LRIs	URIs	Diphtheria	Whooping cough	Tetanus	Measles	Maternal disorders	Neonatal disorders	NM skin cancer (SCC)	Breast cancer	Cervical cancer	Uterine cancer	Colon cancer	Testicular cancer	Hodgkin's lymphoma	Leukaemia	Rheumatic HD	Ischaemic HD	Stroke	Hypertensive HD	Chronic respiratory	Peptic ulcer	Appendicitis	Hernia	Gallbladder	Epilepsy	Diabetes	Chronic kidney	Congenital heart	Adverse med treat
Iceland [1]	97	100	98	76	100	100	100	100	100	100	100	72	100	95	99	96	100	100	98	100	87	96	94	100	100	100	100	98	85	100	100	94	93
Norway [2]	97	100	99	90	100	100	100	100	100	100	95	75	97	95	95	95	100	100	95	100	91	90	100	100	87	100	100	99	78	85	100	88	100
Netherlands [3]	96	100	97	81	100	100	100	100	100	100	80	74	97	86	97	97	100	99	97	100	100	95	100	100	100	100	99	92	84	94	97	89	100
Luxembourg [4]	96	100	90	99	100	100	99	100	100	100	99	67	99	82	100	99	100	100	97	89	99	97	92	100	100	100	98	96	84	100	88	100	77
Australia [5]	96	100	96	93	100	100	100	100	100	100	83	100	99	69	86	100	100	100	99	97	96	100	100	91	100	100	100	99	88	89	87	87	88
Finland [6]	96	100	100	100	100	100	100	100	100	100	100	71	100	100	91	92	95	98	90	100	78	84	77	100	81	100	99	96	84	85	100	88	100
Switzerland [7]	96	100	90	98	100	100	100	100	100	100	81	77	93	78	94	99	82	95	97	100	98	100	92	100	100	100	100	99	95	100	99	86	100
Sweden [8]	95	100	99	86	100	100	100	100	100	100	95	73	98	86	96	88	100	94	79	100	81	90	96	100	83	100	100	98	90	86	97	92	99
Italy [9]	95	100	99	100	100	100	100	100	100	100	86	67	98	74	100	99	96	88	67	86	99	98	70	100	100	100	99	92	100	99	89	86	94
Andorra [10]	95	100	96	81	100	100	97	100	100	100	98	58	97	94	97	95	99	99	98	99	85	98	91	74	87	100	99	95	85	94	100	81	92
Ireland [11]	95	97	97	85	100	100	100	100	100	100	88	73	92	89	92	89	95	95	83	97	83	99	97	95	90	100	99	94	86	100	91	80	98
Japan [12]	94	95	90	71	100	100	100	100	100	100	100	27	100	100	92	100	92	92	95	100	99	76	99	93	98	100	100	90	100	100	79	84	99
Austria [13]	94	100	99	100	100	100	100	100	100	100	89	42	89	84	96	91	95	83	95	98	87	100	74	100	99	100	100	99	97	95	80	90	73
Canada [14]	94	100	95	81	100	100	100	100	100	100	70	57	94	79	94	92	97	100	97	91	76	93	100	93	98	100	100	99	97	82	84	79	93
Belgium [15]	93	100	91	74	100	100	100	100	100	100	86	60	94	79	94	93	97	95	88	93	91	92	99	96	94	100	98	94	78	99	92	93	74
New Zealand [16]	92	100	91	100	100	100	100	100	100	100	96	76	95	89	84	78	88	86	89	90	74	83	93	98	85	100	100	100	97	82	91	70	78	100
Denmark [17]	92	100	90	84	100	100	100	100	100	100	79	53	87	86	91	88	98	85	99	100	97	89	100	98	75	100	98	90	84	78	86	83	95
Germany [18]	92	100	96	83	100	100	100	100	100	100	86	66	92	83	98	94	96	96	37	89	87	97	71	100	86	100	100	95	75	91	82	88	79
Spain [19]	92	99	98	98	100	100	100	100	100	100	88	57	84	60	87	87	79	78	83	82	100	99	96	100	100	100	98	89	100	100	90	90	84
France [20]	92	99	89	89	100	100	100	100	100	100	84	62	89	79	87	86	90	86	69	91	100	100	98	100	100	100	99	97	79	96	99	83	63
Slovenia [21]	91	99	100	98	100	100	100	100	100	100	97	56	83	88	93	78	84	73	94	81	95	87	68	100	88	100	95	88	93	100	100	92	51
Singapore [22]	91	85	99	41	100	100	100	100	100	100	100	30	93	79	89	95	87	90	96	100	67	74	56	100	96	100	100	86	100	100	57	88	100
UK [23]	90	100	94	68	100	100	100	100	100	100	78	80	85	77	93	87	99	94	96	97	85	90	84	80	76	100	87	81	71	93	100	72	84
Greece [24]	90	96	100	90	100	100	100	100	100	100	86	64	85	78	83	81	85	72	58	100	68	77	80	100	91	100	100	100	100	100	76	74	66
South Korea [25]	90	69	96	86	100	100	98	100	100	100	90	20	96	91	88	95	88	87	89	100	100	62	90	100	99	100	100	74	82	74	73	91	97
Cyprus [26]	90	100	83	98	100	100	100	100	100	100	89	52	92	71	85	98	91	86	83	70	74	93	76	98	100	100	100	74	97	72	66	94	72
Malta [27]	90	100	100	79	100	100	100	100	100	100	69	63	84	72	81	94	83	75	56	87	69	89	81	99	94	100	97	98	93	84	75	73	90
Czech Republic [28]	89	100	96	77	100	100	100	100	100	100	92	67	85	67	87	72	83	84	95	86	68	84	70	100	71	100	97	78	86	90	83	94	79
USA [29]	89	100	82	58	100	100	100	100	100	81	67	92	100	86	99	93	96	100	79	80	66	78	55	76	95	100	99	94	100	62	54	71	70
Croatia [30]	87	86	98	97	100	100	100	100	100	100	76	38	77	92	97	71	77	86	96	86	65	58	53	100	71	100	86	82	72	93	73	76	80
Estonia [31]	86	74	100	76	100	100	100	100	100	100	98	47	75	76	96	80	75	88	89	73	61	72	26	100	65	100	100	96	63	75	73	82	77
Portugal [32]	86	83	91	71	100	100	100	100	100	100	92	54	80	66	79	76	72	63	34	87	100	74	92	98	95	100	96	82	94	91	76	88	75
Lebanon [33]	86	90	75	97	100	100	90	100	100	98	60	60	85	73	77	80	72	61	46	100	57	97	78	91	100	100	100	99	89	80	66	43	73
Taiwan (Province of China) [34]	85	78	91	67	100	100	93	100	88	100	80	20	91	82	86	94	87	95	100	93	87	63	61	100	77	97	100	64	75	60	55	69	83
Israel [35]	85	100	90	73	100	100	100	100	100	99	91	62	75	73	72	68	71	58	29	79	86	82	98	91	100	100	99	89	76	84	56	88	62
Slovakia [36]	83	97	89	61	100	100	95	100	100	100	76	48	74	73	80	74	81	77	98	83	51	61	56	98	62	100	88	73	65	88	69	65	76
Bermuda [37]	83	100	95	69	100	100	100	100	100	100	86	52	77	61	95	87	71	60	54	98	59	60	67	84	69	73	74	99	89	73	50	77	63
Puerto Rico [38]	83	95	81	44	100	100	100	100	100	93	63	40	83	66	100	99	86	82	79	91	61	68	50	86	96	87	97	74	74	46	36	71	54
Poland [39]	82	80	100	74	100	100	100	100	100	100	80	53	78	33	83	50	73	68	96	72	64	69	66	100	63	99	91	92	74	81	75	68	70
Hungary [40]	82	96	91	95	100	100	100	100	100	100	73	55	72	60	80	64	71	62	74	81	52	61	40	94	55	97	81	66	88	82	76	63	87
Qatar [41]	82	86	89	88	100	100	98	100	99	97	66	53	68	50	64	59	63	41	32	100	50	87	94	82	100	100	100	100	91	71	48	46	76
Montenegro [42]	81	91	96	99	100	100	75	100	100	100	67	46	69	63	73	58	62	51	46	77	58	38	98	100	82	100	100	85	98	68	55	94	63
Latvia [43]	81	69	99	69	100	100	100	100	100	99	88	36	67	56	92	63	64	71	75	69	45	46	51	100	60	100	100	87	67	69	77	74	65
Kuwait [44]	81	83	85	56	100	100	100	100	100	100	70	33	73	49	78	69	72	59	66	99	48	68	33	85	97	88	100	100	83	92	50	39	60
Lithuania [45]	80	58	97	66	100	100	100	100	100	100	89	38	70	50	95	67	70	81	95	64	42	56	56	100	51	92	91	72	67	76	84	64	68
Belarus [46]	79	61	100	83	100	100	100	100	100	100	82	35	66	59	79	63	60	58	69	58	18	41	53	100	76	94	98	83	78	93	83	52	40
Romania [47]	78	60	73	50	100	100	100	100	100	92	69	43	66	61	79	72	67	63	69	79	52	38	36	100	75	98	88	96	81	90	67	55	84
China [48]	78	70	79	81	100	100	98	100	100	96	53	21	80	62	66	79	63	43	63	54	73	31	47	95	73	100	100	81	80	85	58	36	97
Chile [49]	78	74	93	70	100	100	92	100	100	88	66	39	75	69	72	66	71	51	40	79	92	69	64	88	90	89	75	65	76	88	52	58	77
Serbia [50]	77	82	88	89	100	100	78	100	100	95	59	45	65	58	73	59	68	53	28	92	64	49	61	98	61	97	86	83	72	71	56	55	76
Bulgaria [51]	77	81	80	67	100	100	100	100	100	95	70	34	77	66	73	68	62	68	45	62	37	36	24	98	72	83	78	98	76	74	57	43	78
Saudi Arabia [52]	77	64	81	53	100	100	97	100	99	100	68	23	71	50	72	63	65	58	44	91	46	51	83	92	100	98	100	91	78	84	25	59	30
Brunei [53]	76	61	87	47	100	100	96	100	100	78	69	24	87	80	78	88	84	79	76	70	55	46	70	68	72	72	100	51	48	42	41	54	78
Oman [54]	76	83	91	50	100	100	100	99	100	99	69	27	60	47	54	52	48	27	27	91	30	45	79	98	97	88	100	100	75	51	46	70	90
Cuba [55]	76	100	81	56	100	100	100	100	100	78	81	28	66	60	80	77	59	43	32	73	52	46	57	86	73	69	69	70	89	81	50	66	82
Albania [56]	75	100	93	72	100	100	98	100	99	98	51	44	55	55	53	43	39	26	16	77	48	38	83	73	99	100	95	99	60	99	57	28	75
Macedonia [57]	75	79	78	91	100	100	67	100	100	100	52	44	63	53	67	53	54	41	31	79	51	24	44	90	80	100	98	100	74	71	54	58	86
Russia [58]	75	51	84	49	100	100	100	100	100	91	70	23	67	68	80	64	60	66	74	65	27	30	49	100	53	89	76	74	99	83	75	56	59
Ukraine [59]	75	54	93	74	100	100	100	100	100	90	61	30	59	55	70	62	51	50	50	59	15	40	51	100	66	89	96	93	81	76	88	42	47
Turkey [60]	74	81	74	77	100	100	72	100	83	91	46	40	70	63	62	60	59	41	29	100	61	66	58	69	100	100	97	87	57	71	47	33	83

Figure 3 continues on next page

	HAQ Index	Tuberculosis	Diarrhoeal diseases	LRIs	URIs	Diphtheria	Whooping cough	Tetanus	Measles	Maternal disorders	Neonatal disorders	NM skin cancer (SCC)	Breast cancer	Cervical cancer	Uterine cancer	Colon cancer	Testicular cancer	Hodgkin's lymphoma	Leukaemia	Rheumatic HD	Ischaemic HD	Stroke	Hypertensive HD	Chronic respiratory	Peptic ulcer	Appendicitis	Hernia	Gallbladder	Epilepsy	Diabetes	Chronic kidney	Congenital heart	Adverse med treat
Virgin Islands [61]	74	89	86	54	100	100	70	100	45	94	56	36	87	60	100	98	88	88	95	85	27	42	34	82	73	54	81	51	72	53	34	60	46
Costa Rica [62]	74	83	73	75	100	100	100	100	100	84	55	50	66	57	72	71	51	30	24	84	73	81	65	75	77	76	79	71	79	86	38	50	53
Northern Mariana Islands [63]	74	69	100	45	100	100	98	100	86	78	100	31	71	72	71	67	65	64	61	55	60	35	56	88	69	73	100	45	91	37	21	91	49
Bosnia and Herzegovina [64]	72	72	83	100	100	100	76	100	92	100	71	39	54	51	56	44	41	27	23	88	63	46	73	100	78	91	82	75	68	62	60	63	56
Bahrain [65]	72	78	90	67	100	100	100	100	100	91	76	35	62	46	59	52	49	28	27	82	41	71	66	77	69	60	95	77	59	46	34	66	72
Iran [66]	72	76	71	64	100	100	100	100	99	92	42	33	71	60	64	59	53	41	30	80	36	46	24	70	71	86	99	89	70	65	48	38	54
Libya [67]	71	70	70	59	100	100	86	100	81	88	56	29	70	41	67	60	59	55	35	83	38	53	63	80	85	81	100	85	66	66	25	51	51
Uruguay [68]	71	80	76	52	100	100	99	100	100	81	66	38	64	67	60	54	57	33	27	73	79	58	66	73	83	76	75	60	74	79	60	48	48
Barbados [69]	71	89	76	40	100	100	100	100	100	72	41	38	72	57	87	80	63	54	38	77	65	41	53	77	62	67	73	85	63	42	39	38	36
Armenia [70]	71	67	73	62	100	100	100	100	100	88	59	74	62	58	62	51	49	36	27	56	38	55	58	100	52	86	68	48	97	59	64	43	60
Sri Lanka [71]	71	66	83	61	100	100	99	100	99	77	63	4	55	59	51	50	44	29	29	76	56	62	55	68	100	90	96	100	65	53	39	52	63
Maldives [72]	70	67	82	85	100	100	74	100	98	72	60	15	54	61	49	52	43	27	30	66	50	60	55	54	98	100	100	100	61	79	30	78	76
United Arab Emirates [73]	70	78	92	68	100	100	92	70	99	100	86	35	68	49	60	55	52	33	15	47	29	36	60	88	76	83	100	83	68	67	26	53	10
Jordan [74]	70	92	78	58	100	100	95	100	100	67	43	23	55	48	46	47	43	24	20	94	51	55	26	91	90	99	100	81	74	61	27	28	80
Antigua and Barbuda [75]	70	91	69	38	100	100	100	100	100	77	56	36	68	52	81	76	58	42	35	77	59	36	38	71	75	69	88	76	38	46	33	46	46
Thailand [76]	69	59	74	44	100	100	71	100	96	90	74	5	61	66	56	56	51	36	32	100	90	56	90	73	80	74	100	51	81	62	34	73	57
Tunisia [77]	69	72	77	63	100	100	96	100	89	81	50	27	57	44	48	46	41	25	16	91	44	54	67	77	89	89	100	88	73	72	36	39	57
Kazakhstan [78]	69	53	77	52	100	100	100	100	100	83	53	72	63	65	62	54	49	39	31	49	24	31	40	92	62	89	78	73	65	74	53	41	47
Mauritius [79]	69	83	67	56	100	100	100	100	100	75	43	18	66	64	61	63	56	49	39	74	45	50	34	50	69	97	100	91	54	23	4	45	35
Guam [80]	69	67	92	34	100	100	92	100	61	69	54	32	75	75	74	74	73	77	79	53	16	32	25	59	75	50	97	70	84	45	25	49	45
Colombia [81]	68	74	66	58	100	100	92	100	100	70	43	50	65	54	69	68	45	25	26	100	67	69	56	58	74	60	70	48	77	77	47	39	84
Panama [82]	68	58	48	44	100	100	89	100	100	62	52	45	75	59	79	77	53	34	23	89	71	57	71	52	79	63	79	70	71	61	34	36	79
Argentina [83]	68	76	74	33	100	100	81	100	100	66	53	31	66	72	63	58	61	37	29	54	59	59	54	70	80	80	83	66	96	72	45	48	34
Malaysia [84]	68	61	79	22	100	100	91	100	81	69	78	14	70	66	66	66	59	53	50	72	36	40	80	77	53	74	86	53	77	64	44	59	47
Venezuela [85]	68	68	54	56	100	100	88	100	100	62	41	46	71	63	77	75	52	33	23	100	51	54	40	76	71	67	66	73	63	54	25	38	71
Greenland [86]	68	63	80	47	100	100	87	100	49	72	44	62	70	74	71	62	73	48	36	69	49	35	62	97	40	65	82	59	44	87	68	54	71
Moldova [87]	67	55	79	44	100	100	100	100	100	92	58	31	46	51	53	41	33	25	24	60	20	26	40	100	50	95	77	80	71	84	80	47	71
Syria [88]	67	93	83	65	100	100	42	100	94	89	62	37	50	54	39	40	32	16	19	74	24	49	74	48	100	68	100	100	89	76	40	39	64
Georgia [89]	67	60	75	72	100	100	99	100	100	75	34	63	60	56	59	49	48	32	25	43	41	33	31	62	59	88	80	96	81	63	52	53	47
The Bahamas [90]	66	69	74	36	100	100	100	100	100	64	58	35	69	55	84	77	61	50	32	74	43	28	12	68	62	62	72	54	66	44	30	54	35
Mexico [91]	66	70	58	54	100	100	91	100	100	69	50	79	71	52	76	76	57	33	29	82	70	68	60	64	63	51	51	46	64	38	5	33	61
Azerbaijan [92]	66	54	53	35	100	100	61	100	100	79	31	66	69	63	64	56	56	44	30	57	19	33	56	66	63	94	100	92	46	54	48	26	48
Seychelles [93]	66	75	82	24	100	100	100	99	98	78	51	23	64	68	59	58	49	39	32	70	56	49	3	75	36	24	100	86	72	66	17	39	77
Peru [94]	64	58	63	28	100	100	64	100	100	56	47	38	56	50	61	77	40	19	26	91	94	78	89	64	74	58	79	59	97	76	44	52	48
Trinidad and Tobago [95]	64	77	68	49	100	100	100	100	100	74	30	22	63	55	78	73	62	44	28	75	37	37	36	55	49	66	53	70	45	27	27	31	37
Brazil [96]	64	67	59	39	100	100	84	100	100	66	41	41	63	56	66	66	50	31	27	78	50	41	48	68	67	60	61	43	76	58	45	40	58
Saint Lucia [97]	63	68	69	47	100	100	97	100	100	68	33	36	57	52	68	60	45	28	28	66	70	38	39	57	67	61	82	78	49	40	31	52	37
El Salvador [98]	63	78	56	43	100	100	61	100	100	73	58	43	55	51	56	56	36	17	22	97	64	77	60	68	57	49	65	70	77	44	5	38	76
Algeria [99]	63	67	69	56	100	100	92	100	83	60	40	24	49	37	41	37	32	21	13	84	46	50	57	71	84	82	99	84	68	65	36	30	51
Uzbekistan [100]	63	48	73	27	100	100	100	100	100	75	39	71	56	57	50	45	39	28	25	38	7	26	0	100	46	93	94	74	19	47	40	53	68
Ecuador [101]	62	62	61	38	100	100	90	100	100	60	46	43	55	50	58	72	39	22	24	78	83	57	48	67	69	48	71	53	63	55	24	40	57
Jamaica [102]	62	89	64	55	100	100	79	100	100	67	34	27	55	53	65	58	40	26	21	70	72	28	40	45	53	68	69	86	62	39	29	37	42
Dominica [103]	62	63	66	39	100	100	89	100	100	87	24	30	61	53	71	65	49	31	24	66	58	40	22	56	58	66	71	78	38	39	21	30	25
Turkmenistan [104]	62	47	53	30	100	100	75	100	100	90	29	66	66	60	61	53	54	42	25	47	4	10	32	64	53	75	79	75	50	52	32	17	41
Nicaragua [105]	61	65	51	56	100	100	80	100	100	63	49	40	47	46	45	47	26	14	20	94	80	70	52	62	70	61	64	75	68	50	6	46	72
Dominican Republic [106]	61	62	49	50	100	100	54	91	100	63	25	31	56	51	64	59	42	25	22	80	42	35	46	52	63	77	97	97	80	58	40	36	32
Kyrgyzstan [107]	61	47	49	39	100	100	100	100	100	62	25	72	43	48	38	36	26	17	23	44	23	21	43	100	63	91	91	68	39	76	48	36	72
Vietnam [108]	60	44	83	63	100	100	52	94	99	87	56	9	43	46	38	39	29	18	24	69	71	30	46	73	56	71	100	65	50	64	40	32	60
American Samoa [109]	59	79	79	35	100	100	90	100	64	56	74	38	61	60	58	57	54	44	36	40	45	33	38	66	57	45	70	50	50	22	11	64	20
Grenada [110]	58	82	72	23	100	100	100	100	100	77	40	31	54	44	62	57	41	23	20	52	42	24	34	59	50	54	52	61	47	33	17	38	14
Egypt [111]	58	76	33	44	100	100	81	90	97	64	58	22	56	57	42	44	32	21	21	68	17	25	46	49	60	63	86	23	87	50	28	43	65
Morocco [112]	58	34	42	48	100	100	80	84	87	64	39	22	53	48	39	39	30	18	18	77	26	39	62	71	75	78	99	80	42	56	28	38	51
Saint Vincent and the Grenadines [113]	57	66	61	34	100	100	100	100	100	70	38	29	49	45	56	51	36	20	22	64	42	24	21	70	43	53	53	78	40	31	25	42	35
Palestine [114]	57	100	76	40	100	100	74	100	77	66	39	24	26	34	14	25	12	11	16	81	18	25	43	84	74	75	99	73	43	54	16	32	60
Paraguay [115]	57	59	58	52	100	100	54	100	100	55	39	28	53	51	56	52	38	19	24	82	52	37	46	68	66	50	43	45	71	51	22	36	43
Belize [116]	56	54	62	31	100	100	98	100	92	78	46	31	43	52	50	41	28	17	28	65	47	37	33	52	57	58	59	49	55	38	17	54	12
Cape Verde [117]	55	51	57	33	100	100	72	100	69	72	44	36	39	44	29	27	16	10	16	71	56	48	55	83	82	57	69	78	28	61	45	57	47
Suriname [118]	54	72	44	41	100	100	77	100	100	64	20	33	52	48	64	56	42	27	29	70	48	23	34	44	45	53	45	49	47	45	20	28	8
Mongolia [119]	53	45	97	47	100	100	69	100	43	62	37	61	50	49	45	40	36	20	20	40	35	14	48	67	29	25	86	36	46	65	38	41	71
North Korea [120]	53	51	51	65	100	100	64	96	99	53	31	10	28	48	16	27	13	10	11	29	59	14	42	78	50	93	99	51	56	67	47	15	72

Figure 3 continues on next page

	HAQ Index	Tuberculosis	Diarrhoeal diseases	LRIs	URIs	Diphtheria	Whooping cough	Tetanus	Measles	Maternal disorders	Neonatal disorders	NM skin cancer (SCC)	Breast cancer	Cervical cancer	Uterine cancer	Colon cancer	Testicular cancer	Hodgkin's lymphoma	Leukaemia	Rheumatic HD	Ischaemic HD	Stroke	Hypertensive HD	Chronic respiratory	Peptic ulcer	Appendicitis	Hernia	Gallbladder	Epilepsy	Diabetes	Chronic kidney	Congenital heart	Adverse med treat
Tajikistan [121]	52	53	32	25	100	100	52	100	100	64	27	72	40	43	29	32	20	14	21	39	21	18	40	67	43	65	83	72	20	53	51	42	56
Botswana [122]	52	24	35	23	100	100	96	100	67	61	51	16	55	49	52	42	31	19	22	51	62	43	22	68	55	61	63	49	10	25	39	88	49
Guatemala [123]	51	65	38	18	100	100	68	100	100	50	38	35	44	45	41	43	23	13	21	99	70	59	61	56	30	35	42	55	46	30	14	46	46
Philippines [124]	51	30	47	30	100	100	99	72	98	54	34	5	49	66	40	44	31	21	27	47	42	25	19	30	24	54	72	48	82	45	14	29	64
Iraq [125]	51	56	51	49	100	100	55	100	83	49	32	10	27	34	15	23	11	9	12	47	13	22	34	62	79	85	100	99	55	25	16	21	44
Guyana [126]	50	47	47	32	100	100	100	100	100	51	25	31	47	46	52	49	33	21	22	55	21	9	12	55	38	31	44	48	42	26	22	43	14
South Africa [127]	50	25	35	17	100	100	66	100	56	42	30	43	62	60	55	54	42	34	27	55	74	52	25	35	57	55	68	53	6	24	32	67	56
Tonga [128]	50	73	71	32	100	100	89	100	90	40	43	38	35	38	31	29	23	14	22	49	51	43	48	46	32	18	55	28	80	21	12	50	33
Equatorial Guinea [129]	49	32	56	34	100	95	62	79	30	33	25	21	49	51	47	38	36	21	39	71	72	55	40	77	51	53	61	55	70	53	65	65	49
Bolivia [130]	49	46	49	17	100	100	56	100	100	40	30	32	43	38	46	54	25	12	18	67	57	43	58	41	46	29	52	35	60	57	21	34	37
Fiji [131]	48	58	47	18	100	100	58	100	31	57	30	34	61	69	54	58	49	43	27	19	17	31	16	29	45	34	69	53	47	0	2	14	36
Samoa [132]	48	63	84	36	100	100	37	100	44	64	64	33	26	41	21	22	14	7	19	36	45	31	30	57	53	44	79	53	67	29	12	60	33
Bangladesh [133]	48	44	48	61	100	100	52	77	89	46	25	18	40	50	22	39	18	18	22	41	65	31	52	58	48	43	56	63	35	56	45	57	40
Bhutan [134]	47	52	51	42	100	100	67	96	59	48	26	20	38	41	27	29	19	12	11	44	44	43	45	45	53	49	62	71	44	57	36	38	34
Honduras [135]	47	52	45	66	100	100	61	100	100	51	38	32	36	30	39	36	25	11	18	74	40	49	38	27	37	28	23	5	43	57	10	53	30
Sudan [136]	46	41	34	46	100	100	41	96	80	29	19	25	38	46	25	30	17	13	16	48	28	38	50	35	54	55	88	65	57	57	26	3	36
Namibia [137]	45	24	23	22	100	100	64	100	67	43	28	16	42	35	42	29	22	13	20	51	66	46	24	49	54	59	63	43	14	37	43	74	50
Indonesia [138]	44	29	42	57	100	100	47	63	47	38	33	11	55	61	46	47	37	26	25	50	42	22	33	64	30	37	33	39	60	34	38	43	51
Timor-Leste [139]	43	40	28	46	100	100	41	75	74	24	29	9	33	44	30	26	16	10	21	49	57	42	38	44	41	50	71	52	61	65	46	32	51
Yemen [140]	43	46	27	48	100	100	38	91	84	31	25	22	25	32	15	22	12	10	16	43	18	24	44	52	50	54	84	56	53	54	24	25	34
Marshall Islands [141]	43	49	69	23	100	100	33	100	47	44	43	25	46	68	30	41	23	17	18	23	31	18	27	35	40	30	70	43	57	0	2	51	24
Nigeria [142]	42	32	15	28	100	90	33	64	35	22	12	43	33	35	30	28	15	15	27	73	82	66	63	53	69	51	68	71	52	73	78	48	34
Myanmar [143]	42	33	47	47	100	100	61	81	89	41	29	7	6	2	12	8	20	3	3	46	84	33	27	48	39	52	73	60	53	48	32	45	35
Federated States of Micronesia [144]	42	50	73	22	99	100	46	100	78	48	47	26	28	35	27	22	23	10	12	17	22	9	18	42	37	23	62	34	53	12	1	42	19
India [145]	41	30	35	41	100	100	51	71	52	45	24	12	42	45	33	33	26	18	24	24	28	30	39	62	45	31	42	59	39	57	30	40	24
Mauritania [146]	41	45	28	29	100	100	32	80	71	19	23	33	18	21	20	11	7	4	9	67	67	54	53	63	62	41	61	68	43	65	45	53	31
Swaziland [147]	40	15	18	6	100	100	74	99	54	49	27	16	44	49	36	34	18	14	20	42	57	30	17	46	43	50	50	41	2	14	31	66	42
Gabon [148]	40	30	39	19	100	100	59	94	46	30	24	20	31	30	31	23	26	10	16	57	60	35	26	65	37	35	48	33	55	46	50	56	39
Nepal [149]	40	40	47	50	100	100	46	53	76	30	31	12	21	26	12	20	11	10	19	36	45	42	47	55	42	39	55	57	41	58	33	68	28
Kenya [150]	39	30	26	23	100	100	55	26	32	27	30	11	40	39	31	31	16	15	23	74	84	47	41	67	49	49	25	42	63	61	72	98	50
Cambodia [151]	39	38	52	28	100	100	55	57	88	42	29	6	23	33	16	17	11	5	16	50	69	30	35	65	10	23	48	24	59	52	36	65	41
São Tomé and Príncipe [152]	39	44	38	17	100	100	48	66	53	38	37	33	23	30	15	19	9	8	12	44	75	35	59	49	51	39	40	45	51	71	21	57	42
Ghana [153]	39	30	44	24	100	100	58	65	54	38	21	31	21	24	13	11	7	4	12	62	58	28	40	65	42	46	59	63	61	48	43	49	15
Pakistan [154]	38	31	26	55	100	100	39	58	72	31	11	20	34	35	22	38	20	17	16	23	33	30	34	47	36	25	45	50	47	50	30	45	27
Laos [155]	37	32	35	29	100	100	42	67	56	33	15	8	30	44	18	27	14	10	10	39	43	27	30	28	27	40	64	49	55	37	28	16	37
Rwanda [156]	36	22	31	28	96	100	54	58	62	26	26	11	18	22	12	14	6	6	7	64	82	44	33	46	38	42	39	35	52	52	64	81	39
The Gambia [157]	36	27	28	32	98	100	39	71	38	17	23	29	14	28	14	9	4	6	12	61	63	51	54	60	50	36	46	58	41	65	45	50	28
Djibouti [158]	35	22	38	23	99	100	29	55	61	23	26	11	19	24	15	14	5	5	4	64	63	44	36	52	47	43	36	49	37	49	56	87	36
Mali [159]	35	37	13	45	93	100	30	67	59	14	11	30	15	24	12	14	5	10	17	49	68	44	46	71	45	32	44	55	37	57	45	47	24
Congo (Brazzaville) [160]	34	20	30	25	100	100	49	87	39	16	24	17	24	29	19	19	17	9	19	47	54	32	22	52	27	24	39	20	51	47	50	58	35
Tanzania [161]	34	25	33	23	96	100	41	55	61	17	24	9	16	18	13	9	4	3	2	61	58	47	31	47	41	43	42	42	48	48	56	76	33
Angola [162]	33	18	24	20	100	100	50	72	52	25	28	17	18	26	12	16	11	8	17	46	52	30	24	51	27	28	36	31	49	52	55	56	33
Comoros [163]	33	24	31	19	96	100	26	58	37	40	20	10	18	20	10	13	5	4	3	62	57	39	33	55	46	41	40	35	36	49	60	83	37
Vanuatu [164]	32	40	50	19	99	100	33	100	46	38	35	24	20	36	12	17	11	7	14	5	9	3	19	29	23	18	49	25	49	18	5	31	14
Solomon Islands [165]	32	37	48	27	94	100	43	100	56	34	39	22	17	34	9	14	9	6	14	5	21	6	15	34	21	14	47	24	48	8	0	36	13
Liberia [166]	32	26	16	25	87	100	27	80	37	11	24	26	13	20	15	10	4	7	21	52	60	40	45	60	40	30	41	54	43	54	35	47	27
Malawi [167]	32	22	27	21	84	100	43	67	46	20	17	8	19	29	18	14	3	8	13	57	66	44	31	49	36	32	28	27	39	52	54	80	35
Haiti [168]	32	42	24	32	97	100	35	56	100	23	17	19	23	30	20	24	10	10	17	28	22	9	20	19	20	24	25	33	38	30	20	27	16
Togo [169]	32	25	30	24	89	100	39	71	60	24	20	25	11	15	9	5	2	2	8	47	51	37	43	60	37	22	31	44	33	52	43	42	19
Lesotho [170]	32	3	13	14	97	100	51	86	38	26	13	12	38	44	33	32	17	15	27	27	54	24	5	37	30	37	38	28	2	12	26	62	35
Cameroon [171]	32	29	27	22	92	100	39	74	51	15	18	28	17	23	16	8	4	3	8	51	64	36	40	49	37	27	33	50	35	45	36	32	17
Papua New Guinea [172]	32	50	43	21	97	100	32	97	36	22	30	19	24	44	14	25	14	13	26	6	27	15	22	13	20	15	47	21	60	19	9	31	14
Uganda [173]	31	13	30	31	95	100	36	53	44	22	21	10	22	27	15	17	5	8	10	58	74	40	31	49	30	33	24	29	44	44	54	83	34
Zimbabwe [174]	31	14	20	10	92	100	53	100	50	19	19	3	17	12	15	10	6	3	4	38	65	43	38	45	54	37	46	6	20	26	27	54	28
Senegal [175]	31	24	25	23	97	100	42	71	52	17	26	27	9	13	8	1	0	1	3	53	50	37	46	58	40	25	33	48	29	49	34	42	18
Sierra Leone [176]	31	22	13	17	82	100	34	62	75	11	13	26	16	25	13	13	5	8	17	45	51	38	43	50	32	24	31	46	41	49	37	28	18
Benin [177]	31	29	16	23	96	100	39	68	45	18	21	27	10	16	11	5	2	3	12	48	64	36	42	59	37	25	32	53	32	53	37	43	20
Burkina Faso [178]	30	22	25	24	80	100	41	58	67	18	20	27	5	9	4	4	2	3	8	33	63	55	30	46	33	24	36	49	51	48	49	33	15
Mozambique [179]	30	16	32	25	80	100	25	54	39	19	19	9	11	16	7	8	3	4	4	53	72	31	30	47	38	37	56	39	49	46	56	78	32
Madagascar [180]	30	36	16	20	90	100	35	63	43	18	18	10	22	30	12	21	7	10	13	33	58	11	15	19	34	32	30	29	41	48	61	61	36

Figure 3 continues on next page

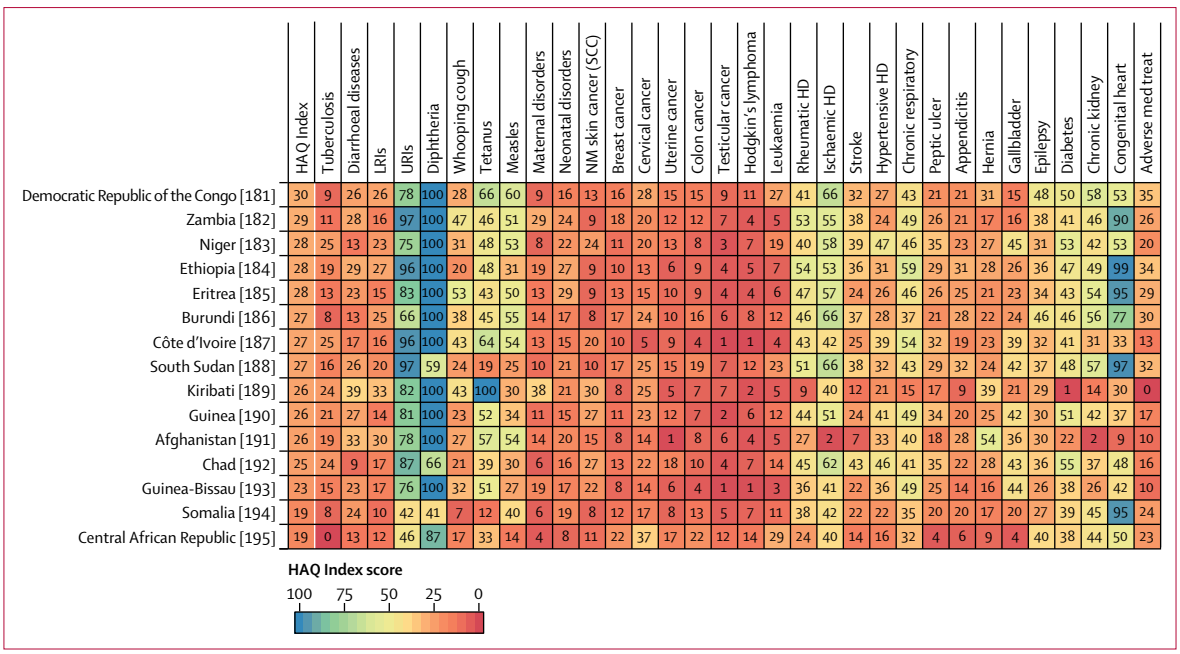


Figure 3: **Performance on the HAQ Index and 32 individual causes, by country or territory, in 2016**
Countries are ranked by their HAQ Index score from highest to lowest in 2016. The HAQ Index and individual causes are reported on a scale of 0–100, with 0 representing the worst levels observed from 1990 to 2016, and 100 reflecting the best during that time. HAQ Index=Healthcare Access and Quality Index. LRIs=lower respiratory infections. URIs=upper respiratory infections. NM=non-melanoma. SCC=squamous-cell carcinoma. Colon cancer=colon and rectum cancer. HD=heart disease. Chronic respiratory=chronic respiratory diseases. Peptic ulcer=peptic ulcer disease. Hernia=inguinal, femoral, and abdominal hernia. Gallbladder=gallbladder and biliary diseases. Chronic kidney=chronic kidney disease. Congenital heart=congenital heart anomalies. Adverse med treat=adverse effects of medical treatment.

