

Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021

GBD 2021 Diseases and Injuries Collaborators; Hay, Simon I; Thayakaran, Rasiah

DOI:

[10.1016/S0140-6736\(24\)00757-8](https://doi.org/10.1016/S0140-6736(24)00757-8)

License:

Creative Commons: Attribution (CC BY)

*Document Version*

Publisher's PDF, also known as Version of record

*Citation for published version (Harvard):*

GBD 2021 Diseases and Injuries Collaborators, Hay, SI & Thayakaran, R 2024, 'Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021', *The Lancet*. [https://doi.org/10.1016/S0140-6736\(24\)00757-8](https://doi.org/10.1016/S0140-6736(24)00757-8)

[Link to publication on Research at Birmingham portal](#)

**General rights**

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

**Take down policy**

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact [UBIRA@lists.bham.ac.uk](mailto:UBIRA@lists.bham.ac.uk) providing details and we will remove access to the work immediately and investigate.

Download date: 07. May. 2024

# Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021



GBD 2021 Diseases and Injuries Collaborators\*



## Summary

**Background** Detailed, comprehensive, and timely reporting on population health by underlying causes of disability and premature death is crucial to understanding and responding to complex patterns of disease and injury burden over time and across age groups, sexes, and locations. The availability of disease burden estimates can promote evidence-based interventions that enable public health researchers, policy makers, and other professionals to implement strategies that can mitigate diseases. It can also facilitate more rigorous monitoring of progress towards national and international health targets, such as the Sustainable Development Goals. For three decades, the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) has filled that need. A global network of collaborators contributed to the production of GBD 2021 by providing, reviewing, and analysing all available data. GBD estimates are updated routinely with additional data and refined analytical methods. GBD 2021 presents, for the first time, estimates of health loss due to the COVID-19 pandemic.

Published Online  
April 17, 2024  
[https://doi.org/10.1016/S0140-6736\(24\)00757-8](https://doi.org/10.1016/S0140-6736(24)00757-8)  
\*Listed at the end of the Article

Correspondence to:  
Prof Simon I Hay, Institute for Health Metrics and Evaluation, University of Washington, Seattle, WA 98195, USA  
[sihay@uw.edu](mailto:sihay@uw.edu)

**Methods** The GBD 2021 disease and injury burden analysis estimated years lived with disability (YLDs), years of life lost (YLLs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries using 100 983 data sources. Data were extracted from vital registration systems, verbal autopsies, censuses, household surveys, disease-specific registries, health service contact data, and other sources. YLDs were calculated by multiplying cause-age-sex-location-year-specific prevalence of sequelae by their respective disability weights, for each disease and injury. YLLs were calculated by multiplying cause-age-sex-location-year-specific deaths by the standard life expectancy at the age that death occurred. DALYs were calculated by summing YLDs and YLLs. HALE estimates were produced using YLDs per capita and age-specific mortality rates by location, age, sex, year, and cause. 95% uncertainty intervals (UIs) were generated for all final estimates as the 2·5th and 97·5th percentiles values of 500 draws. Uncertainty was propagated at each step of the estimation process. Counts and age-standardised rates were calculated globally, for seven super-regions, 21 regions, 204 countries and territories (including 21 countries with subnational locations), and 811 subnational locations, from 1990 to 2021. Here we report data for 2010 to 2021 to highlight trends in disease burden over the past decade and through the first 2 years of the COVID-19 pandemic.

**Findings** Global DALYs increased from 2·63 billion (95% UI 2·44–2·85) in 2010 to 2·88 billion (2·64–3·15) in 2021 for all causes combined. Much of this increase in the number of DALYs was due to population growth and ageing, as indicated by a decrease in global age-standardised all-cause DALY rates of 14·2% (95% UI 10·7–17·3) between 2010 and 2019. Notably, however, this decrease in rates reversed during the first 2 years of the COVID-19 pandemic, with increases in global age-standardised all-cause DALY rates since 2019 of 4·1% (1·8–6·3) in 2020 and 7·2% (4·7–10·0) in 2021. In 2021, COVID-19 was the leading cause of DALYs globally (212·0 million [198·0–234·5] DALYs), followed by ischaemic heart disease (188·3 million [176·7–198·3]), neonatal disorders (186·3 million [162·3–214·9]), and stroke (160·4 million [148·0–171·7]). However, notable health gains were seen among other leading communicable, maternal, neonatal, and nutritional (CMNN) diseases. Globally between 2010 and 2021, the age-standardised DALY rates for HIV/AIDS decreased by 47·8% (43·3–51·7) and for diarrhoeal diseases decreased by 47·0% (39·9–52·9). Non-communicable diseases contributed 1·73 billion (95% UI 1·54–1·94) DALYs in 2021, with a decrease in age-standardised DALY rates since 2010 of 6·4% (95% UI 3·5–9·5). Between 2010 and 2021, among the 25 leading Level 3 causes, age-standardised DALY rates increased most substantially for anxiety disorders (16·7% [14·0–19·8]), depressive disorders (16·4% [11·9–21·3]), and diabetes (14·0% [10·0–17·4]). Age-standardised DALY rates due to injuries decreased globally by 24·0% (20·7–27·2) between 2010 and 2021, although improvements were not uniform across locations, ages, and sexes. Globally, HALE at birth improved slightly, from 61·3 years (58·6–63·6) in 2010 to 62·2 years (59·4–64·7) in 2021. However, despite this overall increase, HALE decreased by 2·2% (1·6–2·9) between 2019 and 2021.

**Interpretation** Putting the COVID-19 pandemic in the context of a mutually exclusive and collectively exhaustive list of causes of health loss is crucial to understanding its impact and ensuring that health funding and policy address needs at both local and global levels through cost-effective and evidence-based interventions. A global epidemiological transition remains underway. Our findings suggest that prioritising non-communicable disease prevention and treatment policies, as well as strengthening health systems, continues to be crucially important. The progress on reducing the burden of CMNN diseases must not stall; although global trends are improving, the burden of CMNN diseases remains unacceptably high. Evidence-based interventions will help save the lives of young children and mothers and improve the overall health and economic conditions of societies across the world. Governments and multilateral organisations should prioritise pandemic preparedness planning alongside efforts to reduce the burden of diseases and injuries that will strain resources in the coming decades.

**Funding** Bill & Melinda Gates Foundation.

**Copyright** © 2024 The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY 4.0 license.

## Introduction

Comprehensive estimates of the global burden of disease have a crucial role in improving understanding of the impact of diseases and injuries on population health and assessing progress towards international

health targets. Since the early 1990s, the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) has systematically and comprehensively produced estimates of global health and health loss across stratified age groups, locations, and sexes.<sup>1,2</sup> In 2020, the COVID-19

### Research in context

#### Evidence before this study

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2021 is a comprehensive study of global health loss. GBD 2021 provides current information on the distribution and burden of diseases and injuries across time, age, sex, location, and sociodemographic group. GBD quantifies burden using disability-adjusted life-years (DALYs), a metric introduced in the World Bank's 1993 World Development Report and since adopted as a key measure of disease burden by WHO, the UN, the World Bank, and governmental agencies around the world. The previous GBD cycle, GBD 2019, estimated prevalence, incidence, and burden as years lived with disability, years of life lost to premature mortality, DALYs, and healthy life expectancy for 369 diseases and injuries in 204 countries and territories, from 1990 to 2019, across age groups and by sex. While other groups have reported on DALYs and other population health metrics in recent years, including the WHO World Health Statistics 2020 report and national-level burden of disease studies, GBD remains the most comprehensive disease burden research effort to date.

#### Added value of this study

GBD 2021 includes 19 189 new data sources for DALYs, 12 new causes, and other important methodological updates. Notably, we disaggregated the under-5 age group, providing more detailed age-based estimates of burden for young children. GBD 2021 reports ten non-COVID-19-related causes for the first time: pulmonary arterial hypertension, hepatoblastoma, Burkitt lymphoma, other non-Hodgkin lymphoma, eye cancer (including retinoblastoma and other eye cancers as distinct causes), soft tissue and other extraosseous sarcomas, malignant neoplasm of bone and articular cartilage, neuroblastoma, and other peripheral nervous cell tumours.

Another important advancement of GBD 2021 is the addition of the impact of the COVID-19 pandemic on disease burden. GBD 2021 includes the estimation of burden for COVID-19, post-COVID-19 condition (also known as long COVID), other pandemic-related outcomes, and the effect of COVID-19 on other selected diseases and injuries. By modelling the burden of COVID-19 and related outcomes within a mutually exclusive and collective exhaustive cause hierarchy, this Article provides both policy makers and practitioners with scientific and evidence-based insights to help guide decision making, priority setting, and resource allocation from subnational to global levels. Policy makers benefit from robust evidence to formulate effective policies, while practitioners gain actionable insights for programme design and implementation. This report's global perspective aids in coordinated resource allocation, fostering collaborative efforts to address interconnected health challenges efficiently, such that it provides a comprehensive toolkit to inform and enhance decision-making processes across various levels of governance and practice.

#### Implications of all the available evidence

Timely and comprehensive estimates of disease burden are crucial for making health-related policy decisions. At the global level, in this study we found that the burden of diseases and injuries shifted in 2021 compared with previous years, with COVID-19 imposing additional health loss as the leading cause of burden in 2021. Neonatal disorders, ischaemic heart disease, and stroke continued to be among the leading causes of DALYs globally in 2021, as in every year of the previous decade. These findings highlight the importance of continuing to prioritise non-communicable disease prevention and treatment policies, along with health system improvements and ongoing COVID-19 vaccination and other transmission-prevention efforts.

pandemic shifted global health priorities to control transmission of SARS-CoV-2 and respond to added demands on health services. Since then, COVID-19 has transitioned from being a new threat requiring emergency response, to an infectious disease that populations need to live with and manage. Within this context, systematic and up-to-date analysis of disease burden by cause, age, sex, location, and year assumes an even more important function. The results generated by such analyses provide the evidence base on which the emergence of COVID-19 can be better understood, as well as the altered burden of disease landscape that ensued in 2020 and 2021 after the novel coronavirus circulated widely.

GBD 2021 highlights new and existing health threats that require prioritisation on international public health agendas. GBD 2021 estimates will allow up to date identification of health disparities within and between populations, enabling evaluation of how these have changed over time, quantify health gains, and, in turn, identify policies or interventions that present the most promising opportunities for impact in the post-COVID-19 era. GBD 2021 estimates are given for 371 diseases and injuries (including 95 communicable, maternal, neonatal, and nutritional [CMNN] diseases, 234 non-communicable diseases, and 40 injuries); 204 countries and territories; 21 countries with subnational locations; 25 age groups; females, males, and both sexes combined; and for the years 1990–2021. Here, we report prevalence, incidence, years lived with disability (YLDs; quantifying non-fatal health loss), years of life lost (YLLs; quantifying fatal health loss), disability-adjusted life-years (DALYs; quantifying both years lost to premature mortality and years lived with disability), and healthy life expectancy (HALE; quantifying expected years of life lived in good health). We focused on estimates between 2010 and 2021 to highlight trends in disease burden over the past decade and in 2020 and 2021, the first 2 years of the COVID-19 pandemic. In this manuscript we provide high-level findings of GBD 2021. The estimation of causes of deaths and YLLs for GBD 2021 are summarised elsewhere.<sup>3</sup>

There have been key data and methodological updates for GBD 2021, which are summarised in the Methods section. Notably, to our knowledge, GBD 2021 is the first publication to provide comprehensive burden estimates for COVID-19 as an infectious disease inclusive of post-COVID-19 condition (also known as long COVID; disability caused by remaining symptoms after initial SARS-CoV-2 infection has been cleared<sup>4</sup>), other COVID-19 pandemic-related outcomes, and the effect of COVID-19 on the burden of selected diseases. GBD 2021 findings therefore supersede those from GBD 2019 and all previous GBD rounds. This manuscript was produced as part of the GBD Collaborator Network and in accordance with the GBD Protocol.<sup>5</sup>

## Methods

### Overview

In this section, we provide an overview of the burden estimation process for GBD 2021, with further details provided in appendix 1. Methods used to generate burden estimates closely followed those for GBD 2019; however, here we summarise new or updated processes since GBD 2019. Methods used to generate GBD 2021 estimates are also available online. Here we report GBD 2021 estimates of incidence, point prevalence (hereafter referred to as prevalence), YLDs, YLLs, and DALYs for 371 diseases and injuries along with estimates of HALE. Estimates were produced by sex (female and male) and age (25 age groups from birth to age 95 years and older) for 204 countries and territories, including subnational estimates for 21 countries and territories. GBD 2021 provides annual estimates between 1990 and 2021; however, in this report we have focused on estimates between 2010 to 2021 to highlight trends over the past decade and the first 2 years of the COVID-19 pandemic. We also present these metrics stratified by Socio-demographic Index (SDI), a composite measure of lag-distributed income per capita, average years of education for those aged 15 years or older, and fertility rates among females younger than 25 years (appendix 1 section 4).

An international network of over 10000 collaborators from more than 150 countries and territories provided, reviewed, or analysed the available data to generate GBD metrics. GBD 2021 complies with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER);<sup>6</sup> a completed GATHER checklist is provided in appendix 1 (table S3). Analyses were completed using Python (version 3.10.4), Stata (version 13.1), and R (version 4.2.1).

### Geographical hierarchy

GBD 2021 produced estimates for 204 countries and territories, grouped into 21 regions and seven super-regions. GBD regions, and in turn GBD super-regions, are made up of countries and territories that are geographically close, epidemiologically similar, and share similar distributions of causes of death. Subnational estimates were produced for the following 21 countries and territories: Brazil, China, Ethiopia, India, Indonesia, Italy, Iran, Japan, Kenya, Mexico, New Zealand, Nigeria, Norway, Pakistan, the Philippines, Poland, Russia, South Africa, Sweden, the UK, and the USA. Subnational analyses were conducted at the first level of administrative organisation within each country, except for New Zealand (which was conducted by Māori ethnicity), Sweden (by Stockholm and non-Stockholm), the UK (by local government authorities), Kenya (by county), and the Philippines (by province). Since GBD 2019, the GBD location hierarchy has included all WHO Member States. At the most detailed level, we generated estimates for 983 specific locations. A full list of the geographical hierarchy is in appendix 1 (table S1).

See Online for appendix 1

For more on methods to generate GBD 2021 estimates see <https://ghdx.healthdata.org/gbd-2021>

### Disease and injury hierarchy

The 371 diseases and injuries included in GBD 2021 were organised within a cause hierarchy with four levels plus the Level 0 aggregate of all causes. Level 1 consisted of other COVID-19 pandemic-related outcomes and three broad aggregate categories: CMNN diseases; non-communicable diseases; and injuries. Level 2 included 22 clusters of causes that each fell within a Level 1 category. Level 3 included 175 causes of which 132 were specific causes and 43 were clusters of Level 4 causes. Level 4 consisted of 302 specific causes, including 170 specific causes that each fell within the 43 Level 3 clusters of causes and the 132 Level 3 specific causes that were not further disaggregated at Level 4. Overall, 365 causes had non-fatal outcomes, and 288 causes had fatal outcomes. A full list of causes by level is in appendix 1 (table S2).

### Data sources

DALY estimates for GBD 2021 were informed by 100 983 data sources (including 19 189 sources newly used in 2021). Included among these data sources were 75 459 data sources on non-fatal causes, among which 36 916 were data sources on incidence, 22 236 were data sources on prevalence, and 45 were data sources on other epidemiological measures (eg, remission). Information on data sources for YLLs for GBD 2021 have been reported elsewhere.<sup>3</sup> For non-fatal estimates, data sources included scientific literature, household survey data, epidemiological surveillance data, disease registry data, clinical informatics data, and other sources (appendix 1 section 3.1.1). Cause-specific literature reviews are described in detail in appendix 1 (section 8) and include searches of online research databases, government and international organisation websites, published reports, primary data sources, and contributions of datasets by GBD Collaborators. Multiple data types were included to capture the widest array of epidemiological information pertaining to a cause. Fatal estimates, methods, and data sources are discussed in full detail elsewhere.<sup>3</sup> Data sources were identified from vital registration, verbal autopsy, registry, survey, police, or surveillance data across all countries and territories. As with any given release of GBD, we sought to incorporate as much available data from around the world as possible into our estimates. We receive data not only through literature reviews, but also through proactive data seeking and through the work of collaborators in our network to identify new datasets and sources.

### Prevalence, incidence, and YLDs

YLDs were calculated with a microsimulation process that used estimated age-sex-location-year-specific prevalent counts of non-fatal disease sequelae (consequences of a disease or injury) for each cause and disability weights for each sequela as the inputs.

### Data processing

Epidemiological data with known biases (eg, alternative case definitions or measurement methods) were adjusted with correction factors estimated by network meta-regressions using MR-BRT (meta-regression—Bayesian, regularised, trimmed; appendix 1 section 3.3).<sup>7</sup> MR-BRT encompasses a series of statistical models—namely, linear and non-linear mixed effects models—and fitting procedures (appendix 1 section 3.5). Input data to estimate correction factors consisted of pairs of estimates where two case definitions or measurement methods were available for the same age-sex-location-year. For example, the correction factor used to adjust past-year prevalence estimates of anxiety disorders down to reflect point prevalence (the gold-standard recall period for this cause) was informed by available past-year prevalence data matched with point prevalence data on age, sex, location, and year (cause-specific corrections applied to the data using MR-BRT are in appendix 1 [section 8]). Input data not reported by sex were adjusted using the cause-specific pooled within-study sex ratio. Input data not reported by age and sex underwent age-sex splitting. Age-specific estimates from sources reporting by age and by sex (but not by age-sex) were adjusted using the within-source sex ratio to provide age-sex-specific estimates. Input data representing an age span greater than 25 years were split into granular age-specific estimates via an alternative age pattern that was estimated with available data from other sources (appendix 1 section 3.3.5).

Clinical informatics data also underwent various forms of data processing, as detailed in appendix 1 (section 3.2). Clinical sources included data on inpatient hospital admissions, outpatient visits (including to general practitioners), and health insurance claims. Data from inpatient hospital admissions reporting a single diagnosis were adjusted to account for readmissions, non-primary diagnoses, and outpatient care. The fraction of unique inpatient cases and ratios between primary and non-primary diagnoses, and inpatient and outpatient care, were extracted from data sources containing this level of detail at the individual level. Age-sex-specific ratios were then estimated by cause using MR-BRT, and inpatient data were adjusted accordingly. Estimates of total inpatient admission rates per capita for each location, year, age, and sex were used to scale inpatient sources that were incomplete for the population. Inpatient sources were additionally transformed using a scalar derived from the Healthcare Access and Quality Index to account for varying health-care access by location.<sup>8</sup> These adjustments aim to produce standardised, population-level clinical estimates of incidence and prevalence.

### Statistical analyses of prevalence estimates

For most diseases and injuries, prevalence and incidence were modelled using DisMod-MR 2.1 (Disease Modelling Meta-Regression; version 2.1). DisMod-MR 2.1 is a Bayesian disease modelling meta-regression tool that

generates internally consistent estimates of prevalence, incidence, remission, and mortality by sex, location, year, and age group. The tool also produced these measures for locations with missing raw epidemiological data by estimating prevalence across a cascade down the five levels of the GBD geographical hierarchy. Epidemiological data from locations higher in the hierarchy served as priors for the estimation of the epidemiological parameter from locations lower in the hierarchy. DisMod-MR 2.1 also uses location-level covariates to inform prevalence and incidence for locations with missing data. More detail on DisMod-MR 2.1 is in appendix 1 (section 3.6) and has been published elsewhere.<sup>9</sup> For some causes, spatiotemporal Gaussian process regression (ST-GPR) disease models were used instead of DisMod-MR 2.1. ST-GPR is a set of regression methods that allow us to analyse heterogeneous and incomplete data requiring statistical smoothing over time, age, and location. More detail on ST-GPR is in appendix 1 (section 3.4). Custom models were used for causes where DisMod-MR 2.1 or ST-GPR could not adequately model prevalence or incidence. Details about cause-specific methods are in appendix 1 (section 8).

#### *Severity distribution and disability weights*

Prevalence and incidence were split into sequela-specific prevalence and incidence for non-fatal causes for which disability varied across a spectrum of severity. Sequela categories varied by non-fatal cause—for instance, categories could represent asymptomatic, mild, moderate, and severe sequelae. Estimates of the proportion of cases in each sequela category for most non-fatal causes were calculated via analysis of the Medical Expenditure Panel Survey (known as MEPS; appendix 1 section 3.8).<sup>10</sup> Severity proportions for remaining non-fatal causes were estimated from an analysis of the US National Epidemiologic Survey on Alcohol and Related Conditions,<sup>11,12</sup> the 1997 Australian National Survey of Mental Health and Wellbeing,<sup>13</sup> or from published survey data sourced from literature reviews. Details on severity proportions by cause are in appendix 1 (section 8). Crude YLD rates were estimated by multiplying sequela-specific prevalence by their respective disability weights. Disability weights represent health loss from a sequela on a scale ranging from 0 (equivalent to no health loss) to 1 (equivalent to death). Disability weights were derived from community surveys of the general population from Bangladesh, Hungary, Indonesia, Italy, Peru, Sweden, Tanzania, the Netherlands, and the USA, and an open internet survey available in English, Spanish, and Mandarin.<sup>14,15</sup> Participants of the surveys were presented pairs of lay descriptions of health states and asked which of the two was the healthier state. Lay descriptions were created by experts, used non-clinical language, and were 35 words or shorter in length. Responses were then anchored between 0 and 1 via population health equivalence questions where respondents were asked to compare the benefit of lifesaving or disease-prevention

programmes. More detail on the estimation of disability weights is provided elsewhere<sup>14,15</sup> and in appendix 1 (section 3.9).

#### *Comorbidity*

YLDs underwent a comorbidity correction to account for the co-occurrence of non-fatal causes in the population and to allow for YLDs to be additive across the GBD 2021 cause hierarchy. The co-occurrence of non-fatal causes was simulated within a population of 20 000 simulated individuals for every age, sex, location, and year. The probability of each simulated individual having each sequela was equal to its prevalence. Each simulated individual was then assigned a cumulative disability weight on the basis of a multiplicative function of all the disability weights assigned to the simulated individual. Sequela-specific disability weights were adjusted accordingly and the YLD rate for each sequela was calculated. YLD counts were then estimated as the YLD rate multiplied by the age-sex-location-year-specific population. More detail on this comorbidity simulation is in appendix 1 (section 3.10).

#### *New for GBD 2021*

For GBD 2021, we further disaggregated all estimates for age groups younger than 5 years into those aged 0–6 days, 7–27 days, 1–5 months, 6–11 months, 12–23 months, and 2–4 years. The relatively broad grouping of 1–4-year-old children in previous iterations of the GBD study limited our ability to make targeted recommendations regarding the burden from neonatal disorders given that the risk factors, health services, supportive equipment needs, and caregiver needs vary considerably within this age group. GBD 2021 reports two new COVID-19-related causes: COVID-19 at Level 3 (including the burden due to long COVID, modelled as a sequela for COVID-19), and other COVID-19 pandemic-related outcomes at Level 1 (appendix 1 table S2). Other COVID-19 pandemic-related outcomes included excess mortality associated with the pandemic minus mortality directly due to COVID-19, lower respiratory infections, measles, malaria, and pertussis, because there was a reduction in deaths from these causes during the pandemic<sup>3</sup> and, hence, we removed that effect on mortality first before calculating other pandemic-related deaths. For the first time, GBD 2021 also reports on five additional Level 3 causes (pulmonary arterial hypertension, eye cancer, soft tissue and other extraosseous sarcomas, malignant neoplasm of bone and articular cartilage, and neuroblastoma and other peripheral nervous cell tumours), and five additional Level 4 causes (hepatoblastoma, Burkitt lymphoma, other non-Hodgkin lymphoma, retinoblastoma, and other eye cancers; appendix 1 table S2). The decision to model and report new causes is manifold and considers such factors as data availability, policy concerns, research

priorities, and methodological refinements. Processes used to incorporate these causes into GBD 2021 are in appendix 1 (section 8). Additionally, the prevalence estimates for major depressive disorder and anxiety disorders were adjusted for the impact of the COVID-19 pandemic using data sourced from a systematic review that informed a meta-regression in MR-BRT. This model was then used to adjust pre-pandemic prevalence of these two disorders estimated via DisMod-MR 2.1 (appendix 1 section 8).<sup>16</sup>

### Deaths and YLLs

YLLs were calculated as the product of estimated age-sex-location-year-specific deaths and the standard life expectancy at the age death occurred for a given cause. This process is summarised here, with detailed information provided in affiliated GBD 2021 publications featuring causes of death and YLLs,<sup>3</sup> as well as updated demographic parameters.<sup>17</sup>

### Data processing

GBD 2021 methods follow principles from the ICD, 11th edition, whereby each death is assigned to the underlying cause that initiated events leading to death. Vital registration data reporting assigned ICD so-called garbage codes (a term used in GBD to represent non-specific codes, implausible codes, or intermediate rather than underlying cause of death codes) were assigned to the most likely cause of death via redistribution algorithms.<sup>18</sup> These algorithms were derived from published studies, expert consultation, or regression on data sources reporting multiple causes of death.<sup>3</sup>

### Statistical analyses of mortality estimates

Cause of death estimates for most diseases and injuries were modelled via the Cause of Death Ensemble model (CODEm). CODEm uses an ensemble of statistical models while also systematically testing combinations of covariates on the basis of their out-of-sample predictive validity. It then combines results to estimate deaths by location, age, sex, and year for a given cause. CODEm was run by sex and separately for countries and territories with and without extensive complete vital registration data to decrease the likelihood of uncertainty inflation from data with high heterogeneity. Multiple iterations of out-of-sample predictive validity for each model were assessed, and models with the smallest root-mean-square error were weighted to generate an ensemble model for a given cause. Other customised modelling strategies were used to estimate deaths for a small group of causes with unique epidemiology, important changes in reporting practices, or a scarcity of data. These modelling strategies included the use of prevalence, incidence, case-fatality data, or data related to sub-causes to inform cause of death estimates; further discussions of these methods are available elsewhere.<sup>3</sup>

### DALYs and HALE

YLDs and YLLs were summed to calculate DALYs by location, age, sex, year, and cause (appendix 1 section 5). HALE was estimated as a complementary measure to DALYs, representing a population's average number of years of life spent in good health. HALE values were calculated using age-specific mortality rates and YLDs per capita. The method used to estimate HALE was unchanged from previous GBD cycles.<sup>19</sup> The method was presented by Sullivan,<sup>20</sup> and is described in appendix 1 (section 6). Both DALYs and HALE were estimated by location, age, sex, and year, and DALYs also by cause.

### Data presentation, annual rate of change, uncertainty, and SDI

GBD 2021 metrics were estimated as counts, all-age and age-specific rates per 100 000 population, and age-standardised rates per 100 000 population, calculated using the GBD standard population structure. We present percentage changes over specified time periods (eg, 2010–21), and annualised rates of change as the difference in the natural log of the values at the start and end of the time interval divided by the number of years in the interval. All calculations were conducted 500 times to generate draw-level estimates. The number of computations per process was reduced from 1000, as in previous GBD iterations, to 500 for GBD 2021 because simulation testing revealed the final estimates and their uncertainty were not affected by this reduction. Final estimates represent the mean estimate across 500 draws, and 95% uncertainty intervals (UIs) are represented by the 2·5th and 97·5th percentile values across the draws. Uncertainty was propagated at each step in the estimation process.

Sociodemographic development has been a leading contributor to health gains over the three decades for which GBD has previously tracked changes in burden by location.<sup>21</sup> In this Article, we also present an analysis of burden for locations across SDI quintiles. SDI is a composite indicator representing the geometric mean of three parameters: the lag-distributed income per capita, average years of schooling, and the fertility rate in females younger than 25 years for a given location. SDI scores were rescaled from 0 (lowest income and years of schooling, and highest fertility) to 100 (highest income and years of schooling, and lowest fertility). This process is further explained in appendix 1 (section 4).

### Role of the funding source

The funder of this study had no role in study design, data collection, data analysis, data interpretation, or the writing of the report.

### Results

We generated results using GBD methods to analyse data between 2010 and 2021 to highlight trends in disease burden over the past decade and through the first 2 years

of the COVID-19 pandemic (2020 and 2021). We present prevalence and incidence results for causes at Level 3 of the GBD cause hierarchy and DALY estimates for all causes combined and individual causes or cause groups at Levels 1–3 of the hierarchy. DALY estimates are presented at the global level, by SDI quintile, GBD regions, and countries and territories.

### Global trends in prevalence and incidence

The number of prevalent cases and age-standardised prevalence and their rank by cause and sex in 2010 and 2021 are presented in appendix 2 (tables S1–S6). Globally, the most prevalent Level 3 diseases and injuries during 2021 (across ages and sexes) were oral disorders (3.69 billion [95% UI 3.40–4.00] cases at any given point during the year), headache disorders (2.81 billion [2.60–3.03]), and haemoglobinopathies and haemolytic anaemias, which includes inherited blood disorders (2.19 billion [2.12–2.27]; appendix 2 table S4). These causes also had the highest age-standardised prevalence of all Level 3 causes (appendix 2 tables S1, S2, S3). There were only minimal changes among the 20 most prevalent causes since 2010.

The Level 3 causes with the highest incidence globally in 2021 (across ages and sexes) were upper respiratory infections (12.8 billion [95% UI 11.4–14.5] new cases), diarrhoeal diseases (4.67 billion [4.11–5.22]), and oral disorders (3.74 billion [3.31–4.22]). These three causes also had the highest incidence globally for all sexes combined since 2010. The number of incident cases and age-standardised incidence and rank by cause, age, and sex, for 2010 and 2021, are in appendix 2 (tables S7, S8, S9, S10, S11, S12).

There were 2.28 billion (95% UI 2.18–2.37) incident cases of COVID-19 globally in 2021, equivalent to an age-standardised incidence rate of 28955.3 (27708.3–30143.2) per 100000 population (appendix 2 tables S7, S10). This was an increase from 1.63 billion (1.55–1.69) incident cases of COVID-19 globally in 2020, equivalent to an age-standardised incidence rate of 20819.8 (19908.0–21681.5) per 100000 (appendix 2 table S7, S10). Although males and females had similar incidence rates of COVID-19 across years (appendix 2 tables S8, S9, S11, S12), females were affected by long COVID at twice the rate of males (63.2% [59.7–66.3] of people with long COVID were female and 36.8% [33.7–40.3] were male in 2020–21; sequela-level estimates not shown).

### Global trends in DALYs between 2010 and 2021

The global number of all-cause DALYs remained steady between 2010 (2.63 billion [95% UI 2.44–2.85]) and 2019 (2.61 billion [2.36–2.88]); however, global all-cause DALYs increased to 2.76 billion (2.50–3.04) in 2020 and to 2.88 billion (2.64–3.15) in 2021 (appendix 2 table S13). Yet, there was a decrease in the global age-standardised DALY rate per 100000 population, which accounts for the

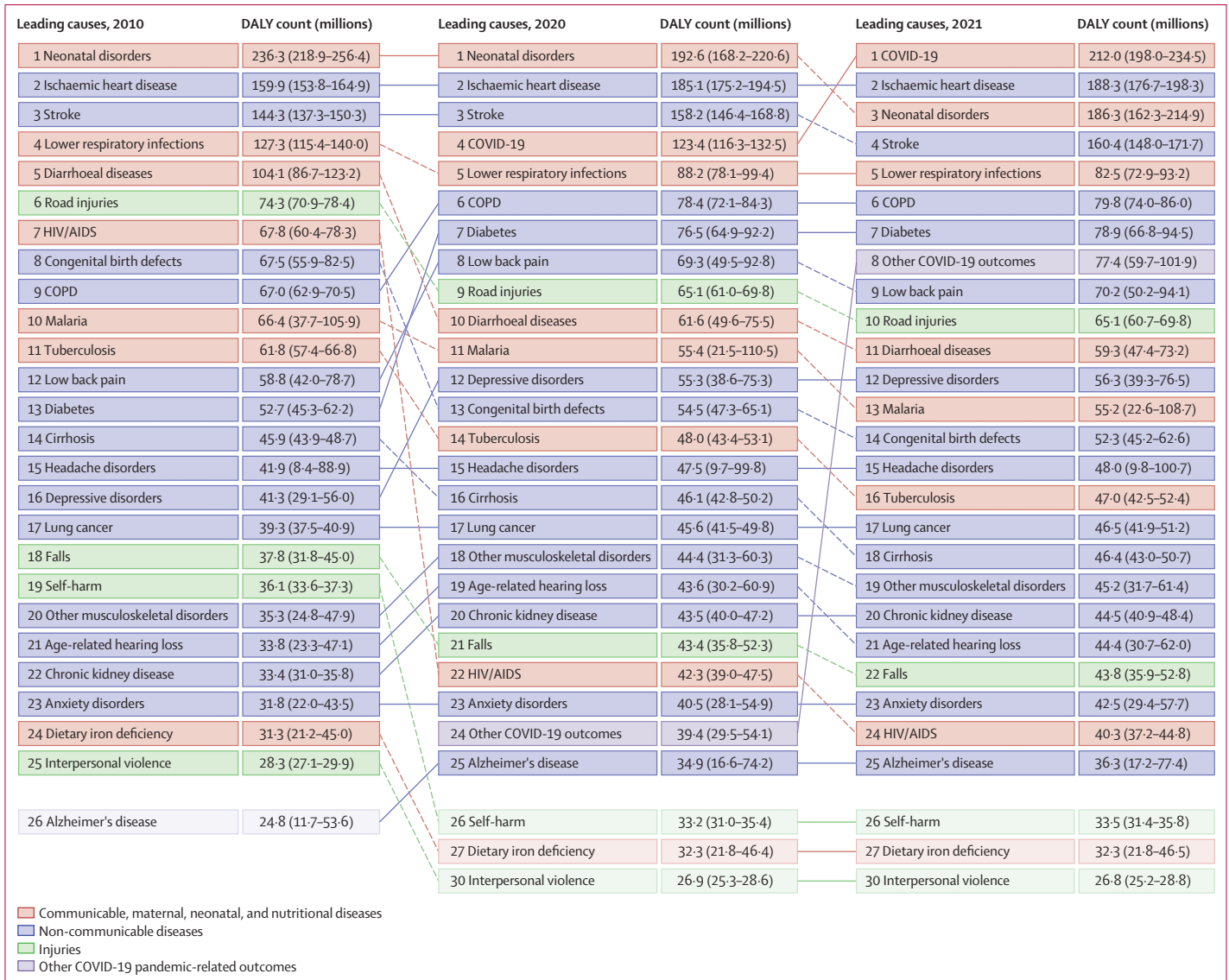
impact of population growth and ageing, between 2010 (39352.9 [36554.8–42641.1]) and 2019 (33763.6 [30685.4–37225.2]), equivalent to a 14.2% (10.7–17.3) decrease in the global age-standardised all-cause burden (appendix 2 table S13). However, the global age-standardised DALY rate per 100000 population increased between 2019 and 2020 by 4.1% (1.8–6.3), to 35143.0 (32052.1–38678.8) in 2020, and by 7.2% (4.7–10.0) between 2019 and 2021, to 36206.8 DALYs (33039.5–39638.7) in 2021 (appendix 2 table S13).

Across the Level 1 causes, non-communicable diseases contributed the highest burden globally and was the only disease group for which DALYs increased between 2010 and 2021, from 1.47 billion (95% UI 1.32–1.64) in 2010 to 1.73 billion (1.54–1.94) in 2021 (appendix 2 table S13). This increase was mostly due to population growth and ageing (165 of 204 countries increased in population between 2010 and 2021), because the age-standardised DALY rates decreased between 2010 and 2021 by 6.4% (3.5–9.5), from 22209.8 (19961.7–24705.4) to 20783.1 (18495.1–23377.4) DALYs per 100000 population. DALYs for CMNN diseases decreased from 876 million (816–939) in 2010 to 831 million (761–909) in 2021. The age-standardised DALY rate for CMNN diseases decreased by 12.9% (5.1–19.2) between 2010 and 2021, from 13062.8 (12173.8–14002.1) to 11373.3 (10360.3–12517.3) DALYs per 100000. DALYs due to injuries decreased from 284 million (266–305) in 2010 to 248 million (227–272) in 2021 (appendix 2 table S13). The age-standardised DALY rate due to injuries decreased by 24.0% (20.7–27.2) from 2010 to 2021, from 4080.1 (3821.4–4385.6) to 3098.9 (2837.2–3404.5) DALYs per 100000. However, most of the health gains from injuries occurred between 2010 and 2019 (a decrease of 20.8% [17.7–23.6] in age-standardised DALY rate) as opposed to between 2019 and 2021 (a decrease of 4.1% [1.1–6.7]).

In total, 15 non-communicable diseases, seven CMNN diseases, two types of injuries, and other COVID-19 pandemic-related outcomes featured within the 25 leading Level 3 causes of DALYs in 2021 (figure 1). Between 2010 and 2020, neonatal disorders, ischaemic heart disease, and stroke were the leading causes of DALYs for all ages and sexes combined. In 2020, COVID-19 emerged as the fourth leading cause of all-age DALYs. In 2021, it became the leading cause of DALYs, surpassing neonatal disorders, ischaemic heart disease, and stroke. Other COVID-19 pandemic-related outcomes was the 24th leading cause of DALYs in 2020 and the eighth leading cause in 2021. The emergence of both these causes in 2020 reversed the decline in DALYs due to CMNN diseases, causing an increase of 18.0% (95% UI 13.8–22.5) in age-standardised DALY rates between 2019 and 2021. However, there were substantial health gains among other leading CMNN diseases, most notably for HIV/AIDS (with a decrease in the age-standardised DALYs rate of 47.8% [43.3–51.7])

See Online for appendix 2





**Figure 1: Leading 25 Level 3 causes of global DALYs in 2010, 2020, and 2021, for both sexes combined, and all ages**  
 Causes are connected by lines between time periods, where solid lines represent an increase or no change in rank and dashed lines represent a decrease in rank. Faded colours indicate that the cause is not within the top 25 causes of DALYs for that year. Data in parentheses are 95% uncertainty intervals. COPD=chronic obstructive pulmonary disease. DALY=disability-adjusted life-year.

between 2010 and 2021) and diarrhoeal diseases (decrease of 47.0% [39.9–52.9]). The smallest health gain among the CMNN diseases was observed for neonatal disorders (decrease in age-standardised DALY rate of 17.1% [4.9–25.9]), which was in the top three leading causes of DALYs in 69 of 204 countries and territories in 2021.

Among the non-communicable diseases featured in figure 1 as the leading Level 3 causes of DALYs in 2021, the largest health gains between 2010 and 2021 were observed for congenital birth defects (with a decrease in the age-standardised DALY rate of 20.9% [95% UI 2.7–30.4], cirrhosis and other chronic liver diseases (a decrease of 18.3% [10.9–26.5]), and stroke (a

decrease of 16.9% [11.7–21.9]; appendix 2, table S25). However, age-standardised DALYs also increased by 14.0% (10.0–17.4) for diabetes, 16.4% (11.9–21.3) for depressive disorders, and 16.7% (14.0–19.8) for anxiety disorders. The two types of injury explaining the most burden globally in 2021 (figure 1) decreased in age-standardised DALY rates between 2010 and 2021. Between 2010 and 2021, age-standardised DALYs for road injuries decreased by 22.9% (18.5–27.1), from 1049.4 (1001.8–1108.3) per 100 000 in 2010 to 808.9 (752.7–865.8) per 100 000 in 2021 and falls decreased by 6.9% (4.0–10.2), from 570.9 (480.7–678.2) per 100 000 in 2010 to 531.2 (437.3–638.8) per 100 000 in 2021. However, most of this change occurred before 2019,

when the rate was 839.9 (788.0–899.3) DALYs per 100 000 for road injuries and 536.7 (442.8–643.0) per 100 000 for falls. Age-standardised DALY rates and number of DALYs by cause and location for 2010, 2019, 2020, and 2021 are presented in appendix 2 table S13.