Cambodia, and Laos (low-middle SDI), and Rwanda and Ethiopia (low SDI), exemplified this trend. Some countries in eastern Europe and central Asia (eg, Russia, Belarus, Kazakhstan) also experienced substantive progress from 2000 to 2016, after stalled gains or faltering performance from 1990 to 2000. A subset of countries, including Vietnam and Nepal, recorded more comparable rates of change for each time period, whereas others, including several countries in Latin America and the Caribbean (eg, Guatemala, Mexico, Dominican Republic; table 2, appendix pp 133–35), had much slower progress after making considerable gains from 1990 to 2000. Nine countries, all low-to-middle SDI, did not record significant increases from 1990 to 2016. Table 2 and the appendix (pp 158–64) provide estimates of HAQ Index values, as well as absolute change and annualised rates of change for 1990–2000, 2000–16, and 1990–2016.

Focusing on 2000–16, examining improvement across health areas highlights a mixture of progress and potential for worsening performance if past trends are not addressed (appendix pp 136–41). Across locations, the largest gains primarily took place for vaccine-preventable diseases (eg, measles), some infectious diseases (eg, diarrhoeal diseases), some cancers (eg, leukaemia), and some non-communicable diseases. Such advances were most pronounced among countries that also recorded substantive increases in their overall HAQ Index (eg, China, Turkey). At the same time, many low-to-middle SDI countries experienced relatively few gains across most non-communicable diseases. Furthermore, countries with minimal progress on overall HAQ Index performance had comparatively small advances, even for health areas in which improvements have been more widespread. The main exception was vaccine-preventable diseases, especially measles, for low-SDI to middle-SDI countries (appendix pp 136–41).

Correlates of HAQ Index performance

Although total health spending per capita was strongly correlated with HAQ Index performance in 2016 (r=0·94; figure 6), large variation existed at similar spending levels. For instance, some countries with HAQ Index scores between 40 and 70 spent at least three times more than did peers with similar performance. Government spending as a fraction of total health spending had positive, albeit moderate, correlation with HAQ Index performance in 2016 (r=0·76; appendix p 145), whereas development assistance for health showed an opposite pattern (r=–0·71; appendix p 147). Country-level HAQ Index scores in 2016 were positively associated with physicians, nurses, and midwives per 1000 (r=0·79), and similar, though more moderate, correlations were found for hospital beds per 1000 and utilisation (appendix pp 149–52). Nonetheless, sizeable heterogeneity emerged across

these health system measures and their relationships to the HAQ Index, particularly among middle-to-high SDI countries. All correlations and additional figures are in the appendix (pp 142–52, 165).

Discussion

Summary of findings

Amid gains on personal health-care access and quality, striking disparities remained regarding HAQ Index scores achieved by 2016, and how quickly locations improved over time. In 2016, HAQ Index performance diverged along the development spectrum, ranging from more than 97 in Iceland to less than 20 in the Central African Republic and Somalia. Subnational inequalities were particularly pronounced in China and India, although high-income countries, including England and the USA, also saw considerable local gaps in performance. The global pace of progress accelerated from 2000 to 2016, a trend fuelled by many low-SDI and low-middle-SDI countries in sub-Saharan Africa and southeast Asia. By contrast, several countries saw slowed or minimal improvement from 2000 to 2016 after recording larger gains from 1990 to 2000. Examining patterns in broader causes unveiled considerable heterogeneity in country-level improvements across health areas. These findings, coupled with the variable relationships between national HAQ Index values and potential correlates of performance, underscore the complexities of orienting health systems toward providing access to quality services across health needs and along continuums of care.

Inequalities in personal health-care access and quality within countries

Our subnational assessment of HAQ Index performance shows the importance of monitoring health-care gaps and gains at more local levels. Further, because some factors might be more uniform because of country-level policy or health-care characteristics (eg, national insurance schemes, federally-maintained referral systems), this analysis offers the opportunity to consider if or how challenges in access and quality are experienced within countries. For instance, Mexico's subnational differences could be more related to state-level variations in quality given the country's concerted efforts to expand access and service coverage through a tiered insurance system.[42,43] Similar factors might underlie disparities in England, where the National Health Service ought to minimise financial barriers to accessing health care.[30] Nonetheless, other obstacles probably exist, including inadequate utilisation of care across Mexican states,[44] and local variations in health funding[45] or human resource constraints within England.[46] Striking disparities in China and India might represent myriad factors, including large variations in physical access to health facilities, health system infrastructure and scale-up of medical technologies, and provision of effective services across continuums of care. Brazil's universal health coverage-focused initiatives, including expanding community-based health programmes and governance functions, seem to have contributed to local reductions in amenable mortality from 2000 to 2012.[14] However, state-level progress on the HAQ Index was generally faster from 1990 to 2000 than from 2000 to 2016, suggesting that advances in access might not always be accompanied by improved quality of care across health services, especially for non-communicable diseases. State-level differences in the USA could be

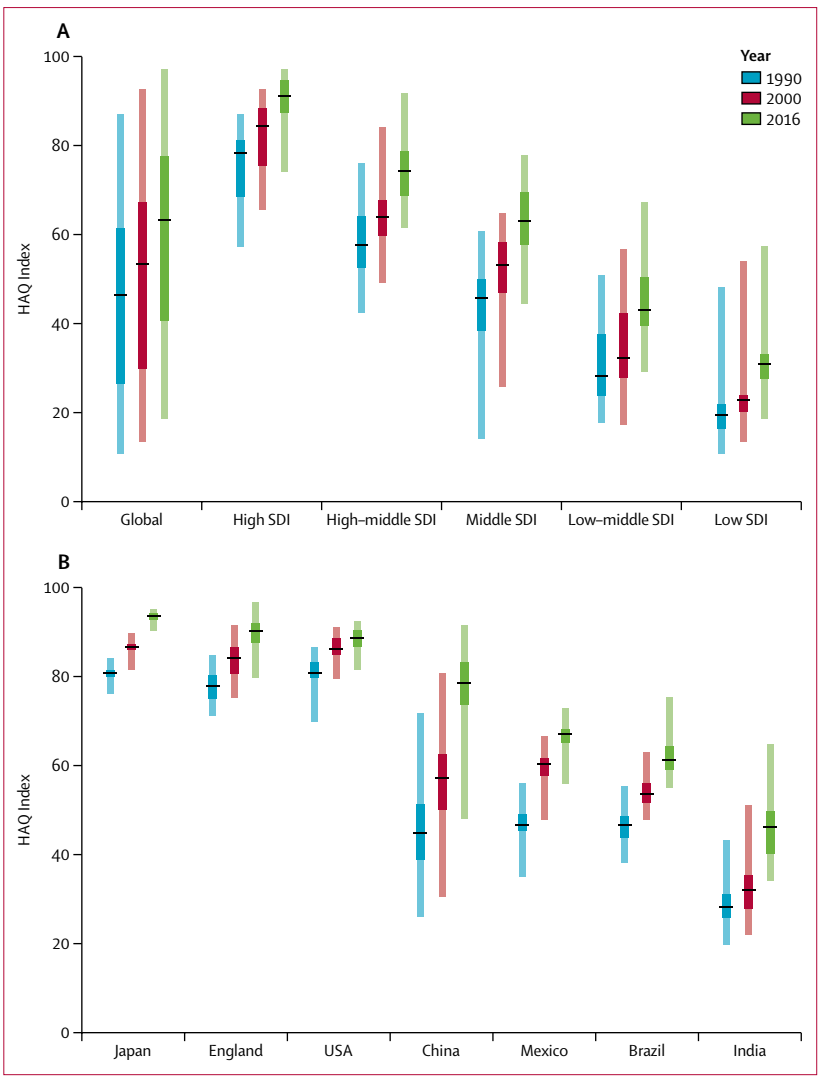


Figure 4: **Median, IQR, and range of the HAQ Index in 1990, 2000, and 2016, globally and by SDI quintile (A), and for seven countries with subnational estimates (B)**

Black lines represent the median, dark-coloured boxes represent the IQR, and the light-coloured boxes represent the full range of values within a given group. Subnational locations represented in panel B are as follows: 47 prefectures in Japan; 150 local government areas in England; 50 states and the District of Columbia in the USA; 33 provinces and special administrative regions in China; 32 states in Mexico; 26 states and the Federal District in Brazil; and 31 states and union territories in India. HAQ Index=Healthcare Access and Quality Index. SDI=Socio-demographic Index.

	HAQ Index (95% UI)			Absolute change (95% UI)			Annualised rate of change (95% UI)		
	1990	2000	2016	1990–2016	1990–2000	2000–16	1990–2016	1990–2000	2000–16
Global	37·6 (36·8 to 38·8)	42·4 (41·6 to 43·2)	54·4 (53·5 to 55·4)	16·8 (15·2 to 18·0)*	4·7 (4·0 to 5·4)*	12·0 (10·9 to 13·1)*	1·42 (1·28 to 1·53)*	1·18 (0·99 to 1·36)*	1·56 (1·42 to 1·70)*
Southeast Asia, east Asia, and Oceania†	37·1 (35·9 to 38·6)	44·9 (43·9 to 46·2)	62·9 (61·8 to 64·2)	25·9 (24·1 to 27·3)*	7·8 (6·9 to 8·8)*	18·0 (16·6 to 19·4)*	2·04 (1·88 to 2·16)*	1·92 (1·67 to 2·17)*	2·11 (1·93 to 2·27)*
East Asia	42·8 (41·4 to 44·6)	53·3 (52·1 to 54·9)	77·0 (75·5 to 78·1)	34·2 (31·7 to 35·9)*	10·5 (8·8 to 12·2)*	23·7 (21·7 to 25·3)*	2·26 (2·08 to 2·39)*	2·20 (1·80 to 2·56)*	2·30 (2·11 to 2·46)*
China	42·6 (41·2 to 44·5)	53·3 (52·0 to 55·1)	77·9 (76·5 to 78·9)	35·3 (32·8 to 37·0)*	10·8 (8·8 to 12·6)*	24·6 (22·4 to 26·2)*	2·33 (2·13 to 2·46)*	2·25 (1·83 to 2·63)*	2·37 (2·15 to 2·54)*
North Korea	49·6 (46·2 to 52·9)	47·6 (44·1 to 51·2)	53·4 (49·6 to 56·9)	3·8 (–1·3 to 8·2)	–1·9 (–6·2 to 2·0)	5·7 (1·2 to 10·2)*	0·28 (–0·10 to 0·62)	–0·40 (–1·26 to 0·41)	0·71 (0·15 to 1·26)*
Taiwan (Province of China)	60·6 (58·6 to 62·7)	71·8 (69·9 to 73·7)	85·4 (82·5 to 88·2)	24·8 (21·4 to 28·1)*	11·2 (8·6 to 13·6)*	13·6 (10·2 to 16·7)*	1·32 (1·14 to 1·49)*	1·70 (1·30 to 2·07)*	1·08 (0·82 to 1·32)*
Oceania	27·2 (22·9 to 31·0)	32·4 (28·4 to 36·3)	36·0 (31·8 to 40·4)	8·8 (4·0 to 13·5)*	5·2 (1·9 to 8·5)*	3·6 (–0·5 to 7·8)	1·08 (0·49 to 1·66)*	1·76 (0·62 to 2·97)*	0·66 (–0·10 to 1·44)
American Samoa	47·6 (44·6 to 50·6)	55·9 (52·9 to 59·1)	59·5 (55·0 to 64·1)	11·9 (6·5 to 17·4)*	8·3 (4·1 to 12·5)*	3·6 (–1·8 to 8·9)	0·86 (0·46 to 1·23)*	1·61 (0·79 to 2·42)*	0·38 (–0·20 to 0·96)
Federated States of Micronesia	27·9 (23·4 to 32·5)	32·2 (27·2 to 37·1)	41·6 (34·8 to 49·1)	13·7 (5·8 to 21·4)*	4·3 (0·0 to 8·0)	9·4 (2·3 to 17·2)*	1·54 (0·68 to 2·40)*	1·44 (0·02 to 2·72)*	1·59 (0·44 to 2·77)*
Fiji	41·0 (34·8 to 47·2)	43·3 (39·7 to 47·0)	47·9 (41·9 to 54·3)	6·8 (–1·9 to 15·4)	2·2 (–4·0 to 8·6)	4·6 (–2·4 to 11·8)	0·59 (–0·17 to 1·35)	0·55 (–0·92 to 2·16)	0·62 (–0·34 to 1·59)
Guam	61·9 (59·0 to 64·9)	71·3 (68·7 to 74·0)	68·7 (64·8 to 72·9)	6·7 (2·0 to 11·6)*	9·4 (5·6 to 13·4)*	–2·7 (–7·5 to 2·5)	0·40 (0·12 to 0·67)*	1·41 (0·83 to 2·03)*	–0·24 (–0·67 to 0·21)
Kiribati	20·3 (17·0 to 23·8)	23·0 (19·9 to 26·3)	26·5 (21·4 to 31·1)	6·2 (1·0 to 11·1)*	2·7 (–1·0 to 6·0)	3·4 (–1·1 to 7·9)	1·02 (0·19 to 1·81)*	1·27 (–0·49 to 2·79)	0·86 (–0·27 to 1·95)
Marshall Islands	33·1 (30·4 to 36·1)	34·5 (31·1 to 38·0)	43·0 (38·0 to 48·2)	9·9 (4·3 to 15·1)*	1·3 (–2·5 to 5·3)	8·6 (3·5 to 13·7)*	1·00 (0·46 to 1·50)*	0·38 (–0·76 to 1·54)	1·39 (0·56 to 2·17)*
Northern Mariana Islands	61·5 (56·0 to 67·0)	71·9 (67·7 to 75·9)	73·7 (69·2 to 78·3)	12·2 (5·4 to 19·4)*	10·4 (5·6 to 15·1)*	1·8 (–3·8 to 7·4)	0·70 (0·30 to 1·12)*	1·56 (0·83 to 2·37)*	0·15 (–0·33 to 0·64)
Papua New Guinea	22·9 (17·8 to 27·7)	28·5 (23·2 to 33·6)	31·8 (26·2 to 37·4)	8·9 (2·7 to 15·1)*	5·6 (1·4 to 9·8)*	3·3 (–2·1 to 8·6)	1·27 (0·37 to 2·15)*	2·19 (0·52 to 3·95)*	0·70 (–0·43 to 1·85)
Samoa	37·4 (32·8 to 41·7)	43·6 (38·8 to 48·2)	47·6 (42·8 to 52·6)	10·3 (4·5 to 16·1)*	6·3 (2·6 to 9·7)*	4·0 (–1·2 to 9·0)	0·93 (0·41 to 1·48)*	1·56 (0·67 to 2·43)*	0·55 (–0·16 to 1·21)
Solomon Islands	26·7 (21·2 to 32·3)	31·4 (25·9 to 36·8)	32·4 (27·1 to 37·7)	5·8 (–0·9 to 12·3)	4·8 (0·4 to 8·8)*	1·0 (–4·6 to 6·2)	0·76 (–0·11 to 1·65)	1·66 (0·14 to 3·15)*	0·20 (–0·87 to 1·24)
Tonga	38·4 (33·7 to 42·9)	42·8 (38·4 to 47·2)	49·6 (44·4 to 54·4)	11·2 (5·0 to 17·4)*	4·4 (0·4 to 8·3)*	6·8 (1·7 to 11·8)*	0·99 (0·44 to 1·55)*	1·10 (0·08 to 2·11)*	0·92 (0·22 to 1·60)*
Vanuatu	28·2 (23·2 to 33·1)	28·7 (24·0 to 33·2)	32·4 (26·9 to 37·5)	4·3 (–2·0 to 10·3)	0·6 (–3·4 to 4·8)	3·7 (–1·9 to 8·9)	0·55 (–0·26 to 1·36)	0·21 (–1·17 to 1·73)	0·75 (–0·39 to 1·82)
Southeast Asia	29·3 (27·8 to 30·8)	34·5 (33·0 to 36·0)	47·5 (45·9 to 49·2)	18·1 (16·4 to 20·0)*	5·1 (4·0 to 6·2)*	13·0 (11·4 to 14·6)*	1·85 (1·67 to 2·05)*	1·61 (1·25 to 1·97)*	2·00 (1·76 to 2·27)*
Cambodia	20·3 (17·7 to 23·6)	23·0 (20·9 to 25·3)	39·4 (36·4 to 42·5)	19·1 (14·8 to 23·0)*	2·7 (–0·7 to 5·7)	16·5 (13·0 to 19·9)*	2·56 (1·90 to 3·12)*	1·25 (–0·33 to 2·76)	3·38 (2·65 to 4·10)*
Indonesia	28·9 (26·4 to 31·7)	33·0 (31·1 to 35·3)	44·5 (42·6 to 46·8)	15·6 (12·8 to 18·4)*	4·1 (1·8 to 6·0)*	11·5 (9·2 to 13·8)*	1·67 (1·33 to 2·01)*	1·34 (0·57 to 2·00)*	1·87 (1·49 to 2·27)*
Laos	18·0 (15·4 to 21·4)	21·8 (18·8 to 24·7)	36·6 (32·6 to 41·1)	18·6 (13·6 to 24·0)*	3·8 (0·4 to 7·1)*	14·8 (10·2 to 19·6)*	2·74 (1·97 to 3·51)*	1·94 (0·21 to 3·58)*	3·24 (2·23 to 4·25)*
Malaysia	44·2 (42·5 to 46·1)	54·2 (52·6 to 55·9)	68·1 (65·9 to 70·2)	23·9 (21·3 to 26·6)*	10·0 (7·8 to 12·3)*	13·9 (11·5 to 16·2)*	1·66 (1·47 to 1·85)*	2·05 (1·59 to 2·51)*	1·43 (1·19 to 1·66)*
Maldives	37·6 (33·6 to 41·0)	52·7 (49·9 to 55·4)	70·4 (65·7 to 74·8)	32·8 (26·9 to 39·1)*	15·1 (11·9 to 18·6)*	17·6 (11·9 to 22·8)*	2·41 (1·98 to 2·92)*	3·39 (2·62 to 4·32)*	1·80 (1·24 to 2·29)*
Mauritius	53·9 (52·6 to 55·3)	61·9 (60·4 to 63·2)	68·7 (65·5 to 71·9)	14·8 (11·6 to 18·0)*	8·0 (6·4 to 9·4)*	6·8 (3·6 to 10·0)*	0·93 (0·75 to 1·12)*	1·38 (1·10 to 1·64)*	0·65 (0·35 to 0·94)*
Myanmar	19·9 (17·2 to 22·6)	23·1 (20·2 to 26·0)	41·6 (38·0 to 45·5)	21·7 (17·4 to 26·4)*	3·1 (–0·2 to 6·2)	18·6 (14·5 to 22·5)*	2·84 (2·29 to 3·44)*	1·46 (–0·08 to 2·86)	3·70 (2·82 to 4·54)*
Philippines	39·0 (37·3 to 40·6)	42·7 (40·7 to 44·5)	51·2 (47·9 to 54·4)	12·2 (8·7 to 15·8)*	3·8 (1·9 to 5·7)*	8·4 (4·8 to 11·9)*	1·05 (0·76 to 1·33)*	0·92 (0·46 to 1·41)*	1·12 (0·65 to 1·56)*
Seychelles	45·9 (43·8 to 48·1)	57·3 (55·2 to 59·4)	65·6 (62·2 to 68·9)	19·8 (16·1 to 23·5)*	11·4 (8·6 to 14·0)*	8·4 (4·6 to 12·0)*	1·38 (1·12 to 1·63)*	2·22 (1·67 to 2·75)*	0·85 (0·48 to 1·22)*

(Table 2 continues on next page)

	HAQ Index (95% UI)			Absolute change (95% UI)			Annualised rate of change (95% UI)		
	1990	2000	2016	1990–2016	1990–2000	2000–16	1990–2016	1990–2000	2000–16
(Continued from previous page)									
Sri Lanka	47·4 (45·1 to 49·8)	54·4 (52·1 to 56·9)	70·6 (66·3 to 75·3)	23·2 (18·5 to 28·1)*	7·0 (3·8 to 10·2)*	16·2 (11·5 to 21·0)*	1·53 (1·24 to 1·84)*	1·38 (0·75 to 2·02)*	1·62 (1·16 to 2·08)*
Thailand	44·4 (42·4 to 46·6)	54·7 (52·2 to 57·4)	69·5 (66·5 to 72·6)	25·1 (21·4 to 28·7)*	10·3 (7·2 to 13·3)*	14·8 (10·9 to 18·6)*	1·72 (1·46 to 1·95)*	2·09 (1·49 to 2·66)*	1·49 (1·09 to 1·88)*
Timor–Leste	22·2 (17·2 to 27·8)	27·3 (23·0 to 34·5)	43·4 (37·2 to 51·9)	21·2 (12·9 to 29·8)*	5·2 (–0·9 to 12·3)	16·0 (9·3 to 22·8)*	2·60 (1·51 to 3·68)*	2·12 (–0·33 to 4·94)	2·89 (1·61 to 4·06)*
Vietnam	36·6 (33·1 to 40·4)	44·7 (41·6 to 48·2)	60·3 (56·3 to 64·1)	23·7 (18·1 to 29·0)*	8·1 (4·2 to 12·1)*	15·6 (10·8 to 20·3)*	1·92 (1·46 to 2·40)*	2·01 (1·01 to 3·05)*	1·87 (1·28 to 2·47)*
Central Europe, eastern Europe, and central Asia†	57·1 (55·8 to 58·6)	59·5 (58·1 to 60·8)	71·4 (68·1 to 74·3)	14·3 (10·9 to 17·4)*	2·5 (0·6 to 4·2)*	11·8 (8·4 to 14·9)*	0·86 (0·66 to 1·03)*	0·43 (0·10 to 0·73)*	1·13 (0·82 to 1·41)*
Central Asia	48·4 (47·0 to 49·9)	49·6 (48·2 to 51·0)	60·2 (58·2 to 62·4)	11·8 (9·5 to 14·1)*	1·2 (–0·5 to 2·8)	10·6 (8·3 to 12·9)*	0·84 (0·68 to 1·00)*	0·25 (–0·10 to 0·58)	1·21 (0·96 to 1·47)*
Armenia	55·7 (53·6 to 58·0)	58·9 (57·2 to 61·0)	70·7 (67·8 to 73·5)	15·0 (11·9 to 18·0)*	3·2 (1·1 to 5·3)*	11·7 (8·9 to 14·8)*	0·92 (0·74 to 1·10)*	0·56 (0·18 to 0·94)*	1·14 (0·87 to 1·42)*
Azerbaijan	49·6 (47·0 to 52·1)	51·9 (49·4 to 54·4)	65·6 (61·2 to 69·6)	16·1 (11·1 to 20·6)*	2·3 (–1·1 to 5·6)	13·8 (9·2 to 18·4)*	1·08 (0·76 to 1·37)*	0·46 (–0·21 to 1·10)	1·47 (1·00 to 1·93)*
Georgia	61·2 (59·0 to 63·5)	63·4 (60·8 to 65·4)	67·1 (62·7 to 71·0)	5·9 (1·1 to 10·7)*	2·1 (–0·7 to 4·7)	3·7 (–0·8 to 7·9)	0·35 (0·07 to 0·63)*	0·34 (–0·11 to 0·76)	0·36 (–0·08 to 0·76)
Kazakhstan	55·5 (53·1 to 57·6)	54·1 (51·4 to 56·5)	69·1 (64·7 to 73·2)	13·6 (9·3 to 18·0)*	–1·4 (–4·3 to 1·5)	15·0 (10·2 to 19·6)*	0·84 (0·58 to 1·10)*	–0·25 (–0·80 to 0·27)	1·53 (1·05 to 1·97)*
Kyrgyzstan	50·9 (49·5 to 53·1)	52·6 (51·3 to 54·2)	60·6 (58·3 to 62·8)	9·7 (6·7 to 12·4)*	1·8 (0·1 to 3·3)*	8·0 (5·2 to 10·3)*	0·67 (0·46 to 0·85)*	0·34 (0·02 to 0·63)*	0·88 (0·57 to 1·13)*
Mongolia	36·6 (34·0 to 39·3)	38·7 (36·1 to 41·5)	53·4 (49·1 to 57·6)	16·8 (11·3 to 21·9)*	2·2 (–1·3 to 5·6)	14·6 (9·5 to 19·7)*	1·45 (0·98 to 1·86)*	0·58 (–0·35 to 1·46)	2·00 (1·32 to 2·65)*
Tajikistan	41·3 (38·7 to 44·2)	42·6 (39·9 to 45·5)	51·7 (47·7 to 55·5)	10·4 (5·7 to 15·3)*	1·3 (–2·7 to 5·1)	9·1 (4·4 to 13·8)*	0·86 (0·48 to 1·25)*	0·30 (–0·64 to 1·24)	1·21 (0·60 to 1·82)*
Turkmenistan	45·4 (43·8 to 46·9)	49·1 (47·1 to 51·0)	61·6 (58·7 to 64·8)	16·2 (13·0 to 20·2)*	3·6 (1·3 to 6·1)*	12·6 (9·8 to 15·3)*	1·17 (0·96 to 1·44)*	0·77 (0·27 to 1·29)*	1·43 (1·12 to 1·71)*
Uzbekistan	50·3 (48·4 to 52·2)	52·8 (51·0 to 54·6)	62·9 (59·3 to 66·0)	12·6 (8·6 to 16·1)*	2·5 (0·2 to 4·8)*	10·1 (6·2 to 13·2)*	0·86 (0·60 to 1·09)*	0·49 (0·04 to 0·92)*	1·09 (0·69 to 1·42)*
Central Europe	58·8 (57·7 to 60·2)	68·9 (67·6 to 69·9)	80·6 (79·2 to 81·7)	21·8 (19·6 to 23·2)*	10·1 (8·3 to 11·3)*	11·7 (10·5 to 12·9)*	1·21 (1·09 to 1·30)*	1·58 (1·30 to 1·79)*	0·98 (0·88 to 1·09)*
Albania	54·8 (52·7 to 56·9)	63·6 (61·5 to 65·7)	75·4 (72·5 to 78·2)	20·6 (17·2 to 24·0)*	8·8 (6·1 to 11·7)*	11·8 (8·4 to 15·0)*	1·23 (1·03 to 1·42)*	1·49 (1·03 to 1·96)*	1·06 (0·77 to 1·35)*
Bosnia and Herzegovina	52·3 (49·4 to 55·2)	61·3 (58·1 to 64·4)	72·2 (67·2 to 76·4)	19·9 (14·8 to 24·6)*	9·0 (5·8 to 12·3)*	10·9 (5·9 to 16·1)*	1·24 (0·94 to 1·52)*	1·59 (1·01 to 2·18)*	1·02 (0·56 to 1·51)*
Bulgaria	65·1 (64·0 to 66·4)	68·0 (66·5 to 69·0)	77·2 (73·3 to 80·7)	12·1 (8·4 to 15·8)*	2·9 (1·2 to 4·2)*	9·2 (5·4 to 12·8)*	0·65 (0·46 to 0·84)*	0·43 (0·18 to 0·63)*	0·79 (0·48 to 1·08)*
Croatia	73·9 (71·9 to 76·2)	78·1 (76·5 to 79·7)	86·9 (84·5 to 89·4)	13·0 (9·7 to 16·4)*	4·2 (1·6 to 6·7)*	8·8 (5·8 to 11·8)*	0·63 (0·46 to 0·79)*	0·55 (0·21 to 0·90)*	0·67 (0·45 to 0·89)*
Czech Republic	72·2 (70·9 to 73·4)	81·4 (79·8 to 82·4)	89·0 (87·5 to 90·4)	16·8 (14·9 to 18·7)*	9·2 (7·4 to 10·4)*	7·6 (6·0 to 9·5)*	0·80 (0·72 to 0·89)*	1·20 (0·96 to 1·35)*	0·56 (0·44 to 0·70)*
Hungary	66·4 (64·8 to 68·6)	74·5 (73·0 to 76·0)	82·1 (79·5 to 84·9)	15·7 (12·6 to 18·7)*	8·0 (6·0 to 9·9)*	7·6 (4·7 to 10·7)*	0·81 (0·66 to 0·96)*	1·14 (0·83 to 1·41)*	0·61 (0·38 to 0·84)*
Macedonia	59·3 (57·2 to 61·6)	65·3 (63·6 to 67·4)	75·1 (72·6 to 77·5)	15·7 (12·3 to 18·9)*	6·0 (3·4 to 8·4)*	9·7 (6·7 to 12·6)*	0·90 (0·71 to 1·09)*	0·96 (0·54 to 1·36)*	0·87 (0·61 to 1·11)*
Montenegro	69·1 (66·5 to 71·7)	70·3 (68·4 to 72·4)	81·0 (78·6 to 83·5)	11·9 (8·3 to 15·5)*	1·1 (–1·8 to 3·9)	10·8 (7·8 to 13·9)*	0·61 (0·42 to 0·80)*	0·16 (–0·26 to 0·57)	0·89 (0·64 to 1·14)*
Poland	61·0 (59·8 to 62·4)	70·8 (69·1 to 72·0)	82·4 (79·7 to 84·6)	21·4 (18·2 to 23·8)*	9·8 (7·6 to 11·4)*	11·6 (9·3 to 14·0)*	1·16 (0·99 to 1·28)*	1·49 (1·16 to 1·73)*	0·95 (0·77 to 1·13)*
Romania	59·1 (57·6 to 61·0)	66·8 (65·2 to 68·4)	78·3 (75·9 to 80·7)	19·2 (16·3 to 21·9)*	7·7 (5·3 to 9·5)*	11·5 (8·9 to 14·2)*	1·08 (0·91 to 1·22)*	1·22 (0·83 to 1·51)*	0·99 (0·78 to 1·21)*
Serbia	64·7 (61·9 to 67·5)	66·9 (64·9 to 69·2)	77·2 (74·9 to 79·3)	12·5 (9·3 to 15·6)*	2·2 (–0·7 to 5·2)	10·3 (7·4 to 13·0)*	0·68 (0·51 to 0·86)*	0·33 (–0·11 to 0·80)	0·90 (0·64 to 1·13)*
Slovakia	67·8 (65·8 to 69·4)	73·6 (71·6 to 75·4)	83·3 (80·4 to 86·3)	15·5 (12·3 to 18·9)*	5·9 (3·6 to 8·1)*	9·7 (6·6 to 12·8)*	0·79 (0·64 to 0·95)*	0·83 (0·51 to 1·15)*	0·77 (0·53 to 1·02)*

(Table 2 continues on next page)

	HAQ Index (95% UI)			Absolute change (95% UI)			Annualised rate of change (95% UI)		
	1990	2000	2016	1990–2016	1990–2000	2000–16	1990–2016	1990–2000	2000–16
(Continued from previous page)									
Slovenia	74·1 (72·2 to 76·1)	79·5 (77·8 to 81·3)	90·8 (88·2 to 93·4)	16·6 (13·5 to 19·8)*	5·3 (3·0 to 7·9)*	11·3 (8·0 to 14·6)*	0·78 (0·63 to 0·92)*	0·70 (0·39 to 1·03)*	0·83 (0·59 to 1·06)*
Eastern Europe	63·5 (61·7 to 65·3)	63·1 (61·1 to 64·8)	75·0 (69·6 to 80·2)	11·5 (5·7 to 16·5)*	−0·4 (−3·0 to 1·9)	11·9 (6·4 to 17·1)*	0·64 (0·33 to 0·90)*	−0·07 (−0·48 to 0·29)	1·08 (0·60 to 1·51)*
Belarus	64·8 (63·4 to 66·3)	66·1 (63·7 to 67·6)	79·0 (75·3 to 82·8)	14·3 (10·5 to 18·1)*	1·3 (−1·6 to 3·1)	13·0 (9·1 to 16·9)*	0·76 (0·58 to 0·96)*	0·20 (−0·25 to 0·48)	1·12 (0·79 to 1·46)*
Estonia	68·2 (66·8 to 69·8)	71·6 (70·2 to 72·8)	85·9 (83·6 to 88·3)	17·7 (15·1 to 20·6)*	3·4 (1·7 to 5·0)*	14·3 (11·8 to 17·0)*	0·89 (0·76 to 1·03)*	0·48 (0·25 to 0·72)*	1·14 (0·94 to 1·35)*
Latvia	67·3 (65·9 to 68·8)	69·6 (68·1 to 71·0)	80·7 (78·0 to 83·3)	13·4 (10·5 to 16·4)*	2·3 (0·4 to 4·1)*	11·1 (8·3 to 14·2)*	0·70 (0·55 to 0·84)*	0·33 (0·06 to 0·61)*	0·93 (0·70 to 1·17)*
Lithuania	69·3 (68·0 to 70·6)	72·1 (70·6 to 73·4)	80·5 (78·7 to 82·3)	11·2 (9·2 to 13·2)*	2·9 (1·2 to 4·4)*	8·3 (6·0 to 10·7)*	0·58 (0·47 to 0·68)*	0·40 (0·17 to 0·62)*	0·68 (0·49 to 0·87)*
Moldova	56·6 (54·4 to 59·0)	58·1 (56·0 to 60·2)	67·4 (64·5 to 70·4)	10·8 (7·3 to 14·0)*	1·5 (−1·5 to 4·3)	9·3 (6·2 to 12·6)*	0·67 (0·46 to 0·86)*	0·26 (−0·25 to 0·76)	0·93 (0·62 to 1·24)*
Russia	63·1 (60·6 to 65·4)	62·5 (60·1 to 64·7)	75·1 (67·7 to 81·7)	11·9 (4·5 to 19·0)*	−0·6 (−3·8 to 2·5)	12·6 (5·0 to 19·4)*	0·66 (0·26 to 1·01)*	−0·10 (−0·63 to 0·40)	1·14 (0·48 to 1·73)*
Ukraine	64·9 (63·3 to 66·5)	64·0 (61·8 to 65·8)	74·6 (68·3 to 79·8)	9·6 (3·3 to 15·2)*	−1·0 (−3·6 to 1·2)	10·6 (4·2 to 16·5)*	0·53 (0·19 to 0·81)*	−0·15 (−0·56 to 0·18)	0·95 (0·39 to 1·45)*
High income†	75·5 (74·4 to 76·6)	83·2 (82·3 to 83·8)	89·8 (89·2 to 90·4)	14·4 (13·3 to 15·5)*	7·7 (6·7 to 8·8)*	6·6 (6·0 to 7·4)*	0·67 (0·62 to 0·73)*	0·98 (0·84 to 1·11)*	0·48 (0·43 to 0·54)*
Australasia	83·2 (82·4 to 84·0)	89·7 (89·0 to 90·5)	95·5 (94·5 to 96·4)	12·3 (11·2 to 13·3)*	6·5 (5·8 to 7·3)*	5·8 (4·8 to 6·8)*	0·53 (0·48 to 0·57)*	0·76 (0·67 to 0·85)*	0·39 (0·32 to 0·46)*
Australia	83·9 (83·0 to 84·7)	90·4 (89·6 to 91·2)	95·9 (94·8 to 96·8)	12·0 (10·9 to 13·1)*	6·5 (5·6 to 7·5)*	5·5 (4·4 to 6·6)*	0·51 (0·47 to 0·56)*	0·75 (0·65 to 0·86)*	0·37 (0·30 to 0·44)*
New Zealand	80·2 (79·2 to 81·4)	87·0 (86·0 to 87·8)	92·4 (90·3 to 94·3)	12·2 (9·8 to 14·3)*	6·8 (5·4 to 7·9)*	5·4 (3·1 to 7·4)*	0·54 (0·44 to 0·64)*	0·81 (0·64 to 0·95)*	0·38 (0·22 to 0·51)*
High-income Asia Pacific	73·7 (72·1 to 75·6)	81·8 (80·6 to 83·1)	93·2 (91·8 to 94·2)	19·5 (16·9 to 21·5)*	8·1 (5·9 to 10·0)*	11·4 (9·7 to 13·0)*	0·90 (0·78 to 1·00)*	1·04 (0·75 to 1·30)*	0·81 (0·69 to 0·93)*
Brunei	62·9 (60·0 to 65·6)	70·0 (67·5 to 72·7)	76·4 (71·9 to 81·0)	13·5 (8·4 to 18·7)*	7·1 (3·9 to 10·6)*	6·4 (1·4 to 11·3)*	0·75 (0·48 to 1·02)*	1·07 (0·60 to 1·60)*	0·55 (0·12 to 0·94)*
Japan	80·9 (80·3 to 81·7)	86·9 (86·3 to 87·5)	94·1 (93·5 to 94·6)	13·3 (12·2 to 13·9)*	6·1 (5·4 to 6·4)*	7·2 (6·6 to 7·8)*	0·58 (0·54 to 0·62)*	0·72 (0·65 to 0·77)*	0·50 (0·45 to 0·54)*
Singapore	69·2 (66·5 to 72·0)	79·7 (77·2 to 82·0)	90·6 (87·2 to 93·3)	21·4 (17·5 to 25·0)*	10·5 (7·1 to 13·9)*	10·9 (7·1 to 14·8)*	1·04 (0·85 to 1·21)*	1·41 (0·95 to 1·88)*	0·80 (0·53 to 1·08)*
South Korea	59·5 (56·2 to 62·9)	74·4 (71·4 to 77·0)	90·3 (85·6 to 93·9)	30·9 (24·6 to 35·7)*	14·9 (10·0 to 18·9)*	15·9 (10·9 to 20·4)*	1·61 (1·28 to 1·87)*	2·24 (1·47 to 2·86)*	1·21 (0·84 to 1·54)*
High-income North America	81·0 (80·1 to 81·7)	87·1 (86·5 to 87·7)	89·1 (88·4 to 89·8)	8·1 (7·4 to 9·0)*	6·1 (5·5 to 6·8)*	2·0 (1·5 to 2·6)*	0·37 (0·34 to 0·41)*	0·73 (0·66 to 0·81)*	0·14 (0·11 to 0·18)*
Canada	83·2 (82·2 to 84·1)	89·3 (88·4 to 90·2)	93·8 (92·8 to 94·8)	10·6 (9·3 to 11·9)*	6·1 (5·1 to 6·9)*	4·5 (3·4 to 5·7)*	0·46 (0·40 to 0·52)*	0·71 (0·59 to 0·80)*	0·31 (0·24 to 0·39)*
Greenland	54·0 (50·6 to 57·5)	59·2 (56·4 to 62·8)	67·5 (62·7 to 72·7)	13·5 (8·0 to 19·0)*	5·2 (1·6 to 8·9)*	8·3 (3·3 to 13·5)*	0·86 (0·52 to 1·19)*	0·92 (0·29 to 1·55)*	0·82 (0·33 to 1·31)*
USA	80·7 (79·8 to 81·5)	86·8 (86·1 to 87·4)	88·7 (88·0 to 89·4)	8·0 (7·2 to 8·8)*	6·1 (5·5 to 6·7)*	1·9 (1·4 to 2·5)*	0·36 (0·33 to 0·40)*	0·72 (0·65 to 0·81)*	0·13 (0·10 to 0·18)*
Southern Latin America	54·2 (52·9 to 55·5)	62·6 (61·0 to 63·8)	70·0 (67·9 to 72·0)	15·8 (13·7 to 17·8)*	8·4 (6·8 to 9·7)*	7·4 (5·2 to 9·5)*	0·99 (0·86 to 1·10)*	1·45 (1·17 to 1·66)*	0·70 (0·50 to 0·89)*
Argentina	53·8 (52·3 to 55·2)	61·7 (59·8 to 63·1)	68·1 (65·8 to 70·1)	14·3 (12·0 to 16·5)*	8·0 (6·1 to 9·5)*	6·3 (4·2 to 8·5)*	0·91 (0·77 to 1·04)*	1·38 (1·06 to 1·64)*	0·61 (0·41 to 0·82)*
Chile	56·5 (54·9 to 58·4)	67·0 (65·4 to 68·5)	77·9 (72·3 to 83·7)	21·4 (15·5 to 27·5)*	10·5 (8·4 to 12·5)*	10·9 (5·3 to 16·4)*	1·23 (0·93 to 1·53)*	1·70 (1·35 to 2·03)*	0·94 (0·47 to 1·39)*
Uruguay	57·9 (56·7 to 59·1)	64·7 (63·2 to 65·8)	71·0 (68·9 to 73·0)	13·1 (10·9 to 15·2)*	6·8 (5·1 to 8·2)*	6·3 (4·1 to 8·5)*	0·79 (0·66 to 0·90)*	1·12 (0·84 to 1·34)*	0·58 (0·39 to 0·78)*
Western Europe	78·6 (77·9 to 79·6)	85·3 (84·6 to 86·0)	92·6 (91·7 to 93·3)	13·9 (12·8 to 14·8)*	6·7 (6·0 to 7·3)*	7·2 (6·6 to 7·9)*	0·63 (0·58 to 0·67)*	0·82 (0·73 to 0·90)*	0·51 (0·46 to 0·56)*
Andorra	84·7 (79·5 to 89·3)	92·8 (88·9 to 96·0)	94·7 (91·2 to 97·0)	10·0 (4·4 to 15·4)*	8·1 (3·8 to 12·6)*	1·8 (−2·5 to 5·8)	0·43 (0·19 to 0·67)*	0·92 (0·43 to 1·45)*	0·12 (−0·17 to 0·39)

(Table 2 continues on next page)

	HAQ Index (95% UI)			Absolute change (95% UI)			Annualised rate of change (95% UI)		
	1990	2000	2016	1990–2016	1990–2000	2000–16	1990–2016	1990–2000	2000–16
(Continued from previous page)									
Austria	80·9 (79·9 to 82·2)	87·4 (86·5 to 88·5)	93·9 (92·6 to 95·3)	13·1 (11·3 to 14·7)*	6·6 (5·6 to 7·6)*	6·5 (5·1 to 8·0)*	0·58 (0·50 to 0·65)*	0·78 (0·66 to 0·91)*	0·45 (0·36 to 0·55)*
Belgium	80·7 (79·4 to 82·2)	86·1 (84·8 to 87·3)	92·9 (90·7 to 95·0)	12·2 (9·6 to 14·7)*	5·4 (3·7 to 7·1)*	6·8 (4·6 to 9·1)*	0·54 (0·43 to 0·65)*	0·65 (0·44 to 0·85)*	0·47 (0·32 to 0·63)*
Cyprus	68·3 (66·3 to 70·5)	78·0 (76·6 to 79·7)	90·3 (88·8 to 91·8)	22·0 (19·6 to 24·3)*	9·6 (7·7 to 11·5)*	12·3 (10·5 to 14·3)*	1·07 (0·95 to 1·20)*	1·32 (1·04 to 1·59)*	0·92 (0·78 to 1·06)*
Denmark	81·1 (79·3 to 82·7)	85·0 (83·5 to 86·8)	92·1 (89·8 to 94·3)	11·0 (8·2 to 13·7)*	3·8 (1·7 to 6·5)*	7·2 (4·5 to 10·0)*	0·49 (0·36 to 0·61)*	0·46 (0·20 to 0·78)*	0·51 (0·32 to 0·70)*
Finland	81·0 (79·8 to 82·3)	87·7 (86·7 to 88·7)	95·9 (94·6 to 96·9)	14·9 (13·0 to 16·5)*	6·8 (5·3 to 8·0)*	8·1 (6·7 to 9·5)*	0·65 (0·56 to 0·72)*	0·80 (0·62 to 0·95)*	0·55 (0·46 to 0·65)*
France	77·6 (76·4 to 79·1)	84·1 (83·0 to 85·3)	91·7 (90·3 to 93·1)	14·1 (12·1 to 16·0)*	6·6 (5·4 to 7·7)*	7·6 (6·0 to 9·1)*	0·64 (0·55 to 0·73)*	0·81 (0·66 to 0·95)*	0·54 (0·42 to 0·65)*
Germany	78·9 (77·5 to 80·6)	86·1 (84·9 to 87·3)	92·0 (90·4 to 93·6)	13·1 (10·8 to 15·1)*	7·2 (5·4 to 8·9)*	5·9 (4·1 to 8·0)*	0·59 (0·49 to 0·68)*	0·87 (0·65 to 1·09)*	0·42 (0·29 to 0·56)*
Greece	79·5 (78·4 to 80·5)	85·3 (84·4 to 86·3)	90·4 (88·8 to 91·9)	10·9 (9·1 to 12·6)*	5·8 (4·8 to 6·8)*	5·1 (3·5 to 6·7)*	0·49 (0·42 to 0·57)*	0·70 (0·58 to 0·84)*	0·36 (0·25 to 0·47)*
Iceland	87·0 (85·6 to 88·5)	92·8 (91·5 to 93·9)	97·1 (95·8 to 98·1)	10·2 (8·6 to 11·7)*	5·8 (4·1 to 7·3)*	4·4 (2·8 to 6·0)*	0·42 (0·36 to 0·49)*	0·65 (0·46 to 0·81)*	0·29 (0·18 to 0·39)*
Ireland	76·3 (74·9 to 77·5)	83·9 (82·4 to 85·4)	94·6 (91·8 to 96·8)	18·3 (15·3 to 20·9)*	7·6 (6·0 to 9·3)*	10·7 (7·8 to 13·4)*	0·83 (0·70 to 0·94)*	0·95 (0·75 to 1·17)*	0·75 (0·55 to 0·93)*
Israel	71·2 (68·9 to 73·7)	77·9 (75·5 to 80·5)	84·8 (80·7 to 88·4)	13·5 (8·6 to 18·0)*	6·7 (3·4 to 10·0)*	6·8 (2·3 to 10·8)*	0·67 (0·43 to 0·88)*	0·90 (0·46 to 1·34)*	0·52 (0·18 to 0·83)*
Italy	81·5 (80·6 to 82·4)	88·8 (87·8 to 89·7)	94·9 (93·4 to 96·0)	13·3 (11·8 to 14·7)*	7·2 (6·3 to 8·1)*	6·1 (4·7 to 7·4)*	0·58 (0·52 to 0·64)*	0·85 (0·74 to 0·96)*	0·41 (0·32 to 0·51)*
Luxembourg	81·4 (79·7 to 83·0)	90·3 (88·8 to 91·6)	96·0 (94·4 to 97·3)	14·7 (12·4 to 16·7)*	8·9 (7·2 to 10·6)*	5·7 (3·9 to 7·4)*	0·64 (0·53 to 0·73)*	1·04 (0·83 to 1·24)*	0·38 (0·26 to 0·49)*
Malta	75·0 (73·0 to 77·0)	81·1 (79·0 to 83·0)	89·9 (86·3 to 93·0)	14·9 (10·8 to 18·8)*	6·1 (3·5 to 8·7)*	8·8 (4·9 to 12·6)*	0·70 (0·52 to 0·87)*	0·78 (0·45 to 1·11)*	0·64 (0·36 to 0·91)*
Netherlands	84·1 (82·8 to 85·4)	88·6 (87·1 to 89·8)	96·1 (94·5 to 97·3)	11·9 (10·0 to 13·6)*	4·5 (3·1 to 6·0)*	7·4 (5·6 to 9·1)*	0·51 (0·43 to 0·58)*	0·52 (0·36 to 0·69)*	0·50 (0·38 to 0·62)*
Norway	84·0 (82·9 to 85·1)	90·6 (89·5 to 91·7)	96·6 (94·9 to 97·9)	12·6 (10·6 to 14·3)*	6·6 (5·4 to 7·9)*	6·0 (4·1 to 7·6)*	0·54 (0·46 to 0·61)*	0·76 (0·62 to 0·91)*	0·40 (0·27 to 0·51)*
Portugal	67·1 (65·9 to 68·3)	76·2 (75·1 to 77·3)	85·7 (84·1 to 87·3)	18·6 (16·9 to 20·4)*	9·1 (8·0 to 10·4)*	9·5 (7·8 to 11·3)*	0·94 (0·86 to 1·03)*	1·27 (1·11 to 1·46)*	0·74 (0·61 to 0·87)*
Spain	76·2 (75·2 to 77·2)	84·1 (83·1 to 84·9)	91·9 (90·5 to 93·2)	15·7 (14·2 to 17·3)*	7·9 (6·9 to 8·8)*	7·8 (6·5 to 9·2)*	0·72 (0·65 to 0·79)*	0·99 (0·87 to 1·11)*	0·56 (0·46 to 0·65)*
Sweden	85·2 (84·2 to 86·2)	92·4 (91·5 to 93·2)	95·5 (93·4 to 97·2)	10·2 (7·9 to 12·1)*	7·1 (6·1 to 8·2)*	3·1 (1·0 to 5·0)*	0·44 (0·34 to 0·51)*	0·81 (0·69 to 0·93)*	0·21 (0·07 to 0·33)*
Switzerland	86·8 (85·2 to 88·2)	91·6 (90·2 to 93·0)	95·6 (92·4 to 97·8)	8·8 (5·3 to 11·4)*	4·8 (3·0 to 6·6)*	4·0 (0·5 to 6·7)*	0·37 (0·22 to 0·48)*	0·54 (0·33 to 0·74)*	0·26 (0·04 to 0·45)*
UK	78·0 (77·1 to 78·6)	83·9 (83·0 to 84·6)	90·5 (89·6 to 91·3)	12·5 (11·8 to 13·4)*	6·0 (5·5 to 6·5)*	6·5 (5·9 to 7·2)*	0·57 (0·54 to 0·61)*	0·74 (0·69 to 0·80)*	0·47 (0·43 to 0·51)*
Latin America and Caribbean†	41·3 (40·3 to 42·5)	52·6 (51·3 to 53·7)	61·8 (60·4 to 63·0)	20·5 (19·0 to 21·8)*	11·3 (9·8 to 12·3)*	9·2 (8·1 to 10·2)*	1·55 (1·43 to 1·65)*	2·42 (2·09 to 2·66)*	1·01 (0·89 to 1·12)*
Andean Latin America	34·1 (32·4 to 36·0)	46·9 (45·3 to 48·6)	59·3 (56·3 to 62·4)	25·2 (21·4 to 28·8)*	12·8 (10·0 to 15·0)*	12·4 (9·5 to 15·3)*	2·13 (1·82 to 2·42)*	3·19 (2·47 to 3·76)*	1·47 (1·14 to 1·77)*
Bolivia	26·2 (23·6 to 29·0)	36·5 (34·2 to 38·9)	48·8 (43·5 to 54·0)	22·6 (16·6 to 28·1)*	10·3 (7·1 to 13·2)*	12·3 (6·8 to 17·6)*	2·39 (1·82 to 2·93)*	3·31 (2·27 to 4·38)*	1·81 (1·08 to 2·51)*
Ecuador	37·8 (36·1 to 39·9)	51·1 (48·9 to 52·8)	62·2 (59·5 to 64·6)	24·3 (20·8 to 27·4)*	13·3 (10·4 to 15·6)*	11·1 (8·8 to 13·4)*	1·91 (1·63 to 2·15)*	3·01 (2·35 to 3·55)*	1·22 (0·98 to 1·47)*
Peru	38·6 (36·3 to 41·3)	51·0 (48·8 to 53·4)	64·3 (59·2 to 69·4)	25·8 (19·8 to 31·4)*	12·4 (8·7 to 15·7)*	13·4 (8·0 to 18·5)*	1·97 (1·52 to 2·34)*	2·79 (1·92 to 3·53)*	1·45 (0·90 to 1·97)*
Caribbean	37·9 (36·1 to 40·0)	45·6 (43·6 to 47·7)	54·2 (51·1 to 57·3)	16·3 (12·7 to 19·7)*	7·7 (5·0 to 10·2)*	8·7 (5·3 to 12·1)*	1·38 (1·09 to 1·64)*	1·85 (1·20 to 2·43)*	1·09 (0·67 to 1·50)*
Antigua and Barbuda	57·0 (54·5 to 59·5)	62·8 (60·2 to 65·4)	69·8 (66·5 to 73·3)	12·8 (8·7 to 16·7)*	5·8 (2·7 to 9·0)*	7·0 (3·2 to 11·2)*	0·78 (0·53 to 1·01)*	0·97 (0·46 to 1·51)*	0·66 (0·31 to 1·04)*

(Table 2 continues on next page)

	HAQ Index (95% UI)			Absolute change (95% UI)			Annualised rate of change (95% UI)		
	1990	2000	2016	1990–2016	1990–2000	2000–16	1990–2016	1990–2000	2000–16
(Continued from previous page)									
Barbados	59·3 (57·1 to 61·6)	67·3 (64·3 to 69·7)	70·8 (67·3 to 73·8)	11·6 (7·5 to 15·4)*	8·0 (4·8 to 11·0)*	3·6 (–0·2 to 7·5)	0·69 (0·45 to 0·90)*	1·27 (0·76 to 1·73)*	0·32 (–0·02 to 0·67)
Belize	46·6 (44·3 to 48·8)	48·6 (46·1 to 50·8)	55·7 (50·8 to 59·9)	9·1 (4·0 to 13·6)*	2·0 (–1·0 to 4·8)	7·2 (2·5 to 11·4)*	0·69 (0·31 to 1·01)*	0·41 (–0·21 to 1·02)	0·86 (0·31 to 1·35)*
Bermuda	63·1 (60·8 to 65·8)	73·5 (71·0 to 76·0)	83·1 (79·7 to 86·3)	20·0 (15·7 to 24·0)*	10·4 (6·8 to 13·7)*	9·6 (5·6 to 13·5)*	1·06 (0·84 to 1·26)*	1·52 (0·98 to 2·01)*	0·76 (0·45 to 1·08)*
Cuba	63·7 (62·4 to 65·5)	67·3 (66·2 to 68·6)	75·5 (73·5 to 77·7)	11·8 (9·5 to 14·2)*	3·6 (2·1 to 5·2)*	8·2 (6·0 to 10·4)*	0·65 (0·53 to 0·78)*	0·56 (0·32 to 0·79)*	0·72 (0·53 to 0·91)*
Dominica	52·4 (50·1 to 54·8)	58·9 (56·3 to 61·2)	61·9 (58·2 to 65·3)	9·5 (5·3 to 13·2)*	6·5 (3·8 to 9·3)*	3·0 (–1·3 to 6·9)	0·64 (0·37 to 0·88)*	1·18 (0·69 to 1·67)*	0·31 (–0·14 to 0·71)
Dominican Republic	38·4 (35·8 to 41·5)	52·5 (49·5 to 55·5)	61·2 (57·3 to 65·6)	22·8 (17·8 to 27·5)*	14·1 (9·6 to 18·1)*	8·7 (4·2 to 13·4)*	1·80 (1·40 to 2·14)*	3·14 (2·07 to 3·95)*	0·96 (0·46 to 1·44)*
Grenada	47·2 (44·1 to 50·4)	53·2 (50·4 to 55·8)	58·5 (54·7 to 62·2)	11·3 (6·7 to 16·2)*	5·9 (2·0 to 9·6)*	5·3 (1·2 to 9·7)*	0·82 (0·49 to 1·19)*	1·19 (0·40 to 1·95)*	0·60 (0·13 to 1·07)*
Guyana	38·4 (36·3 to 40·5)	43·2 (41·0 to 45·1)	49·8 (46·8 to 53·0)	11·4 (8·0 to 15·3)*	4·8 (1·9 to 7·2)*	6·6 (3·4 to 9·9)*	1·00 (0·71 to 1·32)*	1·19 (0·48 to 1·77)*	0·88 (0·46 to 1·32)*
Haiti	16·7 (13·8 to 19·8)	23·2 (19·6 to 26·9)	32·1 (26·6 to 37·8)	15·4 (9·5 to 21·4)*	6·5 (2·0 to 10·9)*	8·9 (2·7 to 15·1)*	2·51 (1·59 to 3·48)*	3·30 (1·02 to 5·61)*	2·02 (0·65 to 3·35)*
Jamaica	51·1 (48·2 to 54·2)	56·4 (52·4 to 59·8)	62·0 (56·8 to 67·3)	10·8 (5·0 to 16·7)*	5·2 (0·7 to 9·2)*	5·6 (0·2 to 10·9)*	0·74 (0·35 to 1·12)*	0·97 (0·13 to 1·69)*	0·59 (0·03 to 1·12)*
Puerto Rico	67·1 (65·7 to 68·8)	74·6 (73·0 to 76·2)	82·7 (80·2 to 85·0)	15·6 (12·7 to 18·2)*	7·5 (5·7 to 9·4)*	8·1 (5·5 to 10·7)*	0·80 (0·66 to 0·93)*	1·06 (0·80 to 1·32)*	0·64 (0·45 to 0·84)*
Saint Lucia	48·9 (46·6 to 51·1)	56·8 (54·5 to 58·9)	63·3 (60·3 to 66·0)	14·4 (10·9 to 17·7)*	7·9 (5·0 to 10·8)*	6·5 (3·3 to 9·7)*	1·00 (0·76 to 1·21)*	1·50 (0·95 to 2·07)*	0·68 (0·35 to 0·98)*
Saint Vincent and the Grenadines	49·6 (47·2 to 51·7)	53·0 (50·7 to 55·1)	57·4 (54·8 to 59·9)	7·8 (4·6 to 11·1)*	3·4 (0·9 to 5·8)*	4·4 (1·5 to 7·6)*	0·56 (0·34 to 0·79)*	0·66 (0·18 to 1·14)*	0·50 (0·17 to 0·86)*
Suriname	41·9 (39·9 to 44·2)	45·6 (43·0 to 47·9)	54·5 (51·2 to 57·6)	12·5 (8·3 to 16·4)*	3·6 (0·3 to 6·4)*	8·9 (5·6 to 12·4)*	1·01 (0·66 to 1·29)*	0·83 (0·07 to 1·47)*	1·12 (0·71 to 1·55)*
The Bahamas	56·1 (54·0 to 58·3)	63·4 (61·3 to 65·4)	66·4 (62·9 to 69·7)	10·3 (6·3 to 14·0)*	7·3 (4·7 to 9·8)*	3·0 (–0·7 to 6·4)	0·65 (0·40 to 0·88)*	1·22 (0·79 to 1·67)*	0·29 (–0·06 to 0·61)
Trinidad and Tobago	51·2 (49·7 to 52·6)	55·7 (53·7 to 57·3)	64·3 (60·7 to 67·5)	13·1 (9·0 to 16·6)*	4·5 (2·3 to 6·4)*	8·6 (5·3 to 11·8)*	0·87 (0·62 to 1·10)*	0·84 (0·43 to 1·18)*	0·89 (0·57 to 1·20)*
Virgin Islands	57·2 (54·6 to 60·4)	65·7 (63·0 to 68·8)	74·0 (70·0 to 79·1)	16·8 (11·9 to 21·9)*	8·5 (4·9 to 12·1)*	8·3 (4·0 to 13·2)*	0·99 (0·72 to 1·28)*	1·38 (0·80 to 1·96)*	0·75 (0·36 to 1·18)*
Central Latin America	43·3 (42·3 to 44·5)	55·8 (54·2 to 56·8)	64·4 (62·6 to 65·6)	21·1 (19·3 to 22·6)*	12·5 (10·8 to 13·7)*	8·6 (7·6 to 9·7)*	1·53 (1·40 to 1·63)*	2·54 (2·20 to 2·78)*	0·90 (0·79 to 1·01)*
Colombia	48·5 (46·7 to 50·6)	57·6 (55·9 to 59·0)	68·5 (65·8 to 70·9)	20·0 (16·6 to 23·0)*	9·1 (6·9 to 11·0)*	10·9 (8·3 to 13·4)*	1·33 (1·11 to 1·53)*	1·72 (1·29 to 2·11)*	1·09 (0·84 to 1·31)*
Costa Rica	60·7 (59·2 to 61·9)	64·7 (63·2 to 65·9)	73·7 (71·2 to 76·0)	13·0 (10·4 to 15·5)*	4·0 (2·5 to 5·5)*	9·0 (6·5 to 11·6)*	0·75 (0·60 to 0·88)*	0·64 (0·40 to 0·88)*	0·82 (0·60 to 1·04)*
El Salvador	38·1 (35·9 to 41·8)	52·1 (49·5 to 54·5)	63·2 (58·9 to 67·2)	25·1 (17·9 to 29·7)*	14·0 (8·5 to 17·2)*	11·1 (7·6 to 15·0)*	1·95 (1·38 to 2·27)*	3·14 (1·86 to 3·86)*	1·20 (0·84 to 1·60)*
Guatemala	30·4 (27·4 to 33·4)	42·0 (38·3 to 45·7)	51·5 (45·3 to 57·7)	21·1 (14·5 to 27·5)*	11·6 (7·1 to 16·1)*	9·4 (2·8 to 16·2)*	2·02 (1·42 to 2·57)*	3·24 (1·97 to 4·51)*	1·26 (0·38 to 2·10)*
Honduras	28·1 (24·8 to 31·3)	38·1 (33·1 to 43·3)	46·5 (40·1 to 53·1)	18·5 (11·4 to 25·5)*	10·0 (5·5 to 15·2)*	8·5 (2·1 to 15·1)*	1·94 (1·26 to 2·65)*	3·04 (1·73 to 4·52)*	1·25 (0·32 to 2·21)*
Mexico	45·5 (44·5 to 46·9)	59·0 (57·6 to 59·9)	66·3 (64·9 to 67·4)	20·8 (19·5 to 22·0)*	13·5 (12·0 to 14·6)*	7·3 (6·4 to 8·2)*	1·45 (1·34 to 1·54)*	2·61 (2·29 to 2·82)*	0·73 (0·64 to 0·82)*
Nicaragua	43·1 (41·0 to 46·2)	49·8 (47·9 to 52·0)	61·2 (57·0 to 65·4)	18·1 (11·9 to 22·9)*	6·7 (3·1 to 9·6)*	11·4 (7·2 to 15·7)*	1·35 (0·88 to 1·67)*	1·45 (0·65 to 2·09)*	1·28 (0·83 to 1·74)*
Panama	52·1 (49·3 to 55·5)	60·8 (58·6 to 62·9)	68·3 (64·6 to 71·9)	16·1 (10·8 to 21·2)*	8·7 (5·0 to 12·0)*	7·4 (3·3 to 11·6)*	1·04 (0·69 to 1·36)*	1·55 (0·86 to 2·15)*	0·72 (0·33 to 1·11)*
Venezuela	51·3 (49·0 to 53·9)	60·0 (58·0 to 61·8)	67·8 (63·6 to 71·8)	16·5 (11·1 to 21·5)*	8·7 (5·4 to 11·6)*	7·8 (3·5 to 11·9)*	1·07 (0·74 to 1·38)*	1·57 (0·97 to 2·10)*	0·76 (0·35 to 1·15)*
Tropical Latin America	46·1 (44·9 to 47·2)	54·9 (53·6 to 55·9)	63·4 (62·0 to 64·4)	17·3 (16·1 to 18·5)*	8·9 (7·9 to 9·7)*	8·4 (7·3 to 9·6)*	1·23 (1·14 to 1·31)*	1·76 (1·57 to 1·94)*	0·89 (0·77 to 1·02)*

(Table 2 continues on next page)