Figure 2 shows the distribution of global DALYs across age groups for females and males in 2021 for Level 2 causes, COVID-19, and other COVID-19 pandemic-related outcomes (the equivalent plot for 2020 is in appendix 2 [figure S1]; age-specific rates for 2021 are in appendix 2 [figure S2]). In 2021, males accounted for

1.55 billion (95% UI 1.43–1.69) global DALYs and females for 1.33 billion (1.19–1.48) global DALYs. In females, COVID-19 was the leading Level 3 cause of DALYs in 2021 (80.2 million [73.1–92.5] DALYs) followed by neonatal disorders (79.9 million [70.3–91.0]; appendix 2 table S14). In males, COVID-19 was also the leading cause of DALYs (132 million [124–143] DALYs), followed by ischaemic heart disease (115 million [108–123]) and neonatal disorders (106 million [91.2–124]; appendix 2 table S15). Most of the burden due to neonatal disorders in 2021 occurred during the first 6 days after birth and burden imposed by neonatal conditions decreased sharply with age

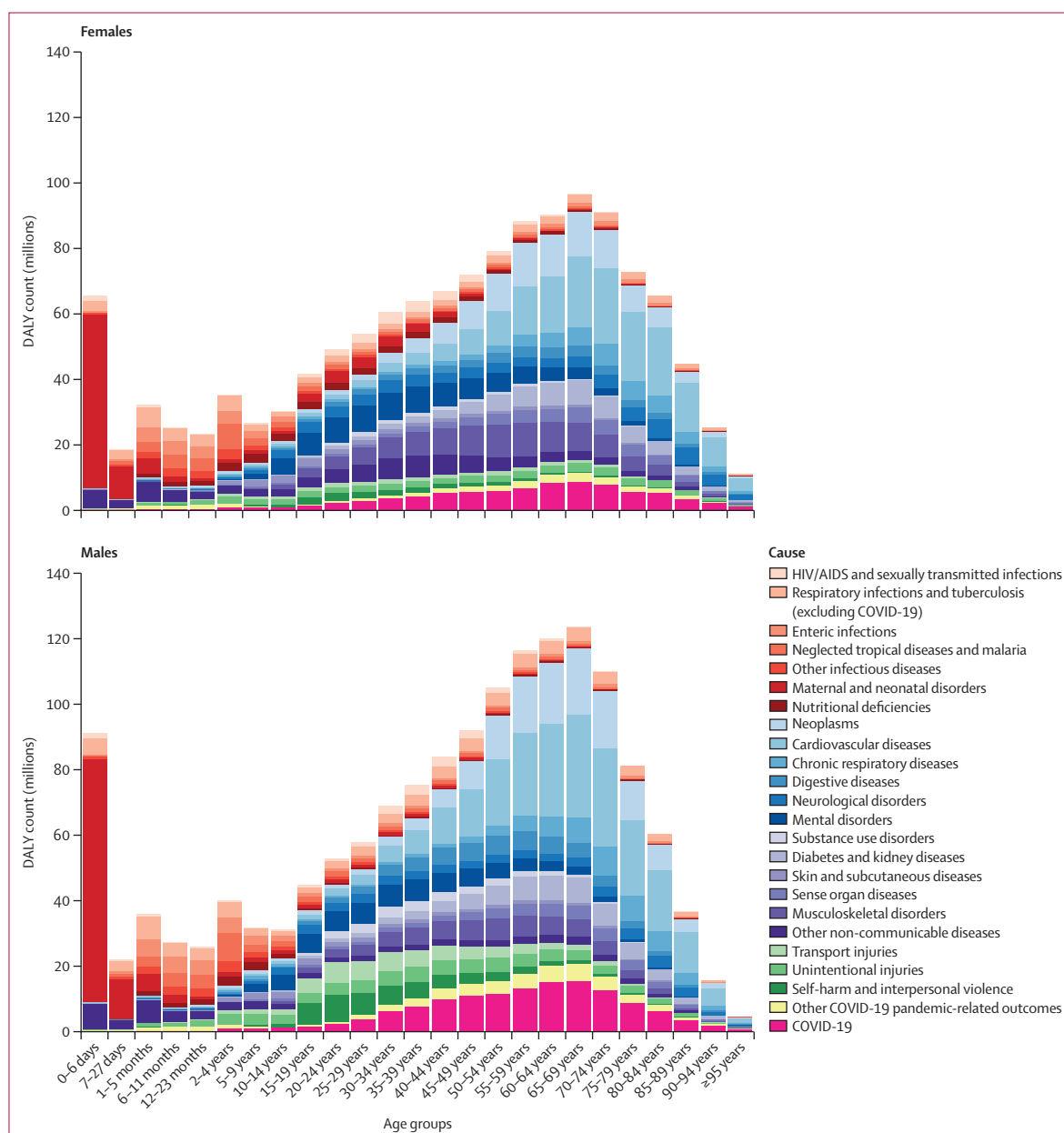


Figure 2: The distribution of global DALYs by age and sex for Level 2 causes, COVID-19, and other COVID-19 pandemic-related outcomes in 2021. DALY=disability-adjusted life-year.

thereafter. Despite similar age-standardised incidence rates of COVID-19 between females and males, the age-standardised DALY rate for COVID-19 was greater among males (3247.9 [3057.9–3521.4] per 100 000 males; 8.5% [7.6–9.5] of male DALYs) than females (1822.6 [1651.0–2125.7] per 100 000 females; 6.1% [5.3–7.0] of female DALYs). Males also had a larger age-standardised rate of DALYs due to other COVID-19 pandemic-related outcomes (1220.4 [909.4–1630.9] DALYs per 100 000) than did females (705.2 [503.6–945.9] per 100 000; appendix 2 tables S14, S15). Older populations had greater health loss due to COVID-19 than did younger populations, with individuals aged 50–69 years having 5834.8 (5515.1–6302.5) DALYs per 100 000 and individuals aged 70 years and older having 11584.1 (11067.8–12262.5) DALYs per 100 000 due to COVID-19 in 2021 (appendix 2 figure S2). This trend was also evident for other COVID-19 pandemic-related outcomes, which accounted for 1911.6 (1429.8–2677.6) DALYs per 100 000 population aged

50–69 years, and 3572.6 (2701.0–4791.8) per 100 000 population aged 70 years and older globally (appendix 2 figure S2).

**Decomposition of DALYs into YLDs and YLLs**

Global all-cause DALYs in 2021 were composed of 907 million (95% UI 680–1170) YLDs (equivalent to 31.3% [25.4–37.5] of total DALYs and an age-standardised rate of 11031.9 [8279.5–14272.4] YLDs per 100 000; appendix 2 table S16) and 1.98 billion (1.87–2.10) YLLs (equivalent to 68.7% [62.5–74.6] of total DALYs and an age-standardised rate of 25175.4 [23693.7–26906.6] YLLs per 100 000; appendix 2 table S19). Global YLDs increased from 738 million (550–959) in 2010 and YLLs increased from 1.89 billion (1.82–1.96) in 2010. All-cause, age-standardised YLD rates, which account for population growth and ageing, remained relatively stable between 2010 and 2021, with only a 2.6% (1.3–4.8) increase globally (appendix 2 table S16).

Cause	YLDs 2021			Percentage change, 2010–21	
	Percentage of all-cause YLDs	Count (millions)	Age-standardised rate (per 100 000)	YLD count	Age-standardised rate
1 Low back pain	7.7% (6.5 to 9.1)	70.2 (50.2 to 94.1)	832.2 (595.9 to 1115.3)	19.4% (17.9 to 20.8)	-2.4% (-2.9 to -1.8)
2 Depressive disorders	6.2% (5.0 to 7.8)	56.3 (39.3 to 76.5)	681.2 (475.3 to 924.0)	36.5% (31.7 to 41.7)	16.4% (11.9 to 21.3)
3 Headache disorders	5.2% (1.2 to 10.4)	48.0 (9.80 to 101)	588.4 (117.6 to 1245.7)	14.4% (12.7 to 17.8)	0.3% (-1.1 to 1.4)
4 Age-related and other hearing loss	4.9% (3.9 to 5.9)	44.4 (30.7 to 62.0)	525.9 (364.2 to 731.9)	31.6% (30.0 to 33.1)	2.5% (1.7 to 3.3)
5 Other musculoskeletal disorders	4.8% (3.6 to 6.2)	43.0 (29.6 to 59.2)	507.2 (349.5 to 698.0)	28.7% (26.7 to 30.8)	6.3% (5.6 to 7.0)
6 Anxiety disorders	4.7% (3.6 to 6.0)	42.5 (29.4 to 57.7)	524.3 (363.3 to 716.2)	33.7% (30.7 to 37.0)	16.7% (14.0 to 19.8)
7 Diabetes mellitus	4.5% (3.9 to 5.2)	41.2 (29.0 to 56.5)	477.0 (336.1 to 653.3)	62.9% (60.3 to 65.8)	25.9% (24.0 to 28.1)
8 Dietary iron deficiency	3.6% (2.8 to 4.2)	32.3 (21.8 to 46.5)	423.7 (285.3 to 611.0)	3.2% (0.9 to 5.2)	-7.3% (-9.4 to -5.5)
9 Blindness and vision loss	3.2% (2.4 to 4.4)	29.2 (19.0 to 42.9)	342.8 (224.2 to 503.6)	32.9% (27.4 to 38.6)	2.6% (-2.5 to 7.7)
10 Gynaecological diseases	3.0% (2.5 to 3.7)	27.4 (19.1 to 38.2)	334.0 (232.7 to 467.5)	15.3% (14.0 to 16.8)	1.4% (0.6 to 2.3)
11 Falls	2.7% (2.3 to 3.0)	24.2 (16.8 to 32.8)	288.6 (200.9 to 391.7)	21.4% (19.2 to 23.3)	-3.5% (-4.7 to -2.6)
12 Oral disorders	2.6% (1.7 to 3.6)	23.2 (13.8 to 35.0)	275.9 (164.2 to 416.8)	25.1% (21.4 to 28.6)	0.4% (-2.6 to 3.3)
13 Neonatal disorders	2.4% (2.0 to 2.8)	21.7 (15.7 to 27.3)	282.7 (204.9 to 356.1)	24.9% (13.8 to 35.3)	13.5% (3.6 to 22.9)
14 Osteoarthritis	2.3% (1.4 to 4.5)	21.3 (10.2 to 42.9)	244.5 (117.1 to 493.1)	36.9% (35.2 to 38.5)	2.4% (1.3 to 3.5)
15 Neck pain	2.2% (1.7 to 2.9)	20.4 (13.6 to 28.9)	242.3 (162.6 to 342.8)	22.0% (19.4 to 24.6)	1.4% (1.0 to 1.9)
16 Stroke	1.7% (1.3 to 2.0)	15.2 (11.0 to 19.4)	178.7 (128.9 to 227.6)	29.1% (25.4 to 32.8)	-1.2% (-4.0 to 1.5)
17 COPD	1.7% (1.3 to 2.1)	14.9 (12.4 to 17.1)	174.4 (145.5 to 201.0)	29.1% (24.8 to 33.3)	-2.5% (-5.7 to 0.5)
18 Schizophrenia	1.7% (1.2 to 2.2)	14.8 (10.9 to 19.1)	177.8 (131.6 to 228.9)	16.3% (14.9 to 17.8)	0.0% (-0.9 to 0.9)
19 COVID-19	1.6% (0.6 to 3.6)	14.3 (5.14 to 33.7)	176.4 (63.1 to 418.9)	..	..
20 Alzheimer's disease and other dementias	1.3% (1.0 to 1.6)	11.6 (7.96 to 15.3)	141.9 (97.7 to 187.2)	45.7% (44.1 to 47.2)	2.6% (1.7 to 3.5)
21 Autism spectrum disorders	1.3% (0.8 to 2.0)	11.5 (7.84 to 16.3)	147.6 (100.2 to 208.1)	12.9% (11.9 to 13.7)	0.7% (-0.2 to 1.4)
22 Alcohol use disorders	1.2% (1.0 to 1.5)	11.0 (7.68 to 15.3)	132.3 (92.3 to 184.5)	6.8% (3.4 to 10.5)	-8.1% (-10.8 to -5.4)
23 Asthma	1.1% (0.9 to 1.4)	10.2 (6.50 to 15.0)	131.1 (84.0 to 194.7)	2.1% (0.2 to 4.4)	-11.1% (-12.8 to -8.9)
24 Drug use disorders	1.0% (0.8 to 1.3)	9.23 (6.54 to 11.8)	114.1 (80.9 to 145.5)	26.2% (22.5 to 30.1)	13.9% (10.9 to 17.2)
25 Other mental disorders	1.0% (0.7 to 1.3)	8.96 (5.72 to 13.5)	106.6 (68.2 to 160.7)	19.5% (18.4 to 21.0)	-0.2% (-0.8 to 0.2)

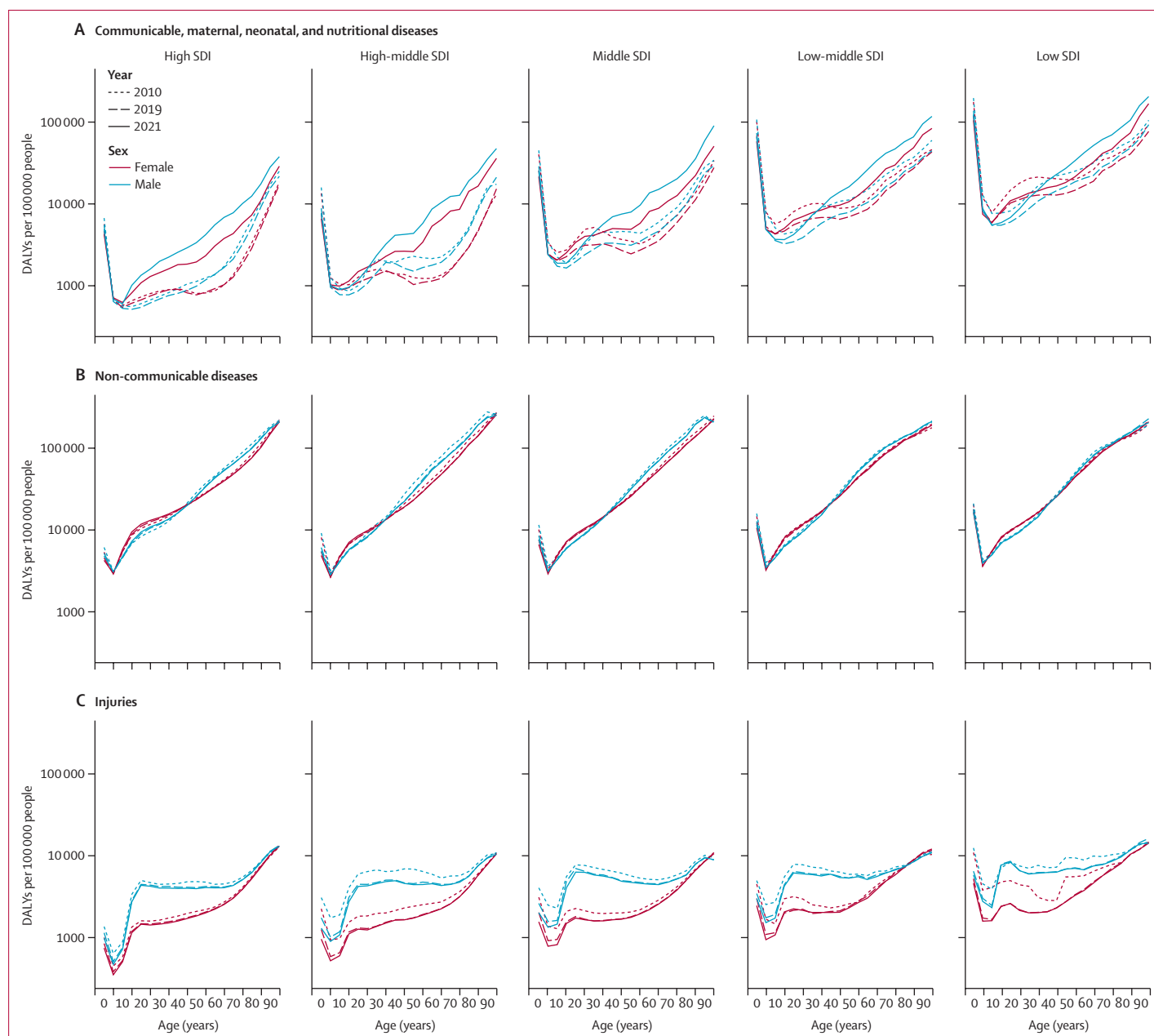
Data in parentheses are 95% uncertainty intervals. Count data are presented to three significant figures, and rates and percentage change data are presented to one decimal place. COPD=chronic obstructive pulmonary disease. YLDs=years lived with disability.

**Table: Top 25 leading Level 3 causes of global YLDs, ranked from 1 to 25, in 2021 across all ages, for both sexes combined, YLD counts, age-standardised rates, and percentage change between 2010 and 2021**

21 non-communicable diseases, three CMNN diseases, and one injury featured within the 25 leading Level 3 causes of YLDs globally in 2021 (table). The top three causes of YLDs, across all ages and sexes combined, were all non-communicable diseases: low back pain (70.2 million [95% UI 50.2–94.1] YLDs), depressive disorders (56.3 million [39.3–76.5] YLDs), and headache disorders (48.0 million [9.80–101] YLDs). Among the 25 leading Level 3 causes of YLDs, we observed the largest increase in age-standardised YLD rates between

2010 and 2021 in diabetes, anxiety disorders, depressive disorders, drug use disorders, and neonatal disorders (table). COVID-19, which was the leading contributor to the increase in DALYs in 2021 (figure 1), did not feature as prominently as a leading cause of YLDs, ranking as the 19th leading Level 3 cause of YLDs in 2021 (14.3 million [5.14–33.7] YLDs; table), up from 41st in 2020 (4.95 million [1.79–11.4] YLDs; appendix 2 table S16).

Global YLLs increased non-significantly (4.6% [95% UI –0.9 to 10.7]) between 2010 and 2021 (appendix 2



**Figure 3:** Age-specific DALY rates for Level 1 causes of communicable, maternal, neonatal, and nutritional diseases (A), non-communicable diseases (B), and injuries (C), by age, sex, year, and SDI quintile

The y-axis shows DALYs per 100 000 population on a logarithmic scale. DALY=disability-adjusted life-year. SDI=Socio-demographic Index.

table S19). However, relative to YLDs, a larger decrease of 12.0% (6.4 to 16.8) in age-standardised YLL rates was found between 2010 (28 595.8 [27 568.9 to 29 636.5] per 100 000) and 2021 (25 175.4 [23 693.7 to 26 906.6] per 100 000). The top three causes of YLLs, across all ages and sexes, in 2021 were: COVID-19 (198 million [187–211] YLLs), ischaemic heart disease (184 million [173–195]), and neonatal disorders (165 million [141–191]; appendix 2 table S19). Age-standardised YLD and YLL rates, and the number of YLDs and YLLs by cause, location, and sex for 2010, 2019, 2020, and 2021 are in appendix 2 (tables S16, S17, S18, S19, S20, S21).

### Trends in DALYs by SDI, location, age, and sex

Trends in DALYs at the global level were informed by complex patterns of cause-specific burden across location, age, and sex. Age-standardised DALY rates for non-communicable diseases in males in 2021 ranged from 18 489.4 (95% UI 16 343.7–21 105.5) DALYs per 100 000 population in the high SDI quintile to 24 964.7 (22 503.7–27 556.8) per 100 000 in the low-middle SDI quintile. In females age-standardised DALY rates ranged from 17 167.4 (14 340.9–20 435.8) per 100 000 in the high SDI quintile to 24 072.6 (21 230.1–27 461.6) per 100 000 in the low SDI quintile (appendix 2 table S22). Across all SDI quintiles, age-specific DALY rates from non-communicable diseases decreased with increasing age from 0–6 days through to 5–9 years, and then increased gradually with age from this point on (figure 3).

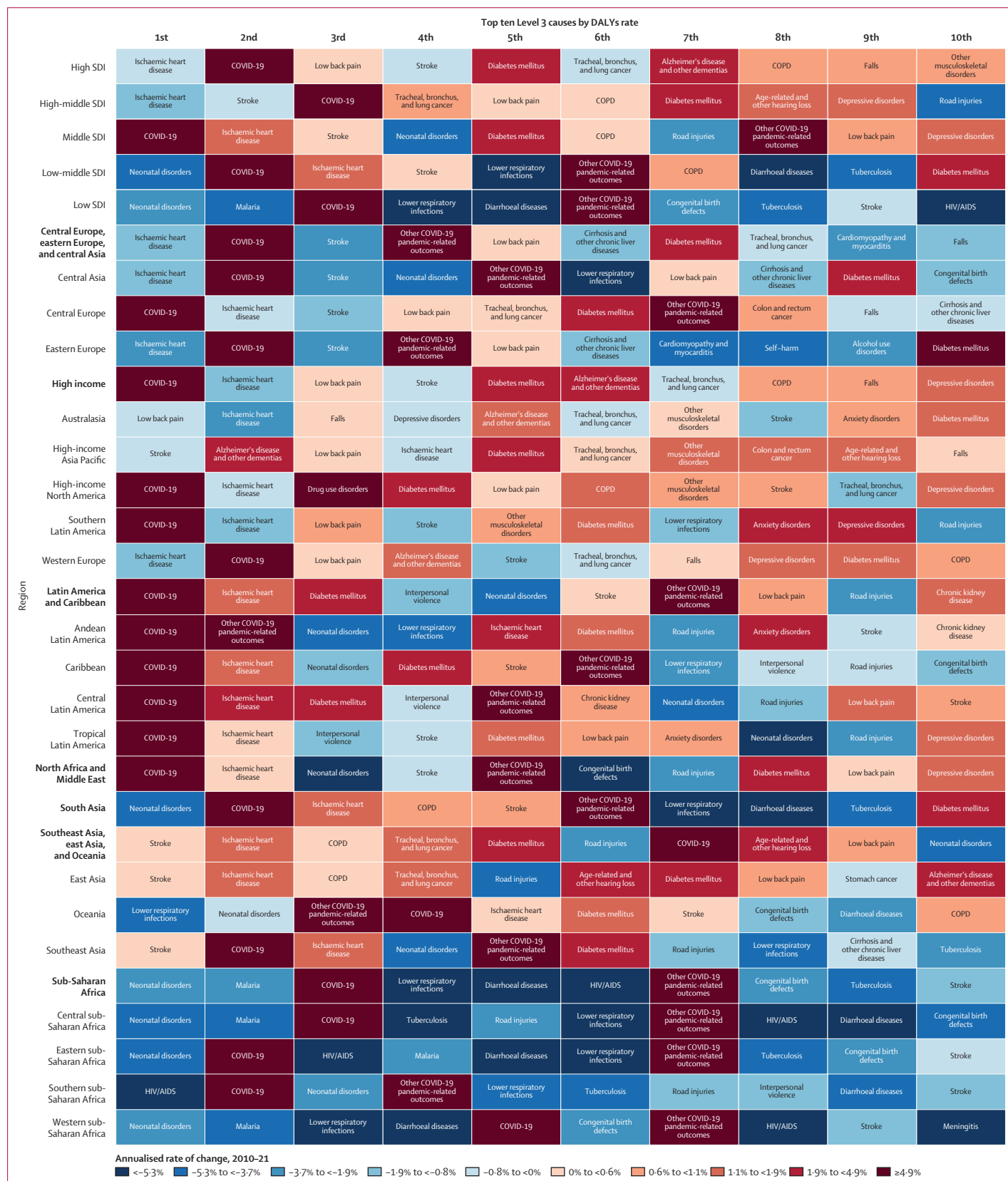
Age-standardised DALY rates for CMNN diseases in males in 2021 ranged from 2902.3 (95% UI 2750.4 to 3092.7) per 100 000 in the high SDI quintile to 28 861.0 (26 081.7 to 32 375.0) per 100 000 in the low SDI quintile. In females, they ranged from 2014.2 (1816.0 to 2272.9) per 100 000 in the high SDI quintile to 24 040.3 (21 630.5 to 26 984.8) per 100 000 in the low SDI quintile (appendix 2 table S22). Age-standardised DALY rates for CMNN diseases decreased between 2010 and 2021 in the low SDI quintile (by 19.3% [12.2 to 25.8]) and the low-middle SDI quintile (by 13.9% [7.1 to 19.7]). Age-standardised DALY rates for CMNN diseases decreased at lower rates in the middle SDI quintile (by 4.9% [–2.0 to 10.8]), whereas (due to the emergence of COVID-19) rates increased for both the high-middle SDI quintile (by 26.9% [20.1 to 34.6]) and the high SDI quintile (by 63.9% [54.9 to 73.8]). Except for the high SDI quintile, age-specific DALY rates for CMNN diseases were higher in females than males in age groups younger than 25 years, and higher among males than females in age groups including those aged 25 years and older. In the high SDI quintile, DALY rates for CMNN diseases were higher among males than among females across most of the lifespan (figure 3).

Age-standardised DALY rates for injuries in males in 2021 ranged from 3050.8 (95% UI 2784.5–3395.9) per 100 000 in the high SDI quintile to 5958.8 (5266.7–6754.1) per 100 000 in the low SDI quintile. In females,

age-standardised DALY rates ranged from 1384.7 (1206.2–1607.8) per 100 000 in the high-middle SDI quintile to 2787.9 (2414.0–3214.2) per 100 000 in the low SDI quintile (appendix 2 table S22). Age-standardised DALY rates for injuries decreased between 2010 and 2021 in all locations, ranging from a decrease of 31.7% (26.3–36.2) in the low SDI quintile to a decrease of 12.3% (10.4–14.2) in the high SDI quintile. Across all SDI quintiles, DALY rates for injuries emerged 0–6 days after birth, declined between the age groups of 7–27 days after birth and 5–9 years, and increased with age thereafter. From age 20 years and older, DALY rates for injuries in males remained relatively stable with increasing age and males aged 15–49 years in low SDI locations had similar DALY rates from injuries in 2021 (6854.7 [6203.9–7633.6] DALYs per 100 000) as they did in 2010 (7317.5 [6689.3–8064.0] per 100 000, a decrease of 6.3% [0.6–11.7]), whereas the DALY rates for females increased quite steadily with age from age 20 years (figure 3).

Drivers of changes in DALYs by location are further illustrated in figure 4, which shows the ten leading Level 3 causes of DALYs in 2021 and their annualised rate of change between 2010 and 2021 by region, super-region, and SDI quintile. In the low SDI quintile, seven of the ten leading Level 3 causes of DALYs were CMNN diseases, led by neonatal disorders (77.9 million [95% UI 65.4 to 92.8] DALYs), malaria (39.7 million [16.2 to 77.3]), and COVID-19 (33.7 million [30.8 to 38.2]; appendix 2 table S23). Age-standardised DALY rates per 100 000 due to these three causes were highest in the low SDI quintile (neonatal disorders: 4599.0 [3868.8 to 5449.4]; malaria: 2872.3 [1135.3 to 5709.5]; COVID-19: 5646.7 [5223.4 to 6170.2]), and lowest in the high SDI quintile (neonatal disorders: 536.1 [477.1 to 596.7]; malaria: 0.0 [0.0 to 0.1]; COVID-19: 1220.2 [1148.4 to 1341.9]; appendix 2 table S22). As SDI increased, more non-communicable diseases emerged in the top ten leading causes of DALYs (figure 4). In the high SDI quintile, eight of the ten leading Level 3 causes of DALYs were non-communicable diseases, led by ischaemic heart disease (23.5 million [21.5 to 24.7] DALYs), low back pain (15.9 million [11.5 to 21.2]), and stroke (15.2 million [13.7 to 16.4]); appendix 2 table S23). However, the age-standardised rate of DALYs due to ischaemic heart disease was lowest in the high SDI quintile (1133.9 [1053.0 to 1185.9] per 100 000) and highest in the low-middle SDI quintile

**Figure 4: Leading ten Level 3 causes of DALYs in 2021 by SDI quintile, region, super-region, and annualised rate of change between 2010 and 2021** Level 3 causes are ranked by attributable DALYs from left (first) to right (tenth) for each GBD region and SDI quintile, with GBD super-regions in bold. Leading ten Level 3 causes of DALYs are ranked according to 2021 DALYs counts. COPD=chronic obstructive pulmonary disease. DALY=disability-adjusted life-year. SDI=Socio-demographic Index.



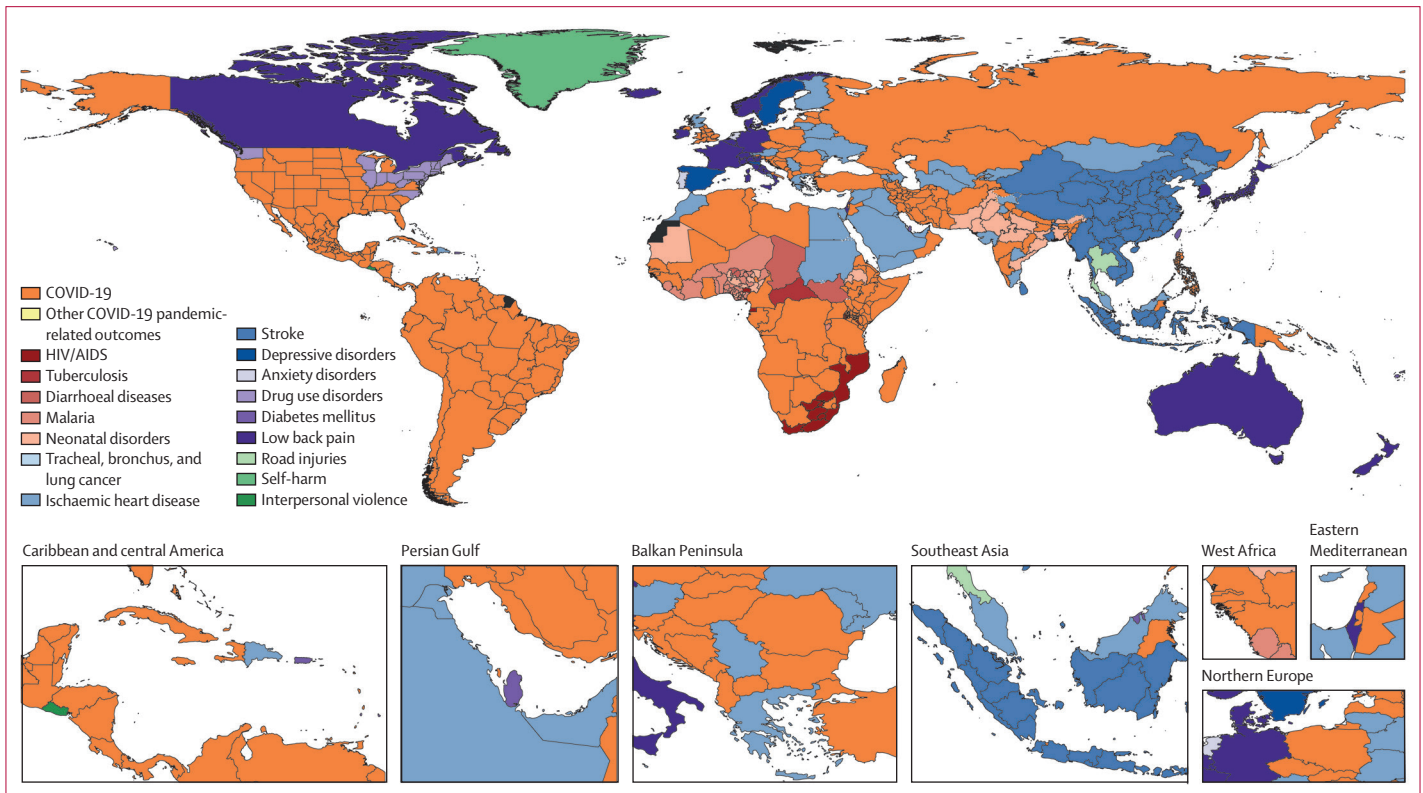
(3137.8 [2912.4 to 3360.9] per 100000). The largest changes in age-standardised DALY rates for ischaemic heart disease between 2010 and 2021 ranged from a decrease of 1.4% (−6.5 to 8.6) in low SDI locations to a decrease of 26.0% (20.6 to 31.3) in high-middle SDI locations. The age-standardised rate of DALYs due to low back pain was highest in the high SDI quintile (1094.3 [792.2 to 1459.2] per 100000) and was lowest in the middle SDI quintile (717.5 [512.8 to 962.4] per 100000). However, the age-standardised DALY rate due to stroke was lowest in high SDI locations (730.5 [665.3 to 786.6] per 100000) and highest in low SDI locations (2462.9 [2203.8 to 2735.2] per 100000). The smallest change in age-standardised DALY rates due to stroke was estimated to be for low SDI locations (decrease of 9.6% [2.5 to 15.8]), whereas the largest decrease was estimated to be for high-middle SDI locations (26.0% [20.6 to 31.3]).

For eight of 21 GBD regions, the leading cause of burden was COVID-19 (figure 4). However, COVID-19 did not feature within the top ten leading Level 3 causes of DALYs in Australasia, high-income Asia Pacific, or east Asia in 2021. The annualised rate of change for number of DALYs between 2010 and 2021 was largest for drug use disorders in high-income North America (6.5% [6.0–7.1]) and diabetes in eastern Europe (5.5% [4.9–6.2]).

The leading Level 3 causes of age-standardised DALY rates by location in 2021 are shown in figure 5 (the equivalent map for 2020, and for 2020 by sex, are in appendix 2 [figures S3, S4, S5, S6, S7]). COVID-19 was the leading cause of age-standardised DALY rates in 95 (47%) of 204 countries and territories. Despite the large burden from COVID-19 in these locations—including many in the super-region of sub-Saharan Africa—neonatal disorders, diarrhoeal diseases, malaria, or HIV/AIDS persisted as the leading Level 3 causes of burden in 17 countries and territories in sub-Saharan Africa. Ischaemic heart disease continued to be the leading cause of burden in nine countries and territories in north Africa and the Middle East, five countries and territories in western Europe, and six countries and territories in central Asia. Low back pain was the most burdensome cause in Canada (in high-income North America), and all locations in Australasia. Stroke was the most burdensome cause in all locations in east Asia.

**Trends in HALE by location and year**

We estimated global HALE at birth of 61.3 years (95% UI 58.6 to 63.6) in 2010, 63.6 years (60.7 to 66.2) in 2019, and 62.2 years (59.4 to 64.7) in 2021 (appendix 2 table S24). HALE at birth increased by 1.4% (0.4 to 2.4) between 2010 and 2021. However, HALE decreased by



**Figure 5: Leading Level 3 causes of age-standardised DALY rates by location, all ages, both sexes, in 2021**  
Dotted lines indicate disputed territories. DALY=disability-adjusted life-year.

2.2% (1.6 to 2.9) between 2019 and 2021. For 2021, we estimated higher HALE at birth in high SDI locations (68.5 years [65.2 to 71.3]) than in low SDI locations (54.4 years [51.6 to 56.7]). We estimated the greatest change in HALE at birth between 2010 and 2021 for low SDI locations (a change of 4.2% [1.9 to 6.0], from 52.2 years [49.6–54.3] in 2010). By comparison, we estimated minimal changes in HALE at birth within high SDI locations between 2010 and 2021 (a change of –0.5% [–0.8 to –0.2], from 68.9 years [65.7 to 71.6] in 2010). We estimated that HALE at birth increased between 2010 and 2021 for 11 of 21 GBD regions, with the largest increases estimated for the Caribbean, where HALE increased by 19.7% (16.5 to 23.3), from 50.4 years (47.9 to 52.6) in 2010 to 60.4 years (57.4 to 63.0) in 2021. We also found that HALE at birth decreased between 2010 and 2021 in six of 21 GBD regions. The largest decrease in HALE at birth was observed in Andean Latin America, which decreased by 5.4% (3.8 to 7.0), from 65.9 years (62.8 to 68.3) in 2010 to 62.3 years (59.4 to 64.7) in 2021.

We estimated improvement in HALE at birth in 59 (29%) of 204 countries and territories between 2010 and 2021 (appendix 2 table S24). Among them, there were 30 countries and territories where HALE at birth increased by more than 2 years between 2010 and 2021. Haiti had the largest improvement in HALE at birth (an increase of 90.2% [95% UI 77.1–104.6], from 27.4 years [25.5–29.3] in 2010 to 52.1 years [48.2–55.4] in 2021) due to the Haiti earthquake in 2010 and recovery thereafter. The next largest improvements were observed in Eswatini (an increase of 11.8% [6.2–19.2], from 41.1 years [38.5–43.7] in 2010 to 45.9 years [43.1–48.7]) and Côte d'Ivoire (an increase of 9.7% [5.8–13.5], from 50.0 years [47.4–52.3] in 2010 to 54.9 years [51.8–57.8] in 2021). In 43 countries and territories, we estimated HALE at birth to decrease between 2010 and 2021, and in 21 countries and territories, HALE at birth decreased by more than 2 years between 2010 and 2021. The largest reduction in HALE at birth was observed in Peru (a decrease of 7.4% [5.2–9.8], from 68.0 years [64.6–70.7] in 2010 to 63.0 years [60.1–65.4] in 2021) and Venezuela (a decrease of 6.9% [3.7–10.1], from 65.4 years [62.4–68.0] in 2010 to 60.9 years [57.7–64.0] in 2021).

## Discussion

In 2020 and 2021, global health outcomes, as measured by age-standardised DALY rates, worsened for the first time in three decades. From 1990 to 2019, GBD analyses showed consistent and rather encouraging improvements in overall health outcomes at the population level. During this period, achievements by the global health community included reductions in vaccine-preventable deaths and improvements in under-5 mortality rates,<sup>3,17</sup> contributing to the trend of people living longer. However, as a global epidemiological transition occurs wherein the greatest

share of disease burden shifts from communicable diseases to non-communicable diseases, populations are living longer but in poorer health. GBD 2021 reports a new global trend: the global number of DALYs and age-standardised DALY rates increased in both 2020 and 2021. This is a setback from the gains in overall human health at the global population level over the past three decades, and the evidence suggests that the COVID-19 pandemic was the inflection point for the reversal in progress. GBD 2021 quantified the health impacts of COVID-19 during some of the worst phases of the pandemic. Estimates of health loss caused by the COVID-19 pandemic provide the global health community—researchers, practitioners, and policy makers—with comprehensive health metrics about the immediate and long-term health needs of the populations most affected. The shared knowledge base provided by GBD 2021 can help stakeholders at all levels of responsibility—from multilateral agencies and national governments to local organisations—identify systemic inefficiencies that must be addressed in preparation for future pandemics and other global health crises.<sup>22</sup> DALYs are a useful metric to understand the effects of the COVID-19 pandemic on population health because they capture overall disease burden by measuring how diseases and injuries reduce years of healthy living. The estimation of DALYs up to 2021 also provides an important new benchmark for evaluating progress towards Sustainable Development Goal 2030 targets. GBD 2021 presents new opportunities for mutual understanding and accountability by countries and territories in their responses to the health inequalities persisting in their populations.

## Important trends

The profound impact of the COVID-19 pandemic affected population health at the global level, the reverberations of which continue to be detected through population-level scientific studies.<sup>16,23–26</sup> GBD 2021 found that the burden of COVID-19, as measured by DALYs, increased between 2020 and 2021. In 2020, the global all-age incidence of COVID-19 was 1.63 billion (95% UI 1.55–1.69) cases, equivalent to an age-standardised incidence rate of 20819.8 (19908.0–21681.5) cases per 100000. Global COVID-19 incidence increased to 2.28 billion (2.18–2.37) in 2021, equivalent to an age-standardised incidence rate of 28955.3 (27708.3–30143.2) per 100000. The distribution of DALYs due to COVID-19 was mostly driven by deaths and YLLs (as opposed to YLDs). Although in 2021 males and females had similar COVID-19 incidence rates, the age-standardised DALY rates for males were higher than for females. We found that, in addition to the sex disparities, both COVID-19 incidence and DALY rates were higher in low SDI locations than in high SDI locations. DALYs from other COVID-19 pandemic-related outcomes followed similar trends as DALYs due to COVID-19, in that they were higher in males than in females and highest in the low SDI quintile.



When shifting our focus from burden imposed directly by COVID-19 to the secondary impacts of the pandemic, other trends emerged. In the cases of both long COVID (data not shown) and depressive and anxiety disorders, the burden was driven by YLDs in 2020 and 2021 and was greater in females than males. The health consequences of the pandemic were unevenly distributed across demographic groups and geographical locations, which exacerbated existing socioeconomic inequities.<sup>27</sup> Government responses to the health-care challenges presented by the COVID-19 pandemic were varied, and susceptible populations were most affected as a result. The delivery of care and services—whether basic and routine care like vaccinations or immediate COVID-19 medical aid—was hampered.<sup>28</sup> Our estimation of burden for COVID-19 accounted for the roll-out of COVID-19 vaccines across countries and territories in 2021. Due to use of face masks, physical distancing, and other non-pharmaceutical interventions deployed during the COVID-19 pandemic, we found evidence that the burden of some other infectious diseases (eg, influenza and respiratory syncytial virus) in some locations was reduced, the effects of which were incorporated into our excess mortality estimations.<sup>23</sup> Locations with strained and under-resourced health systems faced overwhelming structural challenges in securing swift and sufficient supplies of vaccine, which compromised vaccine delivery to high-risk populations,<sup>29</sup> and further affected progress in responding to the burden imposed by the pandemic in under-resourced locations in 2021.<sup>25</sup>

As the pandemic recedes and COVID-19 becomes an endemic disease, a new global health landscape is becoming visible. In addition to COVID-19, six CMNN diseases were in the top 25 leading Level 3 causes of DALYs globally in 2021 (neonatal disorders, lower respiratory infections, diarrhoeal diseases, malaria, tuberculosis, and HIV/AIDS). DALY counts for each of these causes had decreased since 2010, with reductions in age-standardised DALY rates between 2010 and 2021 ranging from a decrease of 17.1% (95% UI 4.9 to 25.9) for neonatal disorders to a decrease of 47.8% (43.3 to 51.7) for HIV/AIDS. As anticipated with the global epidemiological transition,<sup>3,17</sup> the decrease in burden from CMNN diseases between 2010 and 2021 was largely driven by a decrease in age-standardised YLL rates (which decreased by 15.1% [6.7 to 22.2]) rather than YLD rates (which decreased by 4.5% [−3.6 to 20.7], appendix 2 tables S26, S27). The progress on reducing the burden of CMNN diseases must preserve momentum, particularly across low SDI locations. Neonatal disorders remained the third-leading cause of DALYs worldwide in 2021 and was in the top three leading causes of DALYs in 69 of 204 countries and territories. While the global community made progress in curtailing deaths and YLLs from neonatal disorders between 2010 and 2021 (19.5% [7.0 to 29.5] reduction in age-standardised YLL rates between 2010 and 2021),<sup>3</sup> many still experience the

non-fatal health consequences of neonatal disorders throughout their lifespan. The age-standardised DALY rates of diarrhoeal diseases decreased by 47.0% (39.9 to 52.9) between 2010 in 2021 due primarily to progress in the management of its risk factors among children younger than 5 years.<sup>30</sup> However, the decrease in burden of diarrhoeal diseases was not evenly distributed across SDI locations or groups aged 5 years and older and remained one of the top ten leading causes of DALYs in 50 countries and territories in 2021. As with diarrhoeal diseases, the global burden of HIV/AIDS also decreased. Increasing treatment coverage and preventive strategies, particularly advances in antiretroviral therapy and the implementation of treatment-as-prevention programmes,<sup>31</sup> reduced HIV/AIDS burden globally in 2021. In 2021, however, HIV/AIDS remained in the top ten leading causes of DALYs in 39 countries and territories and was the leading cause of DALYs in Congo (Brazzaville), Equatorial Guinea, Djibouti, Malawi, Mozambique, Zambia, Botswana, Eswatini, Lesotho, and South Africa. Global treatment coverage is not increasing at a sufficient rate to meet the joint UNAIDS targets to globally diagnose 95% of people living with HIV, provide treatment to 95% of people diagnosed, and achieve viral suppression in 95% of people on treatment by 2030.<sup>32</sup> Progress to slow down transmission, increase treatment rates, and prevent HIV-related deaths is urgently required.

Between 2010 and 2021, DALYs from non-communicable diseases increased by 17.6% (95% UI 13.8 to 21.0) due to the ageing and growing global population,<sup>17</sup> with only a moderate improvement in corresponding age-standardised DALY rates (decrease of 6.4% [3.5 to 9.5] between 2010 and 2021; appendix 2 table S25). The non-communicable disease burden was distributed widely across the world's populations, irrespective of age, sex, or socioeconomic circumstance, which presents both immediate and long-term challenges to health-care systems.<sup>16,33,34</sup> Cardiovascular diseases—notably, Level 3 causes including ischaemic heart disease and stroke—were in the top five leading sources of global DALYs in 190 countries and territories in 2021. Changes in age-standardised DALY rates from 2010 to 2021 for stroke ranged from decreases of 9.6% (2.5 to 15.8) in low SDI locations to decreases of 24.9% (17.3 to 31.7) in high-middle SDI locations, whereas for ischaemic heart disease changes in age-standardised DALY rates ranged from a decrease of 1.4% (−6.5 to 8.6) in low SDI locations to a decrease of 26.0% (20.6 to 31.3) in high-middle SDI locations. Ischaemic heart disease and stroke share many modifiable risk factors and opportunities for intervention. The increasing global burden from diabetes between 2010 and 2021, alongside established risk factors for cardiovascular diseases (eg, high blood pressure, high cholesterol, high BMI, kidney dysfunction, ambient and household air pollution, physical inactivity, and tobacco use) are known contributors to stagnating progress on reducing the burden from cardiovascular diseases.<sup>35</sup>

Intervention strategies targeting modifiable risks, especially approaches with demonstrated success, such as tobacco control and blood pressure-lowering and cholesterol-lowering strategies,<sup>35</sup> will help reduce the overall burden of non-communicable diseases. In addition to prevention through the management of risk factors, the negative health effects of cardiovascular disease can be mitigated through timely intervention for acute events and surgical procedures. However, geographical disparities between high-income countries and low-income and middle-income countries in access to and quality of cardiac surgical care must be addressed,<sup>36,37</sup> which would help populations for whom the burden of cardiovascular diseases is greatest receive the necessary care and treatment.