	HAQ Index (95% UI)			Absolute change (95% UI)			Annualised rate of change (95% UI)		
	1990	2000	2016	1990–2016	1990–2000	2000–16	1990–2016	1990–2000	2000–16
(Continued from previous page)									
Brazil	46·5 (45·2 to 47·7)	55·3 (53·9 to 56·4)	63·8 (62·3 to 64·9)	17·3 (16·1 to 18·5)*	8·8 (8·0 to 9·6)*	8·5 (7·4 to 9·6)*	1·22 (1·13 to 1·30)*	1·74 (1·57 to 1·90)*	0·89 (0·78 to 1·02)*
Paraguay	43·1 (41·1 to 45·1)	49·8 (46·8 to 52·3)	56·7 (53·1 to 60·2)	13·6 (9·9 to 17·4)*	6·8 (3·7 to 9·5)*	6·9 (3·4 to 10·3)*	1·06 (0·78 to 1·32)*	1·46 (0·82 to 2·07)*	0·81 (0·41 to 1·20)*
North Africa and Middle East†	35·9 (33·7 to 37·9)	42·3 (40·5 to 44·0)	55·8 (54·0 to 57·8)	19·9 (17·6 to 22·2)*	6·4 (5·1 to 7·6)*	13·5 (11·6 to 15·5)*	1·70 (1·49 to 1·93)*	1·63 (1·29 to 2·00)*	1·73 (1·50 to 2·00)*
North Africa and Middle East	35·9 (33·7 to 37·9)	42·3 (40·5 to 44·0)	55·8 (54·0 to 57·8)	19·9 (17·6 to 22·2)*	6·4 (5·1 to 7·6)*	13·5 (11·6 to 15·5)*	1·70 (1·49 to 1·93)*	1·63 (1·29 to 2·00)*	1·73 (1·50 to 2·00)*
Afghanistan	15·8 (12·2 to 19·4)	14·9 (11·5 to 19·1)	25·9 (22·0 to 29·5)	10·1 (5·2 to 14·5)*	−0·9 (−4·1 to 2·7)	11·0 (6·4 to 15·4)*	1·93 (0·96 to 2·83)*	−0·60 (−2·75 to 1·68)	3·51 (1·88 to 5·10)*
Algeria	42·8 (37·6 to 46·7)	50·6 (46·1 to 54·2)	63·1 (59·4 to 66·4)	20·2 (16·0 to 24·6)*	7·8 (4·2 to 11·6)*	12·4 (8·7 to 16·7)*	1·49 (1·16 to 1·90)*	1·68 (0·89 to 2·56)*	1·38 (0·95 to 1·88)*
Bahrain	49·9 (46·7 to 53·1)	59·4 (56·3 to 62·2)	72·0 (67·3 to 76·5)	22·1 (16·5 to 27·2)*	9·5 (5·4 to 13·6)*	12·6 (7·3 to 17·9)*	1·41 (1·07 to 1·73)*	1·75 (0·98 to 2·51)*	1·20 (0·71 to 1·68)*
Egypt	34·2 (31·9 to 37·7)	45·9 (43·4 to 49·2)	58·0 (53·9 to 62·5)	23·8 (19·1 to 28·4)*	11·7 (8·8 to 14·5)*	12·1 (8·1 to 16·5)*	2·03 (1·64 to 2·39)*	2·94 (2·21 to 3·66)*	1·46 (1·00 to 1·95)*
Iran	49·3 (45·0 to 53·5)	61·0 (57·2 to 64·7)	71·8 (67·3 to 76·3)	22·4 (16·3 to 28·6)*	11·6 (6·4 to 16·7)*	10·8 (5·0 to 16·3)*	1·44 (1·04 to 1·87)*	2·12 (1·16 to 3·11)*	1·02 (0·47 to 1·54)*
Iraq	42·4 (38·5 to 47·1)	43·4 (40·0 to 46·8)	51·1 (45·9 to 56·6)	8·6 (1·2 to 15·8)*	0·9 (−3·8 to 5·6)	7·7 (1·6 to 13·7)*	0·71 (0·11 to 1·29)*	0·23 (−0·87 to 1·34)	1·02 (0·21 to 1·75)*
Jordan	50·0 (46·5 to 53·4)	58·3 (53·8 to 62·7)	70·2 (64·8 to 75·3)	20·2 (13·5 to 26·3)*	8·3 (4·0 to 13·0)*	11·9 (5·4 to 18·4)*	1·31 (0·88 to 1·70)*	1·54 (0·76 to 2·41)*	1·16 (0·54 to 1·82)*
Kuwait	66·8 (63·3 to 70·3)	70·8 (68·3 to 73·5)	80·7 (75·5 to 86·1)	13·8 (7·8 to 19·7)*	4·0 (−0·4 to 8·4)	9·9 (4·4 to 15·4)*	0·72 (0·42 to 1·02)*	0·58 (−0·05 to 1·22)	0·81 (0·37 to 1·25)*
Lebanon	53·1 (48·5 to 57·1)	67·2 (63·6 to 70·6)	85·6 (82·8 to 88·2)	32·5 (27·5 to 38·0)*	14·1 (9·8 to 18·5)*	18·4 (14·2 to 23·0)*	1·84 (1·52 to 2·21)*	2·36 (1·60 to 3·19)*	1·52 (1·15 to 1·93)*
Libya	50·9 (46·8 to 54·5)	57·9 (54·5 to 61·0)	71·1 (67·4 to 74·6)	20·2 (15·7 to 24·7)*	7·0 (4·1 to 9·9)*	13·2 (9·5 to 16·8)*	1·29 (1·00 to 1·60)*	1·30 (0·74 to 1·87)*	1·28 (0·93 to 1·65)*
Morocco	37·5 (34·7 to 40·7)	44·6 (41·5 to 47·5)	57·6 (54·5 to 60·8)	20·1 (16·2 to 23·6)*	7·1 (4·1 to 10·0)*	13·0 (9·9 to 16·1)*	1·65 (1·33 to 1·95)*	1·73 (0·99 to 2·45)*	1·60 (1·23 to 2·00)*
Oman	52·5 (49·6 to 55·5)	63·4 (61·1 to 65·9)	76·2 (74·0 to 78·6)	23·7 (20·4 to 27·1)*	10·9 (8·4 to 13·6)*	12·8 (10·0 to 15·4)*	1·43 (1·21 to 1·67)*	1·89 (1·44 to 2·38)*	1·15 (0·89 to 1·38)*
Palestine	48·1 (43·1 to 53·5)	54·1 (51·2 to 57·6)	57·4 (54·1 to 60·6)	9·3 (2·7 to 15·3)*	6·0 (0·4 to 11·7)*	3·3 (−1·0 to 7·2)	0·68 (0·20 to 1·15)*	1·19 (0·07 to 2·37)*	0·37 (−0·11 to 0·80)
Qatar	57·7 (53·3 to 62·2)	64·6 (60·3 to 69·1)	81·7 (75·9 to 86·6)	23·9 (16·8 to 30·8)*	6·9 (1·0 to 12·9)*	17·0 (10·4 to 24·0)*	1·33 (0·94 to 1·74)*	1·13 (0·16 to 2·11)*	1·46 (0·89 to 2·03)*
Saudi Arabia	49·9 (47·0 to 53·0)	56·6 (54·8 to 58·7)	77·1 (74·9 to 79·3)	27·2 (23·4 to 31·2)*	6·7 (3·9 to 9·7)*	20·5 (17·8 to 23·2)*	1·67 (1·42 to 1·95)*	1·26 (0·72 to 1·85)*	1·93 (1·69 to 2·18)*
Sudan	28·6 (24·3 to 31·8)	33·7 (29·8 to 36·7)	45·8 (41·0 to 50·0)	17·2 (13·1 to 21·3)*	5·1 (2·5 to 8·0)*	12·1 (8·0 to 16·0)*	1·81 (1·37 to 2·28)*	1·65 (0·76 to 2·66)*	1·91 (1·31 to 2·51)*
Syria	45·5 (42·6 to 48·3)	56·7 (54·6 to 58·8)	67·2 (64·4 to 70·2)	21·7 (17·9 to 25·7)*	11·2 (8·1 to 14·5)*	10·5 (7·1 to 14·0)*	1·50 (1·23 to 1·79)*	2·21 (1·58 to 2·94)*	1·06 (0·74 to 1·41)*
Tunisia	47·6 (43·2 to 50·9)	59·0 (55·3 to 62·3)	69·4 (65·4 to 73·7)	21·8 (17·1 to 26·8)*	11·4 (8·1 to 14·7)*	10·4 (6·6 to 14·3)*	1·45 (1·14 to 1·83)*	2·15 (1·50 to 2·85)*	1·02 (0·64 to 1·40)*
Turkey	42·5 (38·8 to 46·3)	53·9 (50·8 to 56·8)	74·4 (70·0 to 78·4)	31·9 (26·2 to 37·3)*	11·4 (7·9 to 15·2)*	20·4 (15·5 to 25·2)*	2·16 (1·76 to 2·53)*	2·39 (1·61 to 3·22)*	2·01 (1·53 to 2·50)*
United Arab Emirates	49·8 (43·7 to 55·4)	60·2 (56·0 to 64·4)	70·3 (65·5 to 75·4)	20·5 (12·8 to 28·6)*	10·4 (5·2 to 15·8)*	10·1 (4·1 to 16·6)*	1·33 (0·81 to 1·90)*	1·91 (0·93 to 3·00)*	0·97 (0·39 to 1·59)*
Yemen	25·2 (20·8 to 29·1)	31·4 (26·9 to 35·6)	43·3 (38·3 to 47·9)	18·1 (12·9 to 22·7)*	6·2 (2·6 to 9·9)*	11·9 (7·5 to 16·2)*	2·09 (1·45 to 2·72)*	2·20 (0·92 to 3·57)*	2·01 (1·22 to 2·75)*
South Asia†	23·8 (22·3 to 25·6)	27·6 (26·1 to 29·3)	40·4 (38·7 to 42·2)	16·6 (14·0 to 18·9)*	3·8 (2·1 to 5·2)*	12·9 (10·9 to 14·8)*	2·04 (1·70 to 2·32)*	1·47 (0·84 to 2·09)*	2·39 (2·01 to 2·77)*
South Asia	23·8 (22·3 to 25·6)	27·6 (26·1 to 29·3)	40·4 (38·7 to 42·2)	16·6 (14·0 to 18·9)*	3·8 (2·1 to 5·2)*	12·9 (10·9 to 14·8)*	2·04 (1·70 to 2·32)*	1·47 (0·84 to 2·09)*	2·39 (2·01 to 2·77)*
Bangladesh	17·8 (15·0 to 20·7)	27·5 (25·2 to 30·0)	47·6 (44·3 to 50·9)	29·8 (25·7 to 34·2)*	9·7 (6·5 to 12·8)*	20·1 (16·3 to 23·8)*	3·80 (3·18 to 4·50)*	4·36 (2·84 to 6·05)*	3·44 (2·78 to 4·09)*

(Table 2 continues on next page)

	HAQ Index (95% UI)			Absolute change (95% UI)			Annualised rate of change (95% UI)		
	1990	2000	2016	1990–2016	1990–2000	2000–16	1990–2016	1990–2000	2000–16
(Continued from previous page)									
Bhutan	20·0 (16·2 to 23·9)	29·6 (26·1 to 33·1)	47·3 (42·6 to 52·0)	27·2 (22·1 to 32·6)*	9·6 (5·7 to 13·5)*	17·7 (13·1 to 22·3)*	3·32 (2·58 to 4·11)*	3·94 (2·29 to 5·80)*	2·93 (2·18 to 3·70)*
India	24·7 (22·9 to 27·2)	28·0 (26·3 to 30·3)	41·2 (39·1 to 43·4)	16·5 (13·4 to 19·4)*	3·3 (1·3 to 5·5)*	13·2 (10·7 to 15·6)*	1·97 (1·56 to 2·31)*	1·27 (0·46 to 2·03)*	2·41 (1·93 to 2·85)*
Nepal	21·0 (18·1 to 24·1)	26·5 (23·7 to 29·4)	40·0 (36·5 to 44·4)	19·1 (14·6 to 23·9)*	5·5 (2·5 to 8·5)*	13·6 (10·0 to 17·6)*	2·49 (1·90 to 3·14)*	2·33 (1·05 to 3·69)*	2·59 (1·94 to 3·31)*
Pakistan	26·8 (24·0 to 30·0)	27·4 (24·9 to 30·5)	37·6 (33·7 to 41·9)	10·8 (6·1 to 15·5)*	0·6 (–2·4 to 3·5)	10·2 (5·7 to 14·6)*	1·30 (0·73 to 1·86)*	0·22 (–0·86 to 1·32)	1·98 (1·11 to 2·77)*
Sub–Saharan Africa†	19·6 (18·2 to 21·1)	22·3 (20·9 to 23·8)	31·9 (30·5 to 33·7)	12·3 (10·5 to 14·1)*	2·7 (1·4 to 4·1)*	9·6 (8·0 to 11·3)*	1·88 (1·58 to 2·17)*	1·30 (0·65 to 1·96)*	2·24 (1·85 to 2·65)*
Central sub–Saharan Africa	19·6 (16·6 to 22·9)	20·6 (17·4 to 24·2)	29·2 (25·8 to 32·7)	9·7 (6·0 to 13·1)*	1·1 (–1·7 to 3·8)	8·6 (5·2 to 11·8)*	1·55 (0·96 to 2·19)*	0·54 (–0·86 to 1·87)	2·18 (1·26 to 3·11)*
Angola	18·4 (12·7 to 24·4)	20·6 (14·2 to 27·2)	33·4 (25·5 to 40·4)	14·9 (7·2 to 22·6)*	2·2 (–2·6 to 6·9)	12·8 (6·1 to 19·7)*	2·31 (1·09 to 3·64)*	1·11 (–1·26 to 3·57)	3·06 (1·34 to 4·95)*
Central African Republic	15·8 (12·7 to 19·6)	16·1 (11·2 to 22·1)	18·6 (13·1 to 24·4)	2·7 (–3·2 to 8·9)	0·3 (–4·7 to 5·4)	2·4 (–3·6 to 8·6)	0·59 (–0·80 to 1·85)	0·10 (–3·25 to 2·99)	0·89 (–1·33 to 3·19)
Congo (Brazzaville)	21·0 (17·0 to 25·1)	21·9 (18·0 to 25·9)	34·1 (28·4 to 40·4)	13·0 (6·7 to 20·0)*	0·8 (–3·3 to 5·2)	12·2 (6·4 to 18·6)*	1·86 (0·96 to 2·84)*	0·40 (–1·49 to 2·44)	2·77 (1·49 to 4·19)*
Democratic Republic of the Congo	21·7 (17·6 to 26·4)	22·1 (17·5 to 27·0)	29·6 (25·7 to 33·7)	7·9 (2·8 to 12·7)*	0·4 (–3·6 to 4·4)	7·5 (2·9 to 11·7)*	1·21 (0·44 to 2·00)*	0·19 (–1·59 to 1·98)	1·85 (0·69 to 2·94)*
Equatorial Guinea	13·9 (8·9 to 19·3)	25·7 (18·7 to 34·1)	49·3 (38·3 to 62·0)	35·4 (24·4 to 47·7)*	11·8 (6·1 to 18·5)*	23·6 (13·3 to 33·8)*	4·90 (3·41 to 6·58)*	6·18 (3·18 to 9·59)*	4·11 (2·43 to 5·84)*
Gabon	27·7 (24·2 to 31·4)	28·6 (24·5 to 32·9)	40·4 (35·0 to 46·1)	12·7 (6·6 to 18·9)*	0·9 (–3·7 to 5·4)	11·8 (5·4 to 17·9)*	1·45 (0·76 to 2·13)*	0·30 (–1·35 to 1·87)	2·17 (1·01 to 3·30)*
Eastern sub–Saharan Africa	15·0 (13·3 to 16·8)	18·8 (17·0 to 20·6)	29·2 (27·3 to 31·3)	14·2 (11·9 to 16·4)*	3·7 (1·9 to 5·5)*	10·5 (8·4 to 12·5)*	2·56 (2·11 to 3·03)*	2·22 (1·12 to 3·31)*	2·77 (2·18 to 3·34)*
Burundi	14·3 (10·7 to 18·2)	17·7 (14·2 to 21·3)	27·4 (23·1 to 32·1)	13·1 (7·3 to 18·2)*	3·4 (–0·8 to 7·5)	9·7 (4·6 to 14·5)*	2·52 (1·40 to 3·70)*	2·19 (–0·51 to 4·93)	2·73 (1·29 to 4·14)*
Comoros	19·4 (16·1 to 23·1)	23·4 (20·3 to 26·4)	33·0 (29·5 to 36·7)	13·6 (8·5 to 18·2)*	3·9 (0·5 to 7·4)*	9·6 (5·6 to 13·7)*	2·05 (1·24 to 2·82)*	1·87 (0·20 to 3·57)*	2·16 (1·25 to 3·06)*
Djibouti	23·1 (20·2 to 26·6)	24·3 (19·8 to 30·0)	35·0 (29·7 to 42·0)	11·8 (5·8 to 19·1)*	1·1 (–3·5 to 6·3)	10·7 (5·6 to 15·9)*	1·58 (0·78 to 2·41)*	0·45 (–1·58 to 2·47)	2·29 (1·22 to 3·43)*
Eritrea	12·2 (9·2 to 15·6)	20·7 (17·3 to 24·3)	27·6 (23·7 to 31·3)	15·4 (10·7 to 19·9)*	8·5 (5·1 to 12·1)*	6·9 (2·8 to 10·8)*	3·16 (2·12 to 4·28)*	5·33 (3·13 to 7·94)*	1·81 (0·71 to 2·89)*
Ethiopia	10·6 (7·8 to 14·1)	14·0 (11·1 to 17·3)	28·1 (24·3 to 32·2)	17·5 (12·2 to 22·1)*	3·5 (–0·5 to 7·2)	14·1 (9·3 to 18·9)*	3·79 (2·53 to 5·04)*	2·88 (–0·38 to 6·12)	4·36 (2·85 to 6·01)*
Kenya	32·4 (27·6 to 37·4)	32·3 (28·0 to 36·8)	39·5 (35·0 to 43·9)	7·1 (3·3 to 11·0)*	–0·1 (–3·1 to 2·6)	7·2 (4·2 to 10·2)*	0·76 (0·33 to 1·20)*	–0·03 (–0·96 to 0·82)	1·26 (0·73 to 1·81)*
Madagascar	20·6 (18·0 to 23·2)	23·8 (21·0 to 26·9)	29·6 (24·3 to 35·1)	9·0 (3·5 to 15·0)*	3·3 (0·1 to 6·6)*	5·8 (–0·1 to 11·6)	1·39 (0·57 to 2·23)*	1·47 (0·05 to 2·94)*	1·34 (–0·02 to 2·61)
Malawi	19·0 (13·9 to 25·5)	21·5 (14·8 to 31·9)	32·2 (26·9 to 38·2)	13·2 (6·3 to 20·1)*	2·5 (–2·7 to 8·9)	10·7 (1·0 to 19·3)*	2·06 (0·96 to 3·30)*	1·15 (–1·45 to 3·95)	2·63 (0·19 to 5·04)*
Mozambique	13·8 (11·0 to 17·0)	21·1 (15·9 to 28·1)	30·0 (25·3 to 35·0)	16·3 (11·2 to 21·4)*	7·3 (2·2 to 13·6)*	9·0 (2·0 to 15·2)*	3·01 (2·10 to 3·93)*	4·19 (1·50 to 7·25)*	2·27 (0·45 to 4·02)*
Rwanda	16·7 (13·0 to 20·8)	18·6 (14·4 to 22·8)	36·0 (31·6 to 40·5)	19·2 (14·1 to 24·1)*	1·8 (–2·1 to 5·6)	17·4 (12·1 to 22·7)*	2·96 (2·06 to 3·90)*	1·05 (–1·22 to 3·27)	4·16 (2·77 to 5·75)*
Somalia	12·8 (8·2 to 18·3)	13·5 (9·1 to 19·1)	19·0 (14·3 to 23·7)	6·2 (0·6 to 11·1)*	0·7 (–2·8 to 3·7)	5·5 (0·5 to 9·8)*	1·56 (0·13 to 3·01)*	0·56 (–2·17 to 3·03)	2·19 (0·19 to 4·19)*
South Sudan	22·0 (16·8 to 28·9)	23·6 (17·4 to 30·7)	26·8 (21·0 to 33·1)	4·9 (–2·0 to 11·2)	1·6 (–3·4 to 6·6)	3·3 (–2·7 to 9·0)	0·78 (–0·31 to 1·81)	0·69 (–1·51 to 2·87)	0·84 (–0·66 to 2·31)
Tanzania	21·9 (18·7 to 25·5)	24·7 (20·5 to 30·1)	33·9 (30·0 to 38·4)	11·9 (7·3 to 16·6)*	2·7 (–1·5 to 7·4)	9·2 (4·1 to 14·3)*	1·67 (1·01 to 2·35)*	1·15 (–0·68 to 2·99)	2·00 (0·83 to 3·19)*
Uganda	19·3 (15·6 to 23·5)	23·7 (20·0 to 27·7)	31·4 (27·2 to 35·6)	12·1 (7·2 to 16·8)*	4·4 (0·5 to 8·4)*	7·8 (3·2 to 12·4)*	1·89 (1·11 to 2·70)*	2·06 (0·25 to 3·95)*	1·78 (0·73 to 2·88)*
Zambia	21·9 (17·6 to 27·2)	17·2 (13·0 to 22·7)	29·0 (23·0 to 35·4)	7·1 (0·4 to 14·8)*	–4·7 (–9·2 to 0·3)	11·7 (5·0 to 19·1)*	1·08 (0·07 to 2·22)*	–2·44 (–4·83 to 0·13)	3·28 (1·32 to 5·30)*

(Table 2 continues on next page)

	HAQ Index (95% UI)			Absolute change (95% UI)			Annualised rate of change (95% UI)		
	1990	2000	2016	1990–2016	1990–2000	2000–16	1990–2016	1990–2000	2000–16
(Continued from previous page)									
Southern sub–Saharan Africa	38·2 (36·3 to 40·4)	37·8 (34·8 to 40·6)	44·7 (42·4 to 47·0)	6·5 (3·8 to 9·1)*	−0·4 (−3·0 to 2·2)	7·0 (3·8 to 10·1)*	0·61 (0·34 to 0·84)*	−0·11 (−0·81 to 0·55)	1·06 (0·58 to 1·56)*
Botswana	36·5 (30·6 to 43·0)	39·7 (22·3 to 55·7)	51·5 (40·8 to 69·2)	15·0 (3·5 to 32·8)*	3·2 (−11·5 to 17·2)	11·8 (−8·6 to 34·7)	1·31 (0·32 to 2·57)*	0·54 (−4·08 to 3·84)	1·79 (−1·07 to 5·36)
Lesotho	30·3 (25·9 to 35·5)	29·2 (23·0 to 38·0)	32·0 (24·6 to 40·3)	1·6 (−6·2 to 10·0)	−1·2 (−7·8 to 7·5)	2·8 (−6·1 to 12·2)	0·19 (−0·81 to 1·17)	−0·46 (−2·73 to 2·36)	0·59 (−1·18 to 2·52)
Namibia	27·5 (24·6 to 31·1)	32·2 (24·1 to 43·3)	44·6 (36·4 to 56·2)	17·1 (9·4 to 27·7)*	4·7 (−2·9 to 15·7)	12·4 (3·2 to 20·9)*	1·84 (1·14 to 2·71)*	1·45 (−1·08 to 4·60)	2·09 (0·49 to 3·62)*
South Africa	40·1 (38·0 to 42·3)	40·9 (38·2 to 43·8)	49·7 (47·2 to 52·4)	9·6 (6·6 to 12·7)*	0·8 (−2·3 to 3·9)	8·8 (5·4 to 12·1)*	0·83 (0·57 to 1·08)*	0·19 (−0·56 to 0·95)	1·23 (0·75 to 1·70)*
Swaziland	32·0 (27·3 to 37·0)	34·4 (22·6 to 43·6)	40·5 (30·4 to 52·2)	8·5 (−1·2 to 18·4)	2·4 (−11·1 to 13·5)	6·1 (−9·6 to 20·6)	0·88 (−0·14 to 1·78)	0·59 (−3·91 to 3·86)	1·06 (−1·64 to 3·73)
Zimbabwe	37·3 (31·2 to 48·0)	31·4 (22·6 to 39·7)	31·2 (25·8 to 37·0)	−6·1 (−17·7 to 1·0)	−5·9 (−12·0 to 0·0)	−0·2 (−9·5 to 9·2)	−0·68 (−1·81 to 0·11)	−1·81 (−3·80 to 0·01)	0·02 (−1·79 to 2·04)
Western sub–Saharan Africa	22·4 (20·3 to 24·4)	24·8 (22·4 to 27·2)	34·3 (31·9 to 36·7)	11·9 (9·2 to 14·6)*	2·4 (0·1 to 4·9)*	9·5 (6·5 to 12·6)*	1·64 (1·26 to 2·04)*	1·03 (0·05 to 2·04)*	2·02 (1·35 to 2·74)*
Benin	19·7 (16·9 to 22·7)	22·7 (19·7 to 26·0)	30·8 (27·8 to 34·0)	11·2 (7·2 to 15·2)*	3·1 (−0·1 to 6·4)	8·1 (4·3 to 11·9)*	1·74 (1·09 to 2·38)*	1·45 (−0·06 to 3·08)	1·92 (0·98 to 2·82)*
Burkina Faso	16·4 (13·4 to 20·3)	21·9 (18·7 to 25·6)	30·1 (27·0 to 33·3)	13·7 (9·2 to 17·6)*	5·6 (2·1 to 9·0)*	8·2 (4·2 to 12·1)*	2·36 (1·46 to 3·10)*	2·96 (1·07 to 4·76)*	1·99 (0·99 to 3·02)*
Cameroon	23·4 (20·6 to 26·8)	23·8 (19·7 to 28·1)	31·9 (26·9 to 37·5)	8·5 (3·3 to 14·3)*	0·4 (−3·8 to 4·5)	8·2 (2·9 to 13·3)*	1·19 (0·49 to 1·92)*	0·13 (−1·73 to 1·88)	1·85 (0·69 to 3·00)*
Cape Verde	38·1 (35·4 to 41·2)	41·4 (37·0 to 46·1)	54·8 (51·2 to 58·9)	16·7 (12·5 to 21·2)*	3·3 (−1·3 to 7·8)	13·4 (7·6 to 19·5)*	1·40 (1·03 to 1·76)*	0·81 (−0·34 to 1·91)	1·76 (0·99 to 2·61)*
Chad	18·3 (15·6 to 21·4)	18·2 (15·3 to 21·5)	25·4 (21·9 to 29·0)	7·1 (2·8 to 11·6)*	−0·1 (−3·5 to 3·3)	7·2 (3·2 to 11·1)*	1·27 (0·49 to 2·05)*	−0·05 (−1·92 to 1·81)	2·09 (0·93 to 3·27)*
Côte d'Ivoire	19·9 (17·3 to 22·6)	20·7 (17·1 to 24·3)	27·3 (24·2 to 31·1)	7·5 (3·3 to 11·1)*	0·8 (−2·5 to 4·3)	6·7 (2·5 to 10·8)*	1·23 (0·56 to 1·83)*	0·37 (−1·29 to 2·05)	1·76 (0·61 to 2·95)*
Ghana	25·6 (22·5 to 28·9)	29·6 (26·2 to 33·5)	39·3 (36·0 to 43·4)	13·6 (9·1 to 18·4)*	4·0 (0·1 to 8·0)*	9·7 (5·1 to 14·1)*	1·64 (1·08 to 2·25)*	1·45 (0·04 to 2·82)*	1·77 (0·93 to 2·62)*
Guinea	17·1 (14·3 to 20·3)	20·1 (17·2 to 23·0)	26·4 (22·6 to 30·2)	9·2 (4·5 to 14·2)*	2·9 (−0·6 to 6·3)	6·3 (2·2 to 10·8)*	1·66 (0·80 to 2·54)*	1·58 (−0·31 to 3·49)	1·71 (0·62 to 2·85)*
Guinea–Bissau	12·8 (10·0 to 16·0)	15·7 (12·7 to 19·0)	23·4 (20·2 to 26·8)	10·6 (5·9 to 14·9)*	2·9 (−0·6 to 6·7)	7·7 (3·6 to 11·9)*	2·34 (1·25 to 3·36)*	2·03 (−0·40 to 4·67)	2·53 (1·17 to 3·97)*
Liberia	20·5 (17·6 to 23·6)	23·2 (19·8 to 26·8)	32·2 (29·3 to 35·4)	11·7 (8·0 to 15·5)*	2·8 (−0·7 to 6·6)	8·9 (4·9 to 13·0)*	1·74 (1·15 to 2·36)*	1·26 (−0·31 to 2·98)	2·04 (1·09 to 3·07)*
Mali	16·7 (13·7 to 20·5)	23·7 (20·4 to 27·2)	34·9 (29·9 to 40·1)	18·2 (12·6 to 23·8)*	7·0 (2·9 to 10·6)*	11·2 (5·8 to 16·7)*	2·85 (1·97 to 3·68)*	3·53 (1·38 to 5·44)*	2·43 (1·30 to 3·59)*
Mauritania	24·0 (20·8 to 27·5)	29·7 (25·9 to 36·2)	40·6 (35·0 to 47·5)	16·6 (10·7 to 23·7)*	5·7 (1·8 to 11·5)*	10·9 (4·9 to 17·2)*	2·02 (1·35 to 2·70)*	2·13 (0·68 to 3·91)*	1·95 (0·86 to 2·98)*
Niger	15·6 (12·6 to 19·3)	19·1 (16·0 to 22·3)	28·4 (23·9 to 33·1)	12·8 (7·2 to 18·1)*	3·5 (−0·1 to 7·4)	9·3 (3·8 to 14·7)*	2·30 (1·27 to 3·24)*	2·02 (−0·06 to 4·21)	2·48 (1·06 to 3·87)*
Nigeria	27·5 (23·4 to 31·6)	29·8 (24·9 to 35·3)	41·9 (37·2 to 47·3)	14·4 (8·7 to 20·4)*	2·3 (−2·6 to 7·7)	12·1 (5·5 to 19·0)*	1·62 (0·97 to 2·35)*	0·80 (−0·92 to 2·66)	2·14 (0·93 to 3·38)*
São Tomé and Principe	25·9 (22·4 to 29·7)	30·0 (25·7 to 40·5)	39·3 (34·9 to 44·4)	13·4 (8·2 to 19·2)*	4·2 (−0·1 to 13·3)	9·3 (−0·4 to 14·9)	1·61 (0·97 to 2·28)*	1·46 (−0·05 to 4·06)	1·71 (−0·06 to 2·74)
Senegal	22·4 (19·8 to 25·1)	24·5 (22·0 to 27·3)	31·1 (28·3 to 33·8)	8·6 (5·3 to 11·9)*	2·0 (−0·8 to 5·1)	6·6 (3·4 to 9·7)*	1·26 (0·75 to 1·77)*	0·87 (−0·33 to 2·21)	1·49 (0·73 to 2·21)*
Sierra Leone	20·8 (17·4 to 24·6)	22·1 (19·0 to 25·5)	31·0 (27·4 to 34·5)	10·1 (5·7 to 14·5)*	1·3 (−2·0 to 4·6)	8·8 (4·3 to 12·8)*	1·53 (0·84 to 2·22)*	0·60 (−0·94 to 2·25)	2·11 (1·05 to 3·10)*
The Gambia	27·4 (23·9 to 30·9)	29·9 (26·5 to 33·4)	35·7 (32·3 to 39·3)	8·3 (4·1 to 12·9)*	2·5 (−0·7 to 5·6)	5·8 (1·9 to 9·6)*	1·02 (0·50 to 1·58)*	0·87 (−0·24 to 2·02)	1·12 (0·38 to 1·82)*
Togo	21·7 (19·0 to 24·5)	23·0 (19·1 to 27·9)	32·0 (28·7 to 35·6)	10·2 (6·3 to 14·3)*	1·2 (−3·0 to 6·0)	9·0 (4·0 to 13·6)*	1·48 (0·89 to 2·09)*	0·52 (−1·46 to 2·53)	2·09 (0·85 to 3·24)*

HAQ Index=Healthcare Access and Quality Index. UI=uncertainty interval. *Significant change during this time period. †Refers to Global Burden of Disease super region.

Table 2: **Global, regional, and national or territory estimates of the HAQ Index for 1990, 2000, and 2016, and absolute change and annualised rates of change for 1990–2016, 1990–2000, and 2000–16**

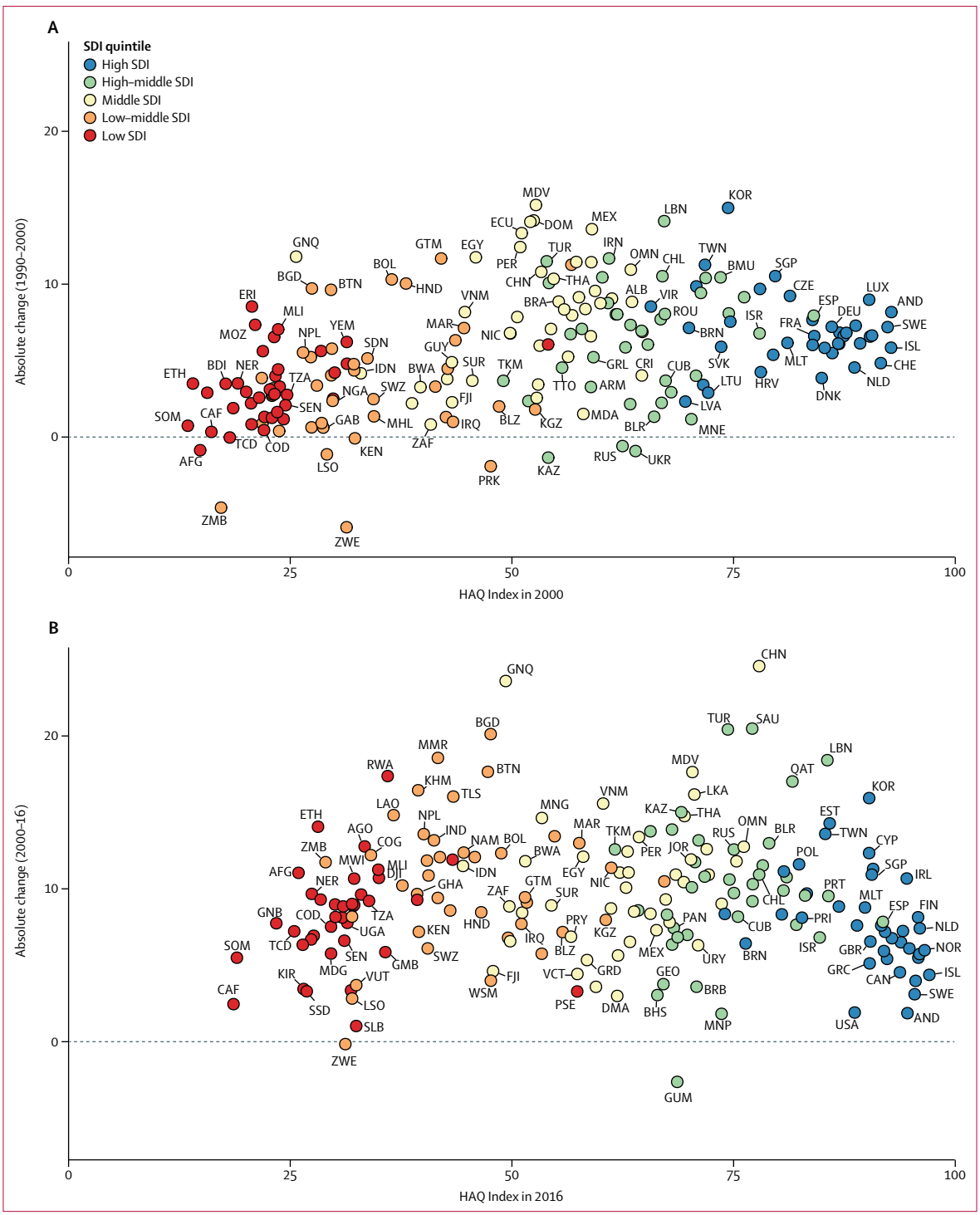


Figure 5: **Absolute change on the HAQ Index, by SDI quintile, 1990–2000 (A) and 2000–16 (B)**
Countries and territories are colour-coded by their SDI quintile, and are abbreviated according to their ISO3 codes, which are listed in the appendix (pp 90–95). HAQ Index=Healthcare Access and Quality Index. SDI=Socio-demographic Index.

linked to the country's widely acknowledged challenges in providing good health-care access to all populations,[13,47] and disparities in the quality of care found in its poorer regions.[13] As future iterations of GBD endeavour to support subnational burden of disease assessments for more countries, we aim to expand locally focused monitoring of health-care access and quality in tandem.