We estimated that 31·3% (95% UI 25·4–37·5) of global DALYs in 2021 were due to YLDs. The leading contributors of global YLDs were non-communicable diseases: low back pain, depressive disorders, and headache disorders. Low back pain was the largest contributor of global all-cause YLDs in 2021, with a decrease in the age-standardised YLD rate of only 2·4% (1·8–2·9) since 2010. Globally, prevalent cases and YLDs from low back pain increased with age—peaking in the 85–89 year age group—presenting huge challenges to countries with ageing populations.<sup>38</sup> Clinical guidelines for treatment and prevention include education, self-care, physical therapy, medication, non-surgical treatments, and surgery.<sup>39,40</sup> Not only are some of these treatment options costly, but also, when used in isolation, rarely address the complex nature of low back pain. A holistic approach to the burden imposed by low back pain, addressing its biological, social, and psychological components, with further research into the efficacy of diagnostic and preventive options, would advance our ability to manage this considerable source of disability worldwide.

The efficacy and cost-effectiveness of treatment options for depressive disorders across low-income, middle-income, and high-income settings have been established by existing research.<sup>16</sup> These include the use of self-care (eg, web-based therapy), primary care, and community outreach programmes to deliver psychological and pharmacological interventions, hospital care, and specialist services.<sup>41</sup> Although mental health interventions are effective and cost-effective, and public opinions regarding the benefits of seeking treatment for mental disorders are becoming more supportive, we estimated there were 332 million (95% UI 298–376) cases of depressive disorders globally in 2021. Cases were distributed across the entire lifespan but were most common among females between age groups 15–19 years and 60–64 years. In many instances, depressive disorders are rarely detected at their onset, and only a small proportion of individuals receive the evidence-based treatment packages considered to be minimally adequate.<sup>34,41</sup> This is also the case for other disabling and burdensome mental disorders, such as anxiety disorders

and schizophrenia, and substance use disorders. The findings of GBD 2021 underline the need for an enhanced response to address mental and substance use disorders through expanded financial commitments and improved service quality and access. The need to intensify our efforts to minimise the negative health consequences of mental and substance use disorders is urgent in the wake of shock events, like the COVID-19 pandemic, natural disasters, and military conflicts.<sup>16</sup> Additionally, many mental disorders are prevalent during childhood or early adulthood, when other risk factors such as bullying victimisation and childhood maltreatment can occur.<sup>16,42</sup> Early interventions with population-based prevention strategies targeting these risk factors and promoting the social and emotional development of younger populations will lead to positive outcomes. Interventions that can address the increasing burden of drug use disorders are also urgently required, particularly for opioid use disorders. Opioid substitution therapy can decrease opioid use and health risks involved with injecting drugs. The effects of an opioid overdose can be reversed with use of the opioid antagonist naloxone, the availability of which ought to be expanded alongside training on safe and effective administration for pharmacists, health-care providers, individuals at risk of opioid overdose, their family members, and social service agencies that work with substance users.<sup>43</sup>

Approximately 2·81 billion (95% UI 2·60 to 3·03) individuals had migraine or tension-type headache in 2021, with females aged 15–49 years being most affected. Interventions targeting the management of symptoms exist, but we found no sign of improvement in the burden of these disorders between 2010 and 2021 (with a 0·3% [–1·1 to 1·4] increase in age-standardised YLD rates). In addition to opportunities to scale up treatment strategies, more work is required to establish the modifiable risk factors of headache disorders.<sup>44</sup>

Among the leading 25 causes of YLDs, we observed the largest increase in global age-standardised YLD rates for diabetes between 2010 and 2021 (25·9% [95% UI 24·0–28·1]). An increase in the age-standardised rate was evident in all 204 countries and territories between 2010 and 2021. This increase in age-standardised YLD rates for diabetes was largely driven by type 2 diabetes and the increasing rates of obesity globally. Type 2 diabetes is preventable and, in some instances, reversible with early detection and adequate care.<sup>33,45,46</sup> GBD 2021 estimates that 525 million (490–565) people had diabetes in 2021; however, without global intervention, a separate GBD 2021 analysis has forecast that more than 1·31 billion people worldwide will have diabetes by 2050.<sup>33</sup> Any coordinated response to the escalating burden of diabetes must target the underlying causes of obesity and help remove the social and logistical barriers to accessing care and services.

The overall burden imposed by injuries was driven by deaths and YLLs, both of which decreased between 2010 and 2021. Reductions in the burden of injuries were not

distributed equally across time, sex, and location. The travel restrictions and physical distancing measures implemented in some countries and territories to control the spread of SARS-CoV-2 during the COVID-19 pandemic might have contributed to small decreases in road accidents in 2020 and 2021; however, data and evidence on this have been inconsistent.<sup>3</sup> Our estimates indicated that most of the health gains from injuries occurred between 2010 and 2019 as opposed to between 2019 and 2021. Burden from injuries was highest in low SDI locations, where exposure to forces of nature (ie, natural disasters) increased the burden due to injuries in 2010 for both males and females. Despite this, males aged 15–49 years in low SDI locations had similar DALY rates from injuries in 2021 as they did in 2010. The leading injuries among males aged 15–49 years in the low SDI quintile in 2021 were road injuries, conflict and terrorism, and interpersonal violence (data not shown). Males were more affected by these injuries than their female counterparts, for whom we saw a substantial decrease in burden from injuries in the same period (decrease of 45·8% [40·9–50·1] since 2010; data not shown). Although populations in many countries and territories are living safer and longer lives, more effort is required to reach those same standards for many others, especially those living in low SDI locations.

Globally, HALE at birth improved from 61·3 years (95% UI 58·6–63·6) in 2010 to 62·2 years (59·4–64·7) in 2021. GBD 2021 provides an important baseline from which we can track the extent to which life expectancies rebound and progress in HALE accelerates after 2021. Between 2010 and 2021, we observed improvements in HALE at birth in 59 countries and territories, with people living in low SDI locations having larger gains than those living in high SDI locations. Faster progress in the sociodemographic circumstances in low SDI locations resulted in larger gains in life expectancy and HALE at birth between 2010 and 2021.

### Limitations

GBD estimates of health and health loss evolve across cycles because of the addition of new data, important improvements made to the burden estimation pipeline, and instability in datasets and processes, which we try to minimise wherever possible. Inconsistencies in the availability of primary epidemiological data remain a limitation and source of instability within GBD analyses. Our estimates depend on the out-of-sample predictive validity of modelling processes in cases where data are insufficient to produce burden estimates for all 204 countries and territories (by year, sex, and age). Although this approach cannot fully replace high quality primary data, it ensures that populations or causes with no or little data are not excluded from important benchmarking exercises intended for burden estimation. With any given GBD release, there might be extant data

not identified or incorporated, which is a key part of the rationale for ongoing cycles of releases, rather than a single update. For the primary data available, our data processing methods account for known sources of variation wherever possible, but fully disentangling variation in our estimates is not always possible due to measurement error and reporting inaccuracies. There are problems with the quality and collection of primary data, such as flawed methodologies and potential under-reporting of illnesses, which is a recurring limitation for GBD that can be continually improved on by strengthening data-collection systems. Our identification of reference and alternative case definitions for epidemiological data undergoing bias correction can further inform survey design in future data collection efforts. Our estimation of 95% UIs is also an area requiring further improvement. Our analyses are intended to capture uncertainty from a range of data types and processes (eg, from stochastic variation in input data, age–sex splitting, bias corrections, and other data manipulations or statistical approaches), but it is difficult to capture all sources of uncertainty across the entire burden estimation pipeline.

Our estimation of YLDs is restricted by several factors. Due to data sparsity, severity distributions do not capture variation by access to treatments for major causes contributing to YLDs. The development of new approaches to model changes in severity by health-care access for depressive and anxiety disorders is underway and could provide a solution to this issue in future GBD cycles.<sup>47</sup> The quality and accuracy of comorbidity corrections also requires improvement. Our comorbidity correction adjusted for the difference between the average disability weight for one sequela and the multiplicatively combined disability weight for multiple sequelae (ie, independent comorbidity). This approach underestimates the comorbidity between sequelae especially for causes (eg, mental disorders) where the comorbidity distribution is reliant on the range of disorders experienced. Limitations related to our estimation of YLLs are discussed in detail elsewhere.<sup>3</sup>

The estimation of DALYs for specific diseases and injuries also has distinct limitations, and these are presented in greater detail in appendix 1 (section 8) and topic-specific publications. Notably, for GBD 2021, challenges associated with collecting data and modelling a novel disease like COVID-19 were present. Modelling COVID-19, long COVID, and other COVID-19 pandemic-related outcomes presented analytical challenges for a range of reasons. First, data on COVID-19 outcomes (eg, cases, deaths, hospital admissions, and seroprevalence) were of highly variable quality and completeness, which required novel methods for standardisation.<sup>23,25,26</sup> Second, approaches for estimating excess mortality, which were used to estimate the extent of other COVID-19 pandemic-related mortality, can produce quite divergent results in some locations.<sup>17</sup> Third, we found considerable

heterogeneity in case definition and instrumentation used to measure long COVID. We concentrated on estimates for three major symptom clusters associated with long-term health loss from COVID-19 because these would not be captured by GBD cause estimates. Cohort data suggest that these three clusters capture the most severe outcomes reported at 3 months or longer after initial infection but are not a complete capture of all long COVID symptoms.<sup>24</sup> However, we had limited ability in GBD 2021 to capture the specific indirect effects of COVID-19, both in modelling fatal and non-fatal outcome estimations. In future analyses, the combined effect of changing virus variants, vaccinations, and past infection on the occurrence of long COVID will need to be evaluated. Due to sparsity of data from long COVID follow-up studies, particularly from low-income and middle-income settings, we were unable to fully assess variation in the occurrence, severity, or duration of long COVID between locations. As more data become available from the pandemic era, the ability to more fully and specifically estimate the indirect effect of the COVID-19 pandemic across many causes is likely to improve. Work to address these limitations in future data collection efforts is in development and will be incorporated into future iterations of GBD.<sup>24</sup>

### Future directions

Efforts by GBD research teams to include new causes and locations, secure new epidemiological data, more precisely correct for measurement error, and capture uncertainty within burden estimates are ongoing areas of priority. Because forecasts of future health trends are of great value to policy makers, forecasting the burden of disease under reference and alternative risk exposure scenarios is another ongoing area of high priority. There also remains a need to analyse the long-term effects of COVID-19 and develop tools and analytical frameworks that can measure the hidden burden of the pandemic. Developing and refining analytical tools to better understand the extent of the burden imposed by COVID-19 will also assist pandemic planning and preparedness. More streamlined incorporation of location-level covariates capturing the effect of the pandemic is being tested within our cause of death and prevalence modelling for the next GBD cycle. The use of DisMod-AT, an updated version of DisMod-MR, to estimate prevalence is also proceeding for several causes. We expect DisMod-AT to produce more accurate trends over age and time within our prevalence estimates, including the integration of the effect of population shock events. We also expect to incorporate severity distributions by health-care access for several causes in the next GBD cycle and continue work to eventually produce dependent comorbidity corrections. Our burden estimation processes are constantly evolving to provide the most comprehensive and accurate information to stakeholders. However, areas of innovation and methods development also need to be staggered to allow us to respond to emerging trends and the ever-evolving public health landscape.

### Conclusion

In 2020 and 2021, the global all-cause burden of disease increased for the first time in three decades. This reversal in progress was due to three main factors: (1) the direct health impacts of COVID-19; (2) the indirect health consequences of COVID-19 and the pandemic, such as the effect on mental disorders; and (3) fallout from overburdened health service systems and uncoordinated policy responses to the COVID-19 pandemic. The effect of the pandemic, as measured by DALYs, was unevenly distributed by age, sex, and location, exacerbating many existing inequalities. As the world starts to recover, continuing gains for other CMNN diseases must not stall. Urgent priority needs to be given to prevalent and disabling non-communicable diseases that have seen insufficient or no improvement despite several calls to action—notably, cardiovascular diseases, musculoskeletal disorders (ie, low back pain), and mental disorders. Ultimately, GBD 2021 results illustrate the need for our global community to come together in a multidisciplinary and coordinated response to deliver not just better survival rates, but healthier and safer outcomes for our ever growing and ageing population.

### GBD 2021 Diseases and Injuries Collaborators

Alize J Ferrari<sup>\*</sup>, Damian Francesco Santomauro<sup>\*</sup>, Amirali Aali, Yohannes Habtegiorgis Abate, Cristiana Abbafati, Hedayat Abbastabar, Samar Abd ElHafeez, Michael Abdelmassih, Sherief Abd-Elsalam, Arash Abdollahi, Auwal Abdullahi, Kedir Hussein Abegaz, Roberto Ariel Abeldaño Zuñiga, Richard Gyan Aboagye, Hassan Abolhassani, Lucas Guimarães Abreu, Hasan Abualruz, Eman Abu-Gharbieh, Niveen ME Abu-Rmeileh, Ilana N Ackerman, Isaac Yeboah Addo, Giovanni Addolorato, Akindele Olupelumi Adebisi, Abiola Victor Adepoju, Habeeb Omoponle Adewuyi, Shadi Afyouni, Saira Afzal, Sina Afzal, Antonella Agodi, Aqeel Ahmad, Danish Ahmad, Firdos Ahmad, Shahzaib Ahmad, Ali Ahmed, Luai A Ahmed, Muktar Beshir Ahmed, Marjan Ajami, Karolina Akinosoglou, Mohammed Ahmed Akkaif, Syed Mahfuz Al Hasan, Samer O Alalalmeh, Ziyad Al-Aly, Mohammed Albashtawy, Robert W Aldridge, Meseret Desalegn Alemu, Yihun Mulugeta Alemu, Kefyalew Addis Alene, Adel Ali Saeed Al-Gheethi, Maryam Alharrasi, Robert Kaba Alhassan, Mohammed Usman Ali, Rafat Ali, Syed Shujait Shujait Ali, Sheikh Mohammad Alif, Syed Mohamed Aljunid, Sabah Al-Marwani, Joseph Uy Almazan, Mahmoud A Alomari, Basem Al-Omari, Zaid Altaany, Nelson Alvis-Guzman, Nelson J Alvis-Zakzuk, Hassan Alwafi, Mohammad Sami Al-Wardat, Yaser Mohammed Al-Worafi, Safwat Aly, Kareem H Alzoubi, Azmeraw T Amare, Prince M Amegbor, Edward Kwabena Ameyaw, Tarek Tawfik Amin, Alireza Amindarolzarbi, Sohrab Amiri, Dickson A Amugsi, Robert Ancuceanu, Deanna Anderlini, David B Anderson, Pedro Prata Andrade, Catalina Liliana Andrei, Hossein Ansari, Catherine M Antony, Saleha Anwar, Sumadi Lukman Anwar, Raziq Anwer, Philip Emeka Anyanwu, Juan Pablo Arab, Jalal Arabloo, Mosab Arafat, Daniel T Araki, Aleksandr Y Aravkin, Mesay Arkew, Benedetta Armocida, Michael Benjamin Arndt, Mahwish Arooj, Anton A Artamonov, Raphael Taiwo Aruleba, Ashokan Arumugam, Charlie Ashbaugh, Mubarek Yesse Ashemo, Muhammad Ashraf, Marvellous O Asika, Elaheh Askari, Thomas Astell-Burt, Seyyed Shamsadin Athari, Prince Atorkey, Maha Moh'd Wahbi Atout, Alok Atreya, Avinash Aujayeb, Marcel Ausloos, Abolfazl Avan, Adedapo Wasiu Awotidebe, Kofi Awuviry-Newton, Beatriz Paulina Ayala Quintanilla, Jose L Ayuso-Mateos, Sina Azadnajafabad, Rui M S Azevedo, Abraham Samuel Babu, Muhammad Badar, Ashish D Badiye, Soroush Baghdadi, Nasser Bagheri, Sulaiman Bah, Ruhai Bai, Jennifer L Baker,

Shankar M Bakkannavar, Abdulaziz T Bako, Senthilkumar Balakrishnan, Kiran Bam, Palash Chandra Banik, Martina Barchitta, Mainak Bardhan, Erfan Bardideh, Suzanne Lyn Barker-Collo, Hiba Jawdat Barqawi, Amadou Barrow, Sandra Barteit, Lingkan Barua, Somaye Bashiri Aliabadi, Afisu Basiru, Sanjay Basu, Saurav Basu, Prapthi Persis Bathini, Kavita Batra, Bernhard T Baune, Nebiyou Simegnaw Bayileyegn, Babak Behnam, Amir Hossein Behnoush, Maryam Beiranvand, Diana Fernanda Bejarano Ramirez, Michelle L Bell, Olorunjuwon Omolaja Bello, Apostolos Beloukas, Isabela M Bensenor, Zombor Berezvai, Eduardo Bernabe, Robert S Bernstein, Paulo J G Bettencourt, Akshaya Srikanth Bhagavathula, Neeraj Bhala, Dinesh Bhandari, Ashish Bhargava, Sonu Bhaskar, Vivek Bhat, Gurjit Kaur Bhatti, Jasvinder Singh Bhatti, Manpreet S Bhatti, Rajbir Bhatti, Zulfiqar A Bhutta, Boris Bikbov, Jessica Devin Bishai, Catherine Bisignano, Veera R Bitra, Tone Bjørge, Virginia Bodolica, Aadam Olalekan Bodunrin, Eyob Ketema Bogale, Milad Bonakdar Hashemi, Aime Bonny, Berrak Bora Basara, Hamed Borhany, Christopher Boxe, Oliver J Brady, Nicola Luigi Bragazzi, Dejana Braithwaite, Luisa C Brant, Michael Brauer, Susanne Breiter, Hermann Brenner, Julie Brown, Traolach Brugh, Norma B Bulamu, Danilo Buonsenso, Katrin Burkart, Richard A Burns, Reinhard Busse, Yasser Bustanji, Zahid A Butt, Justin Byun, Florentino Luciano Caetano dos Santos, Daniela Calina, Luis Alberto Cámera, Ismael R Campos-Nonato, Chao Cao, Angelo Capodici, Sinclair Carr, Giulia Carreras, Andrea Carugno, Márcia Carvalho, Joao Mauricio Castaldelli-Maia, Carlos A Castañeda-Orjuela, Giulio Castelpetra, Alberico L Catapano, Maria Sofia Cattaruzza, Arthur Caye, Luca Cegolon, Francieli Cembranel, Muthia Cenderadewi, Ester Cerin, Promit Ananyo Chakraborty, Jeffrey Shi Kai Chan, Raymond N C Chan, Rama Mohan Chandika, Eeshwar K Chandrasekar, Periklis Charalampous, Vijay Kumar Chattu, Victoria Chatzimavidou-Grigoriadou, Angela W Chen, An-Tian Chen, Catherine S Chen, Haowei Chen, Nathalie M Chen, Esther T W Cheng, Odgerel Chimed-Ochir, Ritesh Chimoriya, Patrick R Ching, William C S Cho, Sungchul Choi, Bryan Chong, Yuen Yu Chong, Sonali Gajanan Choudhari, Rajiv Chowdhury, Steffan Witttrup McPhee Christensen, Dinh-Toi Chu, Isaac Sunday Chukwu, Eric Chung, Eunice Chung, Muhammad Chutiyaani, Mareli M Claassens, Rebecca M Cogen, Alyssa Columbus, Joao Conde, Paolo Angelo Cortesi, Ewerton Cousin, Michael H Criqui, Natália Cruz-Martins, Omid Dadras, Siyu Dai, Xiaochen Dai, Zhaoli Dai, Maxwell Ayindenaba Dalaba, Giovanni Damiani, Jai K Das, Saswati Das, Mohsen Dashti, Claudio Alberto Dávila-Cervantes, Kairat Davletov, Diego De Leo, Akililu Tamire Debele, Shayom Debopadhaya, Nicole K DeCleene, Farah Deeba, Louisa Deegenhardt, Cristian Del Bo', Ivan Delgado-Enciso, Andreas K Demetriades, Edgar Denova-Gutiérrez, Nikolaos Dervenis, Hardik Dineshbhai Desai, Rupak Desai, Keshab Deuba, Kuldeep Dhama, Samath Dhamminda Dharmaratne, Sameer Dhingra, Diana Dias da Silva, Daniel Diaz, Luis Antonio Diaz, Michael J Diaz, Adriana Dima, Delaney D Ding, M Ashworth Dirac, Thao Huynh Phuong Do, Camila Bruneli do Prado, Sushil Dohare, Regina-Mae Villanueva Dominguez, Wanyue Dong, Deepa Dongarwar, Mario D'Oría, E Ray Dorsey, Leila Doshmangir, Robert Kokou Dowou, Tim Robert Driscoll, Haneil Larson Dsouza, Viola Dsouza, John Dube, Samuel C Dumith, Bruce B Duncan, Andre Rodrigues Duraes, Senbagam Duraisamy, Oyewole Christopher Durojaiye, Paulina Agnieszka Dzionach, Arkadiusz Marian Dziedzic, Ejemai Eboreime, Alireza Ebrahimi, Hisham Atan Edinur, David Edvardsson, Terje Andreas Eikemo, Ebrahim Eini, Michael Ekholuenetale, Temitope Cyrus Ekundayo, Iman El Sayed, Maha El Tantawi, Iffat Elbarazi, Noha Mousaad Elemam, Ghada Metwally Tawfik ElGohary, Muhammed Elhadi, Omar Abdelsadek Abdou Elmeligy, Gihan ELNahas, Mohammed Elshaer, Ibrahim Elsohaby, Luchuo Engelbert Bain, Rychindorj Erkhembayar, Babak Eshtrati, Kara Estep, Natalia Fabin, Adeniyi Francis Fagbamigbe, Luca Falzone, Mohammad Fareed, Carla Sofia e Sá Farinha, MoezAllIslam Ezzat Mahmoud Faris, Andre Faro, Pegah Farrokhi, Ali Fatehizadeh, Nelsensius Klau Fauk, Valery L Feigin, Xiaoqi Feng, Seyed-Mohammad Fereshtehnejad, Abdullah Hamid Feroze, Nuno Ferreira, Paulo H Ferreira, Florian Fischer, Joanne Flavel, David Flood, Luisa S Flor, Nataliya A Foigt, Morenike Oluwatoyin Folayan, Lisa M Force, Daniela Fortuna, Matteo Foschi, Richard Charles Franklin, Alberto Freitas, Takeshi Fukumoto, João M Furtado, Peter Andras Gaal, Muktar A Gadanya, Abhay Motiramji Gaidhane, Santosh Gaihre, Yaseen Galali, Mandukhai Ganbat, Aravind P Gandhi, Balasankar Ganesan, Mohd Ashraf Ganie, Mohammad Arfat Ganiyani, William M Gardner, Tilaye Gebru Gebi, Miglas W Gebregorgis, Mesfin Gebrehiwot, Tesfay B B Gebremariam, Teferi Gebru Gebremeskel, Yibeltal Yismaw Gela, Simona Roxana Georgescu, Alberta Getachew Obsa, Peter W Gething, Molla Getie, Keyghobad Ghadiri, Fataneh Ghadrian, Khalid Yaser Ghailan, Alireza Ghajar, MohammadReza Ghasemi, Ghazal Ghasempour Dabaghi, Afsaneh Ghasemzadeh, Ramy Mohamed Ghazy, Ali Gholamrezaezhad, Mahsa Ghorbani, Elena Ghotbi, Ruth Margaret Gibson, Tiffany K Gill, Themba G Ginindza, Alem Girmay, James C Glasbey, Laszlo Göbölös, Myron Anthony Godinho, Salime Goharinezhad, Mohamad Goldust, Mahaveer Golechha, Pouya Goleij, Philimon N Gona, Giuseppe Gorini, Alessandra C Goulart, Ayman Grada, Michal Grivna, Shi-Yang Guan, Giovanni Guarducci, Mohammed Ibrahim Mohialdeen Gubari, Mesay Dechasa Gudeta, Avirup Guha, Stefano Guicciardi, Snigdha Gulati, David Gulisashvili, Damitha Asanga Gunawardane, Cui Guo, Anish Kumar Gupta, Bhawna Gupta, Ishita Gupta, Mohak Gupta, Rajeev Gupta, Veer Bala Gupta, Vijai Kumar Gupta, Vivek Kumar Gupta, Reyna Alma Gutiérrez, Farrokh Habibzadeh, Parham Habibzadeh, Rasool Haddadi, Najah R Hadi, Nils Haep, Nima Hafezi-Nejad, Abdul Hafiz, Hailey Hagins, Esam S Halboub, Aram Halimi, Sebastian Haller, Rabih Halwani, Erin B Hamilton, Graeme J Hankey, Md Abdul Hannan, Md Nuruzzaman Haque, Harapan Harapan, Josep Maria Haro, Jan Hartvigsen, Ahmed I Hasaballah, Ikramul Hasan, Mohammad Hasanian, Md Saquib Hasnain, Amir Hassan, Johannes Haubold, Rasmus J Havmoeller, Simon I Hay, Khezay Hayat, Jeffrey J Hebert, Omar E Hegazi, Golnaz Heidari, Bartosz Helfer, Mehdi Hemmati, Delia Hendrie, Claire A Henson, Kamal Hezam, Yuta Hiraike, Nguyen Quoc Hoan, Ramesh Holla, Julia Hon, Md Mahbub Hossain, Hassan Hosseinzadeh, Mehdi Hosseinzadeh, Mihaela Hostiuc, Sorin Hostiuc, Johnathan M Hsu, Junjie Huang, Fernando N Hugo, Kiyavash Hushmandi, Javid Hussain, Nawfal R Hussein, Chantal K Huynh, Hong-Han Huynh, Bing-Fang Hwang, Vincent C Iannucci, Audrey L Ihler, Adalia I Ikiroma, Kevin S Ikuta, Olayinka Stephen Ilesanmi, Irena M Ilic, Milena D Ilic, Mohammad Tarique Imam, Mustapha Immurana, Lalu Muhammad Irham, Md Rabiul Islam, Sheikh Mohammed Shariful Islam, Farhad Islami, Faisal Ismail, Nahlah Elkudssiah Ismail, Gaetano Isola, Masao Iwagami, Chidozie C D Iwu, Mahalaxmi Iyer, Jalil Jaafari, Kathryn H Jacobsen, Farhad Jadidi-Niaragh, Morteza Jafarinia, Khushleen Jaggi, Kasra Jahankhani, Nader Jahanmeh, Haitham Jahrami, Akhil Jain, Nityanand Jain, Ammar Abdulrahman Jairoun, Abhishek Jaiswal, Mihajlo Jakovljevic, Abubakar Ibrahim Jatau, Sabzali Javadov, Tahereh Javaheri, Sathish Kumar Jayapal, Shubha Jayaram, Sun Ha Jee, Jayakumar Jeganathan, Angeline Jeyakumar, Anil K Jha, Heng Jiang, Yinzi Jin, Jost B Jonas, Tamas Joo, Abel Joseph, Nitin Joseph, Charity Ehimwenma Joshua, Jacek Jerzy Jozwiak, Mikk Jürisson, Vaishali K, Billingsley Kaambwa, Ali Kabir, Zubair Kabir, Vidya Kadashetti, Rizwan Kalani, Leila R Kalankesh, Feroze Kaliyadan, Sanjay Kalra, Kaloyan Kamenov, Naser Kamyari, Thanigaivelan Kanagasabai, Himal Kandel, Arun R Kanmanthareddy, Kehinde Kazeem Kanmodi, Rami S Kantar, Ibraheem M Karaye, Asima Karim, Salah Eddin Karimi, Yeganeh Karimi, Hengameh Kasraei, Molly B Kassel, Joonas H Kauppila, Norito Kawakami, Gbenga A Kayode, Foad Kazemi, Sina Kazemian, Leila Keikavoosi-Arani, Cathleen Keller, John H Kempen, Jessica A Kerr, Kamyab Keshtkar, Emmanuelle Kesse-Guyot, Mohammad Keykhai, Himanshu Khajuria, Amirmohammad Khalaji, Asaad Khalid, Nauman Khalid, Alireza Khalilian, Faham Khamessipour, Asaduzzaman Khan, Ikramullah Khan, Maseer Khan, Moien AB Khan, Shaghayegh Khanmohammadi, Khaled Khatab, Fatemeh Khatami,

Moawiah Mohammad Khatatbeh, Amir M Khater,  
 Hamid Reza Khayat Kashani, Feriha Fatima Khidri, Elaheh Khodadoust,  
 Moein Khormali, Zahra Khorrani, Zemene Demelash Kifle,  
 Min Seo Kim, Ruth W Kimokoti, Adnan Kisa, Sezer Kisa,  
 Ann Kristin Skrindo Knudsen, Jonathan M Kocarnik, Sonali Kochhar,  
 Hyun Yong Koh, Ali-Asghar Kolahi, Farzad Kompani, Gerbrand Koren,  
 Oleksii Korzh, Soewarta Kosen,  
 Sindhura Lakshmi Koulmane Laxminarayana, Kewal Krishan,  
 Varun Krishna, Vijay Krishnamoorthy, Barthelemy Kuate Defo,  
 Md Abdul Kuddus, Mohammed Kuddus, Ilari Kuitunen,  
 Vishnutheertha Kulkarni, Manasi Kumar, Nithin Kumar, Rakesh Kumar,  
 Om P Kurmi, Dian Kusuma, Hmwe Hmwe Kyu, Carlo La Vecchia,  
 Ben Lacey, Muhammad Awwal Ladan, Lucie Laflamme,  
 Alessandra Lafranconi, Chandrakant Lahariya, Daphne Teck Ching Lai,  
 Dharmesh Kumar Lal, Ratilal Lalloo, Tea Lallukka, Judit Lám, Qing Lan,  
 Tuo Lan, Iván Landires, Francesco Lanfranchi, Berthold Langguth,  
 Ariane Laplante-Lévesque, Bagher Larijani, Anders O Larsson,  
 Savita Lasrado, Paolo Lauriola, Huu-Hoai Le, Long Khanh Dao Le,  
 Nhi Huu Hanh Le, Trang Diep Thanh Le, Janet L Leasher,  
 Caterina Ledda, Munjae Lee, Paul H Lee, Sang-woong Lee,  
 Seung Won Lee, Wei-Chen Lee, Yo Han Lee, Kate E LeGrand,  
 Jacopo Lenzi, Elyvna Leong, Janni Leung, Ming-Chieh Li, Wei Li,  
 Xiaopan Li, Yichong Li, Yongze Li, Lee-Ling Lim, Stephen S Lim,  
 Megan Lindstrom, Shai Linn, Gange Liu, Runben Liu, Shiwei Liu,  
 Wei Liu, Xiaofeng Liu, Xuefeng Liu, Erand Llanaj, Chun-Han Lo,  
 Rubén López-Bueno, Arianna Maever Loreche, László Lorenzovici,  
 Rafael Lozano, Jaiios Lubinda, Giancarlo Lucchetti,  
 Raimundas Lunevicius, Jay B Lusk, hengliang lv, Zheng Fei Ma,  
 Nikolaos Machairas, Áurea M Madureira-Carvalho,  
 Javier A Magaña Gómez, Azzam A Maghazachi, Preeti Maharjan,  
 Phetole Walter Mahasha, Mina Maheri, Soleiman Mahjoub,  
 Mansour Adam Mahmoud, Elham Mahmoudi, Azeem Majeed,  
 Konstantinos Christos Makris, Elaheh Malakan Rad, Kashish Malhotra,  
 Ahmad Azam Malik, Iram Malik, Deborah Carvalho Malta, Yosef Manla,  
 Ali Mansour, Pejman Mansouri, Mohammad Ali Mansournia,  
 Ana M Mantilla Herrera, Lorenzo Giovanni Mantovani,  
 Emmanuel Manu, Hamid Reza Marateb, Parham Mardi,  
 Gabriel Martinez, Ramon Martinez-Piedra, Daniela Martini,  
 Francisco Rogerlândio Martins-Melo, Miquel Martorell, Wolfgang Marx,  
 Sharmeen Maryam, Roy Rillera Marzo, Yasith Mathangasinghe,  
 Stephanie Mathieson, Alexander G Mathioudakis,  
 Jishanth Mattumpuram, Andrea Mauerger, Mahsa Mayeli,  
 Mohsen Mazidi, Antonio Mazzotti, John J McGrath, Martin McKee,  
 Anna Laura W McKowen, Michael A McPhail,  
 Kamran Mehrabani-Zeinabed, Entezar Mehrabi Nasab,  
 Tesfahun Mekene Meto, Walter Mendoza, Ritesh G Menezes,  
 George A Mensah, Alexios-Fotios A Mentis, Sultan Ayoub Meo,  
 Haftu Asmerom Meresa, Atte Meretoja, Tuomo J Meretoja,  
 Abera M Mersha, Tomislav Mestrovic,  
 Kukulege Chamila Dinushi Mettananda, Sachith Mettananda,  
 Irmina Maria Michalek, Paul Anthony Miller, Ted R Miller,  
 Edward J Mills, Le Huu Nhat Minh, Antonio Mirijello,  
 Erkin M Mirrakhimov, Mizan Kiros Mirutse,  
 Mohammad Mirza-Aghazadeh-Attari, Maryam Mirzaei, Roya Mirzaei,  
 Awoke Misganaw, Ajay Kumar Mishra, Philip B Mitchell,  
 Chaitanya Mittal, Babak Moazen, Madeline E Moberg, Jama Mohamed,  
 Mouhand F H Mohamed, Nouh Saad Mohamed, Esmail Mohammadi,  
 Soheil Mohammadi, Hussien Mohammed, Salahuddin Mohammed,  
 Shafiq Mohammed, Robin M Mohr, Ali H Mokdad, Sabrina Molinaro,  
 Sara Momtazmanesh, Lorenzo Monasta, Stefania Mondello,  
 AmirAli Moodi Ghalibaf, Maryam Moradi, Yousef Moradi,  
 Maziar Moradi-Lakeh, Paula Moraga, Lidia Morawska,  
 Rafael Silveira Moreira, Negar Morovatdar, Shane Douglas Morrison,  
 Jakub Morze, Abbas Mosapour, Jonathan F Mosser, Elias Mossialos,  
 Rohith Motappa, Vincent Mougoin, Simin Moudi, Matias Mrejen,  
 Ahmed Msherghi, Sumaira Mubarik, Ulrich Otto Mueller,  
 Francesk Multita, Kavita Munjal, Efrén Murillo-Zamora, BV Murlimanju,  
 Ghulam Mustafa, Sathish Muthu, Muhammad Muzaffar,  
 Woojae Myung, Ahamarshan Jayaraman Nagarajan, Pirouz Naghavi,  
 Ganesh R Naik, Firzan Nainu, Sanjeev Nair,  
 Hastyar Hama Rashid Najmuldeen, Vinay Nangia, Atta Abbas Naqvi,  
 Aparna Ichalangod Narayana, Shumaila Nargus, Gustavo G Nascimento,  
 Abdulqadir J Nashwan, Ali Nasrollahizadeh, Amir Nasrollahizadeh,  
 Zuhair S Natto, Biswa Prakash Nayak, Vinod C Nayak,  
 Sabina Onyinye Nduaguba, Hadush Negash, Ionut Negoii,  
 Ruxandra Irina Negoii, Seyed Aria Nejadghaderi, Olivia D Nesbit,  
 Henok Biresaw Netsere, Marie Ng, Georges Nguefack-Tsague,  
 Josephine W Ngunjiri, Dang H Nguyen, Hien Quang Nguyen,  
 Robina Khan Niazi, Taxiarchis Konstantinos Nikolouzakis, Ali Nikoobar,  
 Fatemeh Nikoobanesh, Amin Reza Nikpoor, Chukwudi A Nnaji,  
 Lawrence Achilles Nnyanzi, Efaq Ali Noman, Shuhei Nomura,  
 Bo Norrving, Chisom Adaobi Nri-Ezedi, George Ntaios, Mpiko Ntsekhe,  
 Dieta Nurrika, Chimezie Igwegbe Nzopotam,  
 Ogochukwu Janet Nzopotam, Bogdan Oancea, Ismail A Odetokun,  
 Martin James O'Donnell, Ayodipupo Sikiru Oguntade,  
 James Odhiambo Oguta, Hassan Okati-Aliabad,  
 Sylvester Reuben Okeke, Akinkunmi Paul Okekunle,  
 Osaretin Christabel Okonji, Andrew T Olagunju, Omotola O Olasupo,  
 Matthew Idowu Olatubi, Gláucia Maria Moraes Oliveira,  
 Isaac Iyinoluwa Olufadewa, Bolajoko Olubukunola Olusanya,  
 Jacob Olusegun Olusanya, Hany A Omar, Goran Latif Omer,  
 Abidemi E Emmanuel Omonisi, Sandersan Onie, Obinna E Onwujekwe,  
 Michal Ordak, Verner N Orish, Doris V Ortega-Altamirano,  
 Alberto Ortiz, Edgar Ortiz-Brizuela, Wael M S Osman,  
 Samuel M Ostroff, Uchechukwu Levi Osuagwu, Adrian Otoiu,  
 Nikita Otstavnov, Stanislav S Otstavnov, Amel Ouyahia,  
 Guoqing Ouyang, Mayowa O Owolabi, Mahesh Padukudru P A,  
 Alicia Padron-Monedero, Jagadish Rao Padubidri, Tamás Palicz,  
 Claudia Palladino, Feng Pan, Seithikurippu R Pandi-Perumal,  
 Helena Ulylartha Pangaribuan, Georgios D Panos, Leonidas D Panos,  
 Ana Mihaela Pantea Stoian, Shahina Pardhan, Romil R Parikh,  
 Ava Pashaei, Maja Pasovic, Roberto Passera, Jay Patel,  
 Sangram Kishor Patel, Shankargouda Patil, Dimitrios Patoulias,  
 Venkata Suresh Patthipati, Shrikant Pawar, Hamidreza Pazoki Toroudi,  
 Spencer A Pease, Amy E Peden, Paolo Pedersini, Minjin Peng,  
 Umberto Pensato, Veincent Christian Filipino Pepito,  
 Emmanuel K Peprah, Prince Peprah, João Perdigão,  
 Maria Odete Pereira, Arokiasamy Perianayagam, Norberto Perico,  
 Konrad Pesudovs, Fanny Emily Petermann-Rocha, William A Petri,  
 Hoang Tran Pham, Anil K Philip, Michael R Phillips, Manon Pigeolet,  
 David M Pigott, Julian David Pillay, Zahra Zahid Piracha,  
 Saeed Pirouzpanah, Dietrich Plass, Evgenii Plotnikov, Dimitri Poddighe,  
 Suzanne Polinder, Maarten J Postma, Naeimeh Pourtaheri,  
 Sergio I Prada, Pranil Man Singh Pradhan, V Prakash, Manya Prasad,  
 Elton Junio Sady Prates, Tina Priscilla, Natalie Pritchett, Pooja Puri,  
 Jagadeesh Puvvula, Nameer Hashim Qasim, Ibrahim Qattea,  
 Asma Saleem Qazi, Gangzhen Qian, Mehrdad Rabiee Rad,  
 Raghuram Anekal Radhakrishnan, Venkatraman Radhakrishnan,  
 Hadi Raeisi Shahraki, Quinn Rafferty, Alberto Raggi,  
 Pankaja Raghav Raghav, Md Jillur Rahman, Md Mosfequr Rahman,  
 Mohammad Hifz Ur Rahman, Mosiur Rahman,  
 Muhammad Aziz Rahman, Shayan Rahmani, Mohammad Rahmanian,  
 Setyaningrum Rahmawaty, Sathish Rajaa,  
 Mahmoud Mohammed Ramadan, Shakthi Kumaran Ramasamy,  
 Premkumar Ramasubramani, Sheena Ramazan, Kritika Rana,  
 Chhabi Lal Ranabhat, Nemanja Rancic, Amey Rane, Chyitra R Rao,  
 Kumuda Rao, Mithun Rao, Sowmya J Rao, Mohammad-Mahdi Rashidi,  
 Giridhara Rathnaiah Babu, Santosh Kumar Rauniyar, David Laith Rawaf,  
 Salman Rawaf, Christian Razo, Murali Mohan Rama Krishna Reddy,  
 Elrashdy Moustafa Mohamed Redwan, Lennart Reifels,  
 Robert C Reiner Jr, Giuseppe Remuzzi, Andre M N Renzaho,  
 Bhageerathy Reshmi, Luis Felipe Reyes, Nazila Rezaei, Negar Rezaei,  
 Nima Rezaei, Peyman Rezaei Hachesu, Mohsen Rezaeian,  
 Jennifer Rickard, Célia Fortuna Rodrigues,  
 Jefferson Antonio Buendia Rodriguez, Leonardo Roeber, Luca Ronfani,  
 Gholamreza Roshandel, Kunle Rotimi, Himanshu Sekhar Rout,  
 Bedanta Roy, Nitai Roy, Priyanka Roy, Enrico Rubagotti, Chandan S N,  
 Aly M A Saad, Maha Mohamed Saber-Ayad, Siamak Sabour,  
 Simona Sacco, Perminder S Sachdev, Basema Saddik, Adam Saddler,  
 Bashdar Abuzed Sadee, Erfan Sadeghi, Masoumeh Sadeghi,  
 Mohammad Reza Saeb, Umar Saeed, Sher Zaman Safi, Rajesh Sagar,  
 Dominic Sagoe, Zahra Saif, Mirza Rizwan Sajid, Joseph W Sakshaug,