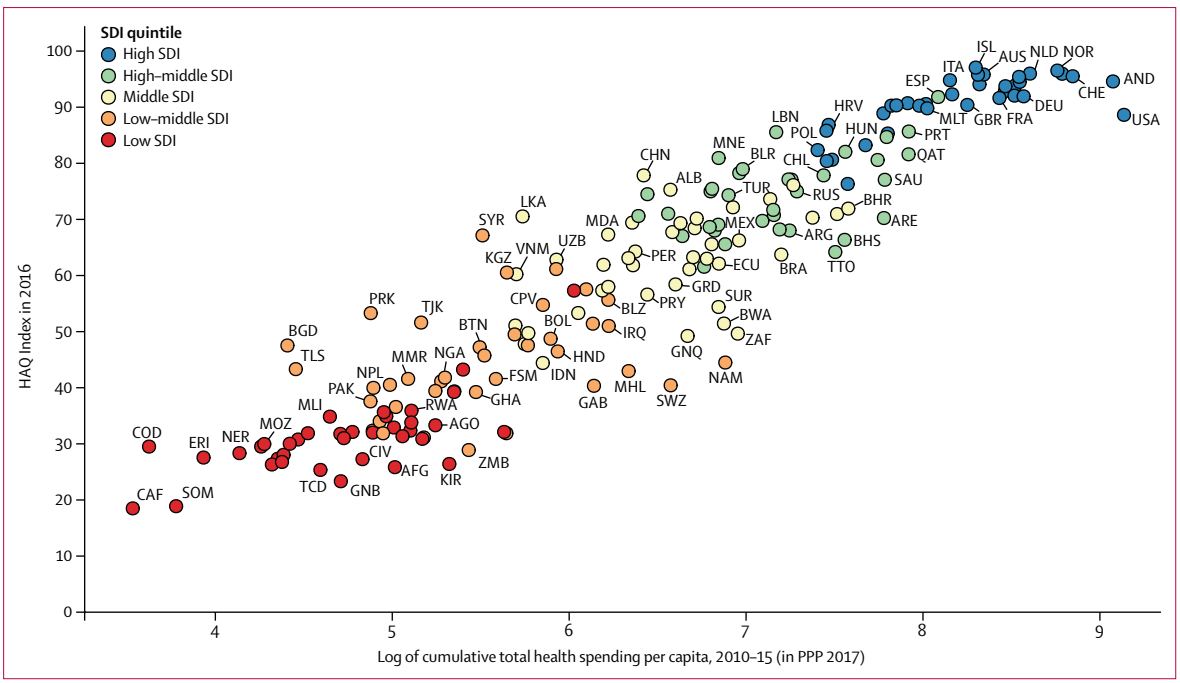


Figure 6: **Comparing the HAQ Index in 2016 to the log of cumulative total health spending per capita, 2010–15**
Total health spending per capita is based on the cumulative per capita spending from 2010 to 2015 in purchasing power parity (PPP) for 2017. Countries and territories are colour-coded by their SDI quintile, and are abbreviated according to their ISO3 codes, which are listed in the appendix (pp 90–95). HAQ Index=Healthcare Access and Quality Index. SDI=Socio-demographic Index.

Pace of past progress and strengthening health systems for the next generation

Current HAQ Index estimates represent the culmination of past health-care policy actions, and thus offer an important entry point for strengthening health systems for the future. Recent demographic and epidemiological trends point to populations living longer and with higher disease burden worldwide,[48] portending an escalation of health-care challenges if countries cannot more expediently shift their models of care away from reactive service delivery and toward more proactive continuums of care. Such action must be accompanied by efforts to further bolster public health programmes and policies, targeting risk factors and socioeconomic factors that are less directly amenable to health care but remain leading contributors to preventable disease burden (eg, smoking).[16]

Historically, global health priorities centred on a subset of health services (ie, vaccine-preventable diseases, infectious diseases, and maternal and child health), which was particularly true during the Millennium Development Goal (MDG) era. Successes in scaling up vaccine coverage, early diagnosis and treatment of infectious disease (eg, antibiotics for lower respiratory infections), and improving access to and quality of maternal care and delivery are illustrated by accelerated HAQ Index performance for many low-to-middle SDI countries from 2000 to 2016. The exact drivers of these improvements vary by context (eg, Timor-Leste emerged from years of conflict in the late 1990s; political strife and HIV devastated health systems throughout sub-Saharan Africa during the 1990s and early 2000s), but some combination of domestic policy action and increased development assistance for health might have hastened progress in many countries.[49]

In parallel, poor access to or quality of non-communicable disease-focused risk management and treatment could explain slower gains or minimal advances for these causes in many countries, a warning sign that health systems are not evolving at the same rate as changing population health needs. For non-communicable diseases, there was a strong divide in performance among high-SDI countries and low-to-middle SDI locations, potentially reflecting inadequate investments in advancing non-communicable disease services across continuums of care, integrating care across health areas, or some combination of both. The importance of, and potential for, improving non-communicable disease prevention and treatment is shown by trends from eastern Europe and central Asia,[50,51] where several countries saw substantive HAQ Index gains from 2000 to 2016 after stagnation or worsening performance during the 1990s.

Gains made against vaccine-preventable diseases and other causes prioritised during the MDGs must be sustained going forward, but not at the expense of preparing health systems for the next generation. Amid shifting epidemiological profiles,[48] countries including China, Turkey, Vietnam, and Nepal recorded consistently sizeable rates of progress on the HAQ Index from

1990 to 2000, and 2000 to 2016. Such trends could reflect several factors (eg, health system structures, governance functions, health insurance expansion),[52–55] but also could represent successes in re-orienting and integrating services to accommodate evolving health-care needs.[56]

Finally, some countries did not experience such catalytic effects during the MDGs and are at risk of falling further behind in the SDG era. These locations include the Central African Republic, Somalia, and South Sudan, which consistently recorded among the lowest HAQ Index scores over time; and Zimbabwe and Lesotho, countries that have struggled to recover from faltering performance during the 1990s and early 2000s. Again, the precise factors underlying these countries' challenges are multifaceted, but commonalities include prolonged conflict, widespread poverty, and comparatively low levels of development assistance for health from development partners.[39]

Progress towards universal health coverage

Providing access to quality health care is a key component of universal health coverage, and the HAQ Index offers a robust metric for monitoring progress across health service areas. This strength is particularly important since achieving universal health coverage is an objective for countries across the development spectrum, and thus comparable measures are needed for benchmarking progress and identifying specific health areas for policy action.[57] For instance, gains in performance on neonatal disorders generally lagged behind those of maternal disorders in many low-to-middle SDI countries, which suggests that greater investment across the continuum of care, from antenatal services to neonatal intensive care units, might support faster progress.[58] Access to quality health care is necessary but far from sufficient for achieving universal health coverage, which also requires provision of care without financial hardship and encompasses services that do not explicitly avert death or fully treat specific health conditions (eg, family planning services, palliative care).[59,60] Substantial debate exists around the effects of national insurance schemes and government health spending on improving access to high-quality health care and overall universal health coverage. Our exploratory analyses point to positive, albeit heterogeneous, relationships between total and government health spending and national HAQ Index scores. These results highlight the importance of dedicated financing for improving health-care access and quality, but also indicate that increased health financing alone is not adequate. Instead, how well health spending translates into heightened access to quality health care is probably shaped by many factors,[61] including health system governance,[2] efficiencies with which financial and health-care resources are dispersed,[62] and relative distributions of health system inputs across service areas and subnational locations.[63] Future work should assess the potential effect of improvements across these dimensions on advances in health-care access and quality.

Future directions for measuring health-care access and quality

With its annual cycle, the GBD study supports ongoing methodological and conceptual improvements for measuring personal health-care access and quality. One priority area, which has been extensively debated, is determining how to best update the amenable cause list, both for fatal and non-fatal outcomes. One approach would entail a systematic review of GBD causes to identify intervention effectiveness by cause and then empirically establish thresholds at which health care significantly improves defined outcomes. Another approach could be to establish key health service areas to be represented by the HAQ Index and then selecting a set of amenable outcomes, fatal and non-fatal, to characterise each health area.[57] The Nolte and McKee list of causes[6–9] includes a range of important areas, but how well performance in these high-priority areas reflects performance in others (eg, vision and hearing, trauma services) is not clear.

Using MIRs for cancers instead of risk-standardised death rates provided an improved indicator of country-level differences in access to effective cancer care. The quantity and quality of cancer-registry data in GBD 2016 supported our use of cancer MIRs, but broader MIR use might be limited by the sparsity of data and methodological demands (eg, reconciling long lag times between disease detection and death from causes like diabetes). Future iterations should consider whether and how to expand the application of MIRs to more GBD causes, particularly those where disease-specific registries or surveillance exist (eg, renal registries). Revisiting age dimensions related to amenable mortality is also warranted, because the current limit of 74 years, as defined by Nolte and McKee,[6–9] for most causes might not fully represent the potential of health care to avert death after that age. However, whether age-group bounds should be determined by changes in life expectancy or age-specific improvements in survival, or demarcated by cause-specific advances in reducing mortality by age group is not immediately clear. Relatedly, age-specific HAQ Index analyses might provide a better understanding of how health-care access and quality varies across the lifespan. Such work could shed light on how well health systems are responding to broader demographic shifts and population ageing.[64,65]

Future work also should seek to disentangle the effects of access from quality on HAQ Index performance. We found that the HAQ Index was strongly correlated with total health spending, but it is not clear how more spending on health culminates in improved access (eg, investments in health-care infrastructure, financing national insurance schemes) versus quality (eg, funding training in effective medical care, purchase and maintenance of functional medical supplies). Further, the relative effect of improved access to, as compared with quality of, health care could vary by therapeutic area and the optimal levels of care. For instance, good access to hospitals with skilled medical personnel and functional surgical equipment without

corresponding access to high-quality primary care could have more negative ramifications for vaccine-preventable diseases than for conditions mainly addressed by surgery. Strengthening the overall continuum of care,[66] by and across health areas, also warrants prioritisation, since efforts to better align primary and specialty care could enhance both patient outcomes and systems efficiency.

Going forward, we aim to incorporate improvements in measuring health-care access and quality into more comprehensive assessments of health system performance. Expanding HAQ Index estimation to subnational locations directly supports this endeavour, and ongoing work to quantify human resources for health and financial risk protection within the broader GBD study support the assessment of other health system domains. Quantifying inequalities in health system responsiveness requires additional attention if the World Health Report 2000 framework is to be replicated,[1] emphasising the need to better parse out the effects of improving quality of care versus access. Additionally, combining the HAQ Index with measures that reflect the effect of interventions on risk factors modifiable by public health programmes (eg, child growth failure) could provide a better assessment of overarching health-system action. Finally, substantial interest exists in translating HAQ Index scores into coverage of populations or number of people with access to quality health services. Multiplying HAQ Index values by population could approximate this (ie, the 0–100 scale approximates 0–100%), and the strong correlation between PCA-derived HAQ Index scores and the arithmetic mean of its component parts (r=0·99; appendix p 153) suggests that results might not be overly sensitive to index construction methods.

Comparison with GBD 2015 assessment of personal health-care access and quality

Compared with GBD 2015,[20] GBD 2016 HAQ Index scores are slightly higher for high-SDI countries and lower for low-to-middle SDI countries, whereas changes in overall rankings followed less consistent SDI patterns (appendix pp 154–55). Although individual country-level changes might represent several factors (eg, availability of new vital registration data, improved cause-specific modelling), the use of MIRs for cancers, and thus their increased contribution to overall HAQ Index scores, was a main contributor. In GBD 2015, many lower-SDI countries received relatively high scores for cancers,[20] whereas conditionalising cancer mortality on incidence resulted in a distinct SDI gradient (appendix p 96–111). Subsequently, we view these results as substantially improved since GBD 2015.

Limitations

Our analysis is subject to limitations beyond those already described. First, any limitations in GBD 2016 cause-of-death estimation are also applicable to this study.[27] For GBD 2016, we aimed to better account for cause-of-death data quality by developing a metric for well-certified deaths and using this measure to inform GBD data standardisation and correction processes. Nonetheless, establishing and maintaining high-quality vital registration systems is essential to improved cause-of-death estimation. For instance, abrupt or prolonged conflict can lead to cause-of-death data gaps or lags in reporting; subsequently, HAQ Index performance might not yet fully capture the ramifications of conflict on health care in some locations. Second, continued updates to the GBD comparative risk assessment improved risk-standardisation of amenable causes, but we might not account for all possible differences in mortality related to underlying risk exposure. Third, our scaling approach (ie, transforming each cause to a scale of 0–100) does not allow for the potential for additional improvements in reducing cause-specific mortality. How to establish empirically-derived lower bounds for each cause remains unclear, but future work should consider the use of alternative scaling methods. Fourth, the HAQ Index does not expressly capture possible effects of personal health care on causes without substantial mortality. Although performance on these causes might be well correlated with the current HAQ Index formulation, their inclusion could strengthen overall measurement. Fifth, the HAQ Index does not explicitly distinguish between the effects of primary and secondary care,[66] though some causes might give a stronger signal on certain health-system dimensions (eg, surgical intervention for appendicitis). Improved performance in particular therapeutic areas might represent a combination of advances in primary care (eg, diagnosis and treatment of hypertension) and secondary or referral services (eg, stroke unit, cardiology), or overall gains in continuums of care. Finally, our exploratory analysis of HAQ Index performance did not account for all potential factors related to health-care access and quality; future work should consider how other dimensions of health financing and health care are associated with the HAQ Index (eg, catastrophic health spending, insurance coverage), as well as broader social determinants of health (eg, poverty, accessibility).[67]

Conclusions

The global ambition towards universal health coverage by 2030 necessitates ensuring that all populations have good access to quality health services. Progress is possible, as shown by accelerated gains on the HAQ Index for many low-SDI countries during the MDG era. However, such advances are not inevitable, as underscored by slowed improvements in several countries and for non-communicable diseases that are best targeted by quality services coordinated across continuums of care. Large geographical inequalities persist across and within countries, highlighting an urgent need for policy attention toward places at risk of being left behind. Current performance represents action from the past, and thus the pace of progress could accelerate for many

middle-to-low SDI countries if recent investments can be translated into health-care gains. To strengthen and deliver health systems for the next generation, national and international health agencies alike must focus on improving health-care access and quality across health service areas and reaffirm their commitment to accelerating progress for the world's poorest populations.

GBD 2016 Healthcare Access and Quality Collaborators

Nancy Fullman, Jamal Yearwood, Solomon M Abay, Cristiana Abbafati, Foad Abd-Allah, Jemal Abdela, Ahmed Abdelalim, Zegeye Abebe, Teshome Abuka Abebo, Victor Aboyans, Haftom Niguse Abraha, Daisy M X Abreu, Laith J Abu-Raddad, Akilew Awoke Adane, Rufus Adesoji Adedoyin, Olatunji Adetokunboh, Tara Ballav Adhikari, Mohsen Afarideh, Ashkan Afshin, Gina Agarwal, Dominic Agius, Anurag Agrawal, Sutapa Agrawal, Aliasghar Ahmad Kiadaliri, Miloud Taki Eddine Aichour, Mohammed Akibu, Rufus Olusola Akinyemi, Tomi F Akinyemiju, Nadia Akseer, Faris Hasan Al Lami, Fares Alahdab, Ziyad Al-Aly, Khurshid Alam, Tahiya Alam, Deena Alasfoor, Mohammed I Albittar, Kefyalew Addis Alene, Ayman Al-Eyadhy, Syed Danish Ali, Mehran Alijanzadeh, Syed M Aljunid, Ala'a Alkerwi, François Alla, Peter Allebeck, Christine Allen, Mahmoud A Alomari, Rajaa Al-Raddadi, Ubai Alsharif, Khalid A Altirkawi, Nelson Alvis-Guzman, Azmeraw T Amare, Kebede Amenu, Walid Ammar, Yaw Ampem Amoako, Nahla Anber, Catalina Liliana Andrei, Sofia Androudi, Carl Abelardo T Antonio, Valdelaine E M Araújo, Olatunde Aremu, Johan Ärnlöv, Al Artaman, Krishna Kumar Aryal, Hamid Asayesh, Ephrem Tsegay Asfaw, Solomon Weldegebreal Asgedom, Rana Jawad Asghar, Mengistu Mitiku Ashebir, Netsanet Abera Asseffa, Tesfay Mehari Atey, Sachin R Atre, Madhu S Atteraya, Leticia Avila-Burgos, Euripide Frinel G Arthur Avokpaho, Ashish Awasthi, Beatriz Paulina Ayala Quintanilla, Animut Alebel Ayalew, Henok Tadesse Ayele, Rakesh Ayer, Tambe Betrand Ayuk, Peter Azzopardi, Natasha Azzopardi-Muscat, Tesleem Kayode Babalola, Hamid Badali, Alaa Badawi, Maciej Banach, Amitava Banerjee, Amrit Banstola, Ryan M Barber, Miguel A Barboza, Suzanne L Barker-Collo, Till Bärnighausen, Simon Barquera, Lope H Barrero, Quique Bassat, Sanjay Basu, Bernhard T Baune, Shahrzad Bazargan-Hejazi, Neeraj Bedi, Ettore Beghi, Masoud Behzadifar, Meysam Behzadifar, Bayu Begashaw Bekele, Abate Bekele Belachew, Saba Abraham Belay, Yihalem Abebe Belay, Michelle L Bell, Aminu K Bello, Derrick A Bennett, James R Bennett, Isabela M Bensenor, Derbew Fikadu Berhe, Eduardo Bernabé, Robert Steven Bernstein, Mircea Beuran, Ashish Bhalla, Paurvi Bhatt, Soumyadeep Bhaumik, Zulfiqar A Bhutta, Belete Biadgo, Ali Bijani, Boris Bikbov, Charles Birungi, Stan Biryukov, Hailemichael Bizuneh, Ian W Bolliger, Kaylin Bolt, Ibrahim R Bou-Orm, Kayvan Bozorgmehr, Oliver Jerome Brady, Alexandra Brazinova, Nicholas J K Breitborde, Hermann Brenner, Gabrielle Britton, Traolach S Brugha, Zahid A Butt, Lucero Cahuana-Hurtado, Ismael Ricardo Campos-Nonato, Julio Cesar Campuzano, Josip Car, Mate Car, Rosario Cárdenas, Juan Jesus Carrero, Felix Carvalho, Carlos A Castañeda-Orjuela, Jacqueline Castillo Rivas, Ferrán Catalá-López, Kelly Cercy, Julian Chalek, Hsing-Yi Chang, Jung-Chen Chang, Aparajita Chattopadhyay, Pankaj Chaturvedi, Peggy Pei-Chia Chiang, Vesper Hichilombwe Chisumpa, Jee-Young J Choi, Hanne Christensen, Devasahayam Jesudas Christopher, Sheng-Chia Chung, Liliana G Ciobanu, Massimo Cirillo, Danny Colombara, Sara Conti, Cyrus Cooper, Leslie Cornaby, Paolo Angelo Cortesi, Monica Cortinovis, Alexandre Costa Pereira, Ewerton Cousin, Michael H Criqui, Elizabeth A Cromwell, Christopher Stephen Crowe, John A Crump, Alemneh Kabeta Daba, Berihun Assefa Dachew, Abel Fekadu Dadi, Lalit Dandona, Rakhi Dandona, Paul I Dargan, Ahmad Daryani, Maryam Daryani, Jai Das, Siddharth Kumar Das, José das Neves, Nicole Davis Weaver, Kairat Davletov, Barbora de Courten, Diego De Leo, Jan-Walter De Neve, Robert P Dellavalle, Gebre Demoz, Kebede Deribe, Don C Des Jarlais, Subhojit Dey, Samath D Dharmaratne, Meghnath Dhimal, Shirin Djalalinia, David Teye Doku, Kate Dolan, E Ray Dorsey, Kadine Priscila Bender dos Santos, Kerrie E Doyle, Tim R Driscoll, Manisha Dubey, Eleonora Dubljanin, Bruce Bartholow Duncan, Michelle Echko, Dumessa Edessa, David Edvardsson, Joshua R Ehrlich, Erika Eldrenkamp, Ziad El-Khatib, Matthias Endres, Aman Yesuf Endries, Babak Eshrati, Sharareh Eskandarieh, Alireza Esteghamati, Mahdi Fakhar, Tamer Farag, Mahbobeh Faramarzi, Emerito Jose Aquino Faraon, André Faro, Farshad Farzadfar, Adesegun Fatusi, Mir Sohail Fazeli, Valery L Feigin, Andrea B Feigl, Netsanet Fentahun, Seyed-Mohammad Fereshtehnejad, Eduarda Fernandes, João C Fernandes, Daniel Obadare Fijabi, Irina Filip, Florian Fischer, Christina Fitzmaurice, Abraham D Flaxman, Luisa Sorio Flor, Nataliya Foigt, Kyle J Foreman, Joseph J Frostad, Thomas Fürst, Neal D Futran, Emmanuela Gakidou, Silvano Gallus, Ketevan Gambashidze, Amiran Gamkrelidze, Morsaleh Ganji, Abadi Kahsu Gebre, Tsegaye Tewelde Gebrehiwot, Amanuel Tesfay Gebremedhin, Yalemzewod Assefa Gelaw, Johanna M Geleijnse, Demeke Geremew, Peter W Gething, Reza Ghadimi, Khalil Ghasemi Falavarjani, Maryam Ghasemi-Kasman, Paramjit Singh Gill, Ababi Zergaw Giref, Maurice Giroud, Melkamu Dedefo Gishu, Giorgia Giussani, William W Godwin, Srinivas Goli, Hector Gomez-Dantes, Philimon N Gona, Amador Goodridge, Sameer Vali Gopalani, Yevgeniy Goryakin, Alessandra Carvalho Goulart, Ayman Grada, Max Griswold, Giuseppe Grosso, Harish Chander Gugnani, Yuming Guo, Rahul Gupta, Rajeev Gupta, Tanush Gupta, Tarun Gupta, Vipin Gupta, Juanita A Haagsma, Vladimir Hachinski, Nima Hafezi-Nejad, Gessessew Bugssa Hailu, Randah Ribhi Hamadeh, Samer Hamidi, Graeme J Hankey, Hilda L Harb, Heather C Harewood, Sivadasanpillai Harikrishnan, Josep Maria Haro, Hamid Yimam Hassen, Rasmus Havmoeller, Caitlin Hawley, Simon I Hay, Jiawei He, Stephen J C Hearps, Mohamed I Hegazy, Behzad Heibati, Mohsen Heidari, Delia Hendrie, Nathaniel J Henry, Victor Hugo Herrera Ballesteros, Claudiu Herteliu, Desalegn Tsegaw Hibstu, Molla Kahssay Hiluf, Hans W Hoek, Enayatollah Homaie Rad, Nobuyuki Horita, H Dean Hosgood, Mostafa Hosseini, Seyed Reza Hosseini, Mihaela Hostiuc, Sorin Hostiuc, Damian G Hoy, Mohamed Hsairi, Aung Soe Htet, Guoqing Hu, John J Huang, Kim Moesgaard Iburg, Fachmi Idris, Ehimario Uche Igumbor, Chad Ikeda, Bogdan Vasile Ileanu, Olayinka S Ilesanmi, Kaire Innos, Seyed Sina Naghibi Irvani, Caleb M S Irvine, Farhad Islami, Troy A Jacobs, Kathryn H Jacobsen, Nader Jahanmehr, Rajesh Jain, Sudhir Kumar Jain, Mihajlo M Jakovljevic, Moti Tolera Jalu, Amr A Jamal, Mehdi Javanbakht, Achala Upendra Jayatilleke, Panniyammakal Jeemon, Ravi Prakash Jha, Vivekanand Jha, Jacek Józwiak, Oommen John, Sarah Charlotte Johnson, Jost B Jonas, Vasna Joshua, Mikk Jürisson, Zubair Kabir, Rajendra Kadel, Amaha Kahsay, Rizwan Kalani, Chittaranjan Kar, Marina Karanikolos, André Karch, Corine Kakizi Karema, Seyed M Karimi, Amir Kasaeian, Dessalegn Haile Kassa, Getachew Mullu Kassa, Tesfaye Dessale Kassa, Nicholas J Kassebaum, Srinivasa Vittal Katikireddi, Anil Kaul, Norito Kawakami, Konstantin Kazanjan, Seifu Kebede, Peter Njenga Keiyoro, Grant Rodgers Kemp, Andre Pascal Kengne, Maia Kereselidze, Ezra Belay Ketema, Yousef Saleh Khader, Morteza Abdullatif Khafaie, Alireza Khajavi, Ibrahim A Khalil, Ejaz Ahmad Khan, Gulfaraz Khan, Md Nuruzzaman Khan, Muhammad Ali Khan, Mukti Nath Khanal, Young-Ho Khang, Mona M Khater, Abdullah Tawfih Abdullah Khoja, Ardeshir Khosravi, Jagdish Khubchandani, Getiye Dejenu Kibret, Daniel Ngari Kiirithio, Daniel Kim, Yun Jin Kim, Ruth W Kimokoti, Yohannes Kinfu, Sanjay Kinra, Adnan Kisa, Niranjan Kissoon, Sonali Kochhar, Yoshihiro Kokubo, Jacek A Kopec, Soewarta Kosen, Parvaiz A Koul, Ai Koyanagi, Michael Kravchenko, Kewal Krishan, Kristopher J Krohn, Barthelemy Kuate Defo, G Anil Kumar, Pushpendra Kumar, Michael Kutz, Igor Kuzin, Hmwe H Kyu, Deepesh Pravinkumar Lad, Alessandra Lafranconi, Dharmesh Kumar Lal, Ratilal Lalloo, Hilton Lam, Qing Lan, Justin J Lang, Van C Lansingh, Sonia Lansky, Anders Larsson, Arman Latifi, Jeffrey Victor Lazarus, Janet L Leasher, Paul H Lee, Yirga Legesse, James Leigh, Cheru Tesema Leshargie, Samson Leta, Janni Leung, Ricky Leung, Miriam Levi, Yongmei Li, Juan Liang, Misgan Legesse Liben, Lee-Ling Lim, Stephen S Lim, Margaret Lind, Shai Linn, Stefan Listl, Patrick Y Liu, Shiwei Liu, Rakesh Lodha, Alan D Lopez, Scott A Lorch, Stefan Lorkowski, Paulo A Lotufo,

Timothy C D Lucas, Raimundas Lunevicius, Grégoire Lurton, Ronan A Lyons, Fadi Maalouf, Erlyn Rachelle King Macarayan, Mark T Mackay, Emilie R Maddison, Fabiana Madotto, Hassan Magdy Abd El Razek, Mohammed Magdy Abd El Razek, Marek Majdan, Reza Majdzadeh, Azeem Majeed, Reza Malekzadeh, Rajesh Malhotra, Deborah Carvalho Malta, Abdullah A Mamun, Helena Manguerra, Treh Manhertz, Mohammad Ali Mansournia, Lorenzo G Mantovani, Tsegahun Manyazewal, Chabila C Mapoma, Christopher Margono, Jose Martinez-Raga, Sheila Cristina Ouriques Martins, Francisco Rogerlândio Martins-Melo, Ira Martopullo, Winfried März, Benjamin Ballard Massenburg, Manu Raj Mathur, Pallab K Maulik, Mohsen Mazidi, Colm McAlinden, John J McGrath, Martin McKee, Suresh Mehata, Ravi Mehrotra, Kala M Mehta, Varshil Mehta, Toni Meier, Fabiola Mejia-Rodriguez, Kidanu Gebremariam Meles, Mulugeta Melku, Peter Memiah, Ziad A Memish, Walter Mendoza, Degu Abate Mengiste, Desalegn Tadese Mengistu, Bereket Gebremichael Menota, George A Mensah, Atte Meretoja, Tuomo J Meretoja, Haftay Berhane Mezgebe, Tomasz Miazgowski, Renata Micha, Robert Milam, Anoushka Millear, Ted R Miller, GK Mini, Shawn Minnig, Andreea Mirica, Erkin M Mirrakhimov, Awoke Misganaw, Philip B Mitchell, Fitsum Weldegebreal Mlashu, Babak Moazen, Karzan Abdulmuhsin Mohammad, Roghayeh Mohammadibakhsh, Ebrahim Mohammed, Mohammed A Mohammed, Shafiu Mohammed, Ali H Mokdad, Glen Liddell D Mola, Mariam Molokhia, Fatemeh Momeniha, Lorenzo Monasta, Julio Cesar Montañez Hernandez, Mahmood Moosazadeh, Maziar Moradi-Lakeh, Paula Moraga, Lidia Morawska, Ilais Moreno Velasquez, Rintaro Mori, Shane D Morrison, Mark Moses, Seyyed Meysam Mousavi, Ulrich O Mueller, Manoj Murhekar, Gudlavalleti Venkata Satyanarayana Murthy, Srinivas Murthy, Jonah Musa, Kamarul Imran Musa, Ghulam Mustafa, Saravanan Muthupandian, Chie Nagata, Gabriele Nagel, Mohsen Naghavi, Aliya Naheed, Gurudatta A Naik, Nitish Naik, Farid Najafi, Luigi Naldi, Vinay Nangia, Jobert Richie Njingang Nansseu, K M Venkat Narayan, Bruno Ramos Nascimento, Ionut Negoi, Ruxandra Irina Negoi, Charles R Newton, Josephine Wanjiku Ngunjiri, Grant Nguyen, Long Nguyen, Trang Huyen Nguyen, Emma Nichols, Dina Nur Anggraini Ningrum, Ellen Nolte, Vuong Minh Nong, Ole F Norheim, Bo Norrving, Jean Jacques N Noubiap, Alypio Nyandwi, Carla Makhlouf Obermeyer, Richard Ofori-Asenso, Felix Akpojene Ogbo, In-Hwan Oh, Olanrewaju Oladimeji, Andrew Toyin Olagunju, Tinuke Oluwasefunmi Olagunju, Pedro R Olivares, Patricia Pereira Vasconcelos de Oliveira, Helen E Olsen, Bolajoko Olubukunola Olusanya, Jacob Olusegun Olusanya, Kanyin Ong, John Nelson Opio, Eyal Oren, Doris V Ortega-Altamirano, Alberto Ortiz, Raziye Ozdemir, Mahesh PA, Amanda W Pain, Marcos Roberto Tovani Palone, Adrian Pana, Songhomitra Panda-Jonas, Jeyaraj D Pandian, Eun-Kee Park, Hadi Parsian, Tejas Patel, Sanghamitra Pati, Snehal T Patil, Ajay Patle, George C Patton, Vishnupriya Rao Paturi, Deepak Paudel, Marcel de Moares Pedroso, Sandra P Pedroza, David M Pereira, Norberto Perico, Hannah Peterson, Max Petzold, Niloofar Peykari, Michael Robert Phillips, Frédéric B Piel, David M Pigott, Julian David Pillay, Michael A Piradov, Suzanne Polinder, Constance D Pond, Maarten J Postma, Farshad Pourmalek, Swayam Prakash, V Prakash, Narayan Prasad, Noela Marie Prasad, Caroline Purcell, Mostafa Qorbani, Hedley Knewjen Quintana, Amir Radfar, Anwar Rafay, Alireza Rafiei, Kazem Rahimi, Afarin Rahimi-Movaghar, Vafa Rahimi-Movaghar, Mahfuzar Rahman, Muhammad Aziz Rahman, Sajjad Ur Rahman, Rajesh Kumar Rai, Sree Bhushan Raju, Usha Ram, Saleem M Rana, Zane Rankin, Davide Rasella, David Laith Rawaf, Salman Rawaf, Sarah E Ray, Christian Aspacia Razo-García, Priscilla Reddy, Robert C Reiner, Cesar Reis, Marissa B Reitsma, Giuseppe Remuzzi, Andre M N Renzaho, Serge Resnikoff, Satar Rezaei, Mohammad Sadegh Rezai, Antonio L Ribeiro, Maria Jesus Rios Blancas, Juan A Rivera, Leonardo Roever, Luca Ronfani, Gholamreza Roshandel, Ali Rostami, Gregory A Roth, Dietrich Rothenbacher, Ambuj Roy, Nobhojit Roy, George Mugambage Ruhago, Yogesh Damodar Sabde, Perminder S Sachdev, Nafis Sadat, Mahdi Safdarian, Saeid Safiri, Rajesh Sagar, Amirhossein Sahebkar, Mohammad Ali Sahraian, Haniye Sadat Sajadi, Joseph Salama, Payman Salamati, Raphael de Freitas Saldanha, Hamideh Salimzadeh, Joshua A Salomon, Abdallah M Samy, Juan Ramon Sanabria, Parag K Sancheti, Maria Dolores Sanchez-Niño, Damian Santomauro, Itamar S Santos, Milena M Santric Milicevic, Abdur Razzaque Sarker, Nizal Sarrafzadegan, Benn Sartorius, Maheswar Satpathy, Miloje Savic, Monika Sawhney, Sonia Saxena, Mete I Saylan, Elke Schaeffner, Josef Schmidhuber, Maria Inês Schmidt, Ione J C Schneider, Austin E Schumacher, Aletta E Schutte, David C Schwebel, Falk Schwendicke, Mario Sekerija, Sadaf G Sepanlou, Edson E Servan-Mori, Azadeh Shafieesabet, Masood Ali Shaikh, Marina Shakh-Nazarova, Mehran Shams-Beyranvand, Heidar Sharafi, Mahdi Sharif-Alhoseini, Sheikh Mohammed Shariful Islam, Meenakshi Sharma, Rajesh Sharma, Jun She, Aziz Sheikh, Mebrahtu Teweldemedhin Shfare, Peilin Shi, Chloe Shields, Mika Shigematsu, Yukito Shinohara, Rahman Shiri, Reza Shirkoohi, Ivy Shiue, Mark G Shrime, Sharvari Rahul Shukla, Soraya Siabani, Inga Dora Sigfusdottir, Donald H Silberberg, Diego Augusto Santos Silva, João Pedro Silva, Dayane Gabriele Alves Silveira, Jasvinder A Singh, Lavanya Singh, Narinder Pal Singh, Virendra Singh, Dhirendra Narain Sinha, Abiy Hiruye Sinke, Mekonnen Sisay, Vegard Skirbekk, Karen Sliwa, Alison Smith, Adauto Martins Soares Filho, Badr H A Sobaih, Melek Somai, Samir Soneji, Moslem Soofi, Reed J D Sorensen, Joan B Soriano, Ireneous N Soyiri, Luciano A Sposato, Chandrashekhar T Sreeramareddy, Vinay Srinivasan, Jeffrey D Stanaway, Vasiliki Stathopoulou, Nicholas Steel, Dan J Stein, Mark Andrew Stokes, Lela Sturua, Muawiyyah Babale Sufiyan, Rizwan Abdulkader Suliankatchi, Bruno F Sunguya, Patrick J Sur, Bryan L Sykes, P N Sylaja, Cassandra E I Szoeke, Rafael Tabarés-Seisdedos, Santosh Kumar Tadakamadla, Andualem Henok Tadesse, Getachew Redae Taffere, Nikhil Tandon, Amare Tariku Tariku, Nuno Taveira, Arash Tehrani-Banihashemi, Girma Temam Shifa, Mohamad-Hani Temsah, Abdullah Sulieman Terkawi, Azeb Gebresilassie Tesema, Dawit Jember Tesfaye, Belay Tessema, JS Thakur, Nihal Thomas, Matthew J Thompson, Taavi Tillmann, Quyen G To, Ruoyan Tobe-Gai, Marcello Tonelli, Roman Topor-Madry, Fotis Topouzis, Anna Torre, Miguel Tortajada, Bach Xuan Tran, Khanh Bao Tran, Avnish Tripathi, Srikanth Prasad Tripathy, Christopher Troeger, Thomas Truelsen, Derrick Tsoi, Lorainne Tudor Car, Kald Beshir Tuem, Stefanos Tyrovolas, Uche S Uchendu, Kingsley Nnanna Ukwaja, Irfan Ullah, Rachel Updike, Olalekan A Uthman, Benjamin S Chudi Uzochukwu, Pascual Rubén Valdez, Job F M van Boven, Santosh Varughese, Tommi Vasankari, Narayanaswamy Venketasubramanian, Francesco S Violante, Sergey K Vladimirov, Vasiliy Victorovich Vlassov, Stein Emil Vollset, Theo Vos, Fasil Wagnew, Yasir Waheed, Mitchell T Wallin, Judd L Walson, Yafeng Wang, Yuan-Pang Wang, Molla Mesele Wassie, Marcia R Weaver, Elisabete Weiderpass, Robert G Weintraub, Jordan Weiss, Kidu Gidey Weldegwergs, Andrea Werdecker, T Eoin West, Ronny Westerman, Richard G White, Harvey A Whiteford, Justyna Widecka, Andrea Sylvia Winkler, Charles Shey Wiysonge, Charles D A Wolfe, Yohanes Ayele Wondimkun, Abdulhalik Workicho, Grant M A Wyper, Denis Xavier, Gelin Xu, Lijing L Yan, Yuichiro Yano, Mehdi Yaseri, Nigus Bililign Yimer, Peng Yin, Paul Yip, Biruck Desalegn Yirsaw, Naohiro Yonemoto, Gerald Yonga, Seok-Jun Yoon, Marcel Yotebieng, Mustafa Z Younis, Chuanhua Yu, Vesna Zadnik, Zoubida Zaidi, Maysaa El Sayed Zaki, Sojib Bin Zaman, Mohammad Zamani, Zerihun Menlkalew Zenebe, Maigeng Zhou, Jun Zhu, Stephanie R M Zimsen, Ben Zipkin, Sanjay Zodpey, Liesl Joanna Zuhlke, Christopher J L Murray, Rafael Lozano.