Nasir Salam, Afeez Abolarinwa Salami, Luciane B Salaroli, Mohamed A Saleh, Marwa Rashad Salem, Mohammed Z Y Salem, Malik Sallam, Sara Samadzadeh, Saad Samargandy, Yoseph Leonardo Samodra, Abdallah M Samy, Juan Sanabria, Francesca Sanna, Itamar S Santos, Milena M Santric-Milicevic, Made Ary Sarasmita, Yaser Sarikhani, Rodrigo Sarmiento-Suárez, Gargi Sachin Sarode, Sachin C Sarode, Arash Sarveazad, Brijesh Sathian, Anudeep Sathyanarayan, Maheswar Satpathy, Monika Sawhney, Nikolaos Scarneas, Benedikt Michael Schaarschmidt, Maria Inês Schmidt, Ione Jayce Ceola Schneider, Austin E Schumacher, David C Schwebel, Falk Schwendicke, Mansour Sedighi, Sabyasachi Senapati, Subramanian Senthilkumaran, Sadaf G Sepanlou, Yashendra Sethi, Soko Setoguchi, Allen Seylani, Jamileh Shadid, Mahan Shafie, Humaira Shah, Nilay S Shah, Pritik A Shah, Ataollah Shahbandi, Samiah Shahid, Wajehah Shahid, Moyad Jamal Shahwan, Masood Ali Shaikh, Alireza Shakeri, Ali S Shalash, Sunder Sham, Muhammad Aaqib Shamim, Mohammad Ali Shamshirgaran, Mohammad Anas Shamsi, Mohd Shanawaz, Abhishek Shankar, Mohammed Shannawaz, Medha Sharath, Amin Sharifan, Javad Sharifi-Rad, Manoj Sharma, Rajesh Sharma, Saurab Sharma, Ujjawal Sharma, Vishal Sharma, Rajesh P Shastry, Amin Shavandi, Amir Mehdi Shayan, Maryam Shayan, Amr Mohamed Elsayed Shehabeldine, Pavanchand H Shetty, Kenji Shibuya, Jemal Ebrahim Shifa, Desalegn Shiferaw, Wondimeneh Shibabaw Shiferaw, Mika Shigematsu, Rahman Shiri, Nebiyu Aniley Shitaye, Aminu Shittu, K M Shivakumar, Velizar Shivarov, Zahra Shokati Eshkiki, Sina Shool, Sunil Shrestha, Kerem Shuval, Migbar Mekonnen Sibhat, Emmanuel Edwar Siddig, Inga Dora Sigfusdottir, Diego Augusto Santos Silva, João Pedro Silva, Luís Manuel Lopes Rodrigues Silva, Soraia Silva, Colin R Simpson, Anjali Singal, Abhinav Singh, Balbir Bagicha Singh, Harmanjit Singh, Jasvinder A Singh, Mahendra Singh, Paramdeep Singh, Søren T Skou, David A Sleet, Erica Leigh N Slepak, Ranjan Solanki, Sameh S M Soliman, Suhang Song, Yimeng Song, Reed J D Sorensen, Joan B Soriano, Ireneus N Soyiri, Michael Spartalis, Chandrashekar T Sreeramareddy, Benjamin A Stark, Antonina V Starodubova, Caroline Stein, Dan J Stein, Caitlyn Steiner, Timothy J Steiner, Jaimie D Steinmetz, Paschalis Steiropoulos, Leo Stockfelt, Mark A Stokes, Narayan Subedi Subedi, Vetriselvan Subramanian, Claudia Kimie Suemoto, Muhammad Suleman, Rizwan Suliankatchi Abdulkader, Abida Sultana, Johan Sundström, Chandan Kumar Swain, Lukasz Szarpak, Payam Tabaei Damavandi, Rafael Tabarés-Seisdedos, Ozra Tabatabaei Malazy, Seyed-Amir Tabatabaeizadeh, Shima Tabatabai, Celine Tabche, Mohammad Tabish, Santosh Kumar Tadakamadla, Yasaman Taheri Abkenar, Moslem Taheri Soodejani, Amir Taherkhani, Jabeen Taiba, Iman M Talaat, Ashis Talukder, Mircea Tampa, Jacques Lukenze Tamuzi, Ker-Kan Tan, Sarmila Tandukar, Haosu Tang, Razieh Tavakoli Oliaee, Seyed Mohammad Tavangar, Mojtaba Teimoori, Mohamad-Hani Temsah, Masayuki Teramoto, Pugazhenthan Thangaraju, Kavumpurathu Raman Thankappan, Rekha Thapar, Rasiah Thayakaran, Sathish Thirunavukkarasu, Nihal Thomas, Nikhil Kenny Thomas, Chern Choong Chern Thum, Ales Tichopad, Jansje Henny Vera Ticoalu, Tala Tillawi, Tenaw Yimer Tiruye, Ruoyan Tobe-Gai, Marcello Tonelli, Roman Topor-Madry, Anna E Torre, Mathilde Touvier, Marcos Roberto Tovani-Palone, Jasmine T Tran, Mai Thi Ngoc Tran, Nghia Minh Tran, Ngoc-Ha Tran, Domenico Trico, Samuel Joseph Tromans, Thien Tan Tri Tai Truyen, Aristidis Tsatsakis, Guesh Mebrahtom Tsegay, Evangelia Eirini Tsermpini, Munkhtuya Tumurkhuu, Stefanos Tyrovolas, Arit Udoh, Muhammad Umair, Srikanth Umakanthan, Tungki Pratama Umar, Eduardo A Undurraga, Brigid Unim, Bhaskaran Unnikrishnan, Carolyn Anne Unsworth, Era Upadhyay, Daniele Urso, Jibrin Sammani Usman, Seyed Mohammad Vahabi, Asokan Govindaraj Vaithinathan, Jef Van den Eynde, Orsolya Varga, Ravi Prasad Varma, Priya Vart, Tommi Juhani Vasankari, Milena Vasic, Siavash Vaziri, Balachandar Vellingiri, Narayanaswamy Venketasubramanian, Massimiliano Veroux, Georgios-Ioannis Verras, Dominique Vervoort, Jorge Hugo Villafaña, Francesco S Violante, Vasily Vlassov, Stein Emil Vollset, Simona Ruxandra Volovat, Avina Vongpradith, Yasir Waheed, Cong Wang, Fang Wang, Ning Wang, Shu Wang, Yanzhong Wang, Yuan-Pang Wang, Paul Ward, Emebet Gashaw Wassie, Marcia R Weaver, Kosala Gayan Weerakoon, Robert G Weintraub, Daniel J Weiss, Abrha Hailay Weldemariam, Katherine M Wells, Yi Feng Wen, Joanna L Whisnant, Harvey A Whiteford, Tawewat Wiangkham, Dakshitha Praneeth Wickramasinghe, Nuwan Darshana Wickramasinghe, Angga Wilandika, Caroline Wilkerson, Peter Willeit, Anders Wimo, Demewoz H Woldegebreal, Axel Walter Wolf, Yen Jun Wong, Anthony D Woolf, Chenkai Wu, Felicia Wu, Xinsheng Wu, Zenghong Wu, Sarah Wulf Hanson, Yanjie Xia, Hong Xiao, Xiaoyue Xu, Yvonne Yiru Xu, Lalit Yadav, Ali Yadollahpour, Sajad Yaghoubi, Kazumasa Yamagishi, Lin Yang, Yuichiro Yano, Yao Yao, Habib Yaribeygi, Mohammad Hosein Yazdanpanah, Pengpeng Ye, Sisay Shewasinad Yehualashet, Subah Abderehim Yesuf, Saber Yezli, Arzu Yiğit, Vahit Yiğit, Zeamanuel Anteneh Yigzaw, Yazachew Yismaw, Dong Keon Yon, Naohiro Yonemoto, Mustafa Z Younis, Chuanhua Yu, Yong Yu, Hadiza Yusuf, Mondal Hasan Zahid, Fathiah Zakham, Leila Zaki, Nazar Zaki, Burhan Abdullah Zaman, Nelson Zamora, Ramin Zand, Ghazal G Z Zandieh, Heather J Zar, Armin Zarrintan, Mikhail Sergeevich Zastrozhin, Haijun Zhang, Ning Zhang, Yunquan Zhang, Hanqing Zhao, Chenwen Zhong, Panliang Zhong, Juexiao Zhou, Zhaohua Zhu, Makan Ziafati, Magdalena Zielińska, Stephanie R M Zimsen, Mohammad Zoladl, Alimuddin Zumla, Samer H Zyoude, Theo Vost†, and Christopher J L Murray†.

\*Joint first authors.  
†Joint senior authors

**Affiliations**  
School of Public Health (A J Ferrari PhD, D F Santomauro PhD, A M Mantilla Herrera PhD, P A Miller PhD, J Shadid BSc, Prof H A Whiteford PhD), Centre for Sensorimotor Performance (D Anderlini MD), Department of Urology (Prof E Chung MD), School of Health and Rehabilitation Sciences (A Khan PhD), School of Dentistry (R Lalloo PhD), Queensland Brain Institute (Prof J J McGrath MD), The University of Queensland, Brisbane, QLD, Australia; Institute for Health Metrics and Evaluation (A J Ferrari PhD, D F Santomauro PhD, C M Antony MA, D T Araki MPH, A Y Aravkin PhD, M B Arndt PhD, C Ashbaugh MA, J D Bishai BA, C Bisignano MPH, Prof M Brauer DSc, K Burkart PhD, J Byun BS, C S Chen BA, N M Chen BA, E Chung MSc, R M Cogen BA, E Cousin PhD, X Dai PhD, N K DeCleene BS, Prof L Degenhardt PhD, Prof S D Dharmaratne MD, M A Dirac MD, R V Dominguez BS, K Estep MPA, Prof V L Feigin PhD, L S Flor MPH, L M Force MD, W M Gardner MPH, H Hagins MSPH, E B Hamilton MPH, Prof S I Hay FMedSci, C A Henson MPH, J Hon MLS, J M Hsu BA, C K Huynh BA, V C Iannucci BA, A L Ihler PSM, K S Ikuta MD, M B Kassel BA, C Keller MPH, J M Kocarnik PhD, H H Kyu PhD, K E LeGrand MPH, Prof S S Lim PhD, M Lindstrom PhD, Prof R Lozano MD, A W McKowen MA, T Mestrovic PhD, P A Miller PhD, M E Moberg MS, R M Mohr MA, A H Mokdad PhD, J F Mosser MD, V Mouglin BA, O D Nesbit MA, S M Ostroff PhD, M Pasovic MEd, S A Pease BS, D M Pigott PhD, N Pritchett DrPH, Q Rafferty BA, C Razo PhD, R C Reiner Jr PhD, A E Schumacher PhD, J Shadid BSc, E N Slepak MLIS, R J D Sorensen PhD, B A Stark MA, C Stein PhD, C Steiner MPH, J D Steinmetz PhD, A E Torre BS, Prof S E Vollset DrPH, A Vongpradith BA, Prof M R Weaver PhD, K M Wells BA, J L Whisnant MPH, Prof H A Whiteford PhD, C Wilkerson MPH, S Wulf Hanson PhD, Y Xu MPH, S R M Zimsen MA, Prof T Vos PhD, Prof C J L Murray DPhil), Department of Applied Mathematics (A Y Aravkin PhD), Department of Health Metrics Sciences, School of Medicine (A Y Aravkin PhD, K Burkart PhD, E Cousin PhD, X Dai PhD, Prof S D Dharmaratne MD, M A Dirac MD, L S Flor MPH, L M Force MD, Prof S I Hay FMedSci, H H Kyu PhD, Prof S S Lim PhD, Prof R Lozano MD, A Misganaw PhD, A H Mokdad PhD, D M Pigott PhD, R C Reiner Jr PhD, C Stein PhD, Prof S E Vollset DrPH, Prof M R Weaver PhD, Prof T Vos PhD, Prof C J L Murray DPhil), Department of Global Health (M B Arndt PhD, S Kochhar MD, R J D Sorensen PhD), Department of Health Systems and Population Health (A W Chen MSc), Department of

Family Medicine (M A Dirac MD), Division of Pediatric Hematology-Oncology (L M Force MD), Department of Neurology (R Kalani MD), Department of Anesthesiology & Pain Medicine (V Krishnamoorthy MD), Division of Plastic and Reconstructive Surgery (S D Morrison MD), Henry M Jackson School of International Studies (S M Ostroff PhD), University of Washington, Seattle, WA, USA; Policy and Epidemiology Group (D F Santomauro PhD), West Moreton Hospital Health Services (A M Mantilla Herrera PhD), Queensland Centre for Mental Health Research, Wacol, QLD, Australia; Faculty of Medicine (A Aali MD), Dental Research Center (E Bardideh DDS), Department of Orthodontics (M Ghorbani DDS), Clinical Research Development Unit (N Morovatdar MD), Mashhad University of Medical Sciences, Mashhad, Iran; Department of Clinical Governance and Quality Improvement (Y H Abate MSc), Aleta Wondo Hospital, Aleta Wondo, Ethiopia; Department of Juridical and Economic Studies (C Abbafati PhD), Department of Public Health and Infectious Diseases (M S Cattaruzza PhD), La Sapienza University, Rome, Italy; Advanced Diagnostic and Interventional Radiology Research Center (H Abbastabar PhD), Research Center for Immunodeficiencies (H Abolhassani PhD, Prof N Rezaei PhD), Non-communicable Diseases Research Center (S Azadnajafabad MD, M Keykhaei MD, S Momtazmanesh MD, S Rahmani MD, M Rashidi MD, N Rezaei MD, N Rezaei PhD), School of Medicine (A Behnoud BS, N Hafezi-Nejad MD, A Khalaji BS, S Khanmohammadi MD, M Mayeli MD, S Mohammadi MD, S Momtazmanesh MD), Iranian Research Center for HIV/AIDS (O Dadras DrPH), Cardiac Primary Prevention Research Center (S Kazemian MD), Department of Cardiac Electrophysiology (S Kazemian MD), Students' Scientific Research Center (SSRC) (M Keykhaei MD), Center for Research and Training in Skin Diseases and Leprosy (F Khamesipour PhD), Urology Research Center (Prof F Khatami PhD), Sina Trauma and Surgery Research Center (M Khormali MD, S Shool MD), Children's Medical Center (F Kompani MD), Endocrinology and Metabolism Research Institute (Prof B Larjani FACE, N Rezaei PhD, O Tabatabaei Malazy PhD), Department of Cardiology (E Mahmoudi MD, P Mansouri MD), Department of Pediatric Cardiology (Prof E Malakan Rad MD), Department of Epidemiology and Biostatistics (M Mansournia PhD), Tehran Heart Center (E Mehrabi Nasab MD, A Nasrollahizadeh MD), Water Quality Research Center (R Mirzaei PhD), Faculty of Medicine (E Mohammadi MD, A Nasrollahizadeh MD, S Vahabi MD), Digestive Diseases Research Institute (S G Sepanlou MD, M Yazdanpanah MD), Department of Neurology (M Shafie MD), Department of Medicine (A Shahbandi MD), Department of Pharmaceutical Care (A Sharifan PharmD), Research Center for Rational Use of Drugs (A Sharifan PharmD), Department of Pathology (Prof S Tavangar MD), Tehran University of Medical Sciences, Tehran, Iran (E Mohammadi MD); Department of Epidemiology (S Abd ElHafeez DrPH), Biomedical Informatics and Medical Statistics Department (I El Sayed PhD), Department of Pediatric Dentistry and Dental Public Health (Prof M El Tantawi PhD), Pediatric Dentistry and Dental Public Health Department (Prof O A A Elmeligy PhD), Department of Tropical Health and Parasitology (R M Ghazy PhD), Department of Pathology (Prof I M Talaat PhD), Alexandria University, Alexandria, Egypt; Department of Surgery (M Abdelmasseh MD, Prof J Sanabria MD), Marshall University, Huntington, WV, USA; Department of Tropical Medicine and Infectious Diseases (S Abd-Elsalam PhD), Tanta University, Tanta, Egypt; Minimally Invasive Surgery Research Center (A Abdollahi MD, A Kabir MD), Health Management and Economics Research Center (J Arabloo PhD, A Nasrollahizadeh MD), Preventive Medicine and Public Health Research Center (B Eshtrati PhD, S Goharinezhad PhD, M Moradi-Lakeh MD), School of Medicine (Y Karimi MD), Eye Research Center (H Kasraei MD), Educational Development Center (E Khodadoust MD), Comprehensive Research Laboratory (R Mirzaei PhD), Gastrointestinal and Liver Diseases Research Center (M Moradi-Lakeh MD), Department of Physiology (H Pazoki Toroudi PhD), Physiology Research Center (H Pazoki Toroudi PhD), Colorectal Research Center (A Sarveazad PhD), Department of Ophthalmology (M Ziafati MD), Iran University of Medical Sciences, Tehran, Iran (M Moradi MD); Department of Physiotherapy (A Abdullahi PhD, A W Awotidebe PhD, J S Usman PhD), Department of Community Medicine (Prof M A Gadanya FMCPh), Department of Nursing Science (M Ladan PhD), Bayero University Kano, Kano, Nigeria; Department of Rehabilitation Sciences (A Abdullahi PhD, M U Ali MSc, J S Usman PhD), School of Nursing (S Tyrovolas PhD), Hong Kong Polytechnic University, Hong Kong, China; Department of Biostatistics (K H Abegaz PhD), Near East University, Nicosia, Turkey; Department of Biostatistics and Health Informatics (K H Abegaz PhD), Madda Walabu University, Bale Robe, Ethiopia; Postgraduate Department (Prof R A Abeldaño Zuñiga PhD), University of Sierra Sur, Miahuatlan de Porfirio Diaz, Mexico; National Research Council of Mexico, Mexico City, Mexico (Prof R A Abeldaño Zuñiga PhD); Department of Family and Community Health (R G Aboagye MPH), Institute of Health Research (R K Alhassan PhD, M Immurana PhD), Institute of Health and Allied Sciences (M A Dalaba PhD), Department of Epidemiology and Biostatistics (R K Dowou Mphil Applied Epidemiology), Department of Population and Behavioural Sciences (E Manu PhD), Department of Microbiology and Immunology (V N Orish PhD), University of Health and Allied Sciences, Ho, Ghana; Department of Medical Biochemistry and Biophysics (H Abolhassani PhD), Department of Global Public Health (K Deuba DrPH, Prof L Laflamme PhD), Department of Neurobiology, Care Sciences, and Society (S Fereshtehnejad PhD), Department of Molecular Medicine and Surgery (Prof J H Kaupilla MD), Karolinska Institute, Stockholm, Sweden; Department of Pediatric Dentistry (Prof L G Abreu PhD), Department of Internal Medicine (Prof L C Brant PhD), Department of Maternal and Child Nursing and Public Health (Prof D C Malta PhD, E J S Prates BS), Department of Applied Nursing (Prof M O Pereira PhD), Federal University of Minas Gerais, Belo Horizonte, Brazil; Department of Nursing (H Abualruz PhD), Al Zaytoonah University of Jordan, Amman, Jordan; Clinical Sciences Department (E Abu-Gharbieh PhD, H J Barqawi MPhil, Prof R Halwani PhD, Prof A A Maghazachi PhD, M M Saber-Ayad MD, Prof I M Talaat PhD), College of Medicine (F Ahmad PhD, Prof R Halwani PhD, Prof B Saddik PhD, M A Saleh PhD), Department of Pharmacy Practice and Pharmacotherapeutics (Prof K H Alzoubi PhD, Prof H A Omar PhD), Department of Physiotherapy (A Arumugam PhD), Department of Basic Biomedical Sciences (Y Bustanji PhD), Sharjah Institute for Medical Research (N M Elemam PhD), Department of Clinical Nutrition and Dietetics (M E M Faris PhD), Department of Basic Medical Sciences (A Karim PhD), Department of Clinical Science (Prof M M Ramadan PhD), Department of Medicinal Chemistry (S S M Soliman PhD), University of Sharjah, Sharjah, United Arab Emirates; Institute of Community and Public Health (Prof N M Abu-Rmeileh PhD), Birzeit University, Ramallah, Palestine; School of Public Health and Preventive Medicine (I N Ackerman PhD, S M Alif PhD, P Maharjan MPH), Monash University, Melbourne, VIC, Australia; Centre for Social Research in Health (I Y Addo PhD, S R Okeke PhD), National Drug and Alcohol Research Centre (Prof L Degenhardt PhD), School of Population Health (X Feng PhD), School of Psychiatry (Prof P B Mitchell MD), Black Dog Institute, Centre for Research Excellence in Suicide Prevention (S Onie PhD), School of Public Health and Community Medicine (A E Peden PhD), Centre for Primary Health Care and Equity (CPHCE) (P Peprah MSc), School of Optometry and Vision Science (Prof K Pesudovs PhD), Faculty of Medicine and Health (S Sharma PhD), The George Institute for Global Health (P Ye MPH), University of New South Wales, Sydney, NSW, Australia; Quality and Systems Performance Unit (I Y Addo PhD), Cancer Institute NSW, Sydney, NSW, Australia; Internal Medicine and Alcohol Related Disease Unit (Prof G Addolorato MD), Department of Woman and Child Health and Public Health (D Buonsenso MD), Fondazione Policlinico Universitario A Gemelli IRCCS (Agostino Gemelli University Polyclinic IRCCS), Rome, Italy; Department of Medical and Surgical Sciences (Prof G Addolorato MD), Università Cattolica di Roma (Catholic University of Rome), Rome, Italy; Department of Community Medicine (A O Adebisi MD, O S Ilesanmi PhD), Department of Educational Counselling and Developmental Psychology (H O Adewuyi PhD), Department of Epidemiology and Medical Statistics (A F Fagbamigbe PhD), College of Medicine (A P Okekunle PhD), Faculty of Public Health (I I Olufadewa MHS), Department of Medicine



(Prof M O Owolabi DrM), University of Ibadan, Ibadan, Nigeria; Department of Community Medicine (A O Adebijoyi MD, O S Ilesanmi PhD), Department of Medicine (A S Oguntade MSc, Prof M O Owolabi DrM), Department of Oral and Maxillofacial Surgery (A A Salami BDS), University College Hospital, Ibadan, Ibadan, Nigeria; Department of HIV and Infectious Diseases (A V Adepoju MD), Jhpiego, Abuja, Nigeria; Department of Adolescent Research and Care (A V Adepoju MD), Adolescent Friendly Research Initiative and Care, Ado Ekiti, Nigeria; Department of Educational Psychology (H O Adewuyi PhD), University of Johannesburg, Johannesburg, South Africa (A Jeyakumar PhD); Department of Radiology and Radiological Science (S Afyouni PhD, A Aminandarolzarbi MD, N Hafezi-Nejad MD, G G Z Zandieh MD), Department of Biostatistics (A Columbus MS), Department of Neurosurgery (F Kazemi MD), Department of Health Policy and Management (D Vervoort MD), Department of International Health (H Zhang MS), Johns Hopkins University, Baltimore, MD, USA; Department of Community Medicine (Prof S Afzal PhD), King Edward Memorial Hospital, Lahore, Pakistan; Department of Public Health (Prof S Afzal PhD), Public Health Institute, Lahore, Pakistan; Department of Orthopedic Surgery (S Afzal MD), National Nutrition and Food Technology Research Institute (M Ajami PhD), Urology Department (M Bonakdar Hashemi MD), Internal Medicine Department of SBMU (H Borhani MD), Psychiatric Nursing and Management Department (F Ghadirian PhD), Department of Medical Genetics (M Ghasemi PhD), Center for Comprehensive Genetic Services (M Ghasemi PhD), Obstetrics and Gynecology Department (E Ghotbi MD), Research Institute for Endocrine Sciences (A Halimi BSc), Department of Immunology (K Jahankhani MSc), Department of Health Policy and Management (N Jahanmehr PhD), Safety Promotion and Injury Prevention Research Center (N Jahanmehr PhD), Department of Neurosurgery (H Khayat Kashani MD), Department of Ophthalmology and Vision Science (Z Khorrami PhD), Social Determinants of Health Research Center (A Kolahi MD, A Nikoobar DipSc, M Rashidi MD), School of Medicine (S Nejadghaderi MD, S Rahmani MD), Student Research Committee (M Rahmanian MD), Department of Epidemiology (S Sabour PhD), Department of Anesthesiology (A Shakeri MD), Ophthalmic Research Center (ORC) (M Shayan MD), Emergency Department (S Shool MD), Department of Medical Education (S Tabatabai PhD), Shahid Beheshti University of Medical Sciences, Tehran, Iran; Department of Medical and Surgical Sciences and Advanced Technologies "GF Ingrassia" (Prof A Agodi PhD, M Barchitta PhD, A Maugeri PhD, Prof M Veroux PhD), Department of Biomedical and Biotechnological Sciences (L Falzone PhD), Department of General Surgery and Medical-Surgical Specialties (Prof G Isola PhD), Department of Clinical and Experimental Medicine (C Ledda PhD), University of Catania, Catania, Italy; Department of Medical Biochemistry (A Ahmad PhD), Department of Pediatrics (Prof G Mustafa MD), Department of Pharmacology (M Tabish MPharm), Shaqra University, Shaqra, Saudi Arabia; School of Medicine and Psychology (D Ahmad PhD), National Centre for Epidemiology and Population Health (Y Alemu MPH), Research School of Population Health (N Bagheri PhD, R A Burns PhD), Australian National University, Canberra, ACT, Australia; Public Health Foundation of India, Gandhinagar, India (D Ahmad PhD); Department of Medical Oncology (S Ahmad MD), Department of Medicine (M Ganiyani MD), Miami Cancer Institute, Miami, FL, USA; Department of Community Medicine and Preventive Health (S Ahmad MD), King Edward Medical University Lahore, Lahore, Pakistan; Department of Pharmacy Practice (A Ahmed PhD), Riphah Institute of Pharmaceutical Sciences, Islamabad, Pakistan; Division of Infectious Diseases and Global Public Health (IDGPH) (A Ahmed PhD), University of California San Diego, La Jolla, CA, USA; Institute of Public Health (L A Ahmed PhD, I Elbarazi DrPH), College of Medicine and Health Sciences (Prof M Grivna PhD), Family Medicine Department (M A Khan MSc), Department of Computer Science and Software Engineering (Prof N Zaki PhD), United Arab Emirates University, Al Ain, United Arab Emirates; Department of Epidemiology (M B Ahmed MPH, D Shiferaw MPH), Department of Public Health (M Y Ashemo PhD), Department of Surgery (N S Bayileyegn MD), Jimma University, Jimma, Ethiopia; Australian Center for Precision Health (M B Ahmed MPH), Department of Allied Health and Human Performance (T Y Tiruye PhD), University of South Australia, Adelaide, SA, Australia; Department of Food and Nutrition Policy and Planning Research (M Ajami PhD), National Institute of Nutrition, Tehran, Iran; Department of Internal Medicine (K Akinosoglou PhD), University of Patras, Patras, Greece; Department of Internal Medicine and Infectious Diseases (K Akinosoglou PhD), University General Hospital of Patras, Patras, Greece; Department of Cardiology (M A Akkaif PhD), Department of Health Management Center (X Li PhD), Fudan University, Shanghai, China; Division of Public Health Sciences (S Al Hasan PhD), Washington University School of Medicine, St Louis, MO, USA; Department of Clinical Sciences (S O Alalalmeh BPharm, O E Hegazi BPharm), Center for Medical and Bio-Allied Health Sciences Research (Prof M J Shahwan PhD, M A Shamsi PhD, S H Zyouid PhD), Ajman University, Ajman, United Arab Emirates; John T Milliken Department of Internal Medicine (Z Al-Aly MD), Department of Surgery (T Lan PhD, C Wang MPH), Brown School (C Wang MPH), Washington University in St Louis, St Louis, MO, USA; Clinical Epidemiology Center (Z Al-Aly MD), US Department of Veterans Affairs (VA), St Louis, MO, USA; Department of Community and Mental Health (Prof M Albashtawy PhD), Al al-Bayt University, Mafrqa, Jordan; Institute of Health Informatics (R W Aldridge PhD), Division of Psychology and Language Sciences (M Kumar PhD), Institute of Cardiovascular Science (A S Oguntade MSc), Division of Surgery and Interventional Science (T Umar MD), Department of Infection (Prof A Zumla PhD), University College London, London, UK; Independent Consultant, Hosaena, Ethiopia (M D Alemu MPH); Department of Epidemiology and Biostatistics (Y Alemu MPH), College of Medicine and Health Science (A Amare PhD), Department of Health Promotion and Behavioural Science (E K Bogale MPH, Z A Yigzaw MPH), Department of Surgery (N A Shitaye MD), Department of Pharmacology (Y Yismaw MSc), Bahir Dar University, Bahir Dar, Ethiopia; Faculty of Health Sciences (K A Alene MPH), School of Population Health (Prof P W Gething PhD, D J Weiss PhD), School of Public Health (D Hendrie PhD, T R Miller PhD), Curtin University, Perth, WA, Australia; Wesfarmers Centre of Vaccines and Infectious Diseases (K A Alene MPH), Child Health Analytics Research Program (P A Dzianach PhD, Prof P W Gething PhD, F Sanna PhD, D J Weiss PhD), Geospatial Health and Development Team (J Lubinda PhD, A Saddler PhD), The Malaria Atlas Project (M A McPhail PhD), Telethon Kids Institute, Perth, WA, Australia; Global Centre for Environmental Remediation (A A S Al-Gheethi PhD), School of Medicine and Public Health (P Atorkey MPhil), Department of Public Health and Medicine (K Awuviry-Newton PhD), University of Newcastle, Newcastle, NSW, Australia; Cooperative Research Centre for Contamination Assessment and Remediation of the Environment, Newcastle, NSW, Australia (A A S Al-Gheethi PhD); Adult Health and Critical Care Department (M Alharrasi PhD), Sultan Qaboos University, College of Nursing, Alseeb, Oman; Department of Medical Rehabilitation (Physiotherapy) (M U Ali MSc), Department of Clinical Pharmacy and Pharmacy Administration (H Yusuf PhD), University of Maiduguri, Maiduguri, Nigeria; Department of Biosciences (R Ali MPhil, N Salam PhD), Centre for Interdisciplinary Research in Basic Sciences (CIRBSC) (S Anwar PhD), Centre For Interdisciplinary Research In Basic Sciences (CIRBSC) (M A Shamsi PhD), Jamia Millia Islamia, New Delhi, India; Center for Biotechnology and Microbiology (S S Ali PhD), University of Swat, Swat, Pakistan; Department of Health Policy and Management (Prof S M Aljumid PhD), Kuwait University, Kuwait, Kuwait; International Centre for Casemix and Clinical Coding (Prof S M Aljumid PhD), National University of Malaysia, Bandar Tun Razak, Malaysia; Department of Dentistry (S Al-Marwani MSc), Independent Consultant, Sana'a, Yemen; Public Health and Community Medicine (S Al-Marwani MSc), Independent Consultant, Irbid, Jordan; Department of Medicine (J U Almazan PhD, Prof D Poddighe PhD), Nazarbayev University, Astana, Kazakhstan; Department of Physical Education (Prof M A Alomari PhD), Social and Economic Survey Research Institute (Prof A Perianayagam PhD), Department of Population Medicine (Prof G Rathnaiah Babu PhD), Qatar University, Doha, Qatar; Department of Rehabilitation Sciences and Physical Therapy (Prof M A Alomari PhD), Department of Clinical Rehabilitation Sciences (M S Al-Wardat PhD), Department of Clinical

Pharmacy (Prof K H Alzoubi PhD), Jordan University of Science and Technology, Irbid, Jordan; Department of Epidemiology and Population Health (B Al-Omari PhD), Khalifa University of Science, Technology & Research, Abu Dhabi, United Arab Emirates; Department of Basic Sciences (Z Altaany PhD), Yarmouk University, Irbid, Jordan; Research Group in Hospital Management and Health Policies (Prof N Alvis-Guzman PhD), Department of Economic Sciences (N J Alvis-Zakzuk MSc), Universidad de la Costa (University of the Coast), Barranquilla, Colombia; Research Group in Health Economics (Prof N Alvis-Guzman PhD), University of Cartagena, Cartagena, Colombia; National Health Observatory (N J Alvis-Zakzuk MSc), Colombian National Health Observatory (C A Castañeda-Orjuela MD), National Institute of Health, Bogota, Colombia; Department of Clinical Pharmacology and Toxicology (H Alwafi PhD), Umm Al-Qura University, Makkah, Saudi Arabia; Department of Medical Sciences (Prof Y M Al-Worafi PhD), Azal University for Human Development, Sana'a, Yemen; Department of Clinical Sciences (Prof Y M Al-Worafi PhD), University of Science and Technology of Fujairah, Fujairah, United Arab Emirates; Department of Pediatric Cardiology (S Aly MD), Boston Children's Hospital, Boston, MA, USA; Department of Pediatrics (S Aly MD), Center for Primary Care (S Basu PhD), Harvard Business School (F Caetano dos Santos PhD), Department of Epidemiology (S Carr MS), Department of Neurological Surgery at Brigham and Women's Hospital (A H Feroze MD), Department of Ophthalmology (Prof J H Kempen MD), Department of Health Policy and Oral Epidemiology (Z S Natto DrPH), Department of Global Health and Social Medicine (M Pigeolet MD), T.H. Chan School of Public Health (P M S Pradhan MD), Harvard University, Boston, MA, USA; School of Medicine (A Amare PhD), Adelaide Medical School (T K Gill PhD, L Yadav PhD), School of Public Health (K Malhotra MBBS), University of Adelaide, Adelaide, SA, Australia; School of Global Public Health (P M Amegbor PhD, E K Peprah PhD), New York University, New York, NY, USA; School of Graduate Studies (E K Ameyaw MPhil), Lingnan University, Hong Kong, China; Public Health and Community Medicine Department (Prof T T Amin MD), Department of Neurology (A Hassan MD), National Hepatology and Tropical Medicine Research Institute (A M Khater MD), Cairo University, Cairo, Egypt; Medicine, Quran and Hadith Research Center (S Amiri PhD), Nephrology and Urology Research Center (K Hushmandi PhD), Baqiyatallah University of Medical Sciences, Tehran, Iran; Department of Maternal and Child Wellbeing (D A Amugsi PhD), African Population and Health Research Center, Nairobi, Kenya; Faculty of Pharmacy (Prof R Ancuceanu PhD), Department of Cardiology (C Andrei PhD), Department of Dermatology and Venereology (Prof S R Georgescu PhD), Department of Internal Medicine (M Hostiuc PhD), Department of Legal Medicine and Bioethics (S Hostiuc PhD), Department of General Surgery (I Negoii PhD), Department of Anatomy and Embryology (R I Negoii PhD), Department of Diabetes, Nutrition and Metabolic Diseases (A Pantea Stoian PhD), Department of Dermatology (M Tampa PhD), Carol Davila University of Medicine and Pharmacy, Bucharest, Romania; Neurology Department (D Anderlini MD), Royal Brisbane and Women's Hospital, Brisbane, QLD, Australia; Faculty of Medicine (D B Anderson PhD), School of Architecture, Design, and Planning (Prof T Astell-Burt PhD), Westmead Clinical School (R Chimoriya PhD), School of Pharmacy and Charles Perkins Centre (Z Dai PhD), School of Public Health (Prof T R Driscoll PhD), Faculty of Medicine and Health (Prof P H Ferreira PhD), Sydney Medical School (S Islam PhD), Save Sight Institute (H Kandel PhD), Kolling Institute (S Mathieson PhD), Sydney Musculoskeletal Health (S Mathieson PhD), School of Chemical & Biomolecular Engineering (E A Noman PhD), School of Veterinary Science (B B Singh PhD), University of Sydney, Sydney, NSW, Australia; Department of Health Care Management (P P Andrade MD, Prof R Busse PhD, S Mohammed PhD), Technical University of Berlin, Berlin, Germany; European University, Lisbon, Portugal (P P Andrade MD); Department of Epidemiology and Biostatistics (Prof H Ansari PhD), Health Promotion Research Center (H Okati-Aliabad PhD), Zahedan University of Medical Sciences, Zahedan, Iran; School of Chemical and Life Sciences (SCLS) (S Anwar PhD), Jamia Hamdard, New Delhi, India; Department of Surgery (S Anwar PhD), Gadjah Mada University, Yogyakarta, Indonesia;

Department of Pathology (R Anwer PhD), Imam Mohammad Ibn Saud Islamic University, Riyadh, Saudi Arabia; Warwick Medical School (P E Anyanwu PhD), University of Warwick, Coventry, UK (J W Sakshaug PhD); Department of Medicine (J Arab MD), Western University, London, ON, Canada; Gastroenterology Department (J Arab MD), Department of Gastroenterology, School of Medicine (L A Diaz MD), Pontifical Catholic University of Chile, Santiago, Chile; College of Pharmacy (M Arafat PhD), Al Ain University, Abu Dhabi, United Arab Emirates; University of Texas Health Science Center, Houston, TX, USA (D T Araki MPH); Department of Medical Laboratory Sciences (M Arkew MSc), Department of Health Policy and Management (A T Debele MSc), Health Sciences Department of Oncology Nursing (T G Gebi MSc), Department of Clinical Pharmacy (M D Gudeta MSc), School of Medical Laboratory Sciences (H A Meresa MSc), Haramaya University, Harar, Ethiopia; Department of Cardiovascular, Endocrine-Metabolic Diseases and Aging (B Armocida MSc), Istituto Superiore di Sanità, Rome, Italy; University College of Medicine & Dentistry (Prof M Arooj PhD), Institute of Molecular Biology and Biotechnology (Prof M Ashraf PhD, S Shahid PhD), University Institute of Public Health (A A Malik PhD, S Nargus PhD), Department of Technology (M Muzaffar MBA), Research Centre for Health Sciences (RCHS) (M Muzaffar MBA, S Shahid PhD), Department of Physics (W Shahid PhD), The University of Lahore, Lahore, Pakistan; Department of Biophysics (A A Artamonov PhD), Russian Academy of Sciences, Moscow, Russia; Department of Computer Science (A O Bodunrin MSc), Department of Cardiovascular Sciences (A Ghajar MD), Department of Physiology (M Tumurkhuu PhD), East Carolina University, Greenville, NC, USA (R T Aruleba PhD); Department of Community Medicine and Rehabilitation (A Arumugam PhD), Department of Nursing (Prof D Edvardsson PhD), Umeå University, Umeå, Sweden; Department of Public Health (M Y Ashemo PhD), Wachemo University, Hossana, Ethiopia; Department of Medical Laboratory Sciences (M O Asika BMLS), Department of Pharmacology and Therapeutics (Prof O E Onwujekwe PhD), University of Nigeria Nsukka, Enugu, Nigeria; Department of Telemedicine (M O Asika BMLS), Society For Disease Prevention Inc, Hummelstown, PA, USA; Department of Nutrition (E Askari PhD), Lorestan University of Medical Sciences, Khorramabad, Iran; Department of Immunology (S Athari PhD), Zanjan University of Medical Sciences, Zanjan, Iran; Hunter New England Population Health, Wallsend, NSW, Australia (P Atorkey MPhil); Faculty of Nursing (M M W Atout PhD), Philadelphia University, Amman, Jordan; Department of Forensic Medicine (A Atreya MD), Lumbini Medical College, Palpa, Nepal; Northumbria HealthCare NHS Foundation Trust, Newcastle upon Tyne, UK (A Aujayeb MBBS); School of Business (Prof M Ausloos PhD), Department of Health Sciences (Prof T Brugha MD, P H Lee PhD, S J Tromans PhD), University of Leicester, Leicester, UK; Department of Statistics and Econometrics (Prof M Ausloos PhD, A Otoi PhD), Faculty of Management (A Dima PhD), Bucharest University of Economic Studies, Bucharest, Romania; Roberts Research Institute (A Avan MD), The University of Western Ontario, London, ON, Canada; School of Nursing and Public Health (A W Awotidebe PhD), Discipline of Public Health Medicine (T G Ginindza PhD), University of KwaZulu-Natal, Durban, South Africa; The Judith Lumley Centre (B Ayala Quintanilla PhD), School of Nursing and Midwifery (Prof D Edvardsson PhD, M Rahman PhD), Department of Public Health (H Jiang PhD), La Trobe University, Melbourne, VIC, Australia; San Martin de Porres University, Lima, Peru (B Ayala Quintanilla PhD); Department of Psychiatry (Prof J L Ayuso-Mateos PhD), Universidad Europea de Madrid (European University of Madrid), Madrid, Spain; Biomedical Research Networking Center for Mental Health Network (CIBERSAM) (Prof J L Ayuso-Mateos PhD), National School of Public Health (A Padron-Monedero PhD), Institute of Health Carlos III, Madrid, Spain; Department of Sciences (Prof R M S Azevedo PhD), Toxicology Research Unit (TOXRUN) (Á M Madureira-Carvalho PhD), Cooperativa de Ensino Superior Politécnico e Universitário (CESPU) (University Polytechnic Higher Education Cooperative), Gandra, Portugal; Department of Physiotherapy (A S Babu PhD, Prof V K PhD), Department of Forensic Medicine and Toxicology (S M Bakkannavar MD, Prof V C Nayak MD), Prasanna School of Public Health (PSPH) (V Dsouza MSc), Kasturba