Affiliations

Institute for Health Metrics and Evaluation (N Fullman MPH, J Yearwood BA, A Afshin MD, T Alam MPH, C Allen BA, R M Barber BS, J R Bennett BA, S Biryukov BS, I W Bolliger BA, K Bolt MPH, K Cercy BS, J Chalek BS, D Colombara PhD, L Cornaby BS, E A Cromwell PhD, Prof L Dandona MD, Prof R Dandona PhD, N Davis Weaver MPH, M Echko BSc, E Eldrenkamp BA, T Farag PhD, C Fitzmaurice MD, A D Flaxman PhD, K J Foreman PhD, J J Frostad MPH, Prof E Gakidou PhD, W W Godwin BS, M Griswold MA, C Hawley MSPH, Prof S I Hay DSc, J He MSCE, N J Henry BS/BA, C Ikeda BS, C M S Irvine BA, S C Johnson MSc, N J Kassebaum MD, G R Kemp BA, I A Khalil MD, K J Krohn MPH,

M Kutz BS, H H Kyu PhD, Prof S S Lim PhD, M Lind MPHc, P Y Liu MPH, G Lurton Mac, E R Maddison BS, H Manguerra BS, T Manhertz BA, C Margono BS, I Martopullo MPH, A Millear BA, S Minnig MS, A Misganaw PhD, Prof A H Mokdad PhD, M Moses MHS, Prof M Naghavi PhD, G Nguyen MPH, E Nichols BA, H E Olsen MA, K Ong PhD, A W Pain MPH, S P Pedroza MPH, H Peterson MS, D M Pigott DPhil, C Purcell BS, Z Rankin MPH, S E Ray BS, R C Reiner PhD, M B Reitsma BS, G A Roth MD, N Sadat MA, J Salama MSc, D Santomauro PhD, A E Schumacher BS, C Shields BS, L Singh BS, A Smith BA, R J D Sorensen MPH, V Srinivasan BA, J D Stanaway PhD, P J Sur BA, A Torre BS, C Troeger MPH, D Tsoi BS, R Updike AB, Prof S Vollset DrPH, Prof T Vos PhD, Prof M R Weaver PhD, Prof H A Whiteford PhD, Prof M Zhou PhD, S R M Zimsen MA, B Zipkin BS, Prof C J L Murray DPhil, Prof R Lozano MD), Division of Hematology, Department of Medicine (C Fitzmaurice MD), Center for Health Trends and Forecasts (Prof M M Jakovljevic PhD), Department of Global Health (S Kochhar MD), and Division of Plastic Surgery, Department of Surgery (B B Massenburg MD), University of Washington, Seattle, WA, USA (C S Crowe MD, N D Futran MD, R Kalani MD, J Leung PhD, S D Morrison MD, Prof M J Thompson DPhil, J L Walson MD, T West MD); College of Veterinary Medicine and Agriculture (K Amenu PhD) and School of Public Health (K Deribe MPH), Addis Ababa University, Addis Ababa, Ethiopia (S M Abay PhD, G Demoz MS, A Z Giref PhD, S Leta MS, B G Menota MS, G Temam Shifa MPH, B D Yirsaw PhD); La Sapienza University, Rome, Italy (C Abbafati PhD); Department of Neurology (Prof F Abd-Allah MD, Prof A Abdelalim MD) and Faculty of Medicine (M I Hegazy PhD, M M Khater MD), Cairo University, Cairo, Egypt (M M Khater); College of Health and Medical Sciences (J Abdela MSc), Haramaya University, Harar, Ethiopia (D Edessa MS, M Gishu MS, M T Jalu MPH, D A Mengiste MA, F W Mlashu MS, M Sisay MS, Y A Wondimkun MS); College of Medical and Health Sciences (B Bekele PhD), Department of Epidemiology and Biostatistics, Institute of Public Health (K Alene MPH), and Institute of Public Health (B A Dachew MPH, Y A Gelaw MPH), University of Gondar, Gondar, Ethiopia (Z Abebe MS, A A Adane MPH, B Biadgo MS, A F Dadi MPH, D Geremew MS, M Melku MS, A T Tariku MS, B Tessema PhD, M M Wassie MS); College of Medicine and Health Sciences (T A Abebo MPH, D T Hibstu MPH, D J Tesfaye MPH), Hawassa University, Hawassa, Ethiopia (A K Daba MS); Dupuytren University Hospital, Limoges, France (Prof V Aboyans PhD); College of Health Sciences (D T Mengistu MS, S Muthupandian PhD, E T Asfaw MS), Institute of Biomedical Sciences (S Muthupandian, E T Asfaw), Department of Medical Microbiology (S Muthupandian), School of Pharmacy (D Berhe MS), School of Public Health (A B Belachew MS, G R Taffere PhD, K G Meles MPH, M M Ashebir MPH), and College of Health Sciences (K G Meles), Mekelle University, Mekelle, Ethiopia (H N Abraha MS, S W Asgedom MS, T Atey MS, A K Gebre MS, G B Hailu MSc, A Kahsay MPH, T D Kassa MS, S Kebede MS, E B Ketema MS, Y Legesse MS, H B Mezgebe MS, E Mohammed MS, A G Tesema MPH, K B Tuem MS, K G Weldegwergs MS, Z M Zenebe MS); Federal University of Minas Gerais, Belo Horizonte, Brazil (D M X Abreu PhD, V E M Araújo PhD); Infectious Disease Epidemiology Group, Weill Cornell Medical College in Qatar, Doha, Qatar (L J Abu-Raddad PhD); Queensland Brain Institute (Prof J J McGrath PhD), School of Dentistry (Prof R Lalloo PhD), and School of Public Health (Y A Gelaw MPH, J Leung, D Santomauro, Prof H A Whiteford PhD), University of Queensland, Brisbane, QLD, Australia (A A Adane MPH, B A Dachew MPH, Y Guo PhD, A A Mamun PhD); Department of Community Health, College of Health Sciences (A Fatusi MPH) and Department of Medical Rehabilitation (Prof R A Adedoyin PhD), Obafemi Awolowo University, Ile-Ife, Nigeria; Stellenbosch University, Cape Town, South Africa (O Adetokunboh MD, Prof C S Wiysonge PhD); Faculty of Health Sciences, Unit for Health Promotion Research, University of Southern Denmark, Esbjerg, Denmark (T B Adhikari MPH); Cancer Research Center (Prof R Shirkoohi PhD), Department of Epidemiology and Biostatistics (M Mansournia PhD), Department of Health Management and Economics, School of Public Health (S Mousavi PhD), Digestive Diseases Research Institute (Prof R Malekzadeh MD, G Roshandel PhD, S G Sepanlou PhD), Endocrinology and Metabolism Research Center (M Afarideh MD, Prof A Esteghamati MD, M Ganji MD, N Hafezi-Nejad MD, M Shams-Beyranvand MS), Hematologic Malignancies Research Center (A Kasaeian PhD), Hematology-Oncology and Stem Cell Transplantation Research Center (A Kasaeian PhD), Iranian National Center for Addiction Studies (A Rahimi-Movaghar MD), Knowledge Utilization Research Center and Community Based Participatory Research Center (Prof R Majdzadeh PhD), MS Research Center, Neuroscience Institute (M Sahraian MD), National Institute of Health Research (H S Sajadi PhD), Non-Communicable Diseases Research Center (F Farzadfar MD, A Khosravi PhD), Non-communicable Diseases Research Center, Endocrinology and Metabolism Research Institute (B Moazen MS), and Sina Trauma and Surgery Research Center (Prof V Rahimi-Movaghar MD, M Safdarian MD, Prof P Salamati MD, M Sharif-Alhoseini PhD), Tehran University of Medical Sciences, Tehran, Iran (Prof M Hosseini PhD, H Salimzadeh PhD, M Yaseri PhD); McMaster University, Hamilton, ON, Canada (G Agarwal PhD, T O Olagunju MD); Directorate for Health Information and Research, Pieta, Malta (D Agius MD, N Azzopardi-Muscat PhD); Malta College of Family Doctors, Gzira, Malta (D Agius MD); CSIR—Institute of Genomics and Integrative Biology, Delhi, India (A Agrawal PhD); Department of Internal Medicine, Baylor College of Medicine, Houston, Texas, USA (A Agrawal PhD); Centre for Control of Chronic Conditions (P Jeemon PhD), Indian Institute of Public Health (S Dey PhD, Prof G V S Murthy MD), Public Health Foundation of India, Gurugram, India (S Agrawal PhD, S Bhaumik MSc, Prof L Dandona, Prof R Dandona, G Kumar PhD, D K Lal MD, M R Mathur PhD, S Pati MD, Prof S Zodpey PhD); Department of Clinical Sciences Lund, Orthopedics, Clinical Epidemiology Unit (A Ahmad Kiadaliri PhD), Skane University Hospital, Department of Clinical Sciences Lund, Neurology, Lund University, Lund, Sweden (Prof B Norrving PhD); High National School of Veterinary Medicine, Algiers, Algeria (M Aichour MD); Debere Berhan University, Debre Berhan, Ethiopia (M Akibu MS); University of Ibadan, Ibadan, Nigeria (R O Akinyemi PhD); Newcastle University, Newcastle upon Tyne, UK (R O Akinyemi PhD); Department of Epidemiology (T F Akinyemiju PhD), University of Alabama at Birmingham, Birmingham, AL, USA (M Khan MD, G A Naik MPH, D C Schwebel PhD, J A Singh MD); Centre for Global Child Health, The Hospital for Sick Children, Toronto, ON, Canada (N Akseer MSc, Z A Bhutta PhD); Dalla Lana School of Public Health (N Akseer MSc), Department of Nutritional Sciences, Faculty of Medicine (A Badawi PhD), University of Toronto, Toronto, ON, Canada; Baghdad College of Medicine, Baghdad, Iraq (F H Al Lami PhD); Mayo Clinic Foundation for Medical Education and Research, Rochester, MN, USA (F Alahdab MD); Syrian American Medical Society, Washington, DC, USA (F Alahdab MD); Washington University in St. Louis, St. Louis, MO, USA (Z Al-Aly MD); School of Population and Global Health, University of Western Australia, Perth, WA, Australia (K Alam PhD); International Relations Division (A Htet MPhil), Ministry of Health, Al Khuwair, Oman (D Alasfoor MSc); Independent Consultant, Damascus, Syria (M I Albittar BS, M A Shaikh MD); Department of Global Health, Research School of Population Health (K Alene MPH), Australian National University, Canberra, ACT, Australia (Prof K E Doyle PhD); King Saud University, Riyadh, Saudi Arabia (A Al-Eyadhy MD, K A Altirkawi MD, A A Jamal MD, B H A Sobaih MD, M Temsah MD); King Faisal Specialist Hospital & Research Center, Riyadh, Saudi Arabia (A Al-Eyadhy MD); University of London, London, UK (S Ali BA); SIR Management Consultants, Oxford, UK (S Ali BA); Institute and Faculty of Actuaries, Oxford, UK (S Ali BA); Qazvin University of Medical Sciences, Qavin, Iran (M Alijanzadeh MS); Faculty of Public Health, Kuwait University, Kuwait City, Kuwait (Prof S M Aljunid PhD); International Centre for Casemix and Clinical Coding, National University of Malaysia, Kuala Lumpur, Malaysia (Prof S M Aljunid PhD); Luxembourg Institute of Health, Strassen, Luxembourg (A Alkerwi PhD); School of Public Health, University of Lorraine, Nancy, France (Prof F Alla PhD); Department of Medical Epidemiology and Biostatistics (Prof J J Carrero PhD, E Weiderpass PhD), Department of Neurobiology, Care Sciences and Society, Division of Family Medicine and Primary Care (Prof J Ärnlöv PhD, S Fereshtehnejad PhD), and Department of Public Health Sciences (P Allebeck PhD, Z El-Khatib PhD, N Roy MD), Karolinska Institutet, Stockholm, Sweden (R Havmoeller PhD, L Nguyen MPH); Department of Community Medicine, Public Health

and Family Medicine (Prof Y S Khader ScD) and Division of Physical Therapy, Department of Rehabilitation Sciences, Faculty of Applied Medical Sciences (M A Alomari PhD), Jordan University of Science and Technology, Irbid, Jordan; College of Medicine, Department of Family and Community Medicine, King Abdulaziz University, Jeddah, Saudi Arabia (R Al-Raddadi PhD); Charité–Universitätsmedizin Berlin, Berlin, Germany (U Alsharif MPH, Prof M Endres MD, Prof E Schaeffner MD, Prof F Schwendicke PhD); Universidad de Cartagena, Cartagena de Indias, Colombia (Prof N Alvis-Guzman PhD); Discipline of Psychiatry (A T Olagunju MD), School of Medicine, (A T Amare MPH, Prof B T Baune PhD, L G Ciobanu MS), University of Adelaide, Adelaide, SA, Australia; College of Medicine and Health Sciences (A T Amare MPH), Bahir Dar University, Bahir Dar, Ethiopia; Ministry of Public Health, Beirut, Lebanon (W Ammar PhD, I R Bou-Orm MD, H L Harb MPH); Department of Medicine, Komfo Anokye Teaching Hospital, Kumasi, Ghana (Y A Amoako MD); Faculty of Medicine (Prof M E Zaki PhD), Mansoura University, Mansoura, Egypt (N Anber PhD); Carol Davila University of Medicine and Pharmacy, Bucharest, Romania (C L Andrei PhD, Prof M Beuran PhD, M Hostiuc PhD, S Hostiuc PhD, I Negoi PhD, R I Negoi PhD); University of Thessaly, Larissa, Greece (Prof S Androudi MD); College of Public Health (E A Faraon MD) and Department of Health Policy and Administration, College of Public Health (C T Antonio MD), University of the Philippines Manila, Manila, Philippines; Ministry of Health of Brazil, Brasília, Brazil (V E M Araújo PhD, P P V Oliveira MS, A M Soares Filho MPH); Birmingham City, University Department of Public Health and Therapies, Birmingham, UK (O Aremu PhD); School of Health and Social Studies, Dalarna University, Falun, Sweden (Prof J Ärnlöv PhD); University of Manitoba, Winnipeg, MB, Canada (A Artaman PhD); Nepal Health Research Council, Kathmandu, Nepal (K K Aryal MPH); University of Oslo, Oslo, Norway (K K Aryal MPH, A Htet); Department of Medical Emergency, School of Paramedical, Qom University of Medical Sciences, Qom, Iran (H Asayesh MS); South Asian Public Health Forum, Islamabad, Pakistan (R J Asghar MD); Wolaita Sodo University, Wolaita Sodo, Ethiopia (N Asseffa MPH); Centre for Clinical Global Health Education (S R Atre PhD), Johns Hopkins Bloomberg School of Public Health (A T A Khoja MD), Johns Hopkins University, Baltimore, MD, USA (B X Tran PhD); Dr D Y Patil Vidyapeeth Pune, Pune, India (S R Atre PhD); Keimyung University, Daegu, South Korea (M Atteraya PhD); National Institute of Public Health, Cuernavaca, Mexico (L Avila-Burgos PhD, S Barquera PhD, L Cahuana-Hurtado PhD, I R Campos-Nonato PhD, J C Campuzano PhD, H Gomez-Dantes MSc, F Mejia-Rodriguez MD, J C Montañez Hernandez MSc, D V Ortega-Altamirano PhD, C A Razo-García MSc, M Rios Blancas MPH, Prof J A Rivera PhD, Prof E E Servan-Mori MSc); Institut de Recherche Clinique du Bénin, Cotonou, Benin (E F G Avokpaho MPH); Laboratoire d'Etudes et de Recherche-Action en Santé (LERAS Afrique), Parakou, Benin (E F G Avokpaho MPH); Indian Institute of Public Health, Gandhinagar, India (A Awasthi PhD); Austin Clinical School of Nursing (M Rahman PhD), The Judith Lumley Centre for Mother, Infant and Family Health Research (B P Ayala Quintanilla PhD), La Trobe University, Melbourne, VIC, Australia (Prof D Edvardsson PhD); Peruvian National Institute of Health, Lima, Peru (B P Ayala Quintanilla PhD); Debre Markos University, Debre Markos, Ethiopia (A A Ayalew MS, Y A Belay MPH, D H Kassa MS, G M Kassa MS, G D Kibret MPH, C T Leshargie MPH, F Wagnew MS); Department of Epidemiology, Biostatiststics, and Occupational Health, McGill University, Montreal, QC, Canada (H Ayele PhD); Dilla University, Dilla, Ethiopia (H Ayele PhD); The University of Tokyo, Tokyo, Japan (R Ayer MS); Institute of Medical Research and Plant Medicinal Studies–Cameroon, Yaounde, Cameroon (T B Ayuk MPH); University of South Africa, Pretoria, South Africa (T B Ayuk MPH); Burnet Institute, Melbourne, VIC, Australia (P Azzopardi PhD); Department of Paediatrics (P Azzopardi PhD, Prof G C Patton MD), Murdoch Childrens Research Institute (P Azzopardi, Prof G C Patton), Department of Medicine (A Meretoja PhD), and Institute of Health and Ageing (Prof C E I Szoeke PhD), Melbourne School of Population and Global Health (Prof A D Lopez PhD), University of Melbourne, Melbourne, VIC, Australia (M Rahman PhD, M T Mackay PhD, R G Weintraub MBBS, N M Prasad DO); Wardliparingga Aboriginal Research Unit, South Australian Health and Medical Research Institute, Adelaide, SA, Australia (P Azzopardi PhD); University of Malta Department of Health Services Management/Islands and Small States Institute, Msida, Malta (N Azzopardi-Muscat PhD); Department of Community Health and Primary Care (T K Babalola MS), Department of Psychiatry, College of Medicine, University of Lagos, Lagos, Nigeria (A T Olagunju MD); Invasive Fungi Research Center, Sari, Iran (Prof H Badali PhD); Centre of Expertise in Mycology Radboudumc/CWZ, Nijmegen, Netherlands (Prof H Badali PhD); Public Health Agency of Canada, Toronto, ON, Canada (A Badawi PhD, J J Lang PhD); Department of Hypertension, Medical University of Lodz, Lodz, Poland (Prof M Banach PhD); Institute of Epidemiology & Health (T Tillmann MSc) and The Farr Institute of Health Informatics Research, Institute of Health Informatics (A Banerjee DPhil, S Chung PhD), University College London, London, UK (C Birungi MS, M R Mathur PhD); Public Health Perspective Nepal, Pokhara, Nepal (A Banstola MPH); Hospital Dr Rafael A Calderón Guardia, CCSS, San José, Costa Rica (M A Barboza MD); Universidad de Costa Rica, San Pedro, Costa Rica (M A Barboza MD, Prof J Castillo Rivas MPH); School of Psychology, University of Auckland, Auckland, New Zealand (S L Barker-Collo PhD); Ariadne Labs (E K Macarayan PhD), Department of Global Health and Population, Harvard T H Chan School of Public Health (Prof T Bärnighausen MD, A B Feigl ScD, J A Salomon PhD), Harvard T H Chan School of Public Health (I R Campos-Nonato PhD), Harvard University, Boston, MA, USA; Africa Health Research Institute, Mtubatuba, South Africa (Prof T Bärnighausen); Institute of Public Health (Prof T Bärnighausen, S Mohammed PhD), Heidelberg University, Heidelberg, Germany (Prof S Listl PhD); Department of Industrial Engineering, School of Engineering (L H Barrero ScD), Pontificia Universidad Javeriana, Bogota, Colombia; Barcelona Institute for Global Health, Universitat de Barcelona, Barcelona, Spain (Prof Q Bassat MD); ICREA, Barcelona, Spain (Prof Q Bassat MD); Stanford University, Stanford, CA, USA (S Basu PhD); College of Medicine, Charles R Drew University of Medicine and Science, Los Angeles, CA, USA (Prof S Bazargan-Hejazi PhD); David Geffen School of Medicine, University of California at Los Angeles, Los Angeles, CA, USA (Prof S Bazargan-Hejazi); College of Public Health and Tropical Medicine, Jazan University, Jazan, Saudi Arabia (N Bedi MD); IRCCS–Istituto di Ricerche Farmacologiche Mario Negri, Milan, Italy (E Beghi MD, B Bikbov MD, M Cortinovis Biotech D, S Gallus DSc, G Giussani BiolD, N Perico MD, Prof G Remuzzi MD); Social Determinants of Health Research Center (M Behzadifar MS), Lorestan University of Medical Sciences, Khorramabad, Iran (M Behzadifar MS); Air Pollution Research Center (B Heibati PhD), Department of Community Medicine (A Tehrani-Banihashemi PhD, M Moradi-Lakeh MD), Preventive Medicine and Public Health Research Center (A Tehrani-Banihashemi, M Moradi-Lakeh), Gastrointestinal and Liver Disease Research Center (M Moradi-Lakeh), Health Management and Economics Research Center (M Behzadifar MS), and Department of Environmental Health Engineering, School of Public Health (F Momeniha MS), Iran University of Medical Sciences, Tehran, Tehran, Iran (K Ghasemi Falavarjani MD); Mizan Tepi University, Mizan Aman, Ethiopia (B Bekele PhD, H Y Hassen MPH); Dr Tewelde Legesse Health Sciences College, Mekelle, Ethiopia (S A Belay MPH); Yale University, New Haven, CT, USA (Prof M L Bell PhD, J J Huang MD); University of Alberta, Edmonton, AB, Canada (A K Bello PhD); Oxford Big Data Institute, Li Ka Shing Centre for Health Information and Discovery (Prof S I Hay DSc, T C D Lucas PhD), Nuffield Department of Medicine (T C D Lucas), Department of Zoology (P W Gething PhD), NIHR Musculoskeletal Biomedical Research Centre (Prof C Cooper FMedSci), and Nuffield Department of Population Health (D A Bennett PhD), University of Oxford, Oxford, UK (Prof V Jha DM, Prof C R Newton MD, K Rahimi DM); Center for Clinical and Epidemiological Research Center, Hospital Universitario (A C Goulart PhD), Internal Medicine Department (Prof I S Santos PhD), University of São Paulo, São Paulo, Brazil (I M Bensenor PhD, Prof P A Lotufo DrPH, M R T Palone MSc); Department of Psychiatry, University Medical Center Groningen (Prof H W Hoek MD), University Medical Center Groningen (D Berhe MS), University of Groningen, Groningen, Netherlands (Prof M J Postma PhD, J F M van Boven PhD); Division of Health and Social Care Research (Prof C D Wolfe MD), King's College London, London, UK (E Bernabé PhD, M Molokhia PhD); Department of Global

Health, Rollins School of Public Health (R S Bernstein MD), Emory University, Atlanta, GA, USA (Prof K Narayan MD, Prof M R Phillips MD); Department of Global Health, College of Public Health, University of South Florida, Tampa, FL, USA (R S Bernstein MD); Emergency Hospital of Bucharest, Bucharest, Romania (Prof M Beuran PhD, I Negoi PhD); School of Public Health (Prof J Thakur MD), Post Graduate Institute of Medical Education and Research, Chandigarh, India (A Bhalla MD, D P Lad DM); Medtronic Philanthropy, Minneapolis, MN, USA (P Bhatt MPH); Centre of Excellence in Women and Child Health (Z A Bhutta PhD), Department of Paediatrics and Child Health (J Das MBA), Aga Khan University, Karachi, Pakistan; Health Research Institute (R Ghadimi PhD), Infectious Diseases and Tropical Medicine Research Center, School of Medicine (A Rostami PhD), Social Determinants of Health Research Center, Health Research Institute (S Hosseini MD), Social Determinants of Health Research Center, Health Research Institute (A Bijani PhD), Babol University of Medical Sciences, Babol, Iran (M Faramarzi PhD, M Ghasemi-Kasman PhD, H Parsian PhD, M Zamani MD); St Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia (H Bizuneh MPH, M T Jalu MPH); Jigjiga University, Jigjiga, Ethiopia (H Bizuneh MPH); University Hospital Heidelberg, Department of General Practice and Health Services Research, Heidelberg, Germany (K Bozorgmehr MD); European Observatory on Health Systems and Policies (E Nolte PhD), London School of Hygiene & Tropical Medicine, London, UK (O J Brady DPhil, Prof S Kinra PhD, Prof M McKee DSc, Prof R G White PhD); Faculty of Medicine, Institute of Epidemiology (A Brazinova MD), Comenius University, Bratislava, Slovakia; The Ohio State University, Columbus, OH, USA (Prof N J K Breitborde PhD, M Yotebieng PhD); German Cancer Research Center, Heidelberg, Germany (H Brenner MD); INDICASAT AIP, Panama, Panama (G Britton PhD); University of Leicester, Leicester, UK (Prof T S Brugha MD); Al Shifa Trust Eye Hospital, Rawalpindi, Pakistan (Z A Butt PhD); LKCMedicine, Nanyang Technological University, Singapore, Singapore (J Car PhD, L Tudor Car PhD); Department of Epidemiology and Biostatistics (F B Piel PhD), Department of Infectious Disease Epidemiology (T Fürst PhD), Department of Primary Care & Public Health (Prof A Majeed MD), WHO Collaborating Centre (D L Rawaf MD), Imperial College London, London, UK (J Car PhD, M Car PhD, K J Foreman, Prof S Rawaf MD, S Saxena MD, L Tudor Car PhD); Ministry of Health of the Republic of Croatia, Zagreb, Croatia (M Car PhD); Metropolitan Autonomous University, Mexico City, Mexico (R Cárdenas ScD); Department of Chemical Sciences (Prof E Fernandes PhD), Faculty of Pharmacy (Prof F Carvalho PhD), INEB–Instituto de Engenharia Biomédica (J das Neves PhD), UCIBIO@REQUIMTE, Toxicology Group, Faculty of Pharmacy (J P Silva PhD), i3S–Instituto de Investigação e Inovação em Saúde (J das Neves PhD), University of Porto, Porto, Portugal; Colombian National Health Observatory (C A Castañeda-Orjuela MSc), Instituto Nacional de Salud, Bogota, Colombia; Epidemiology and Public Health Evaluation Group, Public Health Department (C A Castañeda-Orjuela MSc), Universidad Nacional de Colombia, Bogota, Colombia; Caja Costarricense de Seguro Social, San Jose, Costa Rica (Prof J Castillo Rivas MPH); Department of Medicine, University of Valencia, INCLIVA Health Research Institute and CIBERSAM, Valencia, Spain (F Catalá-López PhD, Prof R Tabarés-Seisdedos PhD); Clinical Epidemiology Program, Ottawa Hospital Research Institute, Ottawa, ON, Canada (F Catalá-López PhD); National Health Research Institutes, Zgunan Town, Taiwan (H Chang DrPH); National Yang-Ming University, Taipei, Taiwan (H Chang DrPH); School of Nursing, College of Medicine, National Taiwan University, Taipei, Taiwan (Prof J Chang PhD); International Institute for Population Sciences, Mumbai, India (A Chattopadhyay PhD, M Dubey MPhil, P Kumar MPhil, Prof U Ram PhD); Tata Memorial Hospital, Mumbai, India (Prof P Chaturvedi MD); Clinical Governance Unit, Gold Coast Health, Southport, QLD, Australia (P P Chiang PhD); University of Zambia, Lusaka, Zambia (V H Chisumpa MPhil, C C Mapoma PhD); University of Witwatersrand, Johannesburg, South Africa (V H Chisumpa MPhil); College of Health Sciences, Department of Health Policy and Management (Prof Y Khang MD), Seoul National University, Seoul, South Korea (J J Choi PhD); Seoul National University Medical Library, Seoul, South Korea (J J Choi PhD); Bispebjerg University Hospital, Copenhagen, Denmark (Prof H Christensen DMSCi); Christian Medical College, Vellore, India (Prof D J Christopher MD, Prof N Thomas PhD, Prof S Varughese DM); University of Salerno, Baronissi, Italy (Prof M Cirillo MD); Research Centre on Public Health (P A Cortesi PhD), University of Milano Bicocca, Monza, Italy (S Conti PhD, A Lafranconi MD, F Madotto PhD, Prof L G Mantovani DSc); MRC Lifecourse Epidemiology Unit, University of Southampton, Southampton, UK (Prof C Cooper FMedSci); Heart Institute, University of Sao Paulo, Sao Paulo, Brazil (A Costa Pereira PhD); Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil (E Cousin MS); University of California, San Diego, La Jolla, CA, USA (M H Criqui MD); Centre for International Health, Dunedin School of Medicine, University of Otago, Dunedin, New Zealand (Prof J A Crump MD); Flinders University, Adelaide, SA, Australia (A F Dadi MPH); Guy's and St Thomas' NHS Foundation Trust, London, UK (P I Dargan MBBS); Health Science Research Center, Addiction Institute (M Moosazadeh PhD), Molecular and Cell Biology Research Center, School of Medicine (M Fakhar PhD, Prof A Rafiei DVM), Toxoplasmosis Research Center (Prof A Daryani PhD), Mazandaran University of Medical Sciences, Sari, Iran (M Daryani MD, M Rezai MD); K G Medical University, Lucknow, India (S K Das MD); School of Public Health, Kazakh National Medical University, Almaty, Kazakhstan (K Davletov PhD); Monash University, Melbourne, VIC, Australia (Prof B de Courten PhD, R Ofori-Asenso MS); Monash Medical Center, Clayton, VIC, Australia (Prof B de Courten PhD); Griffith University, Brisbane, QLD, Australia (Prof D De Leo DSc, S K Tadakamadla PhD); Heidelberg Institute of Public Health, Heidelberg, Germany (Prof J De Neve MD); University of Colorado School of Medicine and the Colorado School of Public Health, Aurora, CO, USA (R P Dellavalle MD); College of Health Sciences & Referral Hospital (M T Shfare MS), Aksum University, Aksum, Ethiopia (G Demoz MS); Brighton and Sussex Medical School, Brighton, UK (K Deribe MPH); Mount Sinai Beth Israel, New York, NY, USA (Prof D C Des Jarlais PhD); Icahn School of Medicine at Mount Sinai, New York, NY, USA (Prof D C Des Jarlais PhD); Department of Community Medicine, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka (S D Dharmaratne MD); Nepal Health Research Council, Government of Nepal, Kathmandu, Nepal (M Dhimal PhD); Undersecretary for Research & Technology (S Djalalinia PhD), Ministry of Health & Medical Education, Tehran, Iran (B Eshrati PhD, N Peykari PhD); University of Cape Coast, Cape Coast, Ghana (D T Doku PhD); University of Tampere, Tampere, Finland (D T Doku PhD); UNSW, Sydney, NSW, Australia (Prof K Dolan PhD); University of Rochester Medical Center, Rochester, NY, USA (E Dorsey MD); Universidade do Estado de Santa Catarina, Florianópolis, Brazil (Prof K P B dos Santos MA); RMIT University, Bundoora, VIC, Australia (Prof K E Doyle PhD); Sydney School of Public Health (T R Driscoll PhD), University of Sydney, Sydney, NSW, Australia (J Leigh PhD, M A Mohammed MS); Centre School of Public Health and Health Management (M M Santric Milicevic PhD), Institute of Microbiology and Immunology (E Dubljanin PhD), Institute of Social Medicine, Faculty of Medicine (M M Santric Milicevic), University of Belgrade, Belgrade, Serbia; Federal University of Rio Grande do Sul, Porto Alegre, Brazil (B B Duncan PhD, Prof M I Schmidt MD); University of North Carolina, Chapel Hill, NC, USA (B B Duncan PhD); Umea University, Umea, Sweden (Prof D Edvardsson PhD); University of Michigan, Ann Arbor, MI, USA (J R Ehrlich MD); Department of Global Health and Social Medicine (Z El-Khatib PhD), Program in Global Surgery and Social Change (B B Massenburg MD), Harvard Medical School, Kigali, Rwanda (Prof A Sheikh MD, M G Shrime MD); Arba Minch University, Arba Minch, Ethiopia (A Y Endries MPH, G Temam Shifa MPH); Arak University of Medical Sciences, Arak, Iran (B Eshrati PhD); Multiple Sclerosis Research Center, Tehran, Iran (S Eskandarieh PhD); Department of Health, Manila, Philippines (E A Faraon MD); Federal University of Sergipe, Aracaju, Brazil (Prof A Faro PhD); Doctor Evidence, Santa Monica, CA, USA (M S Fazeli MD, R Milam BS); National Institute for Stroke and Applied Neurosciences, Auckland University of Technology, Auckland, New Zealand (V L Feigin PhD); Institute Health, Faculty of Public Health, Department of Health, Behavior and Society (N Fentahun PhD), Jimma University, Jimma, Ethiopia (T T Gebrehiwot MPH, A T Gebremedhin MPH, A Workicho MPH); CBQF–Center for Biotechnology and Fine Chemistry–Associate Laboratory, Faculty of

Biotechnology, Catholic University of Portugal, Porto, Portugal (J C Fernandes PhD); Heller Graduate School, Brandeis University, Waltham, MA, USA (D O Fijabi MBBS); Kaiser Permanente, Fontana, CA, USA (I Filip MD); School of Public Health, Bielefeld University, Bielefeld, Germany (F Fischer PhD); Fred Hutchinson Cancer Research Center, Seattle, WA, USA (C Fitzmaurice MD); Escola Nacional de Saúde Pública Sergio Arouca, Rio de Janeiro, Brazil (L S Flor MPH); Universidade Federal do Espírito Santo, Vitoria, Brazil (L S Flor MPH); Institute of Gerontology, Academy of Medical Science, Kyiv, Ukraine (N Foigt PhD); Department of Epidemiology and Public Health (T Fürst PhD), Swiss Tropical and Public Health Institute, Basel, Switzerland (C K Karema MSc); University of Basel, Basel, Switzerland (T Fürst PhD); National Center for Disease Control & Public Health, Tbilisi, Georgia (K Gambashidze MS, A Gamkrelidze PhD, K Kazanjan MS, M Kereselidze PhD, M Shakh-Nazarova MS, L Sturua PhD); Ludwig Maximilians University, Munich, Germany (A T Gebremedhin MPH); Division of Human Nutrition (J M Geleijnse PhD), Wageningen University, Wageningen, Netherlands; Department of Nutrition, Babol, Iran (R Ghadimi PhD); University Hospital of Dijon, Dijon, France (Prof M Giroud MD); Kersa Health and Demographic Surveillance System, Harar, Ethiopia (M Gishu MS); Jawaharlal Nehru University, New Delhi, India (S Goli PhD); University of Massachusetts Boston, Boston, MA, USA (Prof P N Gona PhD); Instituto de Investigaciones Cientificas y Servicios de Alta Tecnologia– INDICASAT-AIP, Ciudad del Saber, Panama (A Goodridge PhD); Department of Health and Social Affairs, Government of the Federated States of Micronesia, Palikir, Federated States of Micronesia (S V Gopalani MPH); Organisation for Economic Co-operation and Development, Paris, France (Y Goryakin PhD); Boston University School of Medicine, Boston, MA, USA (A Grada MD); University Hospital Policlinico "Vittorio Emanuele", Catania, Italy (G Grosso PhD); NNEdPro Global Centre for Nutrition and Health, Cambridge, UK (G Grosso PhD); Departments of Microbiology and Epidemiology & Biostatistics, Saint James School of Medicine, The Quarter, Anguilla (Prof H C Gugnani PhD); West Virginia Bureau for Public Health, Charleston, WV, USA (R Gupta MD); Eternal Heart Care Centre and Research Institute, Jaipur, India (R Gupta PhD); Montefiore Medical Center, Bronx, NY, USA (T Gupta MD); Albert Einstein College of Medicine, Bronx, NY, USA (T Gupta, Prof H Hosgood PhD); Indian Institute of Technology Kanpur, Kanpur, India (Prof T Gupta DSc); Department of Anthropology (V Gupta PhD), University of Delhi, Delhi, India; Department of Public Health (S Polinder PhD), Erasmus MC, University Medical Center Rotterdam, Rotterdam, Netherlands (J A Haagsma PhD); Department of Clinical Neurological Sciences (L A Sposato MD), Western University, London, ON, Canada (Prof V Hachinski DSc, T O Olagunju MD); Kilte Awlaelo Health and Demographic Surveillance System, Mekelle, Ethiopia (G B Hailu MSc); Arabian Gulf University, Manama, Bahrain (Prof R R Hamadeh DPhil); Hamdan Bin Mohammed Smart University, Dubai, United Arab Emirates (S Hamidi DrPH); School of Medicine and Pharmacology (Prof G J Hankey MD), University of Western Australia, Perth, WA, Australia (A Sahebkar PhD); Harry Perkins Institute of Medical Research, Nedlands, WA, Australia (Prof G J Hankey MD); Western Australian Neuroscience Research Institute, Nedlands, WA, Australia (Prof G J Hankey MD); Eunice Gibson Polyclinic, Bridgetown, Barbados (H C Harewood MPH); Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, India (S Harikrishnan DM); Research and Development Unit (A Koyanagi MD), Parc Sanitari Sant Joan de Déu–CIBERSAM, Barcelona, Spain (J Haro MD); Child Neuropsychology (S J C Hearps PGDipBiostat), Murdoch Childrens Research Hospital, Parkville, VIC, Australia; Faculty of Health, Hormozgan University of Medical Sciences, Bandar Abbas, Iran (M Heidari PhD); School of Public Health (D Hendrie PhD), School of Public Health (T R Miller PhD), Curtin University, Perth, WA, Australia; Gorgas Memorial Institute for Studies of Health, Panama, Panama (Prof V H Herrera Ballesteros MS); University of Panama, Panama, Panama (Prof V H Herrera Ballesteros MS); Department of Statistics and Econometrics (Prof C Herteliu PhD), Bucharest University of Economic Studies, Bucharest, Romania (B V Ileanu PhD, Prof A Mirica PhD, A Pana MPH); Samara University, Samara, Ethiopia (M K Hiluf MPH, M L Liben MPH); Department of Epidemiology, Mailman School of Public Health (Prof H W Hoek MD), Columbia University, New York, NY, USA (Prof V Skirbekk PhD); Guilan Road Trauma Research Center, Guilan University of Medical Sciences, Rasht, Iran (E Homaie Rad PhD); Department of Pulmonology (N Horita MD), Yokohama City University Graduate School of Medicine, Yokohama, Japan; Public Health Division (D G Hoy PhD), The Pacific Community, Noumea, New Caledonia; Department of Epidemiology (Prof M Hsairi MD), Salah Azaiz Institute, Tunis, Tunisia; Department of Epidemiology and Health Statistics, School of Public Health (G Hu PhD), Central South University, Changsha, China; National Centre for Register-Based Research, Aarhus School of Business and Social Sciences (Prof J J McGrath PhD), Aarhus University, Aarhus, Denmark (K M Iburg PhD); Sriwijaya University, Palembang, Indonesia (Prof F Idris PhD); Social Security Administering Body for Health, Jakarta, Indonesia (Prof F Idris PhD); US Centers for Disease Control and Prevention, Pretoria, South Africa (Prof E U Igumbor PhD); School of Public Health, University of the Western Cape, Cape Town, Western Cape, South Africa (Prof E U Igumbor PhD); National Public Health Institute, Monrovia, Liberia (O S Ilesanmi MD); National Institute for Health Development, Tallinn, Estonia (K Innos PhD); Prevention of Metabolic Disorders Research Center, Research Institute for Endocrine Sciences, Tehran, Iran (S N Irvani MD); Ophthalmic Research Center (M Yaseri PhD), School of Public Health (N Jahanmehr PhD), Shahid Beheshti University of Medical Sciences, Tehran, Tehran, Iran (S N Irvani MD, A Khajavi MS); Surveillance and Health Services Research, American Cancer Society, Atlanta, GA, USA (F Islami PhD); MCH Division, USAID—Global Health Bureau, HIDN, Washington, DC, USA (T A Jacobs MD); Department of Global and Community Health (K H Jacobsen PhD), George Mason University, Fairfax, Virginia, USA; Jain hospital MSS, Kanpur, India (R Jain MD); National Centre For Disease Control Delhi, Delhi, India (S K Jain MD); Faculty of Medical Sciences, University of Kragujevac, Kragujevac, Serbia (Prof M M Jakovljevic PhD); University of Aberdeen, Aberdeen, UK (M Javanbakht PhD); Postgraduate Institute of Medicine, Colombo, Sri Lanka (A U Jayatilleke PhD); Institute of Violence and Injury Prevention, Colombo, Western, Sri Lanka (A U Jayatilleke PhD); Centre for Chronic Disease Control, New Delhi, India (P Jeemon PhD); Banaras Hindu University, Varanasi, India (R P Jha MSc); The George Institute for Global Health, New Delhi, India (Prof V Jha DM, O John MD, S Shariful Islam PhD); Institute of Health and Nutrition Sciences, Czestochowa University of Technology, Czestochowa, Poland (Prof J Jóźwiak PhD); Department of Ophthalmology, Medical Faculty Mannheim, Ruprecht-Karls-University Heidelberg, Mannheim, Germany (Prof J B Jonas MD); National Institute of Epidemiology (V Joshua PhD), Indian Council of Medical Research, Chennai, India (M Sharma PhD); Institute of Family Medicine and Public Health, University of Tartu, Tartu, Estonia (M Jürisson MD); University College Cork, Cork, Ireland (Z Kabir PhD); London School of Economics and Political Science, London, UK (R Kadel MPH); SCB Medical College, Cuttack, India (Prof C Kar DM); European Observatory on Health Systems and Policies, London, UK (M Karanikolos MPH); Epidemiological and Statistical Methods Research Group, Helmholtz Centre for Infection Research, Braunschweig, Germany (A Karch MD); Hannover-Braunschweig Site, German Center for Infection Research, Braunschweig, Germany (A Karch); Quality and Equity Health Care, Kigali, Rwanda (C K Karema MSc); University of Washington Tacoma, Tacoma, WA, USA (S M Karimi PhD); Department of Anesthesiology & Pain Medicine, Seattle Children's Hospital, Seattle, WA, USA (N J Kassebaum MD); MRC/CSO Social & Public Health Sciences Unit, University of Glasgow, Glasgow, UK (S V Katikireddi PhD); Oklahoma State University, Tulsa, OK, USA (A Kaul MD); School of Public Health, University of Tokyo, Tokyo, Japan (Prof N Kawakami MD); Institute of Tropical and Infectious Diseases, Nairobi, Kenya (P N Keiyoro PhD); School of Continuing and Distance Education, Nairobi, Kenya (P N Keiyoro PhD); UKZN Gastrointestinal Cancer Research Centre (Prof B Sartorius PhD), South African Medical Research Council, Cape Town, South Africa (A P Kengne PhD, Prof A E Schutte PhD); Department of Psychiatry (Prof D J Stein PhD), Faculty of Health Sciences, Hatter Institute for Cardiovascular Research in Africa (Prof K Sliwa PhD), University of Cape Town, Cape Town, Western Cape, South Africa (A P Kengne PhD, J N Noubiap MD); Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran (M A Khafaie PhD); Health Services Academy, Islamabad, Pakistan (E A Khan MD); Department of Microbiology and Immunology, College of Medicine & Health Sciences

(G Khan PhD), United Arab Emirates University, Al Ain, United Arab Emirates; The University of Newcastle, Australia, Newcastle, NSW, Australia (M N Khan MS); Jatiya Kabi Kazi Nazrul Islam University, Mymensingh, Bangladesh (M N Khan MS); University of Tennessee Health Science Center, Memphis, TN, USA (M Khan MD); Department of Health Services, Health Management Information System, Kathmandu, Nepal (M N Khanal MA); Institute of Health Policy and Management, Seoul National University Medical Center, Seoul, South Korea (Prof Y Khang MD); Department of Public Health and Department of Family Medicine, College of Medicine, Mohammed Ibn Saudi University, Riyadh, Saudi Arabia (A T A Khoja MD); Iranian Ministry of Health and Medical Education, Tehran, Iran (A Khosravi PhD); Department of Nutrition and Health Science, Ball State University, Muncie, IN, USA (J Khubchandani PhD); Kenya Revenue Authority, Nairobi, Kenya (D N Kiirithio MSc); Synotech Consultants, Nairobi, Kenya (D N Kiirithio MSc); Department of Health Sciences, Northeastern University, Boston, MA, USA (Prof D Kim DrPH); School of Medicine, Xiamen University Malaysia Campus, Sepang, Malaysia (Y Kim PhD); Simmons College, Boston, MA, USA (R W Kimokoti MD); Centre for Research and Action in Public Health, University of Canberra, Canberra, ACT, Australia (Y Kinfu PhD); Oslo University, Oslo, Norway (Prof A Kisa PhD); School of Population and Public Health, Faculty of Medicine (Prof N Sarrafzadegan MD), University of British Columbia, Vancouver, BC, Canada (Prof N Kissoon MD, J A Kopec PhD, S Murthy MD, F Pourmalek PhD); Global Healthcare Consulting, New Delhi, India (S Kochhar MD); Department of Preventive Cardiology, National Cerebral and Cardiovascular Center, Suita, Japan (Y Kokubo PhD); Center for Community Empowerment, Health Policy and Humanities, National Institute of Health Research & Development, Jakarta, Indonesia (S Kosen MD); Sher-i-Kashmir Institute of Medical Sciences, Srinagar, India (Prof P A Koul MD); Research Center of Neurology, Moscow, Russia (M Kravchenko PhD, Prof M A Piradov DSc); Panjab University, Chandigarh, India (K Krishan PhD); Department of Demography and Public Health Research Institute and Department of Social and Preventive Medicine, School of Public Health, University of Montreal, Montreal, QC, Canada (Prof B Kuate Defo PhD); State Institution "Public Health Center" of the Ministry of Health of Ukraine, Kyiv, Ukraine (I Kuzin MPH); Center for Translation Research and Implementation Science, National Heart, Lung, and Blood Institute (G A Mensah MD), Institute of Health Policy and Development Studies (Prof H Lam PhD), National Institutes of Health, Manila, Philippines; National Cancer Institute, Rockville, MD, USA (Q Lan PhD); Children's Hospital of Eastern Ontario Research Institute, Ottawa, ON, Canada (J J Lang PhD); Help Me See, Inc, New York, NY, USA (V C Lansingh PhD); Instituo Mexicano de Oftalmologia, Queretaro, Mexico (V C Lansingh); School of Medicine Federal University of Minas Gerais, Belo Horizonte, Brazil (S Lansky PhD); Secretaria Municipal de Saúde, Belo Horizonte, Brazil (S Lansky PhD); Department of Medical Sciences (Prof A Larsson PhD), Uppsala University, Uppsala, Sweden; Managerial Epidemiology Research Center, Department of Public Health, School of Nursing and Midwifery (S Safiri PhD), Maragheh University of Medical Sciences, Maragheh, Iran (A Latifi PhD); ISGlobal, Hospital Clinic (Prof J V Lazarus PhD), University of Barcelona, Barcelona, Spain; CHIP, Rigshospitalet (Prof J V Lazarus), Department of Neurology, Rigshospitalet (T Truelsen DMSc), University of Copenhagen, Copenhagen, Denmark; College of Optometry (J L Leasher OD), Nova Southeastern University, Fort Lauderdale, Florida, USA; Hong Kong Polytechnic University, Hong Kong, China (P H Lee PhD); State University of New York, Albany, Rensselaer, NY, USA (R Leung PhD); Tuscany Regional Centre for Occupational Injuries and Diseases, Florence, Italy (M Levi PhD); San Francisco VA Medical Center, San Francisco, CA, USA (Y Li PhD); National Office for Maternal and Child Health Surveillance, West China Second University Hospital (Prof J Liang MD), Sichuan University, Chengdu, China; University of Malaya, Kuala Lumpur, Malaysia (L Lim MD); The Chinese University of Hong Kong, Shatin, China (L Lim MD); University of Haifa, Haifa, Israel (Prof S Linn MD); Radboud University Medical Center, Nijmegen, Netherlands (Prof S Listl PhD); National Center for Chronic and Noncommunicable Disease Control and Prevention (S Liu PhD, P Yin PhD, Prof M Zhou PhD), Chinese Center for Disease Control and Prevention, Beijing, China; All India Institute of Medical Sciences, New Delhi, India (R Lodha MD, Prof R Malhotra MS, N Naik DM, A Roy DM, R Sagar MD, Prof N Tandon PhD); Children's Hospital of Philadelphia (S A Lorch MD), The Children's Hospital of Philadelphia, University of Pennsylvania School of Medicine, Philadelphia, PA, USA; Institute of Nutrition (Prof S Lorkowski PhD), Friedrich Schiller University Jena, Jena, Germany; Competence Cluster for Nutrition and Cardiovascular Health (nutriCARD) Halle-Jena-Leipzig, Jena, Germany (Prof S Lorkowski PhD); Aintree University Hospital National Health Service Foundation Trust, Liverpool, UK (Prof R Lunevicius PhD); School of Medicine (Prof R Lunevicius PhD), University of Liverpool, Liverpool, UK; Farr Institute (Prof R A Lyons MD), Swansea University, Swansea, UK; Center for Research on Population and Health, Faculty of Health Sciences (Prof C M Obermeyer DSc), Department of Psychiatry (F Maalouf MD), American University of Beirut, Beirut, Lebanon; Royal Children's Hospital Melbourne, Melbourne, VIC, Australia (M T Mackay PhD); Mansoura Faculty of Medicine, Mansoura, Egypt (H Magdy Abd El Razek MBBCH); Aswan University Hospital (M Magdy Abd El Razek MBBCH), Aswan Faculty of Medicine, Aswan, Egypt; Faculty of Health Sciences and Social Work, Department of Public Health (M Majdan PhD), Trnava University, Trnava, Slovakia; National Institute of Health Research, Tehran, Iran (Prof R Majdzadeh PhD); Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (Prof D C Malta PhD); Ethiopian Public Health Association, Addis Ababa, Ethiopia (T Manyazewal PhD); Hospital Universitario Doctor Peset, Valencia, Spain (J Martinez-Raga PhD, M Tortajada PhD); CEU Cardinal Herrera University, Moncada, Spain (J Martinez-Raga PhD); Hospital de Clinicas de Porto Alegre, Porto Alegre, Brazil (Prof S C O Martins PhD); Hospital Moinhos de Vento, Porto Alegre, Brazil (Prof S C O Martins PhD); Federal Institute of Education, Science and Technology of Ceará, Caucaia, Brazil (F R Martins-Melo PhD); Synlab Academy, Mannheim, Germany (Prof W März MD); Clinical Institute of Medical and Chemical Laboratory Diagnostics, (Prof W März MD), Medical University of Graz, Graz, Austria; George Institute for Global Health India, New Delhi, India (P K Maulik PhD); George Institute for Global Health, Oxford University, Oxford, UK (P K Maulik PhD); Department of Biology and Biological Engineering, Food and Nutrition Science (M Mazidi PhD), Chalmers University of Technology, Gothenburg, Sweden; University Hospitals Bristol NHS Foundation Trust, Bristol, UK (C McAlinden PhD); Public Health Wales, Swansea, UK (C McAlinden PhD); Queensland Centre for Mental Health Research (Prof J J McGrath PhD), The Park Centre for Mental Health, Wacol, QLD, Australia; Ipas Nepal, Kathmandu, Nepal (S Mehata PhD); National Institute of Cancer Prevention & Research, Noida, India (Prof R Mehrotra DPhil); University of California, San Francisco, San Francisco, California, USA (K M Mehta DSc); MGM Medical College, Navi Mumbai, India (V Mehta MBBS); Competence Cluster for Nutrition and Cardiovascular Health (nutriCARD) (T Meier PhD), Institut für Medizinische Epidemiologie, Biometrie und Informatik (I Shiue PhD), Martin-Luther-Universität Halle-Wittenberg, Saale, Germany; University of West Florida, Pensacola, FL, USA (P Memiah PhD); Saudi Ministry of Health, Riyadh, Saudi Arabia (Prof Z A Memish MD); College of Medicine (Prof Z A Memish MD), Alfaisal University, Riyadh, Saudi Arabia; United Nations Population Fund, Lima, Peru (W Mendoza MD); Comprehensive Cancer Center, Breast Surgery Unit (T J Meretoja PhD), Department of Neurology (A Meretoja PhD), Helsinki University Hospital, Helsinki, Finland; Finnish Institute of Occupational Health, Work Organizations, Work Disability Program, Department of Public Health, Faculty of Medicine (R Shiri PhD), University of Helsinki, Helsinki, Finland (T J Meretoja PhD); Pomeranian Medical University, Szczecin, Poland (Prof T Miazgowski PhD); Friedman School of Nutrition Science and Policy (R Micha PhD), Tufts University, Boston, Massachusetts, USA (P Shi PhD); Pacific Institute for Research & Evaluation, Calverton, MD, USA (T R Miller PhD); Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, Thiruvananthapuram, India (G Mini PhD, Prof P Sylaja DM); Amrita Institute of Medical Sciences, Kochi, India (G Mini PhD); Kyrgyz State Medical Academy, Bishkek, Kyrgyzstan (Prof E M Mirrakhimov PhD); National Center of Cardiology and Internal Disease, Bishkek, Kyrgyzstan (Prof E M Mirrakhimov PhD); Brien Holden Vision Institute (Prof S Resnikoff MD), School of Optometry and Vision Science (Prof S Resnikoff MD), University of New South Wales, Kensington, NSW, Australia (Prof P B Mitchell MD, Prof P S Sachdev MD); Department of Ophthalmology, Medical Faculty

Mannheim (S Panda-Jonas MD), Institute of Public Health (B Moazen MS), University of Heidelberg, Heidelberg, Germany; Salahaddin University, Erbil, Iraq (K A Mohammad PhD); Ishik University, Erbil, Iraq (K A Mohammad PhD); Hamedan University of Medical Sciences, Hamedan, Iran (R Mohammadibakhsh PhD); Jigjiga University, Jigjiga, Ethiopia (M A Mohammed MS); Health Systems and Policy Research Unit (S Mohammed PhD), Ahmadu Bello University, Zaria, Nigeria (M B Sufiyan MBA); Reproductive Health and ObGyn School of Medicine and Health Sciences (Prof G L D Mola DPH), University of Papua New Guinea, Boroko, Papua New Guinea; Institute for Maternal and Child Health, IRCCS "Burlo Garofolo", Trieste, Italy (L Monasta DSc, L Ronfani PhD); Lancaster Medical School (P Moraga PhD), Lancaster University, Lancaster, UK; International Laboratory for Air Quality and Health (L Morawska PhD), Queensland University of Technology, Brisbane, QLD, Australia (Q G To MS); Gorgas Memorial Institute for Health Studies, Panama City, Panama (I Moreno Velasquez PhD); National Center for Child Health and Development, Setagaya, Japan (R Mori PhD, C Nagata PhD, R Tobe-Gai PhD); Competence Center Mortality-Follow-Up of the German National Cohort (A Werdecker PhD), Federal Institute for Population Research, Wiesbaden, Germany (Prof U O Mueller PhD, R Westerman PhD); ICMR-National Institute of Epidemiology, Chennai, India (M Murhekar MD); London School of Hygiene and Tropical Medicine, London, UK (Prof G V S Murthy MD); University of Jos, Jos, Nigeria (J Musa MD); Jos University Teaching Hospital, Jos, Nigeria (J Musa MD); School of Medical Sciences (K Musa MD), University of Science Malaysia, Kubang Kerian, Malaysia; Helping Hands Foundation, Multan, Pakistan (Prof G Mustafa MD); Nishtar Medical University, Multan, Pakistan (Prof G Mustafa MD); Institute of Epidemiology and Medical Biometry (Prof D Rothenbacher MD), Ulm University, Ulm, Germany (Prof G Nagel PhD); International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b), Dhaka, Bangladesh (A Naheed PhD, A R Sarker MS, S Zaman MPH); Research Center for Environmental Determinants of Health, School of Public Health (S Rezaei PhD), Kermanshah University of Medical Sciences, Kermanshah, Iran (F Najafi PhD, S Siabani PhD, M Soofi PhD); Azienda Ospedaliera Papa Giovanni XXIII, Bergamo, Italy (Prof L Naldi MD); Suraj Eye Institute, Nagpur, India (V Nangia MD); Department of Public Health, Faculty of Medicine and Biomedical Sciences, University of Yaoundé, Yaoundé, Cameroon (J N Nansseu MD); Department for the Control of Disease, Epidemics and Pandemics, Ministry of Public Health, Yaoundé, Cameroon (J N Nansseu MD); Hospital das Clínicas da Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (Prof B R Nascimento PhD, Prof A L Ribeiro MD); Hospital Universitário Ciências Médicas, Belo Horizonte, Brazil (Prof B R Nascimento PhD); KEMRI-Wellcome Trust, Kilifi, Kenya (Prof C R Newton MD); University of Nairobi, Nairobi, Kenya (J W Ngunjiri PhD); Institute for Global Health Innovations, Duy Tan University, Da Nang, Vietnam (T H Nguyen MSc, V M Nong MSc); Department of Public Health, Semarang State University, Semarang City, Indonesia (D N A Ningrum MPH); Graduate Institute of Biomedical Informatics, Taipei Medical University, Taipei City, Taiwan (D N A Ningrum MPH); University of Bergen, Bergen, Norway (Prof O F Norheim PhD); Medical Diagnostic Centre, Yaounde, Cameroon (J N Noubiap MD); Rwanda Ministry of Health, Kigali, Rwanda (A Nyandwi MPH); Centre for Health Research (F A Ogbo MPH), Western Sydney University, Sydney, NSW, Australia (Prof A M N Renzaho PhD); Department of Preventive Medicine, School of Medicine, Kyung Hee University, Seoul, South Korea (Prof I Oh PhD); Human Sciences Research Council, South Africa and University of KwaZulu-Natal, Durban, South Africa (O Oladimeji MS); Department of Psychiatry, Lagos University Teaching Hospital, Lagos, Nigeria (A T Olagunju MD); Universidad Autonoma de Chile, Talca, Chile (Prof P R Olivares PhD); Center for Healthy Start Initiative, Lagos, Nigeria (B O Olusanya PhD, J O Olusanya MBA); Lira District Local Government, Lira Municipal Council, Uganda (J Opio MPH); Division of Epidemiology & Biostatistics, Graduate School of Public Health (Prof E Oren PhD), San Diego State University, San Diego, CA, USA; IIS-Fundacion Jimenez Diaz-UAM, Madrid, Spain (Prof A Ortiz PhD); Karabuk University, Karabuk, Turkey (R Ozdemir PhD); JSS Medical College, JSS University, Mysore, India (Prof M PA DNB); Christian Medical College Ludhiana, Ludhiana, India (J D Pandian DM); Department of Medical Humanities and Social Medicine, College of Medicine, Kosin University, Busan, South Korea (E Park PhD); White Plains Hospital, White Plains, NY, USA (T Patel MD); Krishan Institute of Medical Sciences, Deemed University, School of Dental Sciences, Karad, India (S T Patil MDS); National Health System Resource Center, Ministry of Health & Family Welfare, New Delhi, India (A Patle MPH); Clinical Research, Diabetes Research Society, Hyderabad, India (V R Paturi MD); DiabetOmics, Portland, OR, USA (V R Paturi MD); UK Department for International Development, Lalitpur, Nepal (D Paudel PhD); Instituto de Comunicação e Informação Científica e Tecnológica em Saúde da Fundação Oswaldo Cruz, Rio de Janeiro, Brazil (M d Pedroso PhD); REQUIMTE/LAQV, Laboratório de Farmacognosia, Departamento de Química, Faculdade de Farmácia, Universidade do Porto, Porto, Portugal (Prof D M Pereira PhD); Health Metrics Unit, University of Gothenburg, Gothenburg, Sweden (Prof M Petzold PhD); University of the Witwatersrand, Johannesburg, South Africa (Prof M Petzold PhD); Shanghai Jiao Tong University School of Medicine, Shanghai, China (Prof M R Phillips MD); Durban University of Technology, Durban, South Africa (J D Pillay PhD); University of Newcastle, Callaghan, NSW, Australia (Prof C D Pond PhD); University Medical Center Groningen, Groningen, Netherlands (Prof M J Postma PhD); Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India (S Prakash PhD); Charotar University of Science and Technology, Anand, India (Prof V Prakash MPT); Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, India (Prof N Prasad MD); The Fred Hollows Foundation, Melbourne, VIC, Australia (N M Prasad); Non-communicable Diseases Research Center, Alborz University of Medical Sciences, Karaj, Iran (M Qorbani PhD); Commemorative Gorgas Institute for Health Studies, Panama, Panama (H K Quintana PhD); A T Still University, Kirksville, MO, USA (A Radfar MD); Contech International Health Consultants, Lahore, Pakistan (A Rafay MS, Prof S M Rana PhD); Contech School of Public Health, Lahore, Pakistan (A Rafay, Prof S M Rana); Research and Evaluation Division, BRAC, Dhaka, Bangladesh (M Rahman PhD); Sweidi Hospital, Riyadh, Saudi Arabia (S U Rahman FCPS); Society for Health and Demographic Surveillance, Suri, India (R Rai MPH); Nizam's Institute of Medical Sciences, Hyderabad, India (Prof S Raju DM); Instituto Gonçalo Muniz, Fundação Oswaldo Cruz, Salvador, Brazil (Prof D Rasella PhD); North Hampshire Hospitals, Basingstroke, UK (D L Rawaf MD); University College London Hospitals, London, UK (D L Rawaf); Human Sciences Research Council, Cape Town, South Africa (P Reddy PhD); Loma Linda University Medical Center, Loma Linda, CA, USA (C Reis MD); Azienda Socio-Sanitaria Territoriale, Papa Giovanni XXIII, Bergamo, Italy (Prof G Remuzzi MD); Department of Biomedical and Clinical Sciences "L Sacco", University of Milan, Milan, Italy (Prof G Remuzzi MD); Federal University of Uberlândia, Uberlandia, Brazil (L Roever MPH); Golestan Research Center of Gastroenterology and Hepatology, Golestan University of Medical Sciences, Gorgan, Iran (G Roshandel PhD); BARC Hospital, HBNI University, Mumbai, India (N Roy MD); Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania (G M Ruhago PhD, B F Sunguya PhD); National Institute for Research in Environmental Health, Bhopal, India (Prof Y D Sabde MD); Prince of Wales Hospital, Randwick, NSW, Australia (Prof P S Sachdev MD); Mashhad University of Medical Sciences, Mashhad, Iran (A Sahebkar PhD); Fiocruz, Rio de Janeiro, Brazil (R d Saldanha MS); Faculty of Science, Ain Shams University, Cairo, Egypt (A M Samy PhD); Department of Public Health (M Sawhney PhD), J Edwards School of Medicine (J R Sanabria MD), Marshall University, Huntington, WV, USA; Case Western Reserve University, Cleveland, OH, USA (J R Sanabria MD); Sancheti Institute for Orthopaedics & Rehabilitation, Pune, India (P K Sancheti MS); IIS-Fundacion Jimenez Diaz, Madrid, Spain (M Sanchez-Niño PhD); Queensland Centre for Mental Health Research, Brisbane, QLD, Australia (D Santomauro, Prof H A Whiteford PhD); Isfahan Cardiovascular Research Institute, Isfahan, Iran (Prof N Sarrafzadegan MD); Public Health Medicine, School of Nursing and Public Health (Prof B Sartorius PhD), University of KwaZulu-Natal, Durban, South Africa; Centre of Advanced Study in Psychology, Utkal University, Bhubaneswar, India (M Satpathy PhD); Center for Disease Burden (Prof S Vollset DrPH), Norwegian Institute of Public Health, Oslo, Norway (M Savic PhD, Prof V Skirbekk PhD); Bayer Turkey, Istanbul, Turkey (M I Saylan PhD); Global Perspective Studies Unit (J Schmidhuber PhD), Food and