Medical College, Mangalore (R Holla MD, M Rao MD), Manipal College of Dental Sciences (Prof A I Narayana PhD, Prof R A Radhakrishnan PhD), Manipal TATA Medical College (M Rahman PhD), Department of Community Medicine (C R Rao MD), Department of Health Information Management (B Reshmi PhD), Manipal Academy of Higher Education, Manipal, India; Gomal Center of Biochemistry and Biotechnology (M Badar PhD), Gomal University, Dera Ismail Khan, Pakistan; Department of Forensic Science (A D Badiye PhD), Government Institute of Forensic Science, Nagpur, India; Division of Orthopaedics (S Baghdadi MD), Children's Hospital of Philadelphia, Philadelphia, PA, USA; Health Research Institute (N Bagheri PhD), University of Canberra, Canberra, ACT, Australia; Department of Public Health (Prof S Bah PhD), Division of Forensic Medicine (Prof R G Menezes MD), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia; School of Public Affairs (R Bai MD), Nanjing University of Science and Technology, Nanjing, China; Center for Clinical Research and Prevention (J L Baker PhD), Bispebjerg University Hospital, Frederiksberg, Denmark; Department of Neurosurgery (A T Bako PhD), Houston Methodist Hospital, Houston, TX, USA; Division of Biological Sciences (S Balakrishnan PhD), Tamil Nadu State Council for Science and Technology, Chennai, India; Department of Medicine (K Bam MPH), School of Nursing and Midwifery (D Bhandari PhD), Australian Regenerative Medicine Institute (Y Mathangasinghe MD), Department of Neuroscience (Prof C A Unsworth PhD), Monash University, Clayton, VIC, Australia; Department of Non-communicable Diseases (P C Banik MPH, L Barua MPH), Bangladesh University of Health Sciences, Dhaka, Bangladesh; Miami Cancer Institute (M Bardhan MD), Baptist Health South Florida, Miami, FL, USA; School of Psychology (Prof S L Barker-Collo PhD), University of Auckland, Auckland, New Zealand; Department of Epidemiology (A Barrow MPH, D Braithwaite PhD, D D Ding BS), College of Medicine (M J Diaz BS), Department of Computer and Information Science and Engineering (P Naghavi MSc), Biology & Emerging Pathogens Institute (M H Zahid PhD), University of Florida, Gainesville, FL, USA; Department of Public & Environmental Health (A Barrow MPH), University of The Gambia, Brikama, The Gambia; Heidelberg Institute of Global Health (HIGH) (S Barteit PhD, B Moazen MSc), Heidelberg University, Heidelberg, Germany; Burn and Regenerative Medicine Research Center (S Bashiiri Aliabadi MD), Department of Environmental Health Engineering (J Jaafari PhD), Guilan University of Medical Sciences, Rasht, Iran; Department of Veterinary Physiology and Biochemistry (A Basiru PhD), Department of Veterinary Public Health and Preventive Medicine (I A Odetokun PhD), University of Ilorin, Ilorin, Nigeria; School of Public Health (S Basu PhD), Department of Primary Care and Public Health (Prof A Majeed MD, Prof S Rawaf MD, C Tabche MSc), Department of Surgery and Cancer (Prof E Mossialos PhD), WHO Collaborating Centre for Public Health Education and Training (D L Rawaf MRCS), Division of Brain Sciences (Prof T J Steiner PhD), Imperial College London, London, UK; Department of Academics (S Basu MD), Indian Institute of Public Health, Gurgaon, India; Department of Clinical Pharmacology (Prof P P Bathini MD), Department of Dermatology, Venereology and Leprosy-DVL (Prof T Priscilla MD), Apollo Institute of Medical Sciences and Research, Hyderabad, India; Department of Medical Education (K Batra PhD), Department of Social and Behavioral Health (Prof M Sharma PhD), University of Nevada Las Vegas, Las Vegas, NV, USA; Department of Psychiatry (Prof B T Baune PhD), University of Münster, Münster, Germany; Department of Psychiatry (Prof B T Baune PhD), Melbourne Medical School, Melbourne, VIC, Australia; Department of Regulatory Affairs (B Behnam MD), NSF International, Ann Arbor, GA, USA; Department of Regulatory Affairs (B Behnam MD), Amarex Clinical Research, Germantown, MD, USA; Endocrinology and Metabolism Research Institute (A Khalaji BS), Department of Epidemiology (S Khanmohammadi MD), S Nejadghaderi MD), Non-Communicable Diseases Research Center (NCDRC), Tehran, Iran (A Behnouth BS); Division of Pulmonary, Critical Care, and Sleep (M Beiranvand PhD), University of Florida, Jacksonville, FL, USA; Department of Medicine (D F Bejarano Ramirez BN), El Bosque University, Bogota, Colombia; Transplant Service (D F Bejarano Ramirez BN), University Hospital Foundation Santa Fe de Bogotá, Bogota, Colombia; School of the Environment (Prof M L Bell PhD, Y Song PhD), Department of Dermatology (M Goldust MD), Department of Psychiatry (W Li PhD), Department of Radiology and Biomedical Imaging (X Liu PhD), Department of Genetics (S Pawar PhD), Yale University, New Haven, CT, USA; Department of Microbiology (O O Bello PhD), Department of Biological Sciences (T C Ekundayo PhD), University of Medical Sciences, Ondo, Ondo, Nigeria; Department of Biomedical Sciences (Prof A Beloukas PhD), University of West Attica, Athens, Greece; Institute of Infection and Global Health (Prof A Beloukas PhD), Department of Surgery (Prof R Lunevicius DSc), University of Liverpool, Liverpool, UK; Department of Internal Medicine (I M Bensenor PhD, I S Santos PhD), Department of Psychiatry (Prof J Castaldelli-Maia PhD, Y Wang PhD), Center for Clinical and Epidemiological Research (I S Santos PhD), University of São Paulo, São Paulo, Brazil; Institute of Marketing (Z Berezvai PhD), Corvinus University of Budapest, Budapest, Hungary; Competition Economics and Market Research Section (Z Berezvai PhD), Hungarian Competition Authority, Budapest, Hungary; Faculty of Dentistry, Oral & Craniofacial Sciences (E Bernabe PhD), Department of Twin Research and Genetic Epidemiology (M Mazidi PhD), Institute of Psychiatry, Psychology & Neuroscience (D Urso MD), School of Population Health and Environmental Sciences (Y Wang PhD), King's College London, London, UK; Hubert Department of Global Health (R S Bernstein MD), Rollins School of Public Health (Prof D A Sleet PhD), Department of Family and Preventive Medicine (S Thirunavukkarasu PhD), Emory University, Atlanta, GA, USA; Butte County Department of Public Health, Chico, CA, USA (R S Bernstein MD); Faculty of Medicine (P J G Bettencourt PhD), Catholic University of Portugal, Rio de Mouro, Portugal; Department of Public Health (A S Bhagavathula PhD), North Dakota State University, Fargo, ND, USA; Institutes of Applied Health Research and Translational Medicine (N Bhala PhD), Queen Elizabeth Hospital Birmingham, Birmingham, UK; Institute of Applied Health Research (N Bhala PhD, K Malhotra MBBS, R Thayakaran PhD), NIHR Global Health Research Unit on Global Surgery (J C Glasbey MSc), University of Birmingham, Birmingham, UK; Public Health Research Laboratory (D Bhandari PhD), Department of Community Medicine (P M S Pradhan MD), Central Department of Public Health (N S Subedi MPH), Tribhuvan University, Kathmandu, Nepal; Department of Internal Medicine (A Bhargava MD), Wayne State University, Detroit, MI, USA; Global Health Neurology Lab (S Bhaskar PhD), NSW Brain Clot Bank, Sydney, NSW, Australia; Department of Neurology and Neurophysiology (S Bhaskar PhD), South West Sydney Local Health District and Liverpool Hospital, Sydney, NSW, Australia; Department of Internal Medicine (V Bhat MBBS), St John's National Academy of Health Sciences, Bangalore, India; Department of Medical Lab Technology (G K Bhatti PhD), University Centre for Research and Development (S Kalra DM), Chandigarh University, Mohali, India; Department of Human Genetics and Molecular Medicine (Prof J S Bhatti PhD, S Senapati PhD, U Sharma PhD), Department of Zoology (B Vellingiri PhD), Central University of Punjab, Bathinda, India; Department of Botanical and Environmental Sciences (Prof M S Bhatti PhD), Department of Pharmaceutical Sciences (R Bhatti PhD), Guru Nanak Dev University, Amritsar, India; Centre for Global Child Health (Prof Z A Bhutta PhD), Temerty Faculty of Medicine (V Chattu MD), Division of Neurology (S Fereshtehnejad PhD), University of Toronto, Toronto, ON, Canada; Centre of Excellence in Women & Child Health (Prof Z A Bhutta PhD), Division of Women and Child Health (J K Das MD), Aga Khan University, Karachi, Pakistan; Scientific-Tools.Org, Bergamo, Italy (B Bikbov MD); Faculty of Health Sciences (V R Bitra PhD), University of Botswana, Gaborone, Botswana; Department of Global Public Health and Primary Care (Prof T Bjørge PhD), Department of Psychosocial Science (D Sagoe PhD), University of Bergen, Bergen, Norway; Cancer Registry of Norway, Oslo, Norway (Prof T Bjørge PhD); School of Business Administration (Prof V Bodolica PhD), American University of Sharjah, Sharjah, United Arab Emirates; Faculty of Medicine and Pharmaceutical Sciences (A Bonny MD), University of Douala, Douala, Cameroon; Department of Cardiology (A Bonny MD), Centre Hospitalier Montfermeil (Montfermeil Hospital Center), Montfermeil, France; General Directorate of Health Information Systems

(B Bora Basara PhD), Ministry of Health, Ankara, Türkiye; Department of Earth, Environment, and Equity (C Boxe PhD), Howard University, Washington, DC, USA; Department of Infectious Disease Epidemiology (O J Brady PhD), MSc Epidemiology Programme (A Hafiz PhD), Department of Non-Communicable Disease Epidemiology (M Iwagami PhD), Department of Health Services Research and Policy (Prof M McKee DSc), London School of Hygiene & Tropical Medicine, London, UK; Department of Health Sciences (DISSAL) (F Lanfranchi MD), University of Genoa, Genoa, Italy (N L Bragazzi PhD); Cancer Population Sciences Program (D Braithwaite PhD), University of Florida Health Cancer Center, Gainesville, FL, USA; School of Population and Public Health (Prof M Brauer DSc, P A Chakraborty MPH), School of Nursing (A Pashaei MSc), University of British Columbia, Vancouver, BC, Canada; Institute for Medical Information Processing, Biometry, and Epidemiology (S Breitner DSc), Ludwig Maximilian University of Munich, Munich, Germany; Institute of Epidemiology (S Breitner DSc), Helmholtz Zentrum München German Research Center for Environmental Health, Neuherberg, Germany; Division of Clinical Epidemiology and Aging Research (Prof H Brenner MD), German Cancer Research Center, Heidelberg, Germany; Department of Injury (J Brown PhD), The George Institute for Global Health, Newtown, NSW, Australia; Faculty of Medicine (J Brown PhD), School of Population Health (Z Dai PhD, X Xu PhD), School of Psychiatry (Prof P S Sachdev MD), University of New South Wales, Kensington, NSW, Australia; Flinders Health and Medical Research Institute (N B Bulamu PhD), College of Medicine and Public Health (T G Gebremeskel PhD, B Kaambwa PhD, G R Naik PhD), Health Economics Unit (B Kaambwa PhD), Flinders University, Adelaide, SA, Australia; Global Health Research Institute (D Buonsenso MD), Università Cattolica del Sacro Cuore (Catholic University of Sacred Heart), Rome, Italy; Department of Biopharmaceutics and Clinical Pharmacy (Y Bustanji PhD), The University of Jordan, Amman, Jordan; School of Public Health Sciences (Z A Butt PhD), University of Waterloo, Waterloo, ON, Canada; Al Shifa School of Public Health (Z A Butt PhD), Al Shifa Trust Eye Hospital, Rawalpindi, Pakistan; Department of Clinical Pharmacy (Prof D Calina PhD), University of Medicine and Pharmacy of Craiova, Craiova, Romania; Department of Internal Medicine (Prof L A Cámara MD), Hospital Italiano de Buenos Aires (Italian Hospital of Buenos Aires), Buenos Aires, Argentina; Board of Directors (Prof L A Cámara MD), Argentine Society of Medicine, Buenos Aires, Argentina; Center for Nutrition and Health Research (I R Campos-Nonato PhD, E Denova-Gutiérrez DSc), Center for Health Systems Research (D V Ortega-Altamirano DrPH), National Institute of Public Health, Cuernavaca, Mexico; Dana-Farber Cancer Institute, Boston, MA, USA (C Cao MPH); Department of Biomedical and Neuromotor Sciences (A Capodici MD, S Guicciardi MD, J Lenzi PhD, A Mazzotti PhD), Department of Medical and Surgical Sciences (Prof F S Violante MD), University of Bologna, Bologna, Italy; Management and Healthcare (EMbeDS) (A Capodici MD), Sant'Anna School of Advanced Studies, Pisa, Italy; Oncological Network, Prevention and Research Institute (G Gorini MD), Institute for Cancer Research, Prevention and Clinical Network, Florence, Italy (G Carreras PhD); Dermatology Unit (A Carugno MD), Azienda Socio Sanitaria Territoriale Papa Giovanni XXIII (Territorial Healthcare Company Pope John XXIII), Bergamo, Italy; Instituto de Investigação, Inovação e Desenvolvimento (Institute of Research Innovation and Development) (M Carvalho PhD), University Fernando Pessoa, Porto, Portugal; Associated Laboratory for Green Chemistry (LAQV) (M Carvalho PhD), Institute for Research and Innovation in Health (Prof N Cruz-Martins PhD), Research Unit on Applied Molecular Biosciences (UCIBIO) (Prof D Dias da Silva PhD, J P Silva PhD), Department of Community Medicine, Information and Health Decision Sciences (A Freitas PhD), Department of Chemical Engineering (Prof C F Rodrigues PhD), University of Porto, Porto, Portugal; Epidemiology and Public Health Evaluation Group (C A Castañeda-Orjuela MD), National University of Colombia, Bogota, Colombia; Department of Medicine (G Castelpietra PhD), University of Udine, Udine, Italy; Department of Mental Health (G Castelpietra PhD), Healthcare Agency "Friuli Occidentale", Pordenone, Italy; Department of Pharmacological and Biomolecular Sciences (Prof A L Catapano PhD), Department of Clinical Sciences and Community Health (Prof C La Vecchia MD), Department of Food, Environmental and Nutritional Sciences (Prof D Martini PhD), University of Milan, Milan, Italy; MultiMedica Sesto San Giovanni IRCCS, Sesto S Giovanni, Italy (Prof A L Catapano PhD); Department of Psychiatry (A Caye PhD), Postgraduate Program in Epidemiology (Prof B B Duncan MD, Prof M I Schmidt MD), Department of Preventive and Social Dentistry (F N Hugo PhD), Federal University of Rio Grande do Sul, Porto Alegre, Brazil; Department of Medical, Surgical & Health Sciences (L Cegolon PhD, Prof M D'Oria MD), University of Trieste, Trieste, Italy; Public Health Unit (L Cegolon PhD), University Health Agency Giuliano-Isontina (ASUGI), Trieste, Italy; Department of Nutrition (Prof F Cembranel DSc), Department of Physical Education (Prof D A S Silva PhD), Federal University of Santa Catarina, Florianópolis, Brazil; College of Public Health, Medical, and Veterinary Sciences (M Cenderadewi MPHTM, Prof R C Franklin PhD, A E Peden PhD), James Cook University, Townsville, QLD, Australia; Department of Public Health (M Cenderadewi MPHTM), University of Mataram, Mataram, Indonesia; Mary MacKillop Institute for Health Research (Prof E Cerin PhD), Australian Catholic University, Melbourne, VIC, Australia; School of Public Health (Prof E Cerin PhD), Department of Urban Planning and Design (C Guo PhD), University of Hong Kong, Hong Kong, China; Heart Failure and Structural Heart Disease Unit (J Chan MBChB), Cardiovascular Analytics Group, Hong Kong, China; Department of Medicine and Therapeutic (R N C Chan MBChB (GPS) (CUHK)), Prince of Wales Hospital, Hong Kong, China; Department of Clinical Nutrition (R M Chandika PhD), Department of Epidemiology (S Dohare MD, K Y Ghailan PhD, M Khan MD), Department of Maxillofacial Surgery and Diagnostic Sciences (E S Halboub PhD), Health Research Center (Prof A Khalid PhD), Department of Health Education and Promotion (M Shanawaz MD), Jazan University, Jazan, Saudi Arabia; Department of Anesthesiology and Perioperative Medicine (E K Chandrasekar MD), University of Rochester, Rochester, NY, USA (E Dorsey MD); Department of Public Health (P Charalampous PhD, S Polinder PhD), Erasmus University Medical Center, Rotterdam, Netherlands; Department of Community Medicine (V Chattu MD), Datta Meghe Institute of Medical Sciences, Sawangi, India; Department of Endocrinology (V Chatzimavridou-Grigoriadou MD), Division of Immunology, Immunity to Infection and Respiratory Medicine (A G Mathioudakis PhD), University of Manchester, Manchester, UK; Department of Endocrinology (V Chatzimavridou-Grigoriadou MD), Christie Hospital NHS Foundation Trust, Manchester, UK; Fuwai Hospital (A Chen PhD), Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, China; Department of Computer Science (A Chen PhD), University of Texas Austin, Austin, TX, USA; Clinical Research Center (H Chen MB), Zhujiang Hospital (Z Zhu PhD), Southern Medical University, Guangzhou, China; Department of Paediatrics (E T W Cheng MBChB, S Dai PhD), The Nethersole School of Nursing (Y Chong PhD), Jockey Club School of Public Health and Primary Care (J Huang MD, C Zhong MD), Department of Medicine and Therapeutics (L Lim MRCP), The Chinese University of Hong Kong, Hong Kong, China; Department of Public Health and Health Policy (O Chimed-Ochir PhD), Hiroshima University, Hiroshima, Japan; Translational Health Research Institute (R Chimoriya PhD), Department of Engineering (G R Naik PhD), Western Sydney University, Sydney, NSW, Australia; Division of Infectious Diseases (P R Ching MD), Virginia Commonwealth University, Richmond, VA, USA; Department of Clinical Oncology (W C S Cho PhD), Queen Elizabeth Hospital, Hong Kong, China; College of Medicine (S Choi MD program student), Department of Epidemiology and Health Promotion (Prof S Jee PhD), Yonsei University, Seoul, South Korea; Department of Medicine (B Chong MBBS), School of Medicine (M Ng PhD), Leadership Institute for Global Health Transformation (LIGHT) (S Ramazan PhD), Department of Surgery (K Tan PhD), Yong Loo Lin School of Medicine (Prof N Venketasubramanian MBBS), National University of Singapore, Singapore, Singapore; Department of Community Medicine (Prof S G Choudhari MD, Prof A M Gaidhane MD), Datta Meghe Institute of Medical Sciences, Wardha, India; Florida International University, Miami, FL, USA (Prof R Chowdhury PhD); Department of Epidemiology (Prof R Chowdhury PhD), Institute of Social and Preventive Medicine (M Ganbat MPH), Department of Neurology (L D Panos MD), University of Bern, Bern, Switzerland; Department of

Health Science and Technology (S W M Christensen PhD), Aalborg University, Aalborg, Denmark; Department of Physiotherapy (S W M Christensen PhD), University College of Northern Denmark, Aalborg, Denmark; Center for Biomedicine and Community Health (D Chu PhD), Viet Nam National University-International School, Hanoi, Viet Nam; Department of Paediatric Surgery (I S Chukwu BMedSc), Federal Medical Centre, Umuahia, Nigeria; Department of AndroUrology (Prof E Chung MD), AndroUrology Centre, Brisbane, QLD, Australia; School of Nursing and Midwifery (M Chutiyami PhD), School of Biomedical Engineering (N Tran MSc), University of Technology Sydney, Sydney, NSW, Australia; Department of Biochemistry and Microbiology (M M Claassens PhD), University of Namibia, Windhoek, Namibia; Department of Paediatrics and Child Health (M M Claassens PhD), Stellenbosch University, Tygerberg, South Africa; Nova Medical School (J Conde PhD), Nova University of Lisbon, Lisbon, Portugal; School of Medicine and Surgery (P A Cortesi PhD, A Lafranconi MD, Prof L G Mantovani DSc), University of Milan Bicocca, Monza, Italy; Department of Family Medicine and Public Health (Prof M H Criqui MD), University of California San Diego, La Jolla, CA, USA; Therapeutic and Diagnostic Technologies Department (Prof N Cruz-Martins PhD), Cooperativa de Ensino Superior Politécnico e Universitário (Polytechnic and University Higher Education Cooperative), Gandra, Portugal; School of Clinical Medicine (S Dai PhD), Hangzhou Normal University, Hangzhou, China; IRCCS Istituto Ortopedico Galeazzi (G Damiani MD), Galeazzi Orthopedic Institute IRCCS (University of Milan), Milan, Italy; Department of Dermatology (G Damiani MD), Lerner College of Medicine (L Göbölös PhD), Harrington Heart and Vascular Institute (A Guha MD), Department of Quantitative Health Science (X Liu PhD), Department of Neonatology (I Qattee MD), Department of Nutrition and Preventive Medicine (Prof J Sanabria MD), Case Western Reserve University, Cleveland, OH, USA; Department of Biochemistry (S Das MD), Ministry of Health and Welfare, New Delhi, India; Department of Radiology (M Dashti MD, A Ghasemzadeh MD, M Mirza-Aghazadeh-Attari MD, A Zarrintan MD), Department of Health Policy and Management (L Doshmangir PhD), Department of Immunology (F Jadidi-Niaragh PhD), School of Management and Medical Informatics (L R Kalankesh PhD), Social Determinants of Health Research Center (S Karimi PhD), Molecular Medicine Research Center (S Pirouzpanah PhD), Department of Health Information Technology (P Rezaei Hachesu PhD), Tabriz University of Medical Sciences, Tabriz, Iran; Department of Population and Development (C A Dávila-Cervantes PhD), Latin American Faculty of Social Sciences Mexico, Mexico City, Mexico; Health Research Institute (K Davletov PhD), Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan; Australian Institute for Suicide Research and Prevention (Prof D De Leo DSc), Griffith University, Mount Gravatt, QLD, Australia; Medical College (S Debopadhyaya BS), Albany Medical College, Albany, NY, USA; Centre for Interdisciplinary Research in Basic Sciences (CIRBSc) (F Deebea PhD), Jamia Millia Islamia, Delhi, India; Department of Food, Environmental and Nutritional Sciences (C Del Bo' PhD), Università degli Studi di Milano (University of Milan), Milano, Italy; School of Medicine (I Delgado-Enciso DSc), University of Colima, Colima, Mexico; Department of Research (I Delgado-Enciso DSc), Colima State Health Services, Colima, Mexico; Department of Neurosurgery (A K Demetriades MD), Global Health Governance Programme (J Patel BSc), Usher Institute (Prof C R Simpson PhD), College of Medicine and Veterinary Medicine (G Verras MD), University of Edinburgh, Edinburgh, UK; Department of Neurosurgery (A K Demetriades MD), National Health Service (NHS) Scotland, Edinburgh, UK; St Paul's Eye Unit (N Dervenis MD), Royal Liverpool University Hospital, Liverpool, UK; Department of Ophthalmology (N Dervenis MD), Second Department of Cardiology (D Patoulias PhD), Aristotle University of Thessaloniki, Thessaloniki, Greece; Graduate Medical Education (H D Desai MD), Gujarat Adani Institute of Medical Sciences, Bhuj, India; Division of Cardiology (R Desai MBBS), Atlanta Veterans Affairs Medical Center, Decatur, GA, USA; National Centre for AIDS and STD Control (K Deuba DrPH), Save the Children, Kathmandu, Nepal; Division of Pathology (K Dhama PhD), ICAR-Indian Veterinary Research Institute, Bareilly, India; Department of Community Medicine (Prof S D Dharmaratne MD), University of Peradeniya, Peradeniya, Sri Lanka; Department of Pharmacy Practice (S Dhingra PhD), National Institute of Pharmaceutical Education and Research, Hajipur, India; Toxicology Research Unit (TOXRUN) (Prof D Dias da Silva PhD), Cooperativa de Ensino Superior Politécnico e Universitário (University Polytechnic Higher Education Cooperative) (CESP), Gandra, Portugal; Faculty of Science (Prof D Diaz PhD), School of Medicine (Prof R Lozano MD), National Autonomous University of Mexico, Mexico City, Mexico; Department of Medicine (T H Do MD), Can Tho University of Medicine and Pharmacy, Can Tho, Viet Nam; Center for Health Sciences (C B do Prado MSc), Department of Integrated Health Education (Prof L B Salaroli PhD), Federal University of Espírito Santo, Vitória, Brazil; School of Elderly Care Services and Management (W Dong MD), Nanjing University of Chinese Medicine, Nanjing, China; Health Science Center (D Dongarwar MS), University of Texas, Houston, TX, USA; Cardio-Thoraco-Vascular Department (Prof M D'Oria MD), Azienda Sanitaria Universitaria Giuliano Isontina, Trieste, Italy; Department of Forensic Medicine and Toxicology (H L Dsouza MD, V Krishna MD, P H Shetty MD), Department of General Medicine (J Jeganathan MD), Department of Community Medicine (N Joseph MD, N Kumar MD, R Motappa MD, R Thapar MD), Department of Anatomy (B Murlimanju MD), Department of Internal Medicine (M M R Reddy MD), Kasturba Medical College, Mangalore (Prof B Unnikrishnan MD), Manipal Academy of Higher Education, Mangalore, India; Department of Forensic Medicine and Toxicology (H L Dsouza MD), Kasturba Medical College Mangalore, Mangalore, India; Office of Institutional Analysis (J Dube MA), University of Windsor, Windsor, ON, Canada; Post-graduate Program in Health Sciences (S C Dumith PhD), Federal University of Rio Grande, Rio Grande, Brazil; School of Medicine (Prof A R Duraes PhD), Federal University of Bahia, Salvador, Brazil; Department of Internal Medicine (Prof A R Duraes PhD), Escola Bahiana de Medicina e Saúde Pública (Bahiana School of Medicine and Public Health), Salvador, Brazil; Department of Biotechnology (S Duraisamy PhD), SRM Institute of Science and Technology, Kattankulathur, India; Department of Infection and Tropical Medicine (O C Durojaiye MPH), School of Health and Related Research (J O Oguta MSc), Department of Psychology (A Yadollahpour PhD), University of Sheffield, Sheffield, UK; Department of Conservative Dentistry with Endodontics (A M Dziedzic DSc), Medical University of Silesia, Katowice, Poland; Department of Psychiatry (E Ebooreime PhD, E Tsermpini PhD), Dalhousie University, Halifax, NS, Canada; Department of Psychiatry (E Ebooreime PhD), University of Alberta, Edmonton, AB, Canada; Department of Orthopaedic Surgery (A Ebrahimi MD), Department of Radiology (X Liu PhD), Division of Cardiology (D H Nguyen BS), Massachusetts General Hospital, Boston, MA, USA; School of Health Sciences (H A Edinur PhD), Universiti Sains Malaysia (University of Science Malaysia), Kubang Kerian, Malaysia; Centre for Global Health Inequalities Research (CHAIN) (Prof T Eikemo PhD), Department of Neuromedicine and Movement Science (Prof T J Steiner PhD), Norwegian University of Science and Technology, Trondheim, Norway; Department of Orthodontics (E Eini DDS), Alimentary Tract Research Center (Z Shokati Eshkiki PhD), Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran; Faculty of Science and Health (M Ekholuenetale PhD), University of Portsmouth, Hampshire, UK; Department of Internal Medicine and Hematology Unit (Prof G M T ElGohary MD), Department of Neuropsychiatry (Prof G ELNahas MD), Department of Entomology (A M Samy PhD), Medical Ain Shams Research Institute (MASRI) (A M Samy PhD), Department of Neurology (Prof A S Shalash PhD), Ain Shams University, Cairo, Egypt; Section of Adult Hematology (Prof G M T ElGohary MD), Department of Physiology (Prof S A Meo PhD), Pediatric Intensive Care Unit (M Tamsah MD), King Saud University, Riyadh, Saudi Arabia; Faculty of Medicine (M Elhadi MD), Department of Radiology (A Msherghi MD), University of Tripoli, Tripoli, Libya; Department of Pediatric Dentistry (Prof O A A Elmeligy PhD), Rabigh Faculty of Medicine (A A Malik PhD), Department of Dental Public Health (Z S Natto DrPH), Department of Community Medicine (S Samargandy PhD), King Abdulaziz University, Jeddah, Saudi Arabia; Executive Committee (Prof G ELNahas MD), International Association for Women Mental Health, Potomac, MD, USA; Department of Clinical Pathology (M Elshaer MD), Department of Cardiology

(Prof M M Ramadan PhD), Faculty of Pharmacy (M A Saleh PhD), Mansoura University, Mansoura, Egypt; Department of Infectious Diseases and Public Health (I Elsohaby PhD), City University of Hong Kong, Hong Kong, China; Department of Animal Medicine (I Elsohaby PhD), Cardiovascular Department (Prof A M A Saad MD), Zagazig University, Zagazig, Egypt; Lincoln International Institute for Rural Health (L Engelbert Bain PhD), University of Lincoln, Lincoln, UK; Department of International Cyber Education (R Erkhembayar MD), Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; Independent Consultant, Bologna, Italy (N Fabin MD); Research Centre for Healthcare and Community (A F Fagbamigbe PhD), Faculty of Health and Life Sciences (O P Kurmi PhD), Coventry University, Coventry, UK; Epidemiology and Biostatistics Unit (L Falzone PhD), IRCCS Pascale, Naples, Italy; Center for Global Health Research (M Fareed PhD), Saveetha Medical College and Hospitals (S R Pandi-Perumal MSc), Saveetha Dental College and Hospitals (M R Tovani-Palone PhD), Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, India; Dissemination Division (C S e Farinha MSc), National Institute of Statistics, Lisbon, Portugal; Activity Planning and Control Unit (C S e Farinha MSc), Directorate-General of Health (DGS), Lisbon, Portugal; Department of Psychology (Prof A Faro PhD), Federal University of Sergipe, São Cristóvão, Brazil; Social and Administrative Pharmacy (P Farrokhi PharmD), Department of Epidemiology and Community Health (R R Parikh MD), Department of Surgery (J Rickard MD), University of Minnesota, Minneapolis, MN, USA; Clinical Pharmacy and Pharmacy Practice (P Farrokhi PharmD), Department of Environmental Health Engineering (A Fatehizadeh PhD), School of Medicine (G Ghasempour Dabaghi MD, M Rabiee Rad MD), Cardiac Rehabilitation Research Center (K Mehrabani-Zeinabad PhD, Prof M Sadeghi MD), Faculty of Medicine (A Nasrollahzadeh MD), Isfahan University of Medical Sciences, Isfahan, Iran; Centre for Health Policy Research (Prof P Ward PhD), Torrens University Australia, Adelaide, SA, Australia (N K Faulk MSc); Institute of Resource Governance and Social Change, Kupang, Indonesia (N K Faulk MSc); National Institute for Stroke and Applied Neurosciences (Prof V L Feigin PhD), Auckland University of Technology, Auckland, New Zealand; Research Center of Neurology, Moscow, Russia (Prof V L Feigin PhD); National Institute of Environmental Health (X Feng PhD), National Center for Chronic and Noncommunicable Disease Control and Prevention (N Wang PhD, P Ye MPH), Chinese Center for Disease Control and Prevention, Beijing, China (Prof S Liu PhD); Department of Social Sciences (Prof N Ferreira PhD), University of Nicosia, Nicosia, Cyprus; Institute of Public Health (F Fischer PhD), Department of Surgery (N Haep MD), Department of Neurology (S Samadzadeh MD), Charité Universitätsmedizin Berlin (Charité Medical University Berlin), Berlin, Germany; School of Social Sciences (J Flavel PhD), Stretton Health Equity, Adelaide, SA, Australia; Center for Research in Indigenous Health (D Flood MD), Maya Health Alliance, Tecpán, Guatemala; Department of Internal Medicine (D Flood MD), University of Michigan, Ann Arbor, MI, USA; Institute of Gerontology (N A Foigt PhD), National Academy of Medical Sciences of Ukraine, Kyiv, Ukraine; Department of Child Dental Health (Prof M O Folayan FWACS), Obafemi Awolowo University, Ile-Ife, Nigeria; Clinical Science Department (Prof M O Folayan FWACS), Nigerian Institute of Medical Research, Yaba, Nigeria; Healthcare Innovation Department (D Fortuna MSc), Regional Agency for Health and Social Care of Emilia-Romagna, Bologna, Italy; Department of Biotechnological and Applied Clinical Sciences (DISCAB) (M Foschi MD), Department of Neurology (Prof S Sacco MD), University of L'Aquila, L'Aquila, Italy; Department of Neuroscience (M Foschi MD), Hospital Santa Maria delle Croci, Ravenna, Italy; Center for Health Technology and Services Research (CINTESIS), Porto, Portugal (A Freitas PhD); Department of Dermatology (T Fukumoto PhD), Kobe University, Kobe, Japan; Division of Ophthalmology (J M Furtado MD), University of São Paulo, Ribeirão Preto, Brazil; Health Services Management Training Centre (P A Gaal PhD, T Joo PhD, J Lám PhD, T Palicz MD), Semmelweis University, Budapest, Hungary; Department of Applied Social Sciences (P A Gaal PhD), Sapientia Hungarian University of Transylvania, Târgu-Mureș, Romania; Department of Community Medicine (Prof M A Gadanya FMCPH), Aminu Kano Teaching Hospital, Kano, Nigeria; Institute of Applied Health Sciences (S Gaihre PhD), University of Aberdeen, Aberdeen, UK; Department of Food Technology (Y Galali ResM, B A Sadee PhD), Salahaddin University-Erbil, Erbil, Iraq; Department of Nutrition and Dietetics (Y Galali ResM, B A Sadee PhD), Cihan University-Erbil, Erbil, Iraq; Department of Research Publication (M Ganbat MPH), Zaigal Research Institute, Ulaanbaatar, Mongolia; Department of Community Medicine and Family Medicine (A P Gandhi MD), All India Institute of Medical Sciences, Nagpur, India; Institute of Health and Wellbeing (B Ganesan PhD), Federation University, Churchill, VIC, Australia; Department of Endocrinology (Prof M Ganie MD), Sheri Kashmir Institute of Medical Sciences, Srinagar, India; Department of Endocrinology and Metabolism (Prof M Ganie MD), All India Institute of Medical Sciences, Delhi, India; Department of General Medicine (M Ganiyani MD), Grant Medical College & Sir J J Group of Hospitals, Mumbai, India; Department of Midwifery (M W Gebregergis MSc), Department of Medical Laboratory Sciences (H Negash MSc), Adigrat University, Adigrat, Ethiopia; Department of Environmental Health (M Gebrehiwot DSc), Wollo University, Dessie, Ethiopia; Department of Public Health Nutrition (T B B Gebremariam MPH), Aksum University, Mekelle, Ethiopia; Department of Reproductive and Family Health (T G Gebremeskel PhD), Axum College of Health Science, Axum, Ethiopia; Department of Human Physiology (Y Gela MSc), Department of Pharmacology (Z D Kifle MSc), School of Nursing (H B Netsere MS), University of Gondar, Gondar, Ethiopia; Department of Dermatology (Prof S R Georgescu PhD), "Victor Babes" Clinical Hospital of Infectious and Tropical Diseases, Bucharest, Romania; School of Psychology (A Getachew Obsa MA), Department of Medical Laboratory Science (M Getie MSc), School of Public Health (D H Woldegebreal MPH), Addis Ababa University, Addis Ababa, Ethiopia; Infectious Disease Research Center (Prof K Ghadiri MD), Pediatric Department (Prof K Ghadiri MD), Universal Scientific Education and Research Network (USERN) (P Goleij MSc), Department of Rehabilitation and Sports Medicine (M Mirzaei MSc), Department of Infectious Disease (Prof S Vaziri MD), Kermanshah University of Medical Sciences, Kermanshah, Iran; Center of Health Management (K Y Ghailan PhD), Aden University, Aden, Yemen; Department of Radiology (A Gholamrezanezhad MD), University of Southern California, Los Angeles, CA, USA; Department of Medicine (R M Gibson PhD), Stanford University, Palo Alto, CA, USA; Department of Nursing (A Girmay MSc, G M Tsegay MSc), Department of Adult Health Nursing (A H Weldemariam MSc), Aksum University, Aksum, Ethiopia; Department of Cardiac Surgery (L Göbölös PhD), Cleveland Clinic Abu Dhabi, Abu Dhabi, United Arab Emirates; Westmead Applied Research Centre (M A Godinho MBBS), University of Sydney, Westmead, NSW, Australia; Department of Health Systems and Policy Research (M Golechha PhD), Indian Institute of Public Health, Gandhinagar, India; Department of Genetics (P Goleij MSc), Sana Institute of Higher Education, Sari, Iran; Department of Exercise and Health Sciences (P N Gona PhD), University of Massachusetts Boston, Boston, MA, USA; Department of Epidemiology (Prof A C Goulart PhD), University of São Paulo, São Paulo, Brazil; Department of Dermatology (A Grada MD), Health Informatics Lab (T Javaheri PhD), Boston University, Boston, MA, USA; Department of Public Health and Preventive Medicine (Prof M Grivna PhD), Charles University, Prague, Czechia; Department of Epidemiology and Biostatistics (S Guan MD), Anhui Medical University, Hefei, China; Post Graduate School of Public Health (G Guarducci MD), University of Siena, Siena, Italy; Department of Family and Community Medicine (M I M Gubari PhD), University of Sulaimani, Sulaimani, Iraq; Division of Cardiovascular Medicine (A Guha MD), Ohio State University, Columbus, OH, USA; Health Directorate (S Guicciardi MD), Local Health Authority of Bologna, Bologna, Italy; Department of General Surgery (S Gulati MD), Dignity Health, Phoenix, AZ, USA; Diagnostic Radiology and Nuclear Medicine (D Gulisashvili MD), School of Medicine (P Habibzadeh MD), University of Maryland, Baltimore, MD, USA; Department of Community Medicine (D A Gunawardana MD), University of Peradeniya, Kandy, Sri Lanka; Department of Internal Medicine (A K Gupta PharmD), Shree Guru Gobind Singh Tricentenary University, Gurugram, India; Non-communicable Division (NCD) (A K Gupta PharmD), Indian Council of Medical Research, Delhi, India; Department of Public Health (B Gupta PhD), Torrens University Australia, Melbourne, VIC, Australia;

Department of Internal Medicine (I Gupta MD), Independent Consultant, Bharatpur, India; NGO (I Gupta MD), Independent Consultant, Delhi, India; Department of Internal Medicine (M Gupta MD), Lerner Research Institute (X Liu PhD), Cleveland Clinic, Cleveland, OH, USA; Department of Preventive Cardiology (Prof R Gupta MD), Eternal Heart Care Centre & Research Institute, Jaipur, India; Department of Medicine (Prof R Gupta MD), Mahatma Gandhi University Medical Sciences, Jaipur, India; School of Medicine (V Gupta PhD), Institute for Mental and Physical Health and Clinical Translation (IMPACT) (W Marx PhD), Deakin University, Geelong, VIC, Australia; School of Biotechnology (V Gupta PhD), Dublin City University, Glasnevin, Ireland; Faculty of Medicine Health and Human Sciences (Prof V K Gupta PhD), Macquarie University, Sydney, NSW, Australia; Department of Epidemiology and Psychosocial Research (R A Gutiérrez PhD), Ramón de la Fuente Muñiz National Institute of Psychiatry, Mexico City, Mexico; Global Virus Network, Middle East Region, Shiraz, Iran (F Habibzadeh MD); Department of Pharmacology and Toxicology (R Haddadi PhD), Research Center for Molecular Medicine (A Taherkhani PhD), Hamadan University of Medical Sciences, Hamadan, Iran; Department of Clinical Pharmacology and Medicine (Prof N R Hadi PhD), University of Kufa, Najaf, Iraq; Clinician Scientist Program (N Haep MD), Berlin Institute of Health, Berlin, Germany; College of Medicine (A Hafiz PhD), Umm AL Qura University, Makkah, Saudi Arabia; Department of Infectious Disease Epidemiology (S Haller MD), Robert Koch Institute, Berlin, Germany; Department of Public Health (S Haller MD), Charité Institute of Public Health, Berlin, Germany; Centre for Neuromuscular and Neurological Disorders (Prof G J Hankey MD), The University of Western Australia, Perth, WA, Australia; Perron Institute for Neurological and Translational Science, Perth, WA, Australia (Prof G J Hankey MD); Department of Biochemistry and Molecular Biology (Prof M Hannan PhD), Bangladesh Agricultural University, Mymensingh, Bangladesh; Department of Anatomy (Prof M Hannan PhD), Dongguk University, Gyeongju, South Korea; Department of Population Science and Human Resource Development (Prof M Haque PhD, Prof M Rahman PhD, M Rahman DrPH), Department of Mathematics (M Kuddus PhD), University of Rajshahi, Rajshahi, Bangladesh; Medical Research Unit (H Harapan PhD), Universitas Syiah Kuala (Syiah Kuala University), Banda Aceh, Indonesia; Research Unit (J M Haro MD), University of Barcelona, Barcelona, Spain; Biomedical Research Networking Center for Mental Health Network (CiberSAM), Barcelona, Spain (J M Haro MD); Department of Sports Science and Clinical Biomechanics (Prof J Hartvigsen PhD, Prof S T Skou PhD), Department of Neurology (S Samadzadeh MD), University of Southern Denmark, Odense, Denmark; Research Department (Prof J Hartvigsen PhD), Nordic Institute of Chiropractic and Clinical Biomechanics, Odense, Denmark; Department of Zoology and Entomology (A I Hasaballah PhD), Botany and Microbiology Department (A M E Shehabeldine PhD), Al-Azhar University, Cairo, Egypt; Department of Pharmaceutical Technology (I Hasan MPharm), University of Dhaka, Dhaka, Bangladesh; Department of Radiology (M Hasanian MD), Arak University of Medical Sciences, Arak, Iran; Department of Pharmacy (Prof M S Hasnain PhD), Palamau Institute of Pharmacy, Daltonganj, India; Department of Diagnostic and Interventional Radiology and Neuroradiology (J Haubold MD, Prof B M Schaarschmidt MD), Institute of Artificial Intelligence in Medicine (J Haubold MD), University Hospital Essen, Essen, Germany; Skaane University Hospital (R J Havmoeller PhD), Skaane County Council, Malmö, Sweden; Institute of Pharmaceutical Sciences (K Hayat MS), University of Veterinary and Animal Sciences, Lahore, Pakistan; Department of Pharmacy Administration and Clinical Pharmacy (K Hayat MS), Xian Jiaotong University, Xian, China; Faculty of Kinesiology (Prof J J Hebert PhD), University of New Brunswick, Fredericton, NB, Canada; School of Allied Health (Prof J J Hebert PhD), Murdoch University, Murdoch, WA, Australia; Independent Consultant, Santa Clara, CA, USA (G Heidari MD); Institute of Psychology (B Helfer PhD), Meta Research Centre (B Helfer PhD), University of Wrocław, Wrocław, Poland; Department of Medicine (M Hemmati MD), MedStar Health, Columbia, MD, USA; Department of Medicine (M Hemmati MD), Georgetown University, Washington, DC, USA; Department of Microbiology (K Hezam PhD), Taiz University, Taiz, Yemen; School of Medicine (K Hezam PhD), Nankai University, Tianjin, China; Division for Health Service Promotion (Y Hiraikhe PhD), Department of Mental Health (Prof N Kawakami PhD), Department of Global Health Policy (S Nomura PhD, S K Rauniyar PhD), University of Tokyo, Tokyo, Japan; School of Dentistry (N Q Hoan DDS), Hanoi Medical University, Hanoi, Viet Nam; Social and Environmental Health Research (M Hossain MPH), Nature Study Society of Bangladesh, Khulna, Bangladesh; Department of Health Promotion and Community Health Sciences (M Hossain MPH), Texas A&M University, College Station, TX, USA; School of Health and Society (H Hosseinzadeh PhD), University of Wollongong, Wollongong, NSW, Australia; Institute of Research and Development (Prof M Hosseinzadeh PhD), Duy Tan University, Da Nang, Viet Nam; Department of Computer Science (Prof M Hosseinzadeh PhD), University of Human Development, Sulaymaniyah, Iraq; Department of Clinical Legal Medicine (S Hostiuic PhD), National Institute of Legal Medicine Mina Minovici, Bucharest, Romania; Department of Biological Sciences and Chemistry (Prof J Hussain PhD), School of Pharmacy (A K Philip PhD), University of Nizwa, Nizwa, Oman; Department of Biomolecular Sciences (N R Hussein PhD), University of Zakho, Zakho, Iraq; International Master Program for Translational Science (H Huynh BS), International Ph.D. Program in Medicine (L Minh MD), Research Center for Artificial Intelligence in Medicine (L Minh MD), School of Public Health (Y L Samodra MPH, Y L Samodra MPH), Department of Clinical Pharmacy (M A Sarasmita PharmD), Taipei Medical University, Taipei, Taiwan; Department of Occupational Safety and Health (Prof B Hwang PhD), China Medical University, Taichung, Taiwan; Department of Occupational Therapy (Prof B Hwang PhD), Asia University, Taiwan, Taichung, Taiwan; Department of Clinical Effectiveness (A I Ikiroma PhD), NHS National Services Scotland, Edinburgh, UK; Division of Infectious Diseases (K S Ikuta MD), Veterans Affairs Greater Los Angeles, Los Angeles, CA, USA; Faculty of Medicine (I M Ilic PhD, Prof M M Santric-Milicevic PhD), School of Public Health and Health Management (Prof M M Santric-Milicevic PhD), University of Belgrade, Belgrade, Serbia; Department of Epidemiology (Prof M D Ilic PhD), University of Kragujevac, Kragujevac, Serbia; College of Pharmacy (M Imam PhD), Department of Electrical Engineering (I Malik PhD), Prince Sattam bin Abdulaziz University, Al Kharij, Saudi Arabia; Faculty of Pharmacy (L M Irham BPharm), University of Ahmad Dahlan, Yogyakarta, Indonesia; School of Pharmacy (M R Islam PhD), BRAC University, Dhaka, Bangladesh; Institute for Physical Activity and Nutrition (S Islam PhD), Department of Psychology (M A Stokes PhD), Deakin University, Burwood, VIC, Australia; Department of Surveillance and Health Services Research (F Ismail PhD), American Cancer Society, Atlanta, GA, USA; Clinical Laboratory (F Ismail PhD), Tobruk University, Tobruk, Libya; Department of Blood Transmitted Diseases (F Ismail PhD), National Center for Disease Control, Tobruk, Libya; Department of Clinical Pharmacy & Pharmacy Practice (Prof N Ismail PhD), Asian Institute of Medicine, Science and Technology, Kedah, Malaysia; Malaysian Academy of Pharmacy, Puchong, Malaysia (Prof N Ismail PhD); Department of Health Services Research (M Iwagami PhD), Research and Development Center for Health Services (Prof K Yamagishi MD), University of Tsukuba, Tsukuba, Japan; School of Health Systems and Public Health (C C D Iwu MPH), Department of Nuclear Medicine (P W Mahasha PhD), University of Pretoria, Pretoria, South Africa; Department of Biotechnology (M Iyer PhD, S Muthu MS), Karpagam Academy of Higher Education (Deemed to be University), Coimbatore, India; Department of Health Studies (K H Jacobsen PhD), University of Richmond, Richmond, VA, USA; Shiraz Neuroscience Research Center (M Jafarinia PhD, R Tavakoli Oliaee PhD), Health Policy Research Center (H Kasraei MD, Y Sarikhani PhD), Department of Epidemiology and Biostatistics (H Raeisi Shahraki PhD), Department of Biostatistics (E Sadeghi PhD), Non-communicable Disease Research Center (S G Sepanlou MD), Shiraz University of Medical Sciences, Shiraz, Iran; Department of Nephrology (K Jaggi MD), San Mateo Medical Center, San Mateo, CA, USA; Department of Nephrology (K Jaggi MD), Mills Peninsula Medical Center, Burlingame, CA, USA; College of Medicine and Medical Sciences (H Jahrami PhD), Arabian Gulf University, Manama, Bahrain; Department of Psychiatry (Z Saif MBA), Ministry of

Health, Manama, Bahrain (H Jahrami PhD); Department of Leukemia (A Jain MD), The University of Texas MD Anderson Cancer Center, Houston, TX, USA; Statistics Unit (N Jain MD), Riga Stradins University, Riga, Latvia; Department of Health and Safety (A A Jairoun PhD), Dubai Municipality, Dubai, United Arab Emirates; Centre for Community Medicine (A Jaiswal MD), Department of Psychiatry (Prof R Sagar MD), Department of Radiation Oncology (A Shankar MD), All India Institute of Medical Sciences, New Delhi, India; The World Academy of Sciences UNESCO, Trieste, Italy (Prof M Jakovljevic PhD); Shaanxi University of Technology, Hanzhong, China (Prof M Jakovljevic PhD); School of Pharmacy and Pharmacology (A Jatau PhD), Menzies Institute for Medical Research (F Pan PhD), University of Tasmania, Hobart, TAS, Australia; Department of Physiology (Prof S Javadov PhD), University of Puerto Rico Medical Sciences Campus, San Juan, Puerto Rico; Centre of Studies and Research (S Jayapal PhD), Ministry of Health, Muscat, Oman; Department of Biochemistry (Prof S Jayaram MD), Government Medical College, Mysuru, India; Department of Nutrition (A Jeyakumar PhD), University of Nevada Reno, Reno, NV, USA; Department of Cardiovascular Medicine (A K Jha MD), Saint Vincent Hospital, Worcester, MA, USA; Melbourne School of Population and Global Health (H Jiang PhD, L Reifels PhD), School of Health Sciences (A Meretoja MD), University of Melbourne, Melbourne, VIC, Australia; Department of Global Health (Y Jin PhD), China Center for Health Development Studies (Y Yao MD), School of Public Health (H Zhang MS), Peking University, Beijing, China; Institute of Molecular and Clinical Ophthalmology Basel, Basel, Switzerland (Prof J B Jonas MD); Department of Ophthalmology (Prof J B Jonas MD), Heidelberg University, Mannheim, Germany; Hungarian Health Management Association (T Palicz MD), Hungarian Health Management Association, Budapest, Hungary (T Joo PhD); Department of Gastroenterology and Hepatology (A Joseph MD), Department of Radiology (S Ramasamy MD), Stanford University, Stanford, CA, USA; Department of Economics (C E Joshua BSc), National Open University, Benin City, Nigeria; Department of Family Medicine and Public Health (J J Jozwiak PhD), University of Opole, Opole, Poland; Institute of Family Medicine and Public Health (M Jürisson PhD), University of Tartu, Tartu, Estonia; School of Public Health (Z Kabir PhD), University College Cork, Cork, Ireland; Department of Oral and Maxillofacial Pathology (V Kadashetti MDS), Department of Public Health Dentistry (Prof K M Shivakumar PhD), Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, India; Department of Dermatology (F Kaliyadan MD), King Faisal University, Hofuf, Saudi Arabia; Department of Endocrinology (S Kalra DM), Bharti Hospital Karnal, Karnal, India; Department of Noncommunicable Diseases (K Kamenov PhD), World Health Organization (WHO), Geneva, Switzerland; Department of Public Health (N Kamyari PhD), Abadan University of Medical Sciences, Abadan, Iran; School of Graduate Studies (T Kanagasabai PhD), Meharry Medical College, Nashville, TN, USA; Sydney Eye Hospital (H Kandel PhD), South Eastern Sydney Local Health District, Sydney, NSW, Australia; Cardiology Division (A R Kanmanthareddy MD), Creighton University, Omaha, NE, USA; College of Public Health (A R Kanmanthareddy MD), Department of Environmental, Agricultural and Occupational Health (J Taiba MPH), University of Nebraska Medical Center, Omaha, NE, USA; Faculty of Dentistry (K K Kanmodi MPH), University of Puthisastra, Phnom Penh, Cambodia; Office of the Executive Director (K K Kanmodi MPH), Campaign for Health and Neck Cancer Education (CHANCE) Programme (A A Salami BDS), Cephas Health Research Initiative Inc, Ibadan, Nigeria; The Hansjörg Wyss Department of Plastic and Reconstructive Surgery (R S Kantar MD), Nab'a Al-Hayat Foundation for Medical Sciences and Health Care, New York, NY, USA; Cleft Lip and Palate Surgery Division (R S Kantar MD), Global Smile Foundation, Norwood, MA, USA; School of Health Professions and Human Services (I M Karaye MD), Hofstra University, Hempstead, NY, USA; Department of Anesthesiology (I M Karaye MD), Montefiore Medical Center, Bronx, NY, USA; Surgery Research Unit (Prof J H Kauppila MD), University of Oulu, Oulu, Finland; International Research Center of Excellence (G A Kayode PhD), Institute of Human Virology Nigeria, Abuja, Nigeria; Julius Centre for Health Sciences and Primary Care (G A Kayode PhD), Copernicus Institute of Sustainable Development (G Koren PhD), Utrecht University, Utrecht, Netherlands; Department of Healthcare Services Management (L Keikavoosi-Arani PhD), Non-communicable Diseases Research Center (P Mardi MD), Alborz University of Medical Sciences, Karaj, Iran; Eye Unit (Prof J H Kempen MD), MyungSung Medical College, Addis Ababa, Ethiopia; Centre for Adolescent Health (J A Kerr PhD), Department of Critical Care and Neurosciences (Prof R G Weintraub MB), Murdoch Childrens Research Institute, Parkville, VIC, Australia; Department of Psychological Medicine (J A Kerr PhD), University of Otago, Christchurch, New Zealand; Department of Biomedical Informatics (K Keshtkar BSc), Arizona State University, Phoenix, AZ, USA; Department of Human Nutrition (E Kesse-Guyot PhD), National Research Institute for Agriculture, Food and Environment, Jouy-en-Josas, France; University Sorbonne Paris Nord (E Kesse-Guyot PhD), Department of Health, Medicine and Human Biology (M Touvier PhD), Sorbonne Paris Nord University, Bobigny, France; Amity Institute of Forensic Sciences (H Khajuria PhD), B P Nayak PhD, P Puri PhD), Amity Institute of Pharmacy (K Munjal PhD), Amity Institute of Public Health (M Shannawaz PhD), Amity University, Noida, India; College of Health Sciences (N Khalid PhD), Abu Dhabi University, Adu Dhabi, United Arab Emirates; Department of Biostatistics (Prof A Khalilian PhD), Mazandaran University of Medical Sciences, Mazandaran, Iran; Research Center for Hydatid Disease in Iran (F Khamesipour PhD), Kerman University of Medical Sciences, Kerman, Iran; Department of Botany (Prof I Khan PhD), Abdul Wali Khan University Mardan, Mardan, Pakistan; Primary Care Department (M A Khan MSc), NHS North West London, London, UK; College of Health, Wellbeing and Life Sciences (Prof K Khatab PhD), Sheffield Hallam University, Sheffield, UK; College of Arts and Sciences (Prof K Khatab PhD), Ohio University, Zanesville, OH, USA; Department of Basic Medical Sciences (M M Khatatbeh PhD), Yarmouk University, Irbid, Jordan; Department of Biochemistry (F Khidri PhD), Liaquat University Of Medical and Health Sciences, Jamshoro, Pakistan; Cardiovascular Disease Initiative (M Kim MD), Broad Institute of MIT and Harvard, Cambridge, MA, USA; Millennium Prevention, Westwood, MA, USA (R W Kimokoti MD); School of Health Sciences (Prof A Kisa PhD), Kristiania University College, Oslo, Norway; Department of International Health and Sustainable Development (Prof A Kisa PhD), Tulane University, New Orleans, LA, USA; Department of Nursing and Health Promotion (S Kisa PhD), Faculty of Health Sciences (Prof A W Wolf PhD), Oslo Metropolitan University, Oslo, Norway; Department of Disease Burden (A S Knudsen PhD), GBD Collaborating Unit (Prof S E Vollset DrPH), Norwegian Institute of Public Health, Bergen, Norway; Global Healthcare Consulting, New Delhi, India (S Kochhar MD); Department of Neurology (H Koh PhD), Baylor College of Medicine, Houston, TX, USA; Department of General Practice-Family Medicine (Prof O Korzh DSc), Kharkiv National Medical University, Kharkiv, Ukraine; Independent Consultant, Jakarta, Indonesia (S Kosen MD); Kasturba Medical College, Mangalore (S Koulmame Laxminarayana MD), Manipal Academy of Higher Education, Udupi, India; Department of Anthropology (Prof K Krishan PhD), Institute of Forensic Science & Criminology (V Sharma PhD), Panjab University, Chandigarh, India; Department of Anesthesiology (V Krishnamoorthy MD), Department of Population Health Sciences (J B Lusk MD), Duke Global Health Institute (C Wu PhD), Center for the Study of Aging and Human Development (Y Yao MD), Duke University, Durham, NC, USA; Department of Demography (Prof B Kuate Defo PhD), Department of Social and Preventive Medicine (Prof B Kuate Defo PhD), University of Montreal, Montreal, QC, Canada; Department of Biochemistry (Prof M Kuddus PhD), College of Public Health & Health Informatics (R Kumar PhD), University of Hail, Hail, Saudi Arabia; Department of Pediatrics (I Kuitunen PhD), Kuopio University Hospital, Kuopio, Finland; Institute of Clinical Medicine (I Kuitunen PhD), University of Eastern Finland, Kuopio, Finland; Department of Medicine (V Kulkarni MS), Queensland Health, Brisbane, QLD, Australia; Department of Psychiatry (M Kumar PhD), University of Nairobi, Nairobi, Kenya; Department of Medicine (O P Kurmi PhD), Department of Health Research Methods, Evidence and Impact (E J Mills PhD), Department of Psychiatry and Behavioural Neurosciences



(A T Olagunju MD), Health Information Research Unit (O O Olasupo PhD), McMaster University, Hamilton, ON, Canada; Department of Health Services Research and Management (D Kusuma DSc), City University of London, London, UK; Faculty of Public Health (D Kusuma DSc), University of Indonesia, Depok, Indonesia; Nuffield Department of Population Health (B Lacey PhD), Health Economics Research Centre (Prof J A B Rodriguez PhD), University of Oxford, Oxford, UK; National Institute for Health Research (NIHR) Oxford Biomedical Research Centre, Oxford, UK (B Lacey PhD); Institute for Social and Health Sciences (Prof L Laflamme PhD), University of South Africa, Pretoria, South Africa; Department of Health Policy and Strategy (Prof C Lahariya MD), Foundation for People-centric Health Systems, New Delhi, India; SD Gupta School of Public Health (Prof C Lahariya MD), Indian Institute of Health Management Research University, Jaipur, India; School of Digital Science (D T C Lai PhD), Institute of Applied Data Analytics (D T C Lai PhD), Faculty of Science (E Leong PhD), Universiti Brunei Darussalam (University of Brunei Darussalam), Bandar Seri Begawan, Brunei; Indian Council of Medical Research, New Delhi, India (D K Lal MD); Department of Public Health (Prof T Lallukka PhD), Department of Virology (F Zakhham PhD), University of Helsinki, Helsinki, Finland (T J Meretoja MD); NEVES Society for Patient Safety, Budapest, Hungary (J Lám PhD); Division of Cancer Epidemiology and Genetics (Q Lan PhD), National Cancer Institute, Rockville, MD, USA; Unit of Genetics and Public Health (Prof I Landires MD), Institute of Medical Sciences, Las Tablas, Panama; Ministry of Health, Herrera, Panama (Prof I Landires MD); Department of Psychiatry and Psychotherapy (B Langguth PhD), University of Regensburg, Regensburg, Germany; Department of Behavioural Sciences and Learning (A Laplante-Lévesque PhD), Linköping University, Linköping, Sweden; Department of Medical Sciences (Prof A O Larsson PhD, Prof J Sundström PhD), Uppsala University, Uppsala, Sweden; Department of Clinical Chemistry and Pharmacology (Prof A O Larsson PhD), Uppsala University Hospital, Uppsala, Sweden; Department of Otorhinolaryngology (S Lasrado MS), Father Muller Medical College, Mangalore, India; International Society Doctors for the Environment, Arezzo, Italy (P Lauriola MD); Faculty of Medicine (H Le MD, N Le MD), University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Viet Nam (T D T Le MD); Cardiovascular Research Department (H Le MD), Department of Cardiovascular Research (N Le MD), Methodist Hospital, Merrillville, IN, USA; Health Economics Division (L K D Le PhD), Monash University, Burwood, VIC, Australia; Independent Consultant, Ho Chi Minh City, Viet Nam (T D T Le MD); College of Optometry (J L Leasher OD), Nova Southeastern University, Fort Lauderdale, FL, USA; Department of Medical Science (M Lee PhD), Ajou University School of Medicine, Suwon, South Korea; Pattern Recognition and Machine Learning Lab (Prof S Lee PhD), Gachon University, Seongnam, South Korea; Department of Precision Medicine (Prof S W Lee MD), Sungkyunkwan University, Suwon-si, South Korea; The Department of Family Medicine (W Lee PhD), University of Texas, Galveston, TX, USA; Department of Preventive Medicine (Prof Y Lee PhD), Korea University, Seoul, South Korea; Center for Youth Substance Abuse Research (J Leung PhD), The University of Queensland, St Lucia, QLD, Australia; Department of Health Promotion and Health Education (M Li PhD), National Taiwan Normal University, Taipei, Taiwan; National Clinical Research Center for Cardiovascular Diseases (Y Li PhD), Chinese Academy of Medical Sciences, Shenzhen, China; Department of Endocrinology and Metabolism (Y Li PhD), The First Hospital of China Medical University, Shenyang, China; Department of Medicine (L Lim MRCP), Faculty of Medicine (H Shah MS), University of Malaya, Kuala Lumpur, Malaysia; School of Public Health (Prof S Linn DrPH), University of Haifa, Haifa, Israel; School of Life Sciences (G Liu PhD), University of Technology Sydney, Ultimo, NSW, Australia; Center for Evidence-Based Medicine and Clinical Research (R Liu MD), The First Clinical College (M Peng MPH), School of Public Health and Management (Y Yu MS), Hubei University of Medicine, Shiyan, China; Institute for Health and Environment (W Liu PhD), Chongqing University of Science and Technology, Chongqing, China; Department of Molecular Epidemiology (E Llanaj PhD), German Institute of Human Nutrition Potsdam-Rehbrücke, Potsdam, Germany; German Center for Diabetes Research (DZD), München-Neuherberg, Germany (E Llanaj PhD); Department of Internal Medicine (C Lo MD), Kirk Kerkorian School of Medicine at UNLV, Las Vegas, NV, USA; Department of Physical Medicine and Nursing (R López-Bueno PhD), University of Zaragoza, Zaragoza, Spain; Department of Musculoskeletal disorders (R López-Bueno PhD), National Research Centre for the Working Environment, Copenhagen, Denmark; National Institutes of Health (A Loreche BS), University of the Philippines Manila, Manila, Philippines; School of Medicine and Public Health (A Loreche BS), Center for Research and Innovation (V F Pepito MSc), Ateneo De Manila University, Pasig City, Philippines; Department of Health Economics (L Lorenzovici MSc), Syreon Research Romania, Targu Mures, Romania; Department of Doctoral Studies (L Lorenzovici MSc), George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, Targu Mures, Romania; School of Medicine (Prof G Lucchetti PhD), Federal University of Juiz de Fora, Juiz de Fora, Brazil; Department of General Surgery (Prof R Lunevicius DSc), Liverpool University Hospitals NHS Foundation Trust, Liverpool, UK; Department of Epidemiology (h lv BA), Chinese Center for Disease Control and Prevention, Shenyang, China; Centre for Public Health and Wellbeing (Z Ma PhD), University of the West of England, Bristol, UK; 2nd Department of Propaedeutic Surgery (N Machairas PhD), 3rd Department of Cardiology (M Spartalis PhD), University of Athens, Athens, Greece; Laboratório de Farmacognosia (LAQV) (Associated Laboratory for Green Chemistry (Á M Madureira-Carvalho PhD), Universidade do Porto (University of Porto), Porto, Portugal; Department of Human Nutrition Research (J A Magaña Gómez PhD), Autonomous University of Sinaloa, Culiacán, Mexico; Grants, Innovation and Product Development Unit (P W Mahasha PhD), Risk and Resilience in Mental Disorders Unit (Prof D J Stein MD), South African Medical Research Council, Cape Town, South Africa (C A Nnaji MPH); Department of Public Health (M Maheri PhD), Social Determinants of Health Center (M Mirza-Aghazadeh-Attari MD), Urmia University of Medical Sciences, Urmia, Iran; Cellular and Molecular Biology Research Center (Prof S Mahjoub PhD), Department of Clinical Biochemistry (Prof S Mahjoub PhD, A Mosapour PhD), Social Determinants of Health Research Center (S Mouodi PhD), Babol University of Medical Sciences, Babol, Iran; Department of Clinical and Hospital Pharmacy (M A Mahmoud PhD), Taibah University, Al-Madinah Al-Munawwarah, Saudi Arabia; Cyprus International Institute for Environmental and Public Health (K C Makris PhD), Cyprus University of Technology, Limassol, Cyprus; Rama Medical College Hospital and Research Centre, Uttar Pradesh, India (K Malhotra MBBS); Smidt Heart Institute (Y Manla MD), Cedars-Sinai Medical Center, Los Angeles, CA, USA; Information and Communication Technology Research Pole (Lab-STICC) (Prof A Mansour PhD), ENSTA Bretagne, Brest, France; Laboratory of Public Health (Prof L G Mantovani DSc), Istituto Auxologico Italiano IRCCS (Italian Auxological Institute), Milan, Italy; Biomedical Engineering Research Center (CREB) (H Marateb PhD), Universitat Politècnica de Catalunya (Barcelona Tech - UPC), Barcelona, Spain; Department of Artificial Intelligence (H Marateb PhD), Smart University of Medical Sciences, Tehran, Iran; Department of Economics (Prof G Martinez PhD), Autonomous Technology Institute of Mexico, Mexico City, Mexico; Noncommunicable Diseases and Mental Health Department (R Martinez-Piedra BSc), Pan American Health Organization, Washington, DC, USA; Campus Fortaleza (F R Martins-Melo PhD), Federal Institute of Education, Science and Technology of Ceará, Fortaleza, Brazil; Department of Nutrition and Dietetics (M Martorell PhD), University of Concepción, Concepción, Chile; Centre for Healthy Living (M Martorell PhD), University of Concepción, Concepción, Chile; Department of Pharmacy (S Maryam PharmD), Bahauddin Zakariya University, Multan, Pakistan; Faculty of Humanities and Health Sciences (Prof R R Marzo MD), Curtin University, Malaysia, Sarawak, Malaysia; Jeffrey Cheah School of Medicine and Health Sciences (Prof R R Marzo MD), School of Pharmacy (Y Wong PhD), Monash University, Subang Jaya, Malaysia; Department of Anatomy, Genetics and Biomedical Informatics (Y Mathangasinghe MD), Department of Surgery (D P Wickramasinghe MD), University of Colombo, Colombo, Sri Lanka; North West Lung Centre (A G Mathioudakis PhD), Manchester University NHS Foundation Trust, Manchester, UK; Department of Medicine (J Mattumpuram MD), University of Louisville, Louisville, KY,

USA; Orthopedic Trauma Pathology Department (A Mazzotti PhD), IRCCS, Bologna, Italy; National Centre for Register-based Research (Prof J J McGrath MD), Aarhus University, Aarhus, Denmark; Department of Public Health (T Mekene Meto MPH), Arba Minch University, Arba Minch, Ethiopia; Peru Country Office (W Mendoza MD), United Nations Population Fund (UNFPA), Lima, Peru; Center for Translation Research and Implementation Science (G A Mensah MD), National Institutes of Health, Bethesda, MD, USA; Department of Medicine (G A Mensah MD), School of Public Health and Family Medicine (C A Nnaji MPH), Division of Cardiology (Prof M Ntsekhe PhD), Department of Paediatrics and Child Health (Prof H J Zar PhD), University of Cape Town, Cape Town, South Africa; International Dx Department (A A Mentis MD), BGI Genomics, Copenhagen, Denmark; Neurology Unit (A Meretoja MD), Breast Surgery Unit (T J Meretoja MD), Helsinki University Hospital, Helsinki, Finland; Department of Nursing (A M Mersha MSc), Arba Minch University, Arba Minch, Ethiopia; University Centre Varazdin (T Mestrovic PhD), University North, Varazdin, Croatia; Department of Pharmacology (Prof K D Mettananda PhD), Department of Paediatrics (Prof S Mettananda DPhil), University of Kelaniya, Ragama, Sri Lanka; Clinical Medicine Department (Prof K D Mettananda PhD), North Colombo Teaching Hospital, Ragama, Sri Lanka; University Paediatrics Unit (Prof S Mettananda DPhil), Colombo North Teaching Hospital, Ragama, Sri Lanka; Department of Epidemiology (I Michalek PhD), National Cancer Registry (I Michalek PhD), Maria Skłodowska-Curie National Research Institute of Oncology, Warsaw, Poland; Queensland Centre for Mental Health Research (QCMHR) (P A Miller PhD), The University of Queensland, Wacol, QLD, Australia; Pacific Institute for Research & Evaluation, Calverton, MD, USA (T R Miller PhD); Department of Medical Sciences (A Mirijello MD), IRCCS Home for the Relief of Suffering General Hospital (IRCCS Casa Sollievo della Sofferenza General Hospital), San Giovanni Rotondo, Italy; Internal Medicine Programme (Prof E M Mirrakhimov PhD), Kyrgyz State Medical Academy, Bishkek, Kyrgyzstan; Department of Atherosclerosis and Coronary Heart Disease (Prof E M Mirrakhimov PhD), National Center of Cardiology and Internal Disease, Bishkek, Kyrgyzstan; Office of the Minister (M K Mirutse MPH), Federal Ministry of Health, Addis Ababa, Ethiopia; National Data Management Centre for Health (A Misganaw PhD), Ethiopian Public Health Institute, Addis Ababa, Ethiopia; Division of Cardiology (A K Mishra MD), St Vincent College, Worcester, MA, USA; Department of Forensic Medicine and Toxicology (C Mittal MD), Dr B C Roy Multi-Specialty Medical Research Centre, Kharagpur, India; Institute of Addiction Research (ISFF) (B Moazan MSc), Frankfurt University of Applied Sciences, Frankfurt am Main, Germany; College of Applied and Natural Science (J Mohamed MSc), University of Hargeisa, Hargeisa, Somalia; Department of Internal Medicine (M F H Mohamed MSc), Brown University, Providence, RI, USA; Molecular Biology Unit (N S Mohamed MSc), Bio-Statistical and Molecular Biology Department (N S Mohamed MSc), Sirius Training and Research Centre, Khartoum, Sudan; Department of Public Health (H Mohammed MPH), Dire Dawa University, Dire Dawa, Ethiopia; Department of Pharmaceutical Sciences (S Mohammed PhD), Notre Dame of Maryland University, Baltimore, MD, USA; Department of Pharmacy (S Mohammed PhD), Mizan-Tepi University, Mizan, Ethiopia; Health Systems and Policy Research Unit (S Mohammed PhD), Ahmadu Bello University, Zaria, Nigeria; Institute of Clinical Physiology (S Molinaro PhD), National Research Council, Pisa, Italy; Clinical Epidemiology and Public Health Research Unit (L Monasta DSc, L Ronfani PhD), Burlo Garofolo Institute for Maternal and Child Health, Trieste, Italy; Department of Biomedical and Dental Sciences and Morphofunctional Imaging (Prof S Mondello MD), Messina University, Messina, Italy; Faculty of Medicine (A Moodi Ghalibaf MD), Infectious Diseases Research Center (F Nikoomanesh PhD), Birjand University of Medical Sciences, Birjand, Iran; Department of Epidemiology and Biostatistics (Y Moradi PhD), Department of Microbiology (M Sedighi PhD), Kurdistan University of Medical Sciences, Sanandaj, Iran; Computer, Electrical, and Mathematical Sciences and Engineering Division (P Moraga PhD), King Abdullah University of Science and Technology, Thuwal, Saudi Arabia; International Laboratory for Air Quality and Health (Prof L Morawska PhD), School of Public Health and Social Work (M T N Tran PhD, N Wang PhD), Queensland University of Technology, Brisbane, QLD, Australia; Department of Public Health (Prof R S Moreira PhD), Oswaldo Cruz Foundation, Recife, Brazil; Department of Public Health (Prof R S Moreira PhD), Federal University of Pernambuco, Recife, Brazil; Department of Biology and Biological Engineering (J Morze PhD), Chalmers University of Technology, Gothenburg, Sweden; College of Medical Sciences (J Morze PhD), SGMK Copernicus University, Warsaw, Poland; Department of Clinical Biochemistry (A Mosapour PhD), Department of Parasitology and Entomology (L Zaki PhD), Tarbiat Modares University, Tehran, Iran; Department of Health Policy (Prof E Mossialos PhD), London School of Economics and Political Science, London, UK; Research Department (M Mrejen PhD), Instituto de Estudos para Políticas de Saúde (IEPS), São Paulo, Brazil; Unit of Pharmacotherapy, Epidemiology and Economy (S Mubarik PhD), University Medical Center Groningen (Prof M J Postma PhD), Department of Internal Medicine (P Vart PhD), University of Groningen, Groningen, Netherlands; Federal Institute for Population Research, Wiesbaden, Germany (Prof U O Mueller MD); Center for Population and Health, Wiesbaden, Germany (Prof U O Mueller MD); Department of Surgery (F Mulita PhD, G Verras MD), General University Hospital of Patras, Patras, Greece; Faculty of Medicine (F Mulita PhD), Department of Internal Medicine (G Ntaios PhD), University of Thessaly, Larissa, Greece; Clinical Epidemiology Research Unit (E Murillo-Zamora PhD), Mexican Institute of Social Security, Villa de Alvarez, Mexico; Postgraduate in Medical Sciences (E Murillo-Zamora PhD), Universidad de Colima, Colima, Mexico; Department of Pediatrics & Pediatric Pulmonology (Prof G Mustafa MD), Institute of Mother & Child Care, Multan, Pakistan; Department of Research Methodology (S Muthu MS), Orthopaedic Research Group, Coimbatore, India; Department of Neuropsychiatry (W Myung PhD), Department of Food and Nutrition (A P Okekunle PhD), Seoul National University, Seoul, South Korea; Research and Analytics Department (A J Nagarajan MTech), Initiative for Financing Health and Human Development, Chennai, India; Department of Research and Analytics (A J Nagarajan MTech), Bioinsilico Technologies, Chennai, India; Faculty of Pharmacy (F Nainu PhD), Hasanuddin University, Makassar, Indonesia; Department of Pulmonary Medicine (S Nair MD), Government Medical College Trivandrum, Trivandrum, India; Health Action by People, Trivandrum, India (S Nair MD); Department of Medical Laboratory Analysis (H H Najmuldeen PhD), Cihan University Sulaymaniyah, Sulaymaniyah, Iraq; Suraj Eye Institute, Nagpur, India (V Nangia MD); School of Pharmacy (A Naqvi PhD), University of Reading, Reading, UK; National Dental Research Institute Singapore (G G Nascimento PhD), Duke-NUS Medical School, Singapore, Singapore; Department of Nursing Education & Research (A J Nashwan MSc), Department of Geriatric and Long Term Care (B Sathian PhD), Hamad Medical Corporation, Doha, Qatar; School of Pharmacy (S O Nduaguba PhD), West Virginia University, Morgantown, WV, USA; Department of General Surgery (I Negoi PhD), Emergency University Hospital Bucharest, Bucharest, Romania; Department of Cardiology (R I Negoi PhD), Cardio-Aid, Bucharest, Romania; College of Medicine and Health Sciences (H B Netsere MS), Bahir Dar University, Gondar, Ethiopia; Department of Public Health (G Nguetack-Tsague PhD), University of Yaoundé I, Yaoundé, Cameroon; Department of Biological Sciences (J W Ngunjiri DrPH), University of Embu, Embu, Kenya; Department of Medical Engineering (D H Nguyen BS), University of South Florida, Tampa, FL, USA; Cardiovascular Research Department (H Q Nguyen MD), Methodist Hospital, Merrillville, IL, USA; International Islamic University Islamabad, Islamabad, Pakistan (R K Niazi PhD); Department of General Surgery (T K Nikolouzakakis PhD), University Hospital of Heraklion, Heraklion, Crete, Greece; Laboratory of Toxicology (T K Nikolouzakakis PhD), Department of Medicine (Prof A Tsatsakis DSc), University of Crete, Heraklion, Greece; Department of Biomedical and Molecular Sciences (A Nikpoor PhD), Queen's University, Kingston, ON, Canada; Center for Public Health (L A Nyanzi PhD), Teesside University, Middlesbrough, UK; Faculty of Applied Sciences and Technology (E A Noman PhD), Universiti Tun Hussein Onn Malaysia, Johor, Malaysia; Department of Health Policy and Management (S Nomura PhD), Keio University, Tokyo, Japan; Department of Clinical Sciences (Prof B Norrving PhD),

Lund University, Lund, Sweden; Department of Paediatrics (C A Nri-Ezedi MD), Nnamdi Azikiwe University, Awka, Nigeria; The Cardiac Clinic (Prof M Ntsekhe PhD), Groote Schuur Hospital, Cape Town, South Africa; Department of Public Health (D Nurrika PhD), Banten School of Health Science, South Tangerang, Indonesia; Ministry of Research, Technology and Higher Education (D Nurrika PhD), Higher Education Service Institutions (LL-DIKTI) Region IV, Bandung, Indonesia; Center of Excellence in Reproductive Health Innovation (CERHI) (C I Nzopotam MPH), University of Benin, Benin City, Nigeria; Department of Physiology (O J Nzopotam PhD), University of Benin, Edo, Nigeria; Department of Physiology (O J Nzopotam PhD), Benson Idahosa University, Benin City, Nigeria; Department of Applied Economics and Quantitative Analysis (Prof B Oancea PhD), University of Bucharest, Bucharest, Romania; Department of Medicine (M J O'Donnell PhD), National University of Ireland - Galway, Galway, Ireland; Independent Consultant, Sydney, NSW, Australia (S R Okeke PhD); School of Pharmacy (O C Okonji MSc), University of the Western Cape, Cape Town, South Africa; Department of Psychiatry (A T Olagunju MD), University of Lagos, Lagos, Nigeria; Department of Nursing Science (M I Olatubi PhD), Bowen University, Iwo, Nigeria; Cardiology Department (G M M Oliveira PhD), Federal University of Rio de Janeiro, Rio de Janeiro, Brazil; Slum and Rural Health Initiative Research Academy (I I Olufadewa MHS), Slum and Rural Health Initiative, Ibadan, Nigeria; Centre for Healthy Start Initiative, Lagos, Nigeria (B O Olusanya PhD, J O Olusanya MBA); Department of Pharmacology and Toxicology (Prof H A Omar PhD), Beni-Suef University, Beni-Suef, Egypt; Surgery Department (G L Omer MD), Sulaimani University, Sulaimani, Iraq; ENT Department (G L Omer MD), Tor Vergata University of Rome, Rome, Italy; Department of Anatomic Pathology (A E E Omonisi FWACP), Ekiti State University, Ado-Ekiti, Nigeria; Department of Anatomic Pathology (A E E Omonisi FWACP), Ekiti State University Teaching Hospital, Ado Ekiti, Nigeria; Faculty of Psychology (S Onie PhD), Universitas Airlangga, Surabaya, Indonesia; Department of Pharmacotherapy and Pharmaceutical Care (M Ordak PhD), Department of Biochemistry and Pharmacogenomics (M Zelińska MPharm), Medical University of Warsaw, Warsaw, Poland; Sickle Cell Unit (V N Orish PhD), Ho Teaching Hospital, Ho Municipality, Ghana; Department of Medicine (Prof A Ortiz MD), Hospital Universitario de La Princesa (Princess University Hospital) (Prof J B Soriano MD), Universidad Autónoma de Madrid (Autonomous University of Madrid), Madrid, Spain; Department of Nephrology and Hypertension (Prof A Ortiz MD), The Institute for Health Research Foundation Jiménez Díaz University Hospital, Madrid, Spain; Department of Infectious Diseases (E Ortiz-Brizuela MSc), Instituto Nacional de Nutrición Salvador Zubirán (Salvador Zubirán National Institute of Medical Sciences and Nutrition), Mexico City, Mexico; Department of Epidemiology, Biostatistics and Occupational Health (E Ortiz-Brizuela MSc), McGill University, Montreal, QC, Canada; Department of Biology (W M S Osman PhD), Khalifa University, Abu Dhabi, United Arab Emirates; School of Medicine (U L Osuagwu PhD), Prof A M N Renzaho PhD), Translational Health Research Institute (K Rana PhD, Prof A M N Renzaho PhD), Western Sydney University, Campbelltown, NSW, Australia; Department of Optometry and Vision Science (U L Osuagwu PhD), University of KwaZulu-Natal, KwaZulu-Natal, South Africa; Laboratory of Public Health Indicators Analysis and Health Digitalization (N Otstavnov BA, S S Otstavnov PhD), Moscow Institute of Physics and Technology, Dolgoprudny, Russia; Department of Project Management (S S Otstavnov PhD), Department of Health Care Administration and Economics (Prof V Vlassov MD), National Research University Higher School of Economics, Moscow, Russia; Faculty of Medicine (Prof A Ouyahia PhD), University Ferhat Abbas of Setif, Setif, Algeria; Division of Infectious Diseases (Prof A Ouyahia PhD), University Hospital of Setif, Setif, Algeria; Department of General Surgery (G Ouyang MD), Central South University, ChangSha, China; Department of Respiratory Medicine (Prof M P P A DNB), Department of Oral and Maxillofacial Surgery (C S N PhD), Jagadguru Sri Shivarathreeswara University, Mysore, India; Department of Forensic Medicine and Toxicology (J Padubidri MD), Kasturba Medical College, Mangalore, Mangalore, India; Research Institute for Medicines (C Palladino PhD), Prof J Perdigão PhD), Universidade de Lisboa (University of Lisbon), Lisbon, Portugal; Division of Research and Development (S R Pandi-Perumal MSc), Lovely Professional University, Phagwara, India; National Research and Innovation Agency Republic of Indonesia (BRIN), Jakarta, Indonesia (H U Pangaribuan MSc); Department of Ophthalmology (G D Panos PhD), Nottingham University Hospitals Queen's Medical Centre Campus, Nottingham, UK; Division of Ophthalmology & Visual Sciences (G D Panos PhD), University of Nottingham, Nottingham, UK; Vision and Eye Research Institute (Prof S Pardhan PhD), Anglia Ruskin University, Cambridge, UK; Department of Medical Sciences (R Passera PhD), University of Torino, Torino, Italy; Department of Imaging (R Passera PhD), AOU Città della Salute e della Scienza di Torino, Torino, Italy; School of Dentistry (J Patel BSc), University of Leeds, Leeds, UK; Department of Poverty, Gender and Youth (S K Patel PhD), Population Council, New Delhi, India; College of Dental Medicine (Prof S Patil PhD), Roseman University of Health Sciences, South Jordan, UT, USA; Centre of Molecular Medicine and Diagnostics (COMManD) (Prof S Patil PhD), Saveetha University, Chennai, India; Second Department of Internal Medicine (D Patoulias PhD), European Interbalkan Medical Center, Thessaloniki, Greece; Department of Internal Medicine (V Pathipati MD), Advent Health, Palm Coast, FL, USA; Department of Hospital Medicine (V Pathipati MD), Sound Physicians, Palm Coast, FL, USA; Clinical Research Department (P Pedersen MSc), IRCCS Fondazione Don Carlo Gnocchi, Milan, Italy; Outpatient Department (M Peng MPH), Taihe Hospital, Shiyan, China; Department of Neurology (U Pensato MD), IRCCS Humanitas Research Hospital, Milan, Italy; Mario Negri Institute for Pharmacological Research, Bergamo, Italy (N Perico MD, Prof G Remuzzi MD); Facultad de Medicina (F E Petermann-Rocha PhD), Universidad Diego Portales (Diego Portales University), Santiago, Chile; School of Cardiovascular and Metabolic Health (F E Petermann-Rocha PhD), University of Glasgow, Glasgow, UK; School of Medicine (W A Petri MD), University of Virginia, Charlottesville, VA, USA; School of Medicine (H Pham MD), Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Viet Nam; Shanghai Mental Health Center (Prof M R Phillips MD), Shanghai Jiao Tong University, Shanghai, China; Department of Psychiatry (Prof M R Phillips MD), Department of Neurology (Prof N Scarneas PhD), Department of Health and Behavior Studies (Prof I D Sigfusdottir PhD), Columbia University, New York, NY, USA; Department of Pediatric Orthopedic Surgery (M Pigeolet MD), Hôpital Necker - Enfants Malades, Paris, France; Basic Medical Sciences Department (J D Pillay PhD), Durban University of Technology, Durban, South Africa; International Center of Medical Sciences Research, Islamabad, Pakistan (Z Z Piracha PhD); Department of Environmental Hygiene (D Plass DrPH), German Environment Agency, Dessau-Roßlau, Germany; Research School of Chemistry and Applied Biomedical Sciences (E Plotnikov PhD), Tomsk Polytechnic University, Tomsk, Russia; Mental Health Research Institute (E Plotnikov PhD), Tomsk National Research Medical Center of the Russian Academy of Sciences, Tomsk, Russia; Clinical Academic Department of Pediatrics (Prof D Poddighe PhD), University Medical Center (UMC), Astana, Kazakhstan; Center of Excellence in Higher Education for Pharmaceutical Care Innovation (Prof M J Postma PhD), Universitas Padjadjaran (Padjadjaran University), Bandung, Indonesia; Non-communicable Diseases Research Center (N Pourtaheri PhD), Bam University of Medical Sciences, Bam, Iran; Centro de Investigaciones Clínicas (Clinical Research Center) (S I Prada PhD), Fundación Valle del Lili (Valle del Lili Foundation), Cali, Colombia; Askok & Rita Patel Institute of Physiotherapy (V Prakash PhD), Charotar University of Science and Technology, Anand, India; Department of Clinical Research and Epidemiology (M Prasad MD), Institute of Liver and Biliary Sciences, New Delhi, New Delhi, India; Department of Biostatistics Epidemiology and Informatics (J Puvvula PhD), University of Pennsylvania, Philadelphia, PA, USA; Cihan University Sulaimaniya Research Center (N H Qasim PhD), Cihan University Sulaimaniya, Sulaimaniya, Iraq; Department of Biological Sciences (A S Qazi PhD), National University of Medical Sciences (NUMS), Rawalpindi, Pakistan; Department of Cardiology (G Qian MS), Third Military Medical University, Chongqing, China; Cardiovascular Research Center (M Rabiee Rad MD), Isfahan Cardiovascular Research Institute, Isfahan,