Agriculture Organization, Rome, Italy; Federal University of Santa Catarina, Florianópolis, Brazil (I J C Schneider PhD, D A S Silva PhD); Hypertension in Africa Research Team, North-West University, Potchefstroom, South Africa (Prof A E Schutte PhD); Croatian National Cancer Registry, Croatian Institute of Public Health, Zagreb, Croatia (M Sekerija PhD); School of Public Health Dr Andrija Å tampar, University of Zagreb School of Medicine, Zagreb, Croatia (M Sekerija PhD); Department of Rehabilitation Medicine (A Shafieesabet MD), New York University Langone Medical Center, New York, NY, USA; Middle East Liver Disease Center, Tehran, Iran (H Sharafi PhD); Institute for Physical Activity and Nutrition (S Shariful Islam PhD), Deakin University, Burwood, VIC, Australia (Prof M A Stokes PhD); University School of Management and Entrepreneurship, Delhi Technological University, Delhi, India (R Sharma MA); Department of Pulmonary Medicine, Zhongshan Hospital, Fudan University, Shanghai, China (J She MD); National Institute of Infectious Diseases, Tokyo, Japan (M Shigematsu PhD); Tachikawa Hospital, Tokyo, Japan (Y Shinohara PhD); Alzheimer Scotland Dementia Research Centre (I Shiue PhD), University of Edinburgh, Edinburgh, UK (Prof A Sheikh MD, I N Soyiri PhD); Symbiosis Institute of Health Sciences, Symbiosis International University, Pune, India (Prof S R Shukla PhD); Diabetes Unit, KEM Hospital Research Centre, Pune, India (Prof S R Shukla); University of Technology Sydney, Sydney, NSW, Australia (S Siabani PhD); Reykjavik University, Reykjavik, Iceland (I D Sigfusdottir PhD); University of Pennsylvania, Philadelphia, PA, USA (D H Silberberg MD, J Weiss MA); Brasília University, Brasília, Brazil (D G A Silveira MD); Max Hospital, Ghaziabad, India (Prof N P Singh MD); Asthma Bhawan, Jaipur, India (V Singh MD); School of Preventive Oncology, Patna, India (D N Sinha PhD); WHO FCTC Global Knowledge Hub on Smokeless Tobacco, National Institute of Cancer Prevention, Noida, India (D N Sinha PhD); Ethiopian Medical Association, Addis Ababa, Ethiopia (A H Sinke MD); King Khalid University Hospital, Riyadh, Saudi Arabia (B H A Sobaih MD); Tunisian Center for Public Health, Les Berges du Lac, Tunisia (M Somai MD); Dartmouth College, Hanover, New Hampshire, USA (S Soneji PhD); Instituto de Investigación Hospital Universitario de la Princesa (IISP), Madrid, Spain (Prof J B Soriano MD); Universidad Autónoma de Madrid, Madrid, Spain (Prof J B Soriano); Department of Community Medicine (C T Sreeramareddy MD), International Medical University, Kuala Lumpur, Malaysia; Attikon University Hospital, Athens, Greece (V Stathopoulou PhD); University of East Anglia, Norwich, UK (Prof N Steel PhD); Public Health England, London, UK (Prof N Steel); South African Medical Research Council Unit on Anxiety & Stress Disorders, Cape Town, Western Cape, South Africa (Prof D J Stein PhD); Ministry of Health, Kingdom of Saudi Arabia, Riyadh, Saudi Arabia (R A Suliankatchi MD); Departments of Criminology, Law & Society, Sociology, and Public Health, University of California, Irvine, Irvine, CA, USA (Prof B L Sykes PhD); Mizan-Tepi University, Mizan-Teferi, Ethiopia (A H Tadesse MPH); Instituto Superior de Ciências da Saúde Egas Moniz, Almada, Portugal (Prof N Taveira PhD); Faculty of Pharmacy, Universidade de Lisboa, Lisboa, Portugal (Prof N Taveira PhD); Department of Anesthesiology, University of Virginia, Charlottesville, VA, USA (A S Terkawi MD); Department of Anesthesiology, King Fahad Medical City, Riyadh, Saudi Arabia (A S Terkawi MD); Outcomes Research Consortium, Cleveland Clinic, Cleveland, OH, USA (A S Terkawi); University of Calgary, Calgary, AB, Canada (Prof M Tonelli MD); Institute of Public Health, Faculty of Health Sciences, Jagiellonian University Medical College, Kraków, Poland (R Topor-Madry PhD); Faculty of Health Sciences, Wroclaw Medical University, Wroclaw, Poland (R Topor-Madry PhD); Aristotle University of Thessaloniki, Thessaloniki, Greece (Prof F Topouzis PhD); School of Medicine), University of Valencia, Valencia, Spain (M Tortajada PhD; Hanoi Medical University, Hanoi, Vietnam (B X Tran PhD); Auckland Cancer Society Research Centre, University of Auckland, Auckland, New Zealand (K B Tran MD); University of Louisville School of Medicine, Louisville, KY, USA (A Tripathi PhD); National Institute for Research in Tuberculosis, Chennai, India (S P Tripathy MD); Parc Sanitari Sant Joan de Déu, Fundació Sant Joan de Déu, Universitat de Barcelona, CIBERSAM, Barcelona, Spain (S Tyrovolas PhD); Department of Veterans Affairs, Washington, DC, USA (U S Uchendu MD); Department of Internal Medicine (K N Ukwaja MD), Federal Teaching Hospital, Abakaliki, Nigeria; Gomal Centre of Biochemistry and Biotechnology, Gomal University, Dera Ismail Khan, Pakistan (Prof I Ullah PhD); Programmatic Management of Drug Resistant TB Unit, TB Culture Laboratory, Mufti Mehmood Memorial Teaching Hospital, Dera Ismail Khan, Pakistan (Prof I Ullah PhD); Warwick Medical School, University of Warwick, Coventry, UK (Prof P S Gill DM, O A Uthman PhD); University of Nigeria, Nsukka, Enugu Campus, Enugu, Nigeria (Prof B S C Uzochukwu MD); Sociedad Argentina de Medicina, Ciudad Autónoma de Buenos Aires, Argentina (Prof P R Valdez PhD); Hospital Vélez Sarsfield, Ciudad Autónoma de Buenos Aires, Argentina (Prof P R Valdez PhD); UKK Institute for Health Promotion Research, Tampere, Finland (Prof T Vasankari PhD); Raffles Neuroscience Centre, Raffles Hospital, Singapore, Singapore (N Venketasubramanian MBBS); University of Bologna, Bologna, Italy (Prof F S Violante MD); Federal Research Institute for Health Organization and Informatics, Moscow, Russia (S K Vladimirov PhD); National Research University Higher School of Economics, Moscow, Russia (Prof V V Vlassov MD); Foundation University, Islamabad, Pakistan (Y Waheed PhD); VA Medical Center, Washington, DC, USA (M T Wallin MD); Neurology Department, Georgetown University, Washington, DC, USA (M T Wallin); Natural History Museum, London, UK (J L Walson MD); Zhongshan Hospital, Fudan University, Shanghai, China (Y Wang MD); The First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China (Y Wang MD); University of São Paulo Medical School, São Paulo, São Paulo, Brazil (Y Wang PhD); The University of Adelaide, Adelaide, SA, Australia (M M Wassie MS); Department of Research, Cancer Registry of Norway, Institute of Population-Based Cancer Research, Oslo, Norway (E Weiderpass); Department of Community Medicine, Faculty of Health Sciences, University of Tromsø, The Arctic University of Norway, Tromsø, Norway (E Weiderpass); Genetic Epidemiology Group, Folkhälsan Research Center, Helsinki, Finland (E Weiderpass); Royal Children's Hospital, Melbourne, VIC, Australia (R G Weintraub MBBS); Murdoch Childrens Research Institute, Melbourne, VIC, Australia (R G Weintraub); German National Cohort Consortium, Heidelberg, Germany (R Westerman PhD); VitroLive Sp z o.o., Szczecin, Poland (J Widecka PhD); Center for Global Health, Department of Neurology, Klinikum rechts der Isar, Technical University of Munich (TUM), Munich, Germany (Prof A S Winkler DrMed); Centre for Global Health, Institute of Health and Society, University of Oslo, Oslo, Norway (Prof A S Winkler); South African Medical Research Council, Cochrane South Africa, Cape Town, South Africa (Prof C S Wiysonge PhD); National Institute for Health Research Comprehensive Biomedical Research Centre, Guy's & St. Thomas' NHS Foundation Trust and King's College London, London, UK (Prof C D Wolfe MD); Ghent University, Ghent, Belgium (A Workicho MPH); NHS National Services Scotland, Glasgow, UK (G M A Wyper MS); University of Strathclyde, Glasgow, UK (G M A Wyper); St John's Medical College and Research Institute, Bangalore, India (Prof D Xavier MD); Department of Neurology, Jinling Hospital, Nanjing University School of Medicine, Nanjing, China (Prof G Xu PhD); Global Health Research Center, Duke Kunshan University, Kunshan, China (Prof L L Yan PhD); Department of Preventive Medicine, Northwestern University, Chicago, IL, USA (Y Yano MD); Woldia University, Woldia, Ethiopia (N B Yimer MS); Social Work and Social Administration Department, The Hong Kong Jockey Club Centre for Suicide Research and Prevention, University of Hong Kong, Hong Kong, China (Prof P Yip PhD); University of South Australia, Mawson Lakes, SA, Australia (B D Yirsaw PhD); Department of Biostatistics, School of Public Health, Kyoto University, Kyoto, Japan (N Yonemoto MPH); NCD Research to Policy Unit, Aga Khan University, East Africa, Nairobi, Kenya (Prof G Yonga MD); Department of Preventive Medicine, College of Medicine, Korea University, Seoul, South Korea (S Yoon PhD); School of Public Health, University of Kinshasa, Kinshasa, Democratic Republic of the Congo (M Yotebieng PhD); Jackson State University, Jackson, MS, USA (Prof M Z Younis DrPH); Department of Epidemiology and Biostatistics, School of Public Health, Global Health Institute, Wuhan University, Wuhan, China (Prof C Yu PhD); Institute of Oncology Ljubljana, Epidemiology and Cancer Registry, Ljubljana, Slovenia (Prof V Zadnik PhD); University Hospital of Setif, Setif, Algeria (Prof Z Zaidi DSc); National Office of MCH Surveillance of China, Chengdu, China (Prof J Zhu MD); Red Cross War Memorial Children's Hospital, Cape Town, South Africa (L J Zuhlke PhD).

Contributors

Nancy Fullman, Rafael Lozano, and Christopher J L Murray prepared the first draft of the manuscript. Jamal Yearwood ran the risk-standardisation analyses, constructed mortality-to-incidence ratios for cancers, and computed indices. Ryan M Barber created the original code and methodological approach for index construction. Julian Chalek and Erika Eldrenkamp generated figures and tables, and contributed to supplementary analyses. Chloe Shields provided project management and support. Nancy Fullman, Rafael Lozano, and Christopher J L Murray conceived this study and provided overall guidance. Nancy Fullman and Rafael Lozano finalised the manuscript on the basis of reviewer feedback. Please see the appendix for more detailed information about all authors' contributions to this work and the GBD 2016 results included in this analysis.

Declaration of interests

Carl Abelardo T Antonio reports grants and personal fees from Johnson & Johnson (Philippines), Inc, outside the submitted work. Johan Ärnlöv reports personal fees from AstraZeneca, outside the submitted work. Oliver Jerome Brady reports personal fees from Sanofi Pasteur, and grants from Janssen, outside the submitted work. Mir Sohail Fazeli reports personal fees from Doctor Evidence LLC, outside the submitted work. Panniyammakal Jeemon reports and Clinical and public health intermediate fellowship from the Wellcome Trust and Department of Biotechnology, India Alliance (2015–20), outside the submitted work. Jacek Józwiak reports grants and personal fees from VALEANT, personal fees from ALAB Laboratoria, personal fees from AMGEN, non-financial support from MICROLIFE, non-financial support from SERVIER, outside the submitted work. Nicholas J Kassebaum reports personal fees and non-financial support from Vifor Pharmaceuticals, outside the submitted work. Srinivasa Vittal Katikireddi reports grants from National Health Service (NHS) Research Scotland (SCAF/15/02), grants from Medical Research Council (MRC; MC_UU_12017/13 & MC_UU_12017/15), and grants from Scottish Government Chief Scientist Office (SPHSU13 & SPHSU15), during the conduct of the study. Jeffrey Victor Lazarus reports grants and personal fees from AbbVie, grants and personal fees from Gilead Sciences, grants and personal fees from MSD, personal fees from CEPHEID, outside the submitted work. Stefan Lorkowski reports that he is a member of the Executive Board of the German Nutrition Society, outside of the submitted work. Ronan A Lyons is supported by the Farr Institute, outside of the submitted work, which is supported by a 10-funder consortium: Arthritis Research UK, the British Heart Foundation, Cancer Research UK, the Economic and Social Research Council, the Engineering and Physical Sciences Research Council, the Medical Research Council, the National Institute of Health Research, the Health and Care Research Wales (Welsh Assembly Government), the Chief Scientist Office (Scottish Government Health Directorates), the Wellcome Trust, (MRC grant number MR/K006525/1). Winfried März reports grants and personal fees from Siemens Diagnostics, Aegerion Pharmaceuticals, AMGEN, AstraZeneca, Danone Research, Pfizer, BASF, Numares AG, and Berlin-Chemie, personal fees from Hoffmann LaRoche, MSD, Sanofi, and Synageva, grants from Abbott Diagnostics, and other from Synlab Holding Deutschland GmbH, outside the submitted work. Renata Micha reports support from National Institute of Health (NIH) grants during the conduct of the study, and research funding from Unilever and personal fees from the World Bank and Bunge, all outside the submitted work. Constance D Pond reports personal fees from Nutricia advisory board, outside the submitted work, and acted as an unpaid consultant to the Wicking Dementia Research and Education Centre in Tasmania for development of GP education on dementia (airfares and accommodation paid), and was paid as a dementia clinical lead and dementia pathways adviser for the Sydney North Primary, outside the submitted work. Maarten J Postma reports grants personal fees from various pharma companies, and holds 2% of stocks in Ingress Health while advising two pharmacoeconomics spin-off companies from the University of Groningen, outside the submitted work. Miloje Savic reports that from Feb 1, 2018, he is an employee of GSK Biologicals SA, Wavre, Belgium. Mark G Shrime reports grants from GE Foundation and from Damon Runyon Cancer Research Foundation, outside the submitted work. Jasvinder A Singh serves as the principal investigator for an investigator-initiated study funded by Horizon pharmaceuticals through a grant to DINORA, Inc, a 501c3 entity, and is on the steering committee of OMERACT, an international organisation that develops measures for clinical trials and receives arm's-length funding from 36 pharmaceutical companies, outside of the submitted work. Jeffrey D Stanaway reports grants from Merck, outside the submitted work. Dan J Stein reports personal fees from Lundbeck, Biocodex, Servier, and SUN, outside the submitted work. Denis Xavier reports grants from Cadila Pharmaceuticals, Boehringer Ingelheim, Sanofi Aventis, Pfizer, Bristol Myers Squibb, and United Health, outside the submitted work. All other authors declare no competing interests.

Acknowledgments

Barbora de Courten is supported by a National Heart Foundation Future Leader Fellowship (100864). Ai Koyanagi's work is supported by the Miguel Servet contract financed by the CP13/00150 and PI15/00862 projects, integrated into the National R + D + I and funded by the ISCIII —General Branch Evaluation and Promotion of Health Research—and the European Regional Development Fund (ERDF-FEDER). Alberto Ortiz was supported by Spanish Government (Instituto de Salud Carlos III RETIC REDINREN RD16/0019 FEDER funds). Ashish Awasthi acknowledges funding support from Department of Science and Technology, Government of India through INSPIRE Faculty scheme Boris Bikbov has received funding from the European Union's Horizon 2020 research and innovation programme under Marie Sklodowska-Curie grant agreement No. 703226. Boris Bikbov acknowledges that work related to this paper has been done on the behalf of the GBD Genitourinary Disease Expert Group. Panniyammakal Jeemon acknowledges support from the clinical and public health intermediate fellowship from the Wellcome Trust and Department of Biotechnology, India Alliance (2015–20). Job F M van Boven was supported by the Department of Clinical Pharmacy & Pharmacology of the University Medical Center Groningen, University of Groningen, Netherlands. Olanrewaju Oladimeji is an African Research Fellow hosted by Human Sciences Research Council (HSRC), South Africa and he also has honorary affiliations with Walter Sisulu University (WSU), Eastern Cape, South Africa and School of Public Health, University of Namibia (UNAM), Namibia. He is indeed grateful for support from HSRC, WSU and UNAM. EUI is supported in part by the South African National Research Foundation (NRF UID: 86003). Ulrich Mueller acknowledges funding by the German National Cohort Study grant No 01ER1511/D, Gabrielle B Britton is supported by Secretaría Nacional de Ciencia, Tecnología e Innovación and Sistema Nacional de Investigación de Panamá. Giuseppe Remuzzi acknowledges that the work related to this paper has been done on behalf of the GBD Genitourinary Disease Expert Group. Behzad Heibati would like to acknowledge Air pollution Research Center, Iran University of Medical Sciences (IUMS), Tehran, Iran. Syed Aljunid acknowledges the National University of Malaysia for providing the approval to participate in this GBD Project. Azeem Majeed and Imperial College London are grateful for support from the Northwest London National Insititute of Health Research (NIHR) Collaboration for Leadership in Applied Health Research & Care. Tambe Ayuk acknowledges the Institute of Medical Research and Medicinal Plant Studies for office space provided. José das Neves was supported in his contribution to this work by a Fellowship from Fundação para a Ciência e a Tecnologia, Portugal (SFRH/BPD/92934/2013). João Fernandes gratefully acknowledges funding from FCT–Fundação para a Ciência e a Tecnologia (grant number UID/Multi/50016/2013). Jan-Walter De Neve was supported by the Alexander von Humboldt Foundation. Kebede Deribe is funded by a Wellcome Trust Intermediate Fellowship in Public Health and Tropical Medicine (201900). Kazem Rahimi was supported by grants from the Oxford Martin School, the NIHR Oxford BRC and the RCUK Global Challenges Research Fund. Laith J Abu-Raddad acknowledges the support of Qatar National Research Fund (NPRP 9-040-3-008) who provided the main funding for generating the data provided to the GBD-IHME effort. Liesl Zuhlke is funded by the national research foundation of South Africa and the Medical Research Council of South Africa. Monica Cortinovis acknowledges that work related to this paper has been done on the behalf of the GBD Genitourinary Disease Expert Group. Chuanhua Yu acknowleges support from the National Natural Science Foundation of China (grant number 81773552 and grant number 81273179) Norberto Perico acknowledges that work related to this paper has been done on behalf of the GBD Genitourinary Disease Expert Group. Charles Shey Wiysonge's work is

supported by the South African Medical Research Council and the National Research Foundation of South Africa (grant numbers 106035 and 108571). John J McGrath is supported by grant APP1056929 from the John Cade Fellowship from the National Health and Medical Research Council and the Danish National Research Foundation (Niels Bohr Professorship). Quique Bassat is an ICREA (Catalan Institution for Research and Advanced Studies) research professor at ISGlobal. Richard G White is funded by the UK MRC and the UK Department for International Development (DFID) under the MRC/DFID Concordat agreement that is also part of the EDCTP2 programme supported by the European Union (MR/P002404/1), the Bill & Melinda Gates Foundation (TB Modelling and Analysis Consortium: OPP1084276/OPP1135288, CORTIS: OPP1137034/OPP1151915, Vaccines: OPP1160830), and UNITAID (4214-LSHTM-Sept15; PO 8477-0-600). Rafael Tabarés-Seisdedos was supported in part by grant number PROMETEOII/2015/021 from Generalitat Valenciana and the national grant PI17/00719 from ISCIII-FEDER. Mihajlo Jakovljevic acknowleges contribution from the Serbian Ministry of Education Science and Technological Development of the Republic of Serbia (grant OI 175 014). Shariful Islam is funded by a Senior Fellowship from Institute for Physical Activity and Nutrition, Deakin University and received career transition grants from High Blood Pressure Research Council of Australia. Sonia Saxena is funded by various grants from the NIHR. Stefanos Tyrovolas was supported by the Foundation for Education and European Culture, the Sara Borrell postdoctoral program (reference number CD15/00019 from the Instituto de Salud Carlos III (ISCIII–Spain) and the Fondos Europeo de Desarrollo Regional. Stefanos was awarded with a 6 months visiting fellowship funding at IHME from M-AES (reference no. MV16/00035 from the Instituto de Salud Carlos III). S Vittal Katikreddi was funded by a NHS Research Scotland Senior Clinical Fellowship (SCAF/15/02), the MRC (MC_UU_12017/13 & MC_UU_12017/15) and the Scottish Government Chief Scientist Office (SPHSU13 & SPHSU15). Traolach S Brugha has received funding from NHS Digital UK to collect data used in this study. The work of Hamid Badali was financially supported by Mazandaran University of Medical Sciences, Sari, Iran. The work of Stefan Lorkowski is funded by the German Federal Ministry of Education and Research (nutriCARD, Grant agreement number 01EA1411A). Mariam Molokhia's research was supported by the National Institute for Health Research (NIHR) Biomedical Research Centre at Guy's and St Thomas' NHS Foundation Trust and King's College London. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health. We also thank the countless individuals who have contributed to GBD 2016 in various capacities.

References

1 WHO. The World Health Report 2000—health systems: improving performance. Geneva: World Health Organization, 2000.

2 WHO. Everybody's business: strengthening health systems to improve health outcomes: WHO's framework for action. Geneva: World Health Organization, 2007.

3 WHO. Declaration of Alma-Ata. Almaty: World Health Organization, 1978.

4 UN. Transforming our world: the 2030 Agenda for Sustainable Development. New York: United Nations, 2015.

5 WHO. The World Health Report 2010—health systems financing: the path to universal coverage. Geneva: World Health Organization, 2010.

6 Nolte E, McKee M. Does health care save lives? Avoidable mortality revisited. London: The Nuffield Trust, 2004.

7 Nolte E, McKee M. Measuring the health of nations: analysis of mortality amenable to health care. *BMJ* 2003; **327:** 1129.

8 Nolte E, McKee CM. Measuring the health of nations: updating an earlier analysis. *Health Aff (Millwood)* 2008; **27:** 58–71.

9 Nolte E, McKee M. Variations in amenable mortality—trends in 16 high-income nations. *Health Policy* 2011; **103:** 47–52.

10 Mackenbach JP, Hoffmann R, Khoshaba B, et al. Using 'amenable mortality' as indicator of healthcare effectiveness in international comparisons: results of a validation study. *J Epidemiol Community Health* 2013; **67:** 139–46.

11 Eurostat. Amenable and preventable deaths statistics. 2017. http://ec.europa.eu/eurostat/statistics-explained/index.php/Amenable_and_preventable_deaths_statistics (accessed Jan 28, 2018).

12 Gay JG, Paris V, Devaux M, de Looper M. Mortality amenable to health care in 31 OECD countries. Paris: Organisation for Economic Co-operation and Development, 2011.

13 Radley DC, McCarthy D, Lippa JA, Hayes SL, Schoen C. Aiming higher: results from a scorecard on state health system performance, 2014. Washington, DC: The Commonwealth Fund, 2014.

14 Hone T, Rasella D, Barreto M, Atun R, Majeed A, Millett C. Large reductions in amenable mortality associated with Brazil's primary care expansion and strong health governance. *Health Aff (Millwood)* 2017; **36:** 149–58.

15 Mackenbach JP, Hu Y, Artnik B, et al. Trends in inequalities in mortality amenable to health care in 17 European countries. *Health Aff (Millwood)* 2017; **36:** 1110–18.

16 Schmidt H, Gostin LO, Emanuel EJ. Public health, universal health coverage, and Sustainable Development Goals: can they coexist? *Lancet* 2015; **386:** 928–30.

17 Weber A, Clerc M. Deaths amenable to health care: Converging trends in the EU? *Health Policy* 2017; **121:** 644–52.

18 Gusmano MK, Rodwin VG, Wang C, Weisz D, Luo L, Hua F. Shanghai rising: health improvements as measured by avoidable mortality since 2000. *Int J Health Policy Manag* 2014; **4:** 7–12.

19 Franco-Marina F, Lozano R, Villa B, Soliz P. La Mortalidad en México, 2000–2004: Muertes Evitables: magnitud, distribución y tendencias. México: Dirección General de Información en Salud, Secretaría de Salud, 2006.

20 Barber RM, Fullman N, Sorensen RJD, et al. Healthcare Access and Quality Index based on mortality from causes amenable to personal health care in 195 countries and territories, 1990–2015: a novel analysis from the Global Burden of Disease Study 2015. *Lancet* 2017; **390:** 231–66.

21 Kruk ME, Kelley E, Syed SB, Tarp F, Addison T, Akachi Y. Measuring quality of health-care services: what is known and where are the gaps? *Bull World Health Organ* 2017; **95:** 389.

22 Sunkara V, Hébert JR. The colorectal cancer mortality-to-incidence ratio as an indicator of global cancer screening and care. *Cancer* 2015; **121:** 1563–69.

23 Mokdad AH, Ballestros K, Echko M, et al. The state of US health, 1990–2016: burden of diseases, injuries, and risk factors among US states. *JAMA* 2018; **319:** 1444–72.

24 Dandona L, Dandona R, Kumar GA, et al. Nations within a nation: variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study. *Lancet* 2017; **390:** 2437–60.

25 ICMR, PHFI, IHME. India: Health of the Nation's States—The India State-Level Disease Burden Initiative. New Dehli: Indian Council of Medical Research, Public Health Foundation of India, Institute for Health Metrics and Evaluation, 2017.

26 de Souza MdeFM, França EB, Cavalcante A. Burden of disease and health situation analysis: results of the Global Burden of Disease (GBD) Brazil network. *Rev Bras Epidemiol* 2017; **20:** 1–3.

27 Nomura S, Sakamoto H, Glenn S, et al. Population health and regional variations of disease burden in Japan, 1990–2015: a systematic subnational analysis for the Global Burden of Disease Study 2015. *Lancet* 2017; **390:** 1521–38.

28 Gómez-Dantés H, Fullman N, Lamadrid-Figueroa H, et al. Dissonant health transition in the states of Mexico, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2016; **388:** 2386–402.

29 Zhou M, Wang H, Zhu J, et al. Cause-specific mortality for 240 causes in China during 1990–2013: a systematic subnational analysis for the Global Burden of Disease Study 2013. *Lancet* 2016; **387:** 251–72.

30 Newton JN, Briggs ADM, Murray CJL, et al. Changes in health in England, with analysis by English regions and areas of deprivation, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2015; **386:** 2257–74.

31 Naghavi M, Abajobir AA, Abbafati C, et al. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2017; **390:** 1151–210.

32 Gakidou E, Afshin A, Abajobir AA, et al. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2017; **390:** 1345–422.

33 Vos T, Abajobir AA, Abate KH, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2017; **390:** 1211–59.

34 Stevens GA, Alkema L, Black RE, et al. Guidelines for Accurate and Transparent Health Estimates Reporting: the GATHER statement. *Lancet* 2016; **388:** e19–23.

35 Asadzadeh Vostakolaei F, Karim-Kos HE, Janssen-Heijnen MLG, Visser O, Verbeek ALM, Kiemeney LALM. The validity of the mortality to incidence ratio as a proxy for site-specific cancer survival. *Eur J Public Health* 2011; **21:** 573–77.

36 Forouzanfar MH, Afshin A, Alexander LT, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016; **388:** 1659–724.

37 Wang H, Abajobir AA, Abate KH, et al. Global, regional, and national under-5 mortality, adult mortality, age-specific mortality, and life expectancy, 1970–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2017; **390:** 1084–150.

38 Fullman N, Barber RM, Abajobir AA, et al. Measuring progress and projecting attainment on the basis of past trends of the health-related Sustainable Development Goals in 188 countries: an analysis from the Global Burden of Disease Study 2016. *Lancet* 2017; **390:** 1423–59.

39 Frenk J. The concept and measurement of accessibility. In: Health services research: an anthology. White KL, Frenk J, Ordonez C, Paganini JM, Starfield B, eds. Washington, DC: Pan American Health Organization, 1992.

40 Dieleman JL, Haakenstad A, Micah A, et al. Spending on health and HIV/AIDS: domestic health spending and development assistance in 188 countries, 1995–2015. *Lancet* 2018; **391:** 1799–829.

41 Wang H, Naghavi M, Allen C, et al. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016; **388:** 1459–544.

42 Knaul FM, González-Pier E, Gómez-Dantés O, et al. The quest for universal health coverage: achieving social protection for all in Mexico. *Lancet* 2012; **380:** 1259–79.

43 Lozano R, Soliz P, Gakidou E, et al. Benchmarking of performance of Mexican states with effective coverage. *Lancet* 2006; **368:** 1729–41.

44 Gutiérrez JP, García-Saisó S, Dolci GF, Ávila MH. Effective access to health care in Mexico. *BMC Health Serv Res* 2014; **14:** 186.

45 Desai M, Nolte E, Karanikolos M, Khoshaba B, McKee M. Measuring NHS performance 1990–2009 using amenable mortality: interpret with care. *J R Soc Med* 2011; **104:** 370–79.

46 Watkins J, Wulaningsih W, Zhou CD, et al. Effects of health and social care spending constraints on mortality in England: a time trend analysis. *BMJ Open* 2017; **7:** e017722.

47 Rice T, Unruh LY, Rosenau P, Barnes AJ, Saltman RB, van Ginneken E. Challenges facing the United States of America in implementing universal coverage. *Bull World Health Organ* 2014; **92:** 894–902.

48 Hay SI, Abajobir AA, Abate KH, et al. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2017; **390:** 1260–344.

49 Dieleman J, Campbell M, Chapin A, et al. Evolution and patterns of global health financing 1995–2014: development assistance for health, and government, prepaid private, and out-of-pocket health spending in 184 countries. *Lancet* 2017; **389:** 1981–2004.

50 Mackenbach JP, Karanikolos M, Lopez Bernal J, Mckee M. Why did life expectancy in Central and Eastern Europe suddenly improve in the 1990s? An analysis by cause of death. *Scand J Public Health* 2015; **43:** 796–801.

51 Shkolnikov VM, Andreev EM, McKee M, Leon DA. Components and possible determinants of decrease in Russian mortality in 2004–2010. *Demogr Res* 2013; **28:** 917–50.

52 Cotlear D, Nagpal S, Smith OK, Tandon A, Cortez RA. Going universal: how 24 developing countries are implementing universal health coverage reforms from the bottom up. Washington, DC: The World Bank, 2015.

53 Yu H. Universal health insurance coverage for 1·3 billion people: What accounts for China's success? *Health Policy* 2015; **119:** 1145–52.

54 Atun R. Transforming Turkey's health system—lessons for universal coverage. *N Engl J Med* 2015; **373:** 1285–89.

55 Shakya HS, Adhikari S, Gurung G, et al. Strengthening national health systems for improving efficiency of health service delivery in Nepal. *J Nepal Health Res Counc* 2012; **10:** 101–07.

56 Lim J, Chan MMH, Alsagoff FZ, Ha D. Innovations in non-communicable diseases management in ASEAN: a case series. *Glob Health Action* 2014; **7:** 25110.

57 Fullman N, Lozano R. Towards a meaningful measure of universal health coverage for the next billion. *Lancet Glob Health* 2017; **6:** e122–23.

58 Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, de Bernis L. Evidence-based, cost-effective interventions: how many newborn babies can we save? *Lancet* 2005; **365:** 977–88.

59 Beattie A, Yates R, Noble D. Accelerating progress toward universal health coverage for women and children in South Asia, East Asia, and the Pacific. New York: United Nations Children's Fund, 2016.

60 Knaul FM, Farmer PE, Krakauer EL, et al. Alleviating the access abyss in palliative care and pain relief—an imperative of universal health coverage: the Lancet Commission report. *Lancet* 2017; **391:** 1391–454.

61 Dieleman JL, Sadat N, Chang AY, et al. Trends in future health financing and coverage: future health spending and universal health coverage in 188 countries, 2016–40. *Lancet* 2018; **391:** 1783–798.

62 Glassman A, Giedion U, Smith PC. What's in what's out? designing benefits for universal health coverage. Washington, DC: Center for Global Development, 2017.

63 Anselmi L, Lagarde M, Hanson K. Equity in the allocation of public sector financial resources in low- and middle-income countries: a systematic literature review. *Health Policy Plan* 2015; **30:** 528–45.

64 Sadana R, Blas E, Budhwani S, Koller T, Paraje G. Healthy ageing: raising awareness of inequalities, determinants, and what could be done to improve health equity. *Gerontologist* 2016; **56** (suppl 2)**:** S178–93.

65 WHO. World report on ageing and health 2015. Geneva: World Health Organization, 2015.

66 Goodyear-Smith F, van Weel C. Account for primary health care when indexing access and quality. *Lancet* 2017; **390:** 205–06.

67 Weiss DJ, Nelson A, Gibson HS, et al. A global map of travel time to cities to assess inequalities in accessibility in 2015. *Nature* 2018; **553:** 333–36.