Iran; Department of Medical Oncology (Prof V Radhakrishnan MD), Cancer Institute (W.I.A), Chennai, India; UO Neurologia, Salute Pubblica e Disabilità (The Neurology, Public Health and Disability Unit) (A Raggi PhD), Fondazione IRCCS Istituto Neurologico Carlo Besta (IRCCS Foundation Carlo Besta Neurological Institute), Milan, Italy; Department of Community Medicine and Family Medicine (Prof P R Raghav MD), Department of Pharmacology (M Shamim MBBS), Department of Urology and Kidney Transplant (M Singh MCh Urology), All India Institute of Medical Sciences, Jodhpur, India; Department of Health Policy & Organization (M Rahim MA), Department of Health Services Administration (M Rahim MA), Department of Psychology (D C Schwebel PhD), School of Medicine (Prof J A Singh MD), University of Alabama at Birmingham, Birmingham, AL, USA; Institute of Health and Wellbeing (M Rahman PhD), Federation University Australia, Berwick, VIC, Australia; Department of Nutrition Science (S Rahmawaty PhD), Muhammadiyah University of Surakarta, Surakarta, Indonesia; Department of Community Medicine (S Rajaa MD), Employees' State Insurance Model Hospital, Chennai, India; Department of Community Medicine (P Ramasubramani MD), Mahatma Gandhi Medical College and Research Institute, Puducherry, India; Research Department (C L Ranabhat PhD), Science, Technology, and Natural Resources Department (S Tandukar PhD), Policy Research Institute, Kathmandu, Nepal; Health and Public Policy Department (C L Ranabhat PhD), Global Center for Research and Development, Kathmandu, Nepal; Centre for Clinical Pharmacology (N Rancic PhD), University of Defence in Belgrade, Belgrade, Serbia; Centre for Clinical Pharmacology (N Rancic PhD), Medical College of Georgia at Augusta University, Belgrade, Serbia; Health Economics and Outcomes Research Department (A Rane MS), Agios Pharmaceuticals, Cambridge, MA, USA; Department of Pharmaceutical Economics and Policy (A Rane MS), Massachusetts College of Pharmacy and Health Sciences, Boston, MA, USA; Department of Oral Medicine and Radiology, Forensic Odontology (K Rao PhD), Nitte University, Mangalore, India; Department of Oral Pathology (S Rao MDS), Sharavathi Dental College and Hospital, Shimogga, India; Inovus Medical, St Helens, UK (D L Rawaf MRCS); Academic Public Health England (Prof S Rawaf MD), Public Health England, London, UK; Department of Biological Sciences (Prof E M M Redwan PhD), King Abdulaziz University, Jeddah, Egypt; Department of Protein Research (Prof E M M Redwan PhD), Research and Academic Institution, Alexandria, Egypt; Unisabana Center for Translational Science (L F Reyes PhD), Universidad de La Sabana (Savannah University), Chia, Colombia; Critical Care Department (L F Reyes PhD), Clinica Universidad De La Sabana (Savannah University Clinic), Chia, Colombia; Network of Immunity in Infection, Malignancy and Autoimmunity (NIIMA) (Prof N Rezaei PhD), Universal Scientific Education and Research Network (USERN), Tehran, Iran; Department of Epidemiology and Biostatistics (Prof M Rezaeian PhD), Rafsanjan University of Medical Sciences, Rafsanjan, Iran; Department of Surgery (J Rickard MD), University Teaching Hospital of Kigali, Kigali, Rwanda; 1H-TOXRUN - One Health Toxicology Research Unit (Prof C F Rodrigues PhD), Instituto Universitário de Ciências da Saúde (CESPU), Paredes, Portugal; Departamento de Farmacologia y toxicologia (Department of Pharmacology and Toxicology) (Prof J A B Rodriguez PhD), Universidad de Antioquia (University of Antioquia), Medellin, Colombia; Department of Clinical Research (L Roeber PhD), Federal University of Uberlândia, Uberlândia, Brazil; Gilbert and Rose-Marie Chagoury School of Medicine (L Roeber PhD), Lebanese American University, Beirut, Lebanon; Golestan Research Center of Gastroenterology and Hepatology (G Roshandel PhD), Golestan University of Medical Sciences, Gorgan, Iran; Technical Department (K Rotimi MSc), Malaria Consortium, Abuja, Nigeria; Department of Public Health Pharmacy (K Rotimi MSc), West African Postgraduate College of Pharmacists, Lagos, Nigeria; Department of Analytical and Applied Economics (Prof H S Rout PhD, C K Swain MPhil), UGC Centre of Advanced Study in Psychology (M Satpathy PhD), Utkal University, Bhubaneswar, India; Faculty of Medicine (B Roy PhD), Quest International University Perak, Ipoh, Malaysia; Department of Biochemistry and Food Analysis (N Roy PhD), Patuakhali Science and Technology University, Patuakhali, Bangladesh; Department of Labour (P Roy PhD), Directorate of Factories, Government of West Bengal, Kolkata, India; Centro de Investigación Palmira (Palmira Research Center) (E Rubagotti PhD), Corporación Colombiana de Investigación Agropecuaria AGROSAVIA (Colombian Agricultural Research Corporation), Bogota, Colombia; Department of Medical Pharmacology (M M Saber-Ayad MD), Public Health and Community Medicine Department (M R Salem MD), Cairo University, Giza, Egypt; Neuropsychiatric Institute (Prof P S Sachdev MD), Prince of Wales Hospital, Randwick, NSW, Australia; Department of Pharmaceutical Chemistry (Prof M R Saeb PhD), Medical University of Gdańsk, Gdańsk, Poland; Multidisciplinary Laboratory Foundation University School of Health Sciences (FUSH) (Prof U Saeed PhD), Foundation University, Islamabad, Pakistan; International Center of Medical Sciences Research (ICMSR), Islamabad, Pakistan (Prof U Saeed PhD); Faculty of Medicine, Bioscience and Nursing (S Z Safi PhD), MAHSA University, Selangor, Malaysia; Interdisciplinary Research Centre in Biomedical Materials (IRCBM) (S Z Safi PhD), COMSATS Institute of Information Technology, Lahore, Pakistan; Department of Statistics (M R Sajid PhD), University of Gujrat, Gujrat, Pakistan; Institute for Employment Research, Nuremberg, Germany (J W Sakshaug PhD); Technology Management Department (Prof M Z Y Salem PhD), University College of Applied Sciences, Gaza, Palestine; School of Economics and Management (Prof M Z Y Salem PhD), University of Kassel, Kassel, Germany; Department of Pathology, Microbiology and Forensic Medicine (M Sallam PhD), Department of Clinical Laboratories and Forensic Medicine (M Sallam PhD), Independent Consultant, Amman, Jordan; Pharmacy Study Program (M A Sarasmita PharmD), Udayana University, Badung, Indonesia; Department of Public Health (Y Sarikhani PhD), Jahrom University of Medical Sciences, Jahrom, Iran; Department of Health and Society (Prof R Sarmiento-Suárez MPH), University of Applied and Environmental Sciences, Bogota, Colombia; National School of Public Health (Prof R Sarmiento-Suárez MPH), Carlos III Health Institute, Madrid, Spain; Department of Oral Pathology and Microbiology (Prof G S Sarode PhD, Prof S C Sarode PhD), Dr D Y Patil University, Pune, India; Faculty of Health & Social Sciences (B Sathian PhD), Bournemouth University, Bournemouth, UK; Department of Medicine (A Sathyanarayan MD, M Sharath MBBS), Bangalore Medical College and Research Institute, Bangalore, India; Udyam-Global Association for Sustainable Development, Bhubaneswar, India (M Satpathy PhD); Department of Public Health Sciences (M Sawhney PhD), University of North Carolina at Charlotte, Charlotte, NC, USA; Department of Neurology (Prof N Scarmeas PhD), National and Kapodistrian University of Athens, Athens, Greece; Department of Health Sciences (I J C Schneider PhD), Federal University of Santa Catarina, Araranguá, Brazil; Clinic for Conservative Dentistry and Periodontology (Prof F Schwendicke PhD), University Hospital of the Ludwig-Maximilians-University Munich, Munich, Germany; Emergency Department (S Senthilkumaran MD), Manian Medical Centre, Erode, India; Department of Medicine and Surgery (Y Sethi MBBS), Government Doon Medical College, Dehradun, India; Department of Medicine (Prof S Setoguchi MD), Rutgers University, New Brunswick, NJ, USA; National Heart, Lung, and Blood Institute (A Seylani BS), National Institute of Health, Rockville, MD, USA; Department of Medicine (N S Shah MD), Northwestern University, Chicago, IL, USA; Department of Infectious Diseases and Microbiology (P A Shah MBBS), Rajiv Gandhi University of Health Sciences, Bangalore, India; HepatoPancreatoBiliary Surgery and Liver Transplant Department (P A Shah MBBS), Healthcare Global Limited Cancer Care Hospital, Bangalore, India; Independent Consultant, Karachi, Pakistan (M A Shaikh MD); Department of Pathology and Laboratory Medicine (S Sham MD), Northwell Health, New York, NY, USA; Department of Pathobiology (M Shamshirgaran PhD), Shahid Bahonar University of Kerman, Kerman, Iran; Facultad de Medicina (Faculty of Medicine) (J Sharifi-Rad PhD), Universidad del Azuay (University of Azuay), Cuenca, Ecuador; University School of Management and Entrepreneurship (R Sharma PhD), Delhi Technological University, Delhi, India; Department of Physiotherapy (S Sharma PhD), Kathmandu University, Dhulikhel, Nepal; Division of Microbiology and Biotechnology (R P Shastri PhD), Yenepoya Research Center,

Mangalore, India; Department of Engineering (A Shavandi PhD), Free University of Brussels, Brussels, Belgium; Department of Bioengineering (A Shayan BS), Clemson University, Clemson, SC, USA; Department of Ophthalmology (M Shayan MD), Harvard Medical School, Boston, MA, USA; Tokyo Foundation for Policy Research, Tokyo, Japan (Prof K Shibuya MD); Department of Psychiatry (J E Shifa MSc), Madda Walabu University, Shashemene, Ethiopia; Department of Mental Health (J E Shifa MSc), Ethiopian Mental Health Association, Addis Ababa, Ethiopia; Department of Public Health (D Shiferaw MPH), Dambi Dollo University, Dembi Dollo, Ethiopia; Department of Nursing (W S Shiferaw MSc), Department of Pediatrics and Child Health Nursing (S S Yehualashet MSc), Debre Berhan University, Debre Berhan, Ethiopia; National Institute of Infectious Diseases, Tokyo, Japan (M Shigematsu PhD); Finnish Institute of Occupational Health, Helsinki, Finland (R Shiri PhD); Department of Veterinary Public Health and Preventive Medicine (A Shittu MSc), Usmanu Danfodiyo University, Sokoto, Sokoto, Nigeria; Department of Clinical Immunology and Hematology (V Shivarov PhD), Sofia University Hospital, Sofia, Bulgaria; Department of Genetics (V Shivarov PhD), Sofia University "St Kliment Ohridski", Sofia, Bulgaria; School of Pharmacy (S Shrestha PharmD), Monash University, Selangor Darul Ehsan, Malaysia; The Cooper Institute, Dallas, TX, USA (K Shuval PhD); Department of Pediatrics and Child Health Nursing (M M Sibhat MSc), Dilla University, Dilla, Ethiopia; Unit of Basic Medical Sciences (E E Siddig MD), University of Khartoum, Khartoum, Sudan; Department of Medical Microbiology and Infectious Diseases (E E Siddig MD), Erasmus University, Rotterdam, Netherlands; Department of Psychology (Prof I D Sigfusdottir PhD), Reykjavik University, Reykjavik, Iceland; Center of Potential and Innovation of Natural Resources (Prof L M R Silva PhD), Polytechnic Institute of Guarda, Guarda, Portugal; Health Sciences Research Centre (Prof L M R Silva PhD), University of Beira Interior, Covilhã, Portugal; Faculty of Pharmacy (S Silva MSc), Coimbra Institute for Biomedical Imaging and Translational Research (S Silva MSc), University of Coimbra, Coimbra, Portugal; School of Health (Prof C R Simpson PhD), Victoria University of Wellington, Wellington, New Zealand; Department of Anatomy (A Singal PhD), Department of Radiodiagnosis (P Singh MD), All India Institute of Medical Sciences, Bathinda, India; Department of Dentistry (A Singh MD), All India Institute of Medical Sciences, Bhopal, India; School of Public Health & Zoonoses (B B Singh PhD), Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana, India; Department of Pharmacology (H Singh DM Clinical Pharmacology), Government Medical College and Hospital, Chandigarh, India; Medicine Service (Prof J A Singh MD), US Department of Veterans Affairs (VA), Birmingham, AL, USA; Department of Physiotherapy and Occupational Therapy (Prof S T Skou PhD), Næstved-Slagelse-Ringsted Hospitals, Slagelse, Denmark; Division of Injury Prevention (Prof D A Sleet PhD), The Bizzell Group, Atlanta, GA, USA; Department of Systemic Pathology (R Solanki MD), Touro College of Osteopathic Medicine, Middletown, NY, USA; Department of Pathology (R Solanki MD), American University of the Caribbean School of Medicine, Cupecoy, Saint Martin; Department of Health Policy and Management (S Song PhD), University of Georgia College of Public Health, Athens, GA, USA; Centro de Investigación Biomédica en Red Enfermedades Respiratorias (Center for Biomedical Research in Respiratory Diseases Network) (CIBERES), Madrid, Spain (Prof J B Soriano MD); Hull York Medical School (I N Soyiri PhD), University of Hull, Hull City, UK; Division of Community Medicine (C T Sreeramareddy MD), International Medical University, Kuala Lumpur, Malaysia; Nutrition and Dietetics Department (A V Starodubova DSc), Federal Research Institute of Nutrition, Biotechnology and Food Safety, Moscow, Russia; Department of Internal Disease (A V Starodubova DSc), Pirogov Russian National Research Medical University, Moscow, Russia; Department of Medicine (P Steiropoulos MD), Democritus University of Thrace, Alexandroupolis, Greece; Occupational and Environmental Medicine Department (L Stockfelt PhD), Institute of Health and Care Sciences (Prof A W Wolf PhD), University of Gothenburg, Gothenburg, Sweden; School of Exercise and Nutrition Sciences (N S Subedi MPH), Deakin University, Melbourne, VIC, Australia; School of Medicine (V Subramaniyan PhD), Monash University, Sunway, Malaysia; Department of Geriatrics (C K Suemoto MD), University of São Paulo, Sao Paulo, Brazil; Center for Biotechnology and Microbiology (M Suleman PhD), University of Swat, Charbagh, Pakistan; School of Life Sciences (M Suleman PhD), Xiamen University, China, Xiamen, China; National Institute of Epidemiology (R Suliankatchi Abdulkader MD), Indian Council of Medical Research, Chennai, India; Mental Health Research (A Sultana MD), Independent Consultant, Khulna, Bangladesh; Division of Global Mental Health (A Sultana MD), EviSyn Health, Khulna, Bangladesh; Cardiovascular Program (X Xu PhD), The George Institute for Global Health, Sydney, NSW, Australia (Prof J Sundström PhD); Department of Clinical Outcomes (Prof L Szarpak PhD), Maria Skłodowska-Curie Medical Academy, Warsaw, Poland; Department of Clinical Research and Development (Prof L Szarpak PhD), LUXMED Group, Warsaw, Poland; Department of Neurology (P Tabae Damavandi MD), Neurocenter of Southern Switzerland (NSI), Lugano, Switzerland; Department of Medicine (Prof R Tabarés-Seisdedos PhD), University of Valencia, Valencia, Spain; Carlos III Health Institute (Prof R Tabarés-Seisdedos PhD), Biomedical Research Networking Center for Mental Health Network (CiberSAM), Madrid, Spain; Department of Basic Medical Sciences (S Tabatabaeizadeh PhD), Department of Internal Medicine (S Tabatabaeizadeh PhD), Islamic Azad University, Mashhad, Iran; School of Dentistry and Oral Health (S K Tadakamadla PhD), Griffith University, Gold Coast, QLD, Australia; Living Systems Institute (Y Taheri Abkenar PharmD), Department of Health and Community Sciences (A Udoh PhD), University of Exeter, Exeter, UK; Department of Biostatistics and Epidemiology (M Taheri Soodejani PhD), Shahid Sadoughi University of Medical Sciences, Yazd, Iran; National Centre for Epidemiology and Population Health (A Talukder MSc), Australian National University, Acton, ACT, Australia; Statistics Discipline (A Talukder MSc), Khulna University, Khulna, Bangladesh; Department of Dermato-Venerology (M Tampa PhD), Dr Victor Babes Clinical Hospital of Infectious Diseases and Tropical Diseases, Bucharest, Romania; Department of Epidemiology (J L Tamuzi MSc), Stellenbosch University, Cape Town, South Africa; Department of Medicine (J L Tamuzi MSc), Northlands Medical Group, Omuthiya, Namibia; State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics (LASG) (H Tang PhD), Chinese Academy of Sciences, Beijing, China; Department of Urology (M Teimoori MD), Sabzevar University of Medical Sciences, Sabzevar, Iran; Department of Epidemiology and Biostatistics (M Teramoto MD), Department of Bioengineering and Therapeutic Sciences (Prof M S Zastrozhin PhD), University of California San Francisco, San Francisco, CA, USA; Department of Pharmacology (P Thangaraju MD), All India Institute of Medical Sciences, Raipur, India; Public Health Department (Prof K R Thankappan MD), Amrita Institute of Medical Sciences, Kochi, India; Faculty of Medicine (R Thayakaran PhD), University of Southampton, Southampton, UK; Department of Endocrinology, Diabetes and Metabolism (Prof N Thomas PhD), Christian Medical College and Hospital (CMC), Vellore, India; Department of Gastroenterology (N K Thomas MD), PSG Institute of Medical Sciences and Research, Coimbatore, India; Department of Psychiatry (C C Thum MB), Hospital Sultan Abdul Aziz Shah Universiti Putra Malaysia, Serdang, Malaysia; Faculty of Biomedical Engineering (A Tichopad PhD), Czech Technical University, Prague, Czechia; Faculty of Public Health (J H V Ticoalu MPH), Universitas Sam Ratulangi, Manado, Indonesia; Nuffield Department of Primary Care Health Sciences (T Tillawi MD), Oxford University, Oxford, UK; Public Health Department (T Y Tiruye PhD), Department of Human Nutrition and Food Sciences (E G Wassie MSc), Debre Markos University, Debre Markos, Ethiopia; Office of Global Relations (Prof R Tobe-Gai PhD), Nagasaki University, Nagasaki, Japan; Department of Medicine (Prof M Tonelli MD), Department of Oncology (L Yang PhD), University of Calgary, Calgary, AB, Canada; Institute of Public Health (R Topor-Madry PhD), Jagiellonian University Medical College, Kraków, Poland; Agency for Health Technology Assessment and Tariff System, Warsaw, Poland (R Topor-Madry PhD); Nutritional Epidemiology Research Team (EREN) (M Touvier PhD), National Institute for Health and Medical Research (INSERM), Paris, France; SRM College of Pharmacy (M R Tovani-Palone PhD), SRM Institute of

Science and Technology (SRMIST), Chennai, India; School of Medicine (J T Tran BS), Indiana University, Indianapolis, IN, USA; Health Informatics Department (M T N Tran PhD), Hanoi Medical University, Ha Noi, Viet Nam; Department of Health (N M Tran MD), Children's Hospital 1, Ho Chi Minh City, Viet Nam; Department of Surgical, Medical, Molecular Pathology and Critical Care Medicine (D Trico MD), University of Pisa, Pisa, Italy; Adult Learning Disability Service (S J Tromans PhD), Leicestershire Partnership National Health Service Trust, Leicester, UK; School of Medicine (T T Truyen MD), Nam Can Tho University, Can Tho, Viet Nam; Department of Nutrition and Food Studies (S Tyrovolas PhD), George Mason University, Fairfax, VA, USA; Medical Genomics Research Department (M Umair PhD), King Abdullah International Medical Research Center, Riyadh, Saudi Arabia; Department of Life Sciences (M Umair PhD), University of Management and Technology, Lahore, Pakistan; Department of Paraclinical Sciences (S Umakanthan MD), The University of the West Indies, St Augustine, Trinidad and Tobago; School of Government (E A Undurraga PhD), Pontificia Universidad Catolica de Chile (Pontifical Catholic University of Chile), Santiago, Chile; Department of Cardiovascular, Endocrine-metabolic Diseases and Aging (B Unim PhD), National Institute of Health, Rome, Italy; Institute of Health and Wellbeing (Prof C A Unsworth PhD), Federation University Australia, Churchill, VIC, Australia; Amity Institute of Biotechnology (E Upadhyay PhD), Amity University Rajasthan, Jaipur, India; Center for Neurodegenerative Diseases and the Aging Brain (D Urso MD), University of Bari, Tricase, Italy; College of Health and Sport Sciences (A G Vaithinathan MSc), University of Bahrain, Salmayya, Bahrain; Department of Cardiovascular Sciences (J Van den Eynde BSc), Katholieke Universiteit Leuven, Leuven, Belgium; Department of Public Health and Epidemiology (O Varga PhD), University of Debrecen, Debrecen, Hungary; Achutha Menon Centre for Health Science Studies (R P Varma MD), Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, India; UKK Institute, Tampere, Finland (Prof T J Vasankari MD); Faculty of Medicine and Health Technology (Prof T J Vasankari MD), Tampere University, Tampere, Finland; Institute of Public Health of Serbia, Belgrade, Serbia (M Vasic PhD); Department of Human Genetics & Molecular Biology (B Vellingiri PhD), Bharathiar University, Coimbatore, India; Raffles Neuroscience Centre (Prof N Venketasubramanian MBBS), Raffles Hospital, Singapore, Singapore; Department of Physiotherapy (J H Villafañe PhD), Universidad Europea de Madrid (European University of Madrid), Villaviciosa de Odón, Spain; Occupational Health Unit (Prof F S Violante MD), Sant'Orsola Malpighi Hospital, Bologna, Italy; Department of Medical Oncology (S R Volovat PhD), University of Medicine and Pharmacy "Grigore T Popa" Iasi, Iasi, Romania; Department of Medical Oncology (S R Volovat PhD), Regional Institute of Oncology, Iasi, Romania; Office of Research, Innovation, and Commercialization (ORIC) (Prof Y Waheed PhD), Shaheed Zulfiqar Ali Bhutto Medical University (SZABMU), Islamabad, Pakistan; Gilbert and Rose-Marie Chagoury School of Medicine (Prof Y Waheed PhD), Lebanese American University, Byblos, Lebanon; School of Public Health (F Wang PhD), Xuzhou Medical University, Xuzhou, China; Department of Neurosurgery (S Wang MD), Capital Medical University, Beijing, China; Department of Neurosurgery (S Wang MD), Beijing Tiantan Hospital, Beijing, China; Department of Parasitology (Prof K G Weerakoon PhD), Department of Community Medicine (N D Wickramasinghe MD), Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka; Cardiology Department (Prof R G Weintraub MB), Royal Children's Hospital, Melbourne, VIC, Australia; Key Laboratory of Shaanxi Province for Craniofacial Precision Medicine Research (Y Wen PhD), Stomatological Hospital (College) of Xi'an Jiaotong University, Xi'an, China; Department of Physical Therapy (T Wiangkham PhD), Naresuan University, Phitsanulok, Thailand; Department of Nursing (A Wilandika MKeP), Universitas Aisyiyah Bandung, Bandung, Indonesia; Department of Medical Statistics, Informatics and Health Economics (Prof P Willeit PhD), Medical University Innsbruck, Innsbruck, Austria; Department of Public Health and Primary Care (Prof P Willeit PhD), University of Cambridge, Cambridge, UK; Department of Neurobiology, Care Sciences and Society (Prof A Wimo PhD), Karolinska Institute, Solna, Sweden; Department of Nutrition (D H Woldegebreel MPH), University of California Davis, Davis, CA, USA; Bone and Joint Research Group

(Prof A D Woolf MBBS), Royal Cornwall Hospital, Truro, UK; Global Alliance for Musculoskeletal Health, Truro, UK (Prof A D Woolf MBBS); Global Health Research Center (C Wu PhD), Duke Kunshan University, Kunshan, China; Department of Food Science and Human Nutrition (Prof F Wu PhD), Michigan State University, East Lansing, MI, USA; School of Public Health (Shenzhen) (X Wu MPH), Sun Yat-sen University, Shenzhen, China; Division of Gastroenterology (Prof Z Wu PhD), Huazhong University of Science and Technology, Wuhan, China; Vanke School of Public Health (Y Xia MD), Tsinghua University, Beijing, China; School of Public Health (H Xiao PhD), Zhejiang University, Zhejiang, China; Department of Public Health Science (H Xiao PhD), Fred Hutchinson Cancer Research Center, Seattle, WA, USA; Australian Institute of Health Innovation (L Yadav PhD), Macquarie University, Macquarie Park, NSW, Australia; Department of Basic Medical Sciences (S Yaghoubi PhD), Neyshabur University of Medical Sciences, Neyshabur, Iran; Graduate School of Medicine (Prof K Yamagishi MD), Osaka University, Suita, Japan; Department of Cancer Epidemiology and Prevention Research (L Yang PhD), Alberta Health Services, Calgary, AB, Canada; Faculty of Medicine (Y Yano MD), Department of Public Health (Prof N Yonemoto PhD), Juntendo University, Tokyo, Japan; Research Center of Physiology (H Yaribeygi PhD), Semnan University of Medical Sciences, Semnan, Iran; Department of Family Medicine (S A Yesuf MSc), St Peter's Specialized Hospital, Addis Ababa, Ethiopia; Independent Consultant, Addis Ababa, Ethiopia (S A Yesuf MSc); Biostatistics, Epidemiology, and Science Computing Department (S Yezli PhD), King Faisal Specialist Hospital & Research Center, Riyadh, Saudi Arabia; Department of Health Management (A Yiğit PhD, V Yiğit PhD), Süleyman Demirel Üniversitesi (Süleyman Demirel University), Isparta, Türkiye; Pharmacy Department (Y Yismaw MSc), Alkan Health Science, Business and Technology College, Bahir Dar, Ethiopia; Department of Pediatrics (Prof D Yon MD), Kyung Hee University, Seoul, South Korea; Department of Biostatistics (Prof N Yonemoto PhD), University of Toyama School of Medicine, Toyama, Japan; Department of Health Policy and Management (Prof M Z Younis PhD), Jackson State University, Jackson, MS, USA; School of Business & Economics (Prof M Z Younis PhD), Universiti Putra Malaysia (University of Putra Malaysia), Kuala Lumpur, Malaysia; Department of Epidemiology and Biostatistics (Prof C Yu PhD), Wuhan University, Wuhan, China; Faculty of Medicine and Health Sciences (F Zakhm PhD), Hodeidah University, Hodeidah, Yemen; Department of Pharmacology (B A Zaman MSc), University of Duhok, Duhok, Iraq; Hospital San Juan de Dios, Tarija, Bolivia (N Zamora MD); Department of Neuroscience (R Zand MD), Geisinger Health System, Danville, PA, USA; Department of Neurology (R Zand MD), University of Tennessee, Memphis, TN, USA; Unit on Child & Adolescent Health (Prof H J Zar PhD), Medical Research Council South Africa, Cape Town, South Africa; Addictology Department (Prof M S Zastrozhin PhD), Russian Medical Academy of Continuous Professional Education, Moscow, Russia; Department of Obstetrics and Gynecology (N Zhang BS), First Affiliated Hospital of Anhui Medical University, Hefei, China; School of Public Health (Y Zhang PhD), Hubei Province Key Laboratory of Occupational Hazard Identification and Control (Y Zhang PhD), Wuhan University of Science and Technology, Wuhan, China; College of Traditional Chinese Medicine (H Zhao MD), Hebei University, Baoding, China; School of Population Medicine and Public Health (P Zhong MSc), Peking Union Medical College, Beijing, China; Computational Bioscience Research Center (J Zhou PhD), King Abdullah University of Science and Technology, Jeddah, Saudi Arabia; Department of Nursing (M Zoladl PhD), Yasuj University of Medical Sciences, Yasuj, Iran; NIHR-Biomedical Research Centre (NIHR-BRC) (Prof A Zumla PhD), University College London Hospitals, London, UK; School of Physics (S H Zyoud PhD), Universiti Sains Malaysia (University of Science Malaysia), Penang, Malaysia.

#### Contributors

Please see appendix 1 section 8 for more detailed information about individual author contributions to the research, divided into the following categories: managing the overall research enterprise; writing the first draft of the manuscript; primary responsibility for applying analytical methods to produce estimates; primary responsibility for

seeking, cataloguing, extracting, or cleaning data; designing or coding figures and tables; providing data or critical feedback on data sources; developing methods or computational machinery; providing critical feedback on methods or results; drafting the manuscript or revising it critically for important intellectual content; and managing the estimation or publications process. The lead, corresponding, and senior authors had full access to the data in the study and had final responsibility for the decision to submit for publication.

#### Declaration of interests

S Afzal reports support for the present manuscript from King Edward Medical University including study material, research articles, valid data sources and authentic real time information for this manuscript; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from King Edward Medical University and collaborative partners including University of Johns Hopkins, University of California, University of Massachusetts, KEMCAANA, KEMCA-UK Scientific Conferences and Webinars; support for attending meetings and/or travel from King Edward Medical University to attend meetings; participation on a Data Safety Monitoring Board or Advisory Board with National Bioethics Committee Pakistan, King Edward Medical University Ethical Review Board, as well as Ethical Review Board Fatima Jinnah Medical University and Sir Ganga Ram Hospital; leadership or fiduciary roles in board, society, committee or advocacy groups, paid or unpaid with Pakistan Association of Medical Editors, Fellow of Faculty of Public Health Royal Colleges UK (FFPH), and Society of Prevention, Advocacy And Research, King Edward Medical University (SPARK); and other support as Dean of Public Health and Preventive Medicine at King Edward Medical University, as the Chief Editor Annals of King Edward Medical University, as the Director of Quality Enhancement Cell King Edward Medical University, as an international-level Fellow of Faculty of Public Health UK, as an Advisory Board Member and Chair Scientific Session KEMCA-UK, as a Chairperson of KEMCAANA (the International Scientific Conference), as a national-level member on the Research and Publications Higher Education Commission (HEC Pakistan), as a member of the Research and Journals Committee (Pakistan) the Medical and Dental Council (Pakistan), the National Bioethics Committee (Pakistan), the Corona Experts Advisory Group (Punjab), the Chair of the Dengue Experts Advisory Group, and a member of the Punjab Residency Program Research Committee; all outside the submitted work. R Ancuceanu reports consulting fees from AbbVie; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events from AbbVie, Sandoz, and B. Braun; all outside the submitted work. D B Anderson reports leadership or fiduciary roles in board, society, committee or advocacy groups, paid or unpaid with PM&R journal as Senior Editor, which includes an annual stipend, outside the submitted work. P Atorkey reports infrastructure support for the present manuscript from the Australian College of Applied Professions, Discipline of Psychological Sciences, Sydney, Australia and the School of Medicine and Public Health, The University of Newcastle, Australia. J L Baker reports grants paid to their institution from Novo Nordisk Foundation, World Cancer Research Fund, Independent Research Council Denmark, and EU Horizon; consulting fees from Novo Nordisk Denmark A/S; unpaid leadership or fiduciary role in other board, society, committee or advocacy group with European Association for the Study of Obesity; all outside the submitted work. S Barteit reports research grants from the Carl-Zeiss Foundation and the German Research Foundation (DFG); stock or stock options from CHEERS company, a for-profit company focusing on climate change and health evaluation and response systems; all outside the submitted work. M L Bell reports grants or contracts paid to their institution from US Environmental Protection Agency (EPA), US National Institutes of Health (NIH), High Tide Foundation, Health Effects Institute, Yale Women Faculty Forum, Environmental Defense Fund, Wellcome Trust Foundation, Yale Climate Change and Health Center, Robert Wood Johnson Foundation, and Hutchinson Postdoctoral Fellowship; consulting fees from Clinique and SciQuest; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events from Colorado School of Public Health, Duke University, University of Texas, Data4Justice, Korea University, Organization of Teratology Information

Specialists, University of Pennsylvania, and Boston University for speaking events, IOP Publishing for editorial duties, NIH, Health Canada, PAC-10, UK Research and Innovation, and AXA Research Fund Fellowship for grant review, Korea University for adjunct teaching/research, Harvard University and University of Montana for external advisory committee membership; support for travel from Colorado School of Public Health, University of Texas, Duke University, Boston University, University of Pennsylvania, Harvard University, *American Journal of Public Health*, and Columbia University; paid leadership or fiduciary roles in board, society, committee or advocacy groups, with US EPA Clean Air Scientific Advisory Committee (CASAC), and unpaid roles with Johns Hopkins EHE Advisory Board, Harvard external advisory committee for training grant, WHO Global Air Pollution and Health Technical Advisory Group, National Academies Panels and Committees; all outside the submitted work. P J G Bettencourt reports patents planned, issued or pending WO2020229805A1, BR112021022592A2, EP3965809A1, OA1202100511, US2023173050A1, EP4265271A2 and EP4275700A2; other interests as project reviewer at Botnar Foundation; all outside the submitted work. S Bhaskar reports grants or contracts from a Grant-in-Aid for Scientific Research (KAKENHI) from Japan Society for the Promotion of Science (JSPS), Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) and a Japan Society for the Promotion of Science (JSPS) International Fellowship from JSPS and the Australian Academy of Science; leadership or fiduciary roles in board, society, committee or advocacy groups, paid or unpaid, with Rotary District 9675 as District Chair, Diversity, Equity & Inclusion, with Global Health & Migration Hub Community, Global Health Hub Germany, Berlin, Germany as Chair and Manager, with *PLoS One*, *BMC Neurology*, *Frontiers in Neurology*, *Frontiers in Stroke*, *Frontiers in Public Health*, and *BMC Medical Research Methodology* as Editorial Board Member, and with College of Reviewers, Canadian Institutes of Health Research (CIHR), and Government of Canada as Member; all outside the submitted work. B Bikbov reports grants or contracts from European Commission and University of Rome; support for attending meetings and/or travel from European Renal Association via reimbursement of hotel stay for congress lecturers; leadership or fiduciary role in other board, society, committee or advocacy group, unpaid, with Advocacy Group, International Society of Nephrology and Western Europe Regional Board, International Society of Nephrology; other non-financial support from Scientific-Tools.Org for a public health consultancy; all outside the submitted work. M Carvalho reports other support from The Laboratório Associado para a Química Verde (LAQV/REQUIMTE), University of Porto, Porto, Portugal, and Foundation for Science and Technology (FCT) and the Portuguese Ministry of Science, Technology, and Higher Education (MCTES) under the scope of the project UIDP/50006/2020 (DOI 10.54499/UIDP/50006/2020), outside the submitted work. A L Catapano reports grants or contracts from Amryt Pharma, Menarini, and Ultragenyx; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events from Amarin, Amgen, Amryt Pharma, AstraZeneca, Daiichi Sankyo, Esperion, Ionis Pharmaceutical, Medscape, Menarini, Merck, Novartis, Novo Nordisk, Peervoice, Pfizer, Recordati, Regeneron, Sandoz, Sanofi, The Corpus, Ultragenyx, and Viatrix; all outside the submitted work. A Caye reports consulting fees from Knight Therapeutics outside the submitted work. J Conde reports grants or contracts from European Research Council Starting Grant (ERC-StG-2019-848325. Funding 1.5M€); patents planned, issued, or pending from Universidade Nova de Lisboa for Surfactant-Based Hydrogel, Methods and Uses Thereof; all outside the submitted work. S Das reports unpaid leadership or fiduciary roles in board, society, committee, or advocacy groups with Association for Diagnostics & Laboratory Medicine (ADLM) India Section as Program Chair, Clinical & Laboratory Standards Institute (CLSI) nominating committee as a member, Women in Global Health India as a member; all outside the submitted work. L Degenhardt reports untied educational grants to examine new opioid medications in Australia from Indivior and Seqirus, outside the submitted work. A K Demetriades reports leadership or fiduciary roles in board, society, committee or advocacy groups, paid or unpaid, with AO Knowledge Forum Degen as Steering Committee Member, Global Neuro Foundation as Board Member, and European Association of Neurosurgical Societies (EANS)

as Board Member/Officer; all outside the submitted work. A Faro reports support for the present manuscript from the National Council for Scientific and Technological Development, CNPq, Brazil. D Flood reports grants or contracts from the National Heart, Lung, and Blood Institute (NHLBI; award number K23HL161271), the University of Michigan Claude D Pepper Older Americans Independence Center (award number 5P30AG024824), and the University of Michigan Caswell Diabetes Institute Clinical Translational Research Scholars Program; consulting fees paid to their institution serving as a diabetes consultant for WHO; unpaid leadership or fiduciary roles in board, society, committee, or advocacy groups with Maya Health Alliance, a non-governmental health organisation in Guatemala, as Staff Physician to carry out diabetes advocacy and solicit funding for clinical diabetes programs; all outside the submitted work. L M Force reports support for the present manuscript from the Bill & Melinda Gates foundation; grants or contracts from Conquer Cancer Foundation, St Jude Children's Research Hospital, St Baldrick's Foundation, and NIH Loan Repayment Program, outside the submitted work; unpaid leadership or fiduciary roles in board, society, committee or advocacy groups with *The Lancet Oncology* International Advisory Board, outside the submitted work. M Foschi reports consulting fees from Roche and Novartis; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from Roche, Novartis, Sanofi, Merck, Biogen, and Bristol Myers Squibb for speaking at sponsored congresses; support for attending meetings and/or travel from Roche, Novartis, Sanofi, Merck, Biogen, and Bristol Myers Squibb; unpaid leadership or fiduciary roles in board, society, committee or advocacy groups with MSBase scientific leadership group; all outside the submitted work. R C Franklin reports grants or contracts from Heatwaves in Queensland – Queensland Government, Mobile Plant Safety – Agrifutures, Arc Flash – Human Factors – Queensland Government; support for attending meetings and/or travel from Australasian College of Tropical Medicine (ACTM) – Tropical Medicine and Travel Medicine Conference 2022, 2023, and International Society of Travel Medicine (ISTM) – Travel Medicine Conference, Basel 2023; leadership or fiduciary roles in board, society, committee or advocacy groups, paid or unpaid, with Kidsafe as President/Director, Farmsafe as Director, Auschem as Director, PHAA Injury Prevention SIG Convenor, ISASH Governance Committee, and ACTM as Vice President; all outside the submitted work. A Guha reports grants or contracts from the American Heart Association and the US Department of Defense; consulting fees from Pfizer, Novartis, and Myovant; leadership or fiduciary roles in board, society, committee or advocacy groups, paid or unpaid, with ZERO Prostate Cancer – health equity task force and Doctorpedia as a founding medical partner; all outside the submitted work. A Hassan reports consulting fees from Novartis, Sanofi Genzyme, Biologix, Merck, Hikma Pharma, Janssen, Inspire Pharma, Future Pharma, and Elixir Pharma; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from Novartis, Allergan, Merck, Biologix, Janssen, Roche, Sanofi Genzyme, Bayer, Hikma Pharma, Al Andalus, Chemipharm, Lundbeck, Inspire Pharma, Future Pharma and Habib Scientific Office, and Everpharma; support for attending meetings and/or travel from Novartis, Allergan, Merck, Biologix, Roche, Sanofi Genzyme, Bayer, Hikma Pharma, Chemipharm, and Al Andalus and Clavita Pharm; all outside the submitted work. I M Ilic reports support for the present manuscript from Ministry of Science, Technological Development and Innovation of the Republic of Serbia (project no. 175042, 2011-2023). M D Ilic reports support for the present manuscript from Ministry of Science, Technological Development and Innovation of the Republic of Serbia (project no. 451-03-47/2023-01/200111). S M S Islam reports support for the present manuscript from an Investigator Grant from the National Health and Medical Research Council (NHMRC; Australia) and a Vanguard Grant from the Heart Foundation. N E Ismail reports leadership or fiduciary role in other board, society, committee, or advocacy group, paid or unpaid, with The Bursar (Council Member), Malaysia, and the Academy of Pharmacy, Malaysia, outside the submitted work. T Joo reports support for the present manuscript from National Research, Development, and Innovation Office in Hungary (RRF-2.3.1-21-2022-00006), Data-Driven Health Division of National Laboratory for Health Security. J J Jozwiak reports payment or honoraria for lectures, presentations, speakers

bureaus, manuscript writing, or educational events from Novartis, Adamed, and Amgen, outside the submitted work. N Kawakami reports grants or contracts from Junpukai Foundation and Department of Digital Mental Health is an endowment department, supported with an unrestricted grant from 15 enterprises (<https://dmh.m.u-tokyo.ac.jp/c/>); consulting fees from Riken Institute, JAXA, Sekisui Chemicals, and SB@WORK; leadership or fiduciary role in other board, society, committee, or advocacy group, paid or unpaid, with Japan Society for Occupational Health; all outside the submitted work. J H Kempen reports grants or contracts from Sight for Souls and Mass Eye and Ear Global Surgery Program; leadership or fiduciary role in other board, society, committee, or advocacy group, paid or unpaid, with the Sight for Souls board (US 501(c)(3)); stock or stock options in Betaliq and Tarsier; all outside the submitted work. K Krishan reports non-financial support from the UGC Centre of Advanced Study, CAS II, awarded to the Department of Anthropology, Panjab University, Chandigarh, India, outside the submitted work. B Lacey reports support for the present manuscript from UK Biobank, funded largely by the UK Medical Research Council and Wellcome. B Langguth reports support for the present manuscript from the EU paid to their institution; grants or contracts paid to their institution from German Research Foundation, German Bundesministerium für Bildung und Forschung, EU, Bavarian-Czech University Association, and Bavarian State; consulting fees from Schwabe, Neuromod, Sea Pharma, and Rovi; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from Schwabe and Neuromod; payment for expert testimony from Bavarian State; leadership or fiduciary role in other board, society, committee, or advocacy group, unpaid, with Tinnitus Research Initiative and the German Society for Brain Stimulation in Psychiatry; stock or stock options in Sea Pharma; receipt of equipment, materials, drugs, medical writing, gifts or other services from Neurocare and Daymed; all outside the submitted work. M Lee reports support for the present manuscript from the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2023S1A3A2A05095298) and Bio-convergence Technology Education Program through the Korea Institute for Advancement Technology (KIAT) funded by the Ministry of Trade, Industry and Energy (No. P0017805). M-C Li reports grants or contracts from The National Science and Technology Council in Taiwan (NSTC 112-2410-H-003-031); leadership or fiduciary role in other board, society, committee, or advocacy group, paid or unpaid, with the *Journal of the American Heart Association* as Technical Editor; all outside the submitted work. P W Mahasha reports support for attending meetings and/or travel South African Medical Research Council, Department of Nuclear Medicine, School of Medicine, University of Pretoria, and Discipline of Traditional Medicine, School of Nursing and Public Health, University of KwaZulu Natal; participation on a Data Safety Monitoring Board or Advisory Board with the Journal Current Research in Public Health (CRPH) as Editorial Board Member, the journal of *Frontiers in Reproductive Health* section HIV and STIs as Associate Editorial Board Member, and the journal *BMC Public Health* as Editorial Board Member; leadership or fiduciary role in other board, society, committee or advocacy group, unpaid, as member of the Federation of Infectious Diseases Societies of Southern Africa (FIDSSA; November 2021–ongoing), Member of the International Society for Infectious Diseases (ISID; November, 2021–ongoing), Member of the COVID-19 Clinical Research Coalition (August, 2021–ongoing), Member of the Global Burden of Disease Collaborator Network (February, 2019–ongoing), Fellow Member of the Scholars Academic and Scientific Society (SAS Society; FSASS; August 2021–ongoing), Member of the South African Council for Natural Scientific Professions (SACNASP; 2018–ongoing), Member of the African Organisation for Standardisation (ARSO), ARSO TC 82 dealing with African Traditional Medicine standards (2023–ongoing, Member of the South African Bureau of Standards (SABS)'s National Committee dealing with African Traditional Medicine standards (2024–ongoing), Member of the Global Forum for Research Ethics and Integrity (GFREI; 2023–ongoing); all outside the submitted work. M A Mahmoud reports grants or contracts from Deputyship for Research & Innovation, Ministry of Education in Saudi Arabia for research through project number 445-5-762 outside the submitted work. L G Mantovani reports support for the present



manuscript from the Italian Ministry of Health. H R Marateb reports grants or contracts outside the submitted work from The Beatriu de Pinós post-doctoral programme from the Office of the Secretary of Universities and Research from the Ministry of Business and Knowledge of the Government of Catalonia (programme: 2020 BP 00261) received through their institution, Universitat Politècnica de Catalunya · Barcelona Tech – UPC. A-F A Mentis reports grants or contract funding from ‘MilkSafe: A novel pipeline to enrich formula milk using omics technologies’, a research co-financed by the European Regional Development Fund of the EU and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH - CREATE - INNOVATE (project code: T2EDK-02222), as well as from ELIDEK (Hellenic Foundation for Research and Innovation, MIMS-860; both outside of the present manuscript); payment for expert testimony from serving as external peer-reviewer for FONDAZIONE CARIPLO, ITALY; participation in a Data Safety Monitoring or Advisory Board as Editorial Board Member for “Systematic Reviews”, for *Annals of Epidemiology*, and as Associate Editor for *Translational Psychiatry*; stock or stock options from a family winery; and other financial interests as the current scientific officer for BGI Group; outside the submitted work. S A Meo reports support for the present manuscript from Research Supporting Project, King Saud University, Riyadh, Saudi Arabia (RSP-2024 R47). P B Mitchell reports payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from Janssen (Australia); participation on a Data Safety Monitoring Board or Advisory Board with Janssen (Australia); all outside the submitted work. L Monasta reports support from the present manuscript from the Italian Ministry of Health (Ricerca Corrente 34/2017), payments made to the Institute for Maternal and Child Health IRCCS Burlo Garofolo. R S Moreira reports grants or contracts from the National Council for Scientific and Technological Development (CNPq) Research Productivity Scholarship (registration number 316607/2021-5), outside the submitted work. J F Mosser reports support for the present manuscripts from the Bill & Melinda Gates Foundation via grant funding; grants or contracts outside the submitted work from Gavi; support for attending meetings or travel from the Bill & Melinda Gates Foundation, outside the submitted work. S Muthu reports support for attending meetings or travel from AO Spine KF Degen LV Award 2024 (travel grants to attend GSC 2024); leadership or fiduciary roles in board, society, committee, or advocacy groups, paid or unpaid, with AOSpine KF Degen as Associate Member, SICOT Grants Committee as a member; ICRS Next Gen Committee as a member; all outside the submitted work. S Nomura reports grant support for the present manuscript from Ministry of Education, Culture, Sports, Science and Technology of Japan (21H03203) and Precursory Research for Embryonic Science and Technology from the Japan Science and Technology Agency (JPMJPR22R8). B Norrving reports participation on a Data Safety Monitoring Board with Simbec Orion in HOVID trial, outside the submitted work. A P Okekun reports support for the present manuscript from the National Research Foundation of Korea funded by the Ministry of Science and ICT (2020H1D3A1A04081265); support for attending meetings and/or travel from National Research Foundation of Korea funded by the Ministry of Science and ICT (2020H1D3A1A04081265), outside the submitted work. S Onie reports support for attending meetings and/or travel from Black Dog Institute for travel to the International Association for Suicide Prevention World Congress, Piran, 2023; leadership or fiduciary roles in board, society, committee, or advocacy groups, paid or unpaid, with International Association for Suicide Prevention as Elected National Representative for Indonesia and Indonesian Association for Suicide Prevention as Founding President; all outside the submitted work. A Ortiz reports grants or contracts from Sanofi, Institution: IIS-FJD; consultancy or speaker fees or travel support from Advicience, Astellas, AstraZeneca, Amicus, Amgen, Boehringer Ingelheim, Fresenius Medical Care, GSK, Bayer, Sanofi-Genzyme, Menarini, Mundipharma, Kyowa Kirin, Lilly, Alexion, Freeline, Idorsia, Chiesi, Otsuka, Novo Nordisk, Sysmex, and Vifor Fresenius Medical Care Renal Pharma and is Director of the Catedra Mundipharma-UAM of diabetic kidney disease and the Catedra Astrazeneca-UAM of chronic kidney disease and electrolytes; leadership or fiduciary roles in board, society, committee, or advocacy groups, paid or unpaid, with European Renal Association; stock or stock options in

Telara Farma; all outside the submitted work. C Palladino reports grants or contracts from FCT – Fundação para a Ciência e a Tecnologia, I.P. (national funding), under a contract-programme as defined by DL No. 57/2016 and Law No. 57/2017 (DL57/2016/CP1376/CT0004). DOI 10.54499/DL57/2016/CP1376/CT0004 (<https://doi.org/10.54499/DL57/2016/CP1376/CT0004>), outside the submitted work. R Passera reports participation on a Data Safety Monitoring Board or Advisory Board, unpaid, as senior biostatistician member of the Data Safety Monitoring Board for the no-profit clinical trial “Consolidation with ADCT-402 (loncastuximab tesirine) after immunochemotherapy: a phase II study in BTKi-treated/ineligible Relapse/Refractory Mantle Cell Lymphoma (MCL) patients” - sponsor FIL, Fondazione Italiana Linfomi, Alessandria-I; leadership or fiduciary roles in board, society, committee, or advocacy groups, unpaid, as Member of the Statistical Committee of the EBMT, the European Society for Bone and Marrow Transplantation, Paris-F; all outside the submitted work. A E Peden reports support for the present manuscript from the Australian National Health and Medical Research Council (grant number: APP2009306). V C F Pepito reports grants or contracts from Sanofi Consumer Healthcare and the International Initiative for Impact Evaluation; outside the submitted work. M Pigeolet reports a grant from The Belgian Kids’ Fund for Pediatric Research, outside the submitted work. A Rane reports stock or stock options in Agios as an employee. L F Reyes reports grants or contracts from MSD, Pfizer, and GSK; consulting fees from GSK and MSD; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from GSK, Pfizer, and MSD; support for attending meetings and/or travel from GSK and Pfizer; all outside the submitted work. L Ronfani reports support for the present manuscript from the Italian Ministry of Health (Ricerca Corrente 34/2017), payments made to the Institute for Maternal and Child Health IRCCS Burlo Garofolo. S Sacco reports grants or contracts from Novartis and Uriach; consulting fees from Novartis, Allergan-Abbvie, Teva, Lilly, Lundbeck, Pfizer, Novo Nordisk, Abbott, and AstraZeneca; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events from Novartis, Allergan-AbbVie, Teva, Lilly, Lundbeck, Pfizer, Novo Nordisk, Abbott, and AstraZeneca; support for attending meetings and/or travel from Lilly, Novartis, Teva, and Lundbeck; leadership or fiduciary role in other board, society, committee, or advocacy group, paid or unpaid, with the European Stroke Organisation as President-elect and the European Headache Federation as Second Vice-President; receipt of equipment, materials, drugs, medical writing, gifts or other services from Allergan-AbbVie and Novo Nordisk; all outside the submitted work. P S Sachdev reports grants or contracts from National Health and Medical Research Council of Australia and the NIH; Payment or honoraria for lectures from Alkem Labs for the Frontiers of Psychiatry June 2023 Seminar, Mumbai, India; Participation on a Data Safety Monitoring Board or Advisory Board with Biogen Australia and Roche Australia; leadership or fiduciary role in other board, society, committee or advocacy group, unpaid, with the VASCOG Society and the World Psychiatric Association; all outside the submitted work. Y L Samodra reports grants or contracts from Taipei Medical University; leadership or fiduciary role in other board, society, committee, or advocacy group, paid or unpaid, with the Benang Merah Research Center; all outside the submitted work. J Sanabria reports support for attending meetings and/or travel from the Department of Surgery, Marshall University School of Medicine (MUSOM); three patents pending; participation in quality assessment and assurance for surgeries of the Department of Surgery MUSOM; leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid with SSAT, ASTS, AHPBA, IHPBA, and AASLD; all outside the submitted work. N Scarmas reports grants or contracts with Novo Nordisk as the Local Principal Investigator of recruiting site for multinational, multicentre industry sponsored phase 3 treatment trial for Alzheimer’s disease with funding paid to the institution; Participation on a Data Safety Monitoring Board or Advisory Board with Albert Einstein College of Medicine (NIH-funded study) as the Chair of Data Safety Monitoring Board; all outside the submitted work. B M Schaarschmidt reports research grants from Else Kröner-Fresenius Foundation, DFG, and PharmaCept; payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from AstraZeneca; support for attending meetings

and/or travel from Bayer AG; all outside the submitted work. S Setoguchi reports grants or contracts paid to their institution from NIH, Cystic Fibrosis Foundation, Pfizer Inc, Daiichi Sankyo, and Bristol Myers Squibb; consulting fees from Pfizer Japan, Merck Inc, Bristol Myers Squibb, and Regeneron for providing scientific advice on study design and analytic approaches for validation studies, post-market safety studies and pre-market studies for medications and medical conditions; all outside the submitted work. A Sharifan reports leadership or fiduciary role in other board, society, committee or advocacy group, unpaid with Cochrane as a steering member of the Cochrane Early Career Professionals Network; and receipt of 30 days of complimentary access to ScienceDirect, Scopus, Reaxys, and Geofacets after reviewing manuscripts for two journals published by Elsevier; outside the submitted work. S Sharma reports support for the present manuscript from the John J Bonica Postdoctoral Fellowship from the International Association for the Study of Pain (IASP; 2021-2023); payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events and a travel grant for delivering a talk on “Technologies for pain education in developing countries” conducted by the Pain Education SIG of the IASP at the World Pain Congress in Toronto (2022); outside the submitted work. V Sharma reports other financial or non-financial support from DFSS (MHA)’s research project (DFSS28(1)2019/EMR/6) at Institute of Forensic Science & Criminology, Panjab University, Chandigarh, India, outside the submitted work. V Shivarov reports one patent and one utility model with the Bulgarian Patent Office; stock or stock options from ICONplc (RSUs); and other financial interests from an ICONplc salary; all outside the submitted work. S Shrestha reports other financial interests from the Graduate Research Merit Scholarship from the School of Pharmacy at Monash University Malaysia, outside the submitted work. J P Silva reports support for the present manuscript from the Portuguese Foundation for Science and Technology through payment of their salary (contract with reference 2021.01789.CEECIND/CP1662/CT0014). C R Simpson reports grants or contracts from MBIE (New Zealand), HRC (New Zealand), Ministry of Health (New Zealand), Medical Research Council (UK), and Chief Scientist Office (UK); leadership or fiduciary role in other board, society, committee, or advocacy group, paid or unpaid with the New Zealand Government Data Ethics Advisory Group as the Chair; outside the submitted work. J A Singh reports consulting fees from AstraZeneca, Crealta/Horizon, Medisys, Fidia, PK Med, Two labs Inc, Adept Field Solutions, Clinical Care options, Clearview healthcare partners, Putnam associates, Focus forward, Navigant consulting, Spherix, MedIQ, Jupiter Life Science, UBM LLC, Trio Health, Medscape, WebMD, and Practice Point communications; and the NIH and the American College of Rheumatology; payment for lectures, presentations, speakers bureaus, manuscript writing, or educational events as a member of the speaker’s bureau of Simply Speaking; support for attending meetings and/or travel as a past steering committee member of OMERACT; participation on a Data Safety Monitoring Board or Advisory Board with the US Food and Drug Administration Arthritis Advisory Committee; leadership or fiduciary role in other board, society, committees or advocacy group, paid or unpaid, as a past steering committee member of the OMERACT, an international organisation that develops measures for clinical trials and receives arm’s length funding from 12 pharmaceutical companies, Co-Chair of the Veterans Affairs Rheumatology Field Advisory Committee, and editor and Director of the UAB Cochrane Musculoskeletal Group Satellite Center on Network Meta-analysis; stock or stock options in Atai life sciences, Kintara therapeutics, Intelligent Biosolutions, Acumen pharmaceutical, TPT Global Tech, Vaxart pharmaceuticals, Atyu biopharma, Adaptimmune Therapeutics, GeoVax Labs, Pieris Pharmaceuticals, Enzolytics Inc, Seres Therapeutics, Tonix Pharmaceuticals Holding Corp, and Charlotte’s Web Holdings Inc, and previously owned stock options in Amarin, Viking, and Moderna pharmaceuticals; outside the submitted work. S T Skou reports grants or contracts from European Research Council paid to their university from the EU’s Horizon 2020 research innovation program (grant agreement No 801790), EU’s Horizon 2020 research innovation program paid to their hospital (grant agreement No 945377), and Region Zealand paid to their hospital; royalties or licenses from Munksgaard for book chapters and TrustMe-Ed for online lectures; payment or honoraria for lectures, presentations,

speakers bureaus, manuscript writing, or educational events from Nestlé Health Science for a presentation at a webinar on osteoarthritis; participation on a Data Safety Monitoring Board or Advisory Board, paid or unpaid, with UK-based National Institute for Health and Care Research (NIHR)-funded trial PERFORM: Personalised Exercise-Rehabilitation FOR people with Multiple long-term conditions (multimorbidity, NIHR 202020); other support as co-founder of GLA:D, a not-for profit initiative hosted at University of Southern Denmark; all outside the submitted work. D J Stein reports consulting fees from Discovery Vitality, Johnson & Johnson, Kanna, L’Oreal, Lundbeck, Orion, Sanofi, Servier, Takeda, and Vistagen, outside the submitted work. A P Stoian reports consulting fees paid to their institution from AstraZeneca, Boehringer Ingelheim, Eli Lilly, Novo Nordisk, Novartis, Sandoz, Sanofi, and Servier; payment or honoraria paid to their institution for lectures, presentations, speakers bureaus, manuscript writing, or educational events from AstraZeneca, Boehringer Ingelheim, Eli Lilly, Novo Nordisk, Novartis, Medochemie, Sandoz, Sanofi, and Servier; support for attending meetings and/or travel, paid to their institution, from Novo Nordisk, Medochemie, and Sanofi; participation on a Data Safety Monitoring Board or Advisory Board, paid to their institution, with AstraZeneca, Eli Lilly, Novo Nordisk, and Sanofi; leadership or fiduciary roles in board, society, committee or advocacy groups, unpaid, with Central European Diabetes Association (CEDA) and Association for Renal-Metabolic & Nutritional Studies (ASRMN); receipt of medical writing (unpaid) from Novo Nordisk and Sanofi; all outside the submitted work. C K Suemoto reports grants or contracts Alzheimer’s Association and São Paulo Research Foundation (FAPESP), paid to their institution, and CNPq, paid to them; support for attending meetings and/or travel from Alzheimer’s Association; leadership or fiduciary roles in other board, society, committee, or advocacy group, unpaid, with Brazilian Society of Geriatrics and Gerontology; all outside the submitted work. J H V Ticoalu reports a leadership or fiduciary role in other board, society, committee or advocacy group with Benang Merah Research Center as Co-founder, outside the submitted work. S J Tromans reports grants or contracts from the 2023 Adult Psychiatric Morbidity Survey team, collecting epidemiological data on community-based adults living in England. This is a contracted study from NHS Digital, via the Department of Health and Social Care; outside the submitted work. P Willeit reports consulting fees from Novartis; outside the submitted work. A Wimo reports grants or contracts from VINNOVA program: PREDEM, EU-project JPND: ADDITION, EU-project JPND: EURO-FINGER, EU-project IHI: PROMINENT, EU-project JPND: PMI-AD, and EU-project H2020: PRODEMOS; royalties or licenses as license holder of RUD-instrument (part); leadership or fiduciary roles in other board, society, committee, or advocacy group, unpaid, with ADI: MSAP; all outside the submitted work. M Zielińska reports other financial interest as an AstraZeneca employee, outside the submitted work. A Zumla reports grants or contracts from The Pan-African Network on Emerging and Re-Emerging Infections (PANDORA-ID-NET, CANTAM-3, and EACCR-3) funded by the European and Developing Countries Clinical Trials Partnership, the EU Horizon 2020 Framework Programme, UK NIHR Senior Investigator, and Mahathir Science Award and EU-EDCTP Pascoal Mocumbi Prize Laureate; participation on a Data Safety Monitoring Board or Advisory Board member of the WHO Mass Gatherings Expert Group and WHO Health Emergencies Programme in Geneva, a member of the EU-EDCTP3-Global Health (Brussels) Scientific Committee; all outside the submitted work.

#### Data sharing

To download the data used in these analyses, please visit the GBD 2021 Sources Tool. The statistical code used in GBD 2021 is available online.

#### Acknowledgments

Research reported in this publication was supported by the Bill & Melinda Gates Foundation (OPP1152504); Queensland Department of Health, Australia; UK Department of Health and Social Care; the Norwegian Institute of Public Health; St Jude Children’s Research Hospital; and the New Zealand Ministry of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the funders. Data for this research was provided by MEASURE Evaluation, funded by the US Agency for International

For the **GBD Sources Tool** see <https://ghdx.healthdata.org/gbd-2021/sources>

For the **statistical code used in GBD 2021** see <http://ghdx.healthdata.org/gbd-2021/code>

Development (USAID). Views expressed do not necessarily reflect those of USAID, the US Government, or MEASURE Evaluation. This study uses a dataset provided by European Centre for Disease Prevention and Control (ECDC) based on data provided by WHO and Ministries of Health from the affected countries. The views and opinions of the authors expressed herein do not necessarily state or reflect those of the ECDC. The accuracy of the authors' statistical analysis and the findings they report are not the responsibility of ECDC. ECDC is not responsible for conclusions or opinions drawn from the data provided. ECDC is not responsible for the correctness of the data and for data management, data merging, and data collation after provision of the data. ECDC shall not be held liable for improper or incorrect use of the data. Health Behaviour in School-Aged Children (HBSC) is an international study carried out in collaboration with WHO/EURO. The international coordinator of the 1997–98, 2001–02, 2005–06, and 2009–10 surveys was Candace Currie and the Data Bank Manager for the 1997–98 survey was Bente Wold, whereas for the following survey Oddrun Samda was the databank manager. A list of principal investigators in each country can be found at <http://www.hbsc.org>. Parts of this material are based on data and information provided by the Canadian Institute for Health Information. However, the analyses, conclusions, opinions and statements expressed herein are those of the author and not those of the Canadian Institute for Health information. The data reported here have been supplied by the US Renal Data System (USRDS). The interpretation and reporting of these data are the responsibility of the authors and in no way should be seen as an official policy or interpretation of the US Government. The data used in this paper come from the 2009–10 Ghana Socioeconomic Panel Study Survey which is a nationally representative survey of over 5,000 households in Ghana. The survey is a joint effort undertaken by the Institute of Statistical, Social and Economic Research (ISSER) at the University of Ghana, and the Economic Growth Centre (EGC) at Yale University. It was funded by the Economic Growth Center. At the same time, ISSER and the EGC are not responsible for the estimations reported by the analyst(s). The harmonised dataset was downloaded from the Global Dietary Database (GDD) website (<https://www.globaldietarydatabase.org/>). The Canadian Community Health Survey - Nutrition (CCHS-Nutrition), 2015 is available online (<https://www.globaldietarydatabase.org/management/microdata-surveys/650>). The harmonisation of the original dataset was performed by GDD. The data was adapted from Statistics Canada, Canadian Community Health Survey: Public Use Microdata File, 2015/2016 (Statistics Canada, CCHS-Nutrition, 2015); this does not constitute an endorsement by Statistics Canada of this product. The data is used under the terms of the Statistics Canada Open Licence (Statistics Canada, Statistics Canada Open Licence. <https://www.statcan.gc.ca/eng/reference/licence>). The Health and Retirement Study (HRS) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. The Palestinian Central Bureau of Statistics granted the researchers access to relevant data in accordance with license no. SLN2014-3-170, after subjecting data to processing aiming to preserve the confidentiality of individual data in accordance with the General Statistics Law - 2000. The researchers are solely responsible for the conclusions and inferences drawn upon available data. The results and conclusions are mine and not those of Eurostat, the European Commission, or any of the national statistical authorities whose data have been used. This manuscript is based on data collected and shared by the International Vaccine Institute (IVI) from an original study it conducted with support from the Bill & Melinda Gates Foundation. This paper uses data from SHARE Waves 1, 2, 3 (SHARELIFE), 4, 5 and 6 (dois: 10.6103/SHARE.w1.611,10.6103/SHARE.w2.611, 10.6103/SHARE.w3.611, 10.6103/SHARE.w4.611, 10.6103/SHARE.w5.611, 10.6103/SHARE.w6.611), see Börsch-Supan et al. (2013) for methodological details. The SHARE data collection has been primarily funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812) and FP7 (SHARE-PREP: N°211909, SHARE-LEAP: N°227822, SHARE M4: N°261982). Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the US National Institute on Aging (U01\_AG09740-13S2, P01\_AG005842, P01\_AG08291, P30\_AG12815,

R21\_AG025169, Y1-AG-4553-01, IAG\_BSR06-11, OGH04\_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see [www.share-project.org](http://www.share-project.org)). This paper uses data from the Algeria - Setif and Mostaganem 2003 STEPS survey, implemented by Ministry of Health, Population and Hospital Reform (Algeria) with the support of WHO. This paper uses data from the Algeria 2016-2017 STEPS survey, implemented by Ministry of Health (Algeria) with the support of WHO. This paper uses data from the American Samoa 2004 STEPS survey, implemented by Department of Health (American Samoa) and Monash University (Australia) with the support of WHO. This paper uses data from the Armenia 2016 STEPS survey, implemented by Ministry of Health (Botswana) with the support of WHO. This paper uses data from the Azerbaijan 2017 STEPS survey, implemented by Ministry of Health (Azerbaijan) with the support of WHO. This paper uses data from the Bangladesh 2018 STEPS survey, implemented by Ministry of Health and Family Welfare (Bangladesh) with the support of WHO. This paper uses data from the Barbados 2007 STEPS survey, implemented by Ministry of Health (Barbados) with the support of WHO. This paper uses data from the Belarus 2016-2017 STEPS survey, implemented by Republican Scientific and Practical Center of Medical Technologies, Informatization, Management and Economics of Public Health (Belarus) with the support of WHO. This paper uses data from the Benin - Littoral 2007 STEPS survey, the Benin 2008 STEPS survey, and the Benin 2015 STEPS survey, implemented by Ministry of Health (Benin) with the support of WHO. This paper uses data from the Bhutan - Thimphu 2007 STEPS survey, implemented by Ministry of Health (Bhutan) with the support of WHO. This paper uses data from the Bhutan 2014 STEPS survey, implemented by Ministry of Health (Bhutan) with the support of the World Health Organization. This paper uses data from the Botswana 2014 STEPS survey, implemented by Ministry of Health (Armenia), National Institute of Health with the support of WHO. This paper uses data from the Brunei 2015-2016 STEPS survey, implemented by Ministry of Health (Brunei) with the support of WHO. This paper uses data from the Cambodia 2010 STEPS survey, implemented by Ministry of Health (Cambodia) with the support of WHO. This paper uses data from the Cameroon 2003 STEPS survey, implemented by Health of Populations in Transition (HoPIT) Research Group (Cameroon) and Ministry of Public Health (Cameroon) with the support of WHO. This paper uses data from the Cape Verde 2007 STEPS survey, implemented by Ministry of Health, National Statistics Office with the support of WHO. This paper uses data from the Central African Republic - Bangui 2010 STEPS survey and Central African Republic - Bangui and Ombella M'Poko 2016 STEPS survey, implemented by Ministry of Health and Population (Central African Republic) with the support of WHO. This paper uses data from the Comoros 2011 STEPS survey, implemented by Ministry of Health (Comoros) with the support of WHO. This paper uses data from the Congo - Brazzaville 2004 STEPS survey, implemented by Ministry of Health, Population and Hospital Reform (Algeria) with the support of WHO. This paper uses data from the Cook Islands 2003–2004 survey and Cook Islands 2013–2015 STEPS survey, implemented by Ministry of Health (Cook Islands) with the support of WHO. This paper uses data from the Eritrea 2010 STEPS survey, implemented by Ministry of Health (Eritrea) with the support of WHO. This paper uses data from the Fiji 2002 STEPS survey, implemented by Fiji School of Medicine, Menzies Center for Population Health Research, University of Tasmania (Australia), Ministry of Health (Fiji) with the support of WHO. This paper uses data from the Fiji 2011 STEPS survey, implemented by Ministry of Health (Fiji) with the support of WHO. This paper uses data from the Georgia 2016 STEPS survey, implemented by National Center for Disease Control and Public Health (Georgia) with the support of WHO. This paper uses data from the Ghana - Greater Accra Region 2006 STEPS survey, implemented by Ghana Health Service with the support of WHO. This paper uses data from the Guinea 2009 STEPS survey, implemented by Ministry of Public Health and Hygiene (Guinea) with the support of WHO. This paper uses data from the Guyana 2016 STEPS survey, implemented by Ministry of Health (Guyana) with the support of WHO. This paper uses data from the Iraq 2015 STEPS survey, implemented by Ministry of Health (Iraq) with the support of WHO. This paper uses data from the Kenya 2015 STEPS survey, implemented by Kenya National Bureau of Statistics, Ministry of Health (Kenya) with

the support of WHO. This paper uses data from the Kiribati 2004–2006 STEPS survey and the Kiribati 2016 survey, implemented by Ministry of Health and Medical Services (Kiribati) with the support of WHO. This paper uses data from the Kuwait 2006 STEPS survey and the Kuwait 2014 STEPS survey, implemented by Ministry of Health (Kuwait) with the support of WHO. This paper uses data from the Kyrgyzstan 2013 STEPS survey, implemented by Ministry of Health (Kyrgyzstan) with the support of WHO. This paper uses data from the Laos 2013 STEPS survey, implemented by Ministry of Health (Laos) with the support of WHO. This paper uses data from the Lebanon 2016–2017 STEPS survey, implemented by Ministry of Public Health (Lebanon) with the support of WHO. This paper uses data from the Lesotho 2012 STEPS survey, implemented by Ministry of Health and Social Welfare (Lesotho) with the support of WHO. This paper uses data from the Liberia 2011 STEPS survey, implemented by Ministry of Health and Social Welfare (Liberia) with the support of WHO. This paper uses data from the Libya 2009 STEPS survey, implemented by Secretariat of Health and Environment (Libya) with the support of WHO. This paper uses data from the Malawi 2009 STEPS survey and Malawi 2017 STEPS survey, implemented by Ministry of Health (Malawi) with the support of WHO. This paper uses data from the Mali 2007 STEPS survey, implemented by Ministry of Health (Mali) with the support of WHO. This paper uses data from the Marshall Islands 2002 STEPS survey and the Marshall Islands 2017–2018 STEPS survey, implemented by Ministry of Health (Marshall Islands) with the support of WHO. This paper uses data from the Mauritania–Nouakchott 2006 STEPS survey, implemented by Ministry of Health (Mauritania) with the support of WHO. This paper uses data from the Micronesia - Chuuk 2006 STEPS survey, implemented by Ministry of Health (Palestine) with the support of WHO. This paper uses data from the Micronesia - Chuuk 2016 STEPS survey, implemented by Chuuk Department of Health Services (Micronesia), Department of Health and Social Affairs (Micronesia) with the support of WHO. This paper uses data from the Micronesia - Pohnpei 2002 STEPS survey, implemented by Centre for Physical Activity and Health, University of Sydney (Australia), Department of Health and Social Affairs (Micronesia), Fiji School of Medicine, Micronesia Human Resources Development Center, Pohnpei State Department of Health Services with the support of WHO. This paper uses data from the Micronesia - Pohnpei 2008 STEPS survey, implemented by FSM Department of Health and Social Affairs, Pohnpei State Department of Health Services with the support of WHO. This paper uses data from the Micronesia - Yap 2009 STEPS survey, implemented by Ministry of Health and Social Affairs (Micronesia) with the support of WHO. This paper uses data from the Micronesia - Kosrae 2009 STEPS survey, implemented by FSM Department of Health and Social Affairs with the support of WHO. This paper uses data from the Moldova 2013 STEPS survey, implemented by Ministry of Health (Moldova) with the support of WHO. This paper uses data from the Mongolia 2005 STEPS survey, the Mongolia 2009 STEPS survey, and the Mongolia 2013 STEPS survey, implemented by Ministry of Health (Mongolia) with the support of WHO. This paper uses data from the Morocco 2017 STEPS survey, implemented by Ministry of Health (Morocco) with the support of WHO. This paper uses data from the Mozambique 2005 STEPS survey, implemented by Ministry of Health (Mozambique) with the support of WHO. This paper uses data from the Myanmar 2014 STEPS survey, implemented by Ministry of Health (Myanmar) with the support of WHO. This paper uses data from the Nauru 2004 STEPS survey and the Nauru 2015–2016 STEPS survey, implemented by Ministry of Health (Nauru) with the support of WHO. This paper uses data from the Niger 2007 STEPS survey, implemented by Ministry of Health (Niger) with the support of WHO. This paper uses data from the Palau 2011–2013 STEPS survey and the Palau 2016 STEPS survey, implemented by Ministry of Health (Palau) with the support of WHO. This paper uses data from the Palestine 2010–2011 STEPS survey, implemented by Chuuk Department of Health Services (Micronesia), Department of Health and Social Affairs (Micronesia) with the support of WHO. This paper uses data from the Qatar 2012 STEPS survey, implemented by Supreme Council of Health (Qatar) with the support of WHO. This paper uses data from the Rwanda 2012–2013 STEPS survey, implemented by Ministry of Health (Rwanda) with the support of WHO. This paper uses data from the Samoa 2002 STEPS survey and the Samoa

2013 STEPS survey, implemented by Ministry of Health (Samoa) with the support of WHO. This paper uses data from the Sao Tome and Principe 2008 STEPS survey, implemented by Ministry of Health (Sao Tome and Principe) with the support of WHO. This paper uses data from the Seychelles 2004 STEPS survey, implemented by Ministry of Health (Seychelles) with the support of WHO. This paper uses data from the Solomon Islands 2005–2006 STEPS survey and the Solomon Islands 2015 STEPS survey, implemented by Ministry of Health and Medical Services (Solomon Islands) with the support of WHO. This paper uses data from the Sri Lanka 2014–2015 STEPS survey, implemented by Ministry of Health (Sri Lanka) with the support of WHO. This paper uses data from the Sudan 2016 STEPS survey, implemented by Ministry of Health (Sudan) with the support of WHO. This paper uses data from the Swaziland 2007 STEPS survey and the Swaziland 2014 STEPS survey, implemented by Ministry of Health (Swaziland) with the support of WHO. This paper uses data from the Tajikistan 2016 STEPS survey, implemented by Ministry of Health (Tajikistan) with the support of WHO. This paper uses data from the Tanzania - Zanzibar 2011 STEPS survey, implemented by Ministry of Health (Zanzibar) with the support of WHO. This paper uses data from the Tanzania 2012 STEPS survey, implemented by National Institute for Medical Research (Tanzania) with the support of WHO. This paper uses data from the Timor-Leste 2014 STEPS survey, implemented by Ministry of Health (Timor-Leste) with the support of WHO. This paper uses data from the Togo 2010–2011 STEPS survey, implemented by Ministry of Health (Togo) with the support of WHO. This paper uses data from the Tokelau 2005 STEPS survey, implemented by Tokelau Department of Health, Fiji School of Medicine with the support of WHO. This paper uses data from the Tonga 2004 STEPS survey and the Tonga 2011–2012 STEPS survey, implemented by Ministry of Health (Tonga) with the support of WHO. This paper uses data from the Tuvalu 2015 STEPS survey, implemented by Ministry of Health (Tuvalu), with the support of WHO. This paper uses data from the Uganda 2014 STEPS survey, implemented by Ministry of Health (Uganda) with the support of WHO. This paper uses data from the Uruguay 2006 STEPS survey and the Uruguay 2013–2014 STEPS survey, implemented by Ministry of Health (Uruguay) with the support of WHO. This paper uses data from the Vanuatu 2011 STEPS survey, implemented by Ministry of Health (Vanuatu) with the support of WHO. This paper uses data from the Viet Nam 2009 STEPS survey and the Viet Nam 2015 STEPS survey, implemented by Ministry of Health (Viet Nam) with the support of WHO. This paper uses data from the Virgin Islands, British 2009 STEPS survey, implemented by Ministry of Health and Social Development (British Virgin Islands) with the support of WHO. This paper uses data from the Zambia - Lusaka 2008 STEPS survey, implemented by Ministry of Health (Zambia) with the support of WHO. This paper uses data from the Zambia 2017 STEPS survey, implemented by Ministry of Health (Zambia) with the support of WHO. This research used data from the Chile National Health Survey 2003, 2009–10, and 2016–17. The authors are grateful to the Ministry of Health, survey copyright owner, for allowing them to have the database. All results of the study are those of the author and in no way committed to the Ministry. This research used information from the Health Surveys for epidemiological surveillance of the Undersecretary of Public Health. The authors thank the Ministry of Health of Chile, having allowed them to have access to the database. All the results obtained from the study or research are the responsibility of the authors and in no way compromise that institution. This research uses data from Add Health, a program project designed by J Richard Udry, Peter S Bearman, and Kathleen Mullan Harris, and funded by a grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 17 other agencies. Special acknowledgment is due to Ronald R Rindfuss and Barbara Entwisle for assistance in the original design. Persons interested in obtaining data files from Add Health should contact Add Health, Carolina Population Center, 123 W. Franklin Street, Chapel Hill, NC 27516-2524, USA (addhealth@unc.edu). No direct support was received from grant P01-HD31921 for this analysis. This study has been realised using the data collected by the Swiss Household Panel (SHP), which is based at the Swiss Centre of Expertise in the Social Sciences FORS. The project is financed by the Swiss National Science Foundation. We thank the Russia Longitudinal Monitoring Survey, RLMS-HSE, conducted by the National

Research University Higher School of Economics and ZAO Demoscope together with Carolina Population Center, University of North Carolina at Chapel Hill, and the Institute of Sociology RAS for making these data available.

Editorial note: The Lancet Group takes a neutral position with respect to territorial claims in published maps and institutional affiliations.

#### References

- Murray CJL. The Global Burden of Disease Study at 30 years. *Nat Med* 2022; **28**: 2019–26.
- World Bank. World development report 1993: investing in health. Washington, DC: Oxford University Press, 1993.
- GBD 2021 Causes of Death Collaborators. Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2024; published online April 3. [https://doi.org/10.1016/S0140-6736\(24\)00367-2](https://doi.org/10.1016/S0140-6736(24)00367-2).
- Soriano JB, Murthy S, Marshall JC, Relan P, Diaz JV. A clinical case definition of post-COVID-19 condition by a Delphi consensus. *Lancet Infect Dis* 2022; **22**: e102–07.
- Institute for Health Metrics and Evaluation. Protocol for the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD). Seattle, WA: Institute for Health Metrics and Evaluation, 2020. <https://www.healthdata.org/research-analysis/about-gbd/protocol> (accessed March 27, 2024).
- Stevens GA, Alkema L, Black RE, et al. Guidelines for Accurate and Transparent Health Estimates Reporting: the GATHER statement. *Lancet* 2016; **388**: e19–23.
- Zheng P, Barber R, Sorensen RJD, Murray CJL, Aravkin AY. Trimmed constrained mixed effects models: formulations and algorithms. *J Comput Graph Stat* 2021; **30**: 544–56.
- GBD 2019 Healthcare Access and Quality Collaborators. Assessing performance of the Healthcare Access and Quality Index, overall and by select age groups, for 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019. *Lancet Glob Health* 2022; **10**: e1715–43.
- Flaxman AD, Vos T, Murray CJL, Kiyono P. An integrative metaregression framework for descriptive epidemiology, 1st edn. Seattle, WA: University of Washington Press, 2015.
- Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey (MEPS). <https://www.ahrq.gov/data/meps.html> (accessed Nov 7, 2023).
- National Institutes of Health. National Epidemiologic Survey on Alcohol and Related Conditions (NESARC)—Wave 1 (2001–2002), and Wave 2 (2004–2005). National Institutes of Health, April 8, 2014. [https://healthdata.gov/dataset/National-Epidemiologic-Survey-on-Alcohol-and-Relat/vq4w-x6us/about\\_data](https://healthdata.gov/dataset/National-Epidemiologic-Survey-on-Alcohol-and-Relat/vq4w-x6us/about_data) (accessed March 27, 2024).
- Hasin DS, Grant BF. The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) Waves 1 and 2: review and summary of findings. *Soc Psychiatry Psychiatr Epidemiol* 2015; **50**: 1609–40.
- Australian Bureau of Statistics. 4326.0 - Mental health and wellbeing: profile of adults, Australia, 1997. <https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4326.0Main+Features11997?OpenDocument> (accessed March 27, 2024).
- Salomon JA, Haagsma JA, Davis A, et al. Disability weights for the Global Burden of Disease 2013 study. *Lancet Glob Health* 2015; **3**: e712–23.
- Salomon JA, Vos T, Hogan DR, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. *Lancet* 2012; **380**: 2129–43.
- COVID-19 Mental Disorders Collaborators. Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *Lancet* 2021; **398**: 1700–12.
- GBD 2021 Demographics Collaborators. Global age-sex-specific mortality, life expectancy, and population estimates in 204 countries and territories and 811 subnational locations, 1950–2021, and the impact of the COVID-19 pandemic: a comprehensive demographic analysis for the Global Burden of Disease Study 2021. *Lancet* 2024; published online March 11. [https://doi.org/10.1016/S0140-6736\(24\)00476-8](https://doi.org/10.1016/S0140-6736(24)00476-8).
- Johnson SC, Cunningham M, Dippenaar IN, et al. Public health utility of cause of death data: applying empirical algorithms to improve data quality. *BMC Med Inform Decis Mak* 2021; **21**: 175.
- GBD 2019 Demographics Collaborators. Global age-sex-specific fertility, mortality, healthy life expectancy (HALE), and population estimates in 204 countries and territories, 1950–2019: a comprehensive demographic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396**: 1160–203.
- Sullivan DF. A single index of mortality and morbidity. *HSMHA Health Rep* 1971; **86**: 347–54.
- GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396**: 1204–22.
- GBD 2017 SDG Collaborators. Measuring progress from 1990 to 2017 and projecting attainment to 2030 of the health-related Sustainable Development Goals for 195 countries and territories: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018; **392**: 2091–138.
- COVID-19 Excess Mortality Collaborators. Estimating excess mortality due to the COVID-19 pandemic: a systematic analysis of COVID-19-related mortality, 2020–21. *Lancet* 2022; **399**: 1513–36.
- Wulf Hanson S, Abbafati C, Aerts JG, et al. Estimated global proportions of individuals with persistent fatigue, cognitive, and respiratory symptom clusters following symptomatic COVID-19 in 2020 and 2021. *JAMA* 2022; **328**: 1604–15.
- COVID-19 Cumulative Infection Collaborators. Estimating global, regional, and national daily and cumulative infections with SARS-CoV-2 through Nov 14, 2021: a statistical analysis. *Lancet* 2022; **399**: 2351–80.
- COVID-19 Forecasting Team. Variation in the COVID-19 infection–fatality ratio by age, time, and geography during the pre-vaccine era: a systematic analysis. *Lancet* 2022; **399**: 1469–88.
- Flor LS, Friedman J, Spencer CN, et al. Quantifying the effects of the COVID-19 pandemic on gender equality on health, social, and economic indicators: a comprehensive review of data from March, 2020, to September, 2021. *Lancet* 2022; **399**: 2381–97.
- Lazarus JV, Romero D, Kopka CJ, et al. A multinational Delphi consensus to end the COVID-19 public health threat. *Nature* 2022; **611**: 332–45.
- Bollyky TJ, Murray CJL, Reiner RC Jr. Epidemiology, not geopolitics, should guide COVID-19 vaccine donations. *Lancet* 2021; **398**: 97–99.
- GBD 2017 Diarrhoeal Disease Collaborators. Quantifying risks and interventions that have affected the burden of diarrhoea among children younger than 5 years: an analysis of the Global Burden of Disease Study 2017. *Lancet Infect Dis* 2020; **20**: 37–59.
- Fauci AS, Lane HC. Four decades of HIV/AIDS - much accomplished, much to do. *N Engl J Med* 2020; **383**: 1–4.
- UNAIDS. The path that ends AIDS: UNAIDS Global AIDS Update 2023. Geneva: Joint United Nations Programme on HIV/AIDS, 2023.
- GBD 2021 Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2023; **402**: 203–34.
- GBD 2019 Mental Disorders Collaborators. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet Psychiatry* 2022; **9**: 137–50.
- Roth GA, Mensah GA, Johnson CO, et al. Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019: update from the GBD 2019 study. *J Am Coll Cardiol* 2020; **76**: 2982–3021.
- Vervoort D, Lee G, Lin Y, Contreras Reyes JR, Kanyepi K, Tapua N. 6 billion people have no access to safe, timely, and affordable cardiac surgical care. *JACC Adv* 2022; **1**: 100061.
- Vervoort D, Swain JD, Pezzella AT, Kpodonu J. Cardiac surgery in low- and middle-income countries: a state-of-the-art review. *Ann Thorac Surg* 2021; **111**: 1394–400.
- GBD 2021 Low Back Pain Collaborators. Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. *Lancet Rheumatol* 2023; **5**: e316–29.

- 39 Knezevic NN, Candido KD, Vlaeyen JWS, Van Zundert J, Cohen SP. Low back pain. *Lancet* 2021; **398**: 78–92.
- 40 Foster NE, Anema JR, Cherkin D, et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. *Lancet* 2018; **391**: 2368–83.
- 41 Patel V, Saxena S, Lund C, et al. The *Lancet* Commission on global mental health and sustainable development. *Lancet* 2018; **392**: 1553–98.
- 42 GBD 2019 Risk Factors Collaborators. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396**: 1223–49.
- 43 GBD 2016 Alcohol and Drug Use Collaborators. The global burden of disease attributable to alcohol and drug use in 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Psychiatry* 2018; **5**: 987–1012.
- 44 GBD 2016 Headache Collaborators. Global, regional, and national burden of migraine and tension-type headache, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Neurol* 2018; **17**: 954–76.
- 45 Afshin A, Forouzanfar MH, Reitsma MB, et al. Health effects of overweight and obesity in 195 countries over 25 years. *N Engl J Med* 2017; **377**: 13–27.
- 46 Teufel F, Seiglie JA, Geldsetzer P, et al. Body-mass index and diabetes risk in 57 low-income and middle-income countries: a cross-sectional study of nationally representative, individual-level data in 685 616 adults. *Lancet* 2021; **398**: 238–48.
- 47 Santomauro DF, Purcell C, Whiteford HA, Ferrari AJ, Vos T. Grading disorder severity and averted burden by access to treatment within the GBD framework: a case study with anxiety disorders. *Lancet Psychiatry* 2023; **10**: 272–81